Comparative Effectiveness Research on Psychiatric HOSpitalisation by record LINKage of large administrative data sets in six European countries

Final Scientific Report for Objectives 1, 2 and 3

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List of abbreviations

ANY-REHOS..................... Re-hospitalisation to any type of hospital
GDP................................ Gross Domestic Product
LEEAR............................. Large existing electronic administrative registry
LOS................................. Length of stay
POC................................ Psychiatric outpatient contact
PPS................................. Purchasing Power Standard
PSY-REHOS...................... Psychiatric re-hospitalisation
RHR .... Re-hospitalisation rate
30d................................. 30 days
365d............................... 365 days

AT.................................. Austria
FI .... Finland
IT .... Italy
NO.................................. Norway
RO .... Romania
SI .... Slovenia
Northern countries ....FI, NO (grouping has only methodological, no geographical meaning)
Southern countries ....AT, IT, RO, SI (grouping has only methodological, no geographical meaning)

Extended Abstract

Background

High re-hospitalisation rates are often regarded as an indicator of malfunctioning of hospitals and health care systems. This applies especially to mental health care where the term "revolving door psychiatry" has been coined for this situation. However, when evaluating mental health care systems, international comparisons of psychiatric re-hospitalisation rates derived from routinely collected health care data are hampered by different ways of establishing them in different countries with different health care systems and different data collection routines, and cannot be used at face value. The overall objective of the CEPHOS-LINK project was to establish psychiatric re-hospitalisation rates and their predictors by applying a common protocol to administrative data from large national electronic health care registries in six European countries (Austria, Finland, Italy, Norway, Romania, Slovenia), all with different health care systems and different data collection routines. Regression analyses were applied using a retrospective cohort study design. The major advantage of this approach is that it allows for the study of very large unselected patient populations, even tens or hundreds of thousands of patients, and that a common design and protocol can be applied to all countries which helps to reduce the "methodological noise" inherent in systematic reviews of separate studies. There is, however, a tradeoff that has to be made between this reduction of methodological noise and the potentially limited insights because of the reduced number and granularity of variables in routine health care databases. Additionally, ascertaining the interoperability of the databases which have all grown historically in different ways in different countries imposed a large burden on the project.

Methods

Ascertaining interoperability between databases

A major part of the project was dedicated to ascertaining the interoperability between the six large national electronic registries of health service utilisation. As a first step, the national databases, the relevant variables and the services covered by each of the databases were identified and described. This step was followed by the analyses of unlinked hospital episodes with respect to the relevant variables required for identifying the study cohort, re-hospitalisation rates, and potential predictor variables. Also, a pilot study was carried out in each country in order to identify problems of using the databases in reality.

Local logistic and Cox regression analyses

Each country identified adult patients (18+ years old), discharged for the first time over a period of 12 months from a psychiatric inpatient bed with a primary functional psychiatric diagnosis (ICD-10 F2-F6). These patients were then followed up over one year. Local single level logistic and Cox regression were performed in order to identify predictors for psychiatric re-hospitalisation, as well as for re-hospitalisation to any hospital. Regression analyses were carried out for patient-level predictors identified as being available in a comparable form across all six countries (gender; age; diagnosis of psychosis; physical comorbidity; length of stay with some restrictions). Multilevel logistic regression analyses were performed with additional contextual/geographical variables on the NUTS 3 level of a patient's place of residence (degree of urbanicity, Gross Domestic Product). In terms of continuity of care, early post-discharge psychiatric outpatient contacts were identified in order to assess their potential modifying effect on the patient-level predictors of psychiatric re-hospitalisation rates.

Pooling of data

In addition to the local analyses carried out by each partner, data from all countries was to be pooled to a common data structure. This pooling process had to involve the secure transfer, quality check, integration and analysis of defined datasets from each participating country. The anticipated added value included additional and independent quality checks, reproducing local analyses, and laying out the foundation for simulation modelling. The pooling procedure had to be split into several steps. First, legal and organisational prerequisites had to be addressed, involving obtaining approval from local ethical committees and from data owners, facilitating the exchange of data protection and non-disclosure agreements, as well as all technical preparations of the data pooling infrastructure. Secondly, a comprehensive pooling protocol describing the entire process in detail was designed, coordinated and executed iteratively. Data quality checks were performed during the loading procedure of the delivered datasets into an integrated database. Finally, by way of example, data analysis was performed with the total pooled data set of 225.600 patients.

Simulation modelling

In a further quantitative approach simulation modelling techniques were applied in order to determine the potential effects that future demographic changes, changes of geographical service accessibility and physical comorbidity with diabetes could have on psychiatric re-hospitalisation rates.

Focus groups

Finally, in order to complement the empirical findings, a qualitative focus group study was performed in all partner countries, including people with lived experience of psychiatric hospitalisation and re-hospitalisation.

Results

Ascertaining interoperability between databases

Results of these activities are reported extensively in this report, together with the main consequences for the final study protocol. One of the main methodological findings in this process was that hospital admission and discharge codes were not reliable for international comparisons and that the study cohorts had to be defined more precisely by excluding patients who had had a hospital admission in a different hospital on the same day as they had ended a hospital episode in a preceding hospital. By implementing this approach it was possible to identify comparable study cohorts. As an expected result of the different population sizes of the individual countries, study cohorts varied considerably in size, with 4.500 in Slovenia to over 100.000 in Romania. Altogether, an impressive total of 225.600 patients from all six countries were included in the analyses. The profiles of psychiatric inpatient services covered were quite diverse, with departments in general hospitals dominating in Italy, small bed units in district psychiatric centers in Norway, and traditional standalone psychiatric hospitals prevailing in Slovenia. For the above mentioned predictor variables comparability across countries was given with one exception. The length of stay variable had limited comparability between countries due to different organisational arrangements of hospital care in the Scandinavian countries related to inconsistent handling of inter- and intra-hospital transfers. Some potentially relevant variables, such as whether a hospitalisation was planned or unplanned, and whether it was involuntary or voluntary, could not be obtained in all countries and were therefore not used for the analyses. Additionally, it was not possible in all countries to identify death during follow-up, therefore the cohorts contained a small proportion of patients who died in the 12 months after discharge. A methods toolkit was prepared which contains a complete set of tools used in the CEPHOS-LINK project for ascertaining interoperability of databases. This toolkit can serve as a model for creating tools for similar projects involving large electronic health care databases of different origins, structure and content.

Local logistic and Cox regression analyses

Between one third (Slovenia: 33,6%, Italy: 35,6%) and nearly one half (Norway: 47,9%, Romania: 45,7%) of all patients were readmitted to a psychiatric inpatient service over the 12 months after discharge (with Finland: 39,9%, and Austria: 40,1% in between). It is tempting to interpret these differences, but one should not rush to premature conclusions. For instance, while both Italy (with its mental health centres, CSM=Centri Di Salute Mentale) and Norway (with its district psychiatric centres, DPS= Distriktspsykiatrisk Senter) have well-developed community mental health services, the re-hospitalisation rates are very different. While these high psychiatric re-hospitalisation rates should already be a cause for concern, a second finding is even more so: Roughly one third out of all re-hospitalisations over a 12 month period occurred already within two months after discharge, in some countries even much earlier (e.g. in Austria after two weeks). The highest risk for re-hospitalisation is thus in the early days and weeks after discharge, and it is there where preventive measures would be best placed by ensuring the availability of seamless transition from inpatient to community care. In the logistic regression analyses, two patient-level predictors proved to be working consistently in the single level multiple logistic regression analyses, with rather large effects in all countries. Firstly, it was found that a primary psychotic diagnosis increases psychiatric re-hospitalisation rates, and secondly, age at or above the median decreases them. Gender had no effect in any of the countries, and long length of stay had inconsistent effects. Physical comorbidity slightly decreases psychiatric re-hospitalisation rates. In a multilevel approach, no consistent effect of NUTS 3 level of urbanicity and GDP was found. The effect of continuity of care was only studied in Austria and Veneto (a region of Italy) and the results were puzzling. In a “correlational approach” the analyses showed high rates of early psychiatric outpatient contacts in Veneto, which were accompanied by low early re-hospitalisation rates. For Austria, the opposite was found. In an individual patient “pre-post” approach in Austria no effect was found, whereas in Veneto, patients with higher early psychiatric outpatient rates had also higher re-hospitalisation rates (for details see Part 3 of the present report). These findings need to be refined by applying more complex statistical methods.

Pooling of data

Data transfer of all local data to a pooling infrastructure in Austria was performed without problems according to the common protocol designed during the preparatory phase. For some countries the application of a data profiling tool revealed quality problems in the data, which had skipped the attention at the local level and which could then be corrected in the local data set for repetition of the local analyses. As a next step the local regression analyses were repeated for each country separately in the pooled data set with the statistical computing environment R, thus avoiding problems of the use of different statistics programs in the local analyses in the different partner countries. By this procedure all results of the local analyses could be corroborated in the pooled data set. Out of the many possible analyses with the large pooled data set of altogether 225.600 patients, one particular logistic regression analysis was carried out by pooling separately countries with a predominantly tax-funded health care system (Finland, Italy, Norway) on the one hand, and countries with a mandatory social health insurance system (Austria, Romania, Slovenia) on the other. A striking result was that a main psychotic diagnosis substantially increases the risk of psychiatric re-hospitalisation in predominantly social health insurance countries (odds ratio nearly 2), but had no effect at all in tax-funded countries. Again, as stated above, also here findings need to be refined by applying more complex statistical methods, and the new opportunities of analysing huge sets of pooled data collected according to a common protocol need to be further explored.

Simulation modelling

Drawing on the pooled dataset, data was then prepared for simulation modelling analyses. With knowledge of the available data, as well as the evaluated modelling methods suitable for answering the three defined questions, it turned out that an agent-based model was the most promising approach. For this kind of model not only data on psychiatric patients, but also prognostic data on the observed population, as well as study results and assumptions for structural changes (e.g. possible future decrease of distance of service in selected NUTS 3 regions), and changes of diabetes prevalence were needed. Due to time restrictions, only Austria, Slovenia and the Veneto region of Italy were included in the modelling analysis. The main benefit of simulation modelling is the possibility of integrating calculations of 'what-if' scenarios into responding to questions on system changes in order to provide insight on the effects of these interventions. It was found, for example, that the changing diabetes prevalence has an impact on psychiatric patients' re-hospitalisations. If the same can be assumed for other comorbidities, they should be considered when analysing future developments in psychiatric re-hospitalisation rates.

Focus groups

Mental health service users' own positive and negative experiences of hospitalisation and re-hospitalisation and their suggestions about how one can avoid re-hospitalisations were explored with altogether eight focus groups in six participating countries, with a total of 55 service users. The focus group participants expressed strongly negative feelings related to their hospitalisation, induced by both the illness and the experiences related to the process of hospitalisation especially in line with involuntary hospitalisation. Some participants described their first hospitalisation in positive terms referring to feelings of relief related to accessing hospital care, a daily structure, and being released from responsibility. A common view among the interviewees across countries was that one must accept the need for re-hospitalisation even though it may be associated with both good and bad experiences. Some participants described their re-hospitalisation as something happening "by default" and without any healing effect. Most of the participants were receiving outpatient treatment, and saw their psychiatrist or psychologist as necessary for treating symptoms and controlling medication. Several participants referred to problems such as not seeing their psychiatrist often enough or the need for a type of service to monitor mental state. They felt that something or someone more is needed—someone who could identify changes and take care of the patient when he/she cannot do so. The availability of different kinds of meeting places, day centres or activity centres with various activities, workshops and seminars was considered helpful for preventing re-hospitalisation. The results indicate that in terms of avoiding re-hospitalisation, follow-up is needed to fulfill the patient's social and need for meaningful activity. Ideally, this should be facilitated as a close collaboration between the hospital, municipality/primary care and mental health service user. Results also indicate the importance of special focus on the first hospitalisation (in addition to re-hospitalisation), as well as on whether the admission is voluntary.

Conclusions

Rendering large national electronic health care databases interoperable and thus comparable across countries is essential for comparing patterns of pathways of health service utilisation in different countries. The CEPHOS-LINK project has carried out pioneering work in this respect. If such interoperability can be achieved, methodological noise can be reduced in studies on quality of care and cost-effectiveness in different health care systems. Thus these differences can be seen as reflecting "real differences" and not as possibly resulting from methodological discrepancies as "artefacts". The CEPHOS-LINK project has demonstrated by using the example of re-hospitalisation of psychiatric patients that such a noise reducing methodological approach is possible. The main findings from the CEPHOS-LINK study are thus in an optimal position of being comparable across countries. They show that between one third and half of all adult psychiatric patients return to hospital within one year after the index discharge, and that a large proportion of these re-hospitalisations occur during the first few weeks. Therefore the focus of potential preventive activities should be placed there. The CEPHOS-LINK project has also produced tools which can be used for increasing interoperability of national databases in other projects. While applying these tools to national databases, the institutions running them could increase awareness for the necessity for harmonising terminology and concepts on a European level, and facilitate future cross-country health care studies with common protocols and pooled data sets. The development of linkable electronic health care records could enhance these possibilities. The CEPHOS-LINK project has also demonstrated through its focus group study including people with lived experience of psychiatric re-hospitalisation that it is a valuable approach to explore experiential, i.e. qualitative data in addition to the quantitative approach. Both the quantitative and qualitative findings have found their way into a set of policy briefs developed at the end of the project.

CEPHOS-LINK

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Final Scientific Report

PART 1

Introduction and Summary of Main Findings

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Contents

1 Background

Mental health care services have undergone dramatic changes over the last decades in most industrialised countries. In general, large mental hospitals, inherited from the 19th century, have been downsized or closed, smaller psychiatric departments in general hospitals have sprung up, and a large array of community mental health services including day hospitals, mobile services, extra mural residential facilities and others have been established in many countries. This process of "deinstitutionalisation" and uptake of the "community mental health" approach is endorsed and promoted by the EU and major international organisations, such as the WHO, the OECD, and the Council of Europe.

However, little is known about the effectiveness of this approach. Research is much needed in order to better inform policy and decision makers for evidence based decisions regarding the improvement of mental health system and health services interventions, also and importantly to ameliorate patients' outcomes and quality of life as well as to increase cost effectiveness. For instance, despite the decrease of psychiatric beds in hospitals in most countries, psychiatric hospitalisations have not diminished, and have even increased in many places. A substantial proportion of such hospitalisations are re-hospitalisations, and the telling term "revolving door psychiatry" has been coined for this phenomenon of frequent re-hospitalisation. Since the beginning of the community mental health care movement half a century ago, the increase of re-hospitalisations has been a concern. Analyses of routine data (which did not allow the linkage of patient records at that time, but only the calculation of a "readmission index") were already common in the 1960's and 1970's. In the 1970's a whole series of studies in Canada remained inconclusive regarding the reasons behind the increasing numbers of re-hospitalisations. This set the stage for the still ongoing discussions on the causes of high re-hospitalisation rates. Today the issue is not settled and still heavily discussed.

Already when simple country specific re-hospitalisation rates are reported, large differences can be observed between countries. A report on sixteen OECD countries (OECD 2011) shows that for the year 2009 the 30-day unplanned readmission rates for schizophrenia (to the same hospital) varied more than six-fold, from a low rate of 4,5 in the Slovak Republic to an astonishingly high one of 29,9 per 100 discharged patients in Norway. This variation is not well understood, although many studies have tried to identify factors which can contribute to increasing psychiatric re-hospitalisations, including, among others, pre-discharge factors such as shorter length of stay, and post discharge factors such as lack of continuity of care in outpatient services. However, re-hospitalisation studies suffer from several shortcomings: they often study rather small patient samples, often on selected diagnostic groups only, and rarely cover whole populations and whole health care systems. They also often assess only readmissions to the same hospital (thereby potentially missing up to 20% of readmissions), use different predictors and indicators for re-hospitalisation in different studies (so that comparability is limited), do not carry out comparisons across different countries, and only exceptionally use record linkage methodology in population based registries. Thus these studies remain mostly inconclusive as far as recommendations to decision makers are concerned.

Based on these considerations the CEPHOS-LINK project proposal was submitted to the European Commission's Seventh Framework Programme and was granted research funding for the period 2014 – 2017.

The European project partners include:

- National Institute for Health and Welfare (THL), Finland
- IMEHPS Research, Austria
- National School of Public Health, Management and Professional Development, Romania
- SINTEF, Norway
- The University of Verona, Italy
- Research Centre of the Slovenian Academy of Sciences and Arts, Slovenia
- dwh GmbH, Austria

Considering

- that re-hospitalisations are not conducive to the needs of mental health patients for an optimal quality of life in the community, and that such re-hospitalisations in fact constitute profound interruptions in a patient's life,
- that psychiatric hospitalisation carries a stigma which patients understandably want to avoid,
- that hospitalisations may be in itself traumatic and create a post-hospital syndrome of increased risk for all kinds of disorders,

the avoidance of re-hospitalisation after a hospitalisation for a psychiatric condition can in itself be regarded as an outcome desired not only by the health care system, but also by patients, i.e. as a patient centred outcome.

Furthermore, considering

- that re-hospitalisations (if unplanned) are in general not regarded as an indicator of good quality of care and are therefore often used as a metric for hospital performance and
- that the use of hospital facilities is expensive and finding ways of avoiding re-hospitalisation would save costs,

the topic of identifying factors which are related to re-hospitalisations chosen for this comparative effectiveness research follow the four objectives below.

Objective 1: To compare in a registry based observational record linkage study design the re-hospitalisation outcome of adult patients discharged with a main psychiatric diagnosis (ICD-10: Chapter V; more specifically "functional" mental disorders F2-F6) from psychiatric hospital treatment in six European countries and to identify specific patient-level and contextual predictors of psychiatric re-hospitalisation.

Objective 2: To explore the additional influence of continuity of care, measured as first psychiatric outpatient contact after the index discharge on psychiatric re-hospitalisation.

Objective 3: To develop a methods toolkit for conducting record linkage studies in the mental health care field in and across European countries, in order to improve the evaluation of mental health care systems in Europe.

Objective 4: To produce recommendations, guidelines and a set of decision support tools for decision makers in the field of mental health system and services intervention related to increasing their understanding of factors that influence re-hospitalisation of psychiatric patients.

In conclusion, in times of emphasis on community mental health care psychiatric re-hospitalisation rates are of interest for health care planners and politicians as a criterion for the quality of care of patients with psychiatric disorders. However, psychiatric re-hospitalisation rates vary to a large extent between countries with different health care systems and it is not clear how much of the variability can be explained by methodological artefacts and how much of it is “real”. Furthermore, systematic reviews of the literature on predictors of psychiatric re-hospitalisation are inconsistent, mainly due to different study designs and different samples of patient populations studied with a different case mix.

2 Study design of local and pooled regression analyses

Based on this lack of clarity the CEPHOS-LINK research project embarked on carrying out comparisons of psychiatric re-hospitalisation rates and identifying their predictors in the unselected patient populations of six European countries with differently organised health care systems (Austria, Finland, Italy, Norway, Romania, Slovenia). Employing a retrospective cohort study design, linked patient-level data in large national electronic administrative health care registries were used according to a common protocol. While it was clear from the beginning that the number and quality of variables contained in routine health care databases are limited (an example is the lack of information on the adherence to treatments), the sheer size of the patient populations which could be included in the study cohorts (altogether hundreds of thousands) was encouraging to undertake the study.

The patient population studied was restricted to adults (aged 18+ years) who were discharged from a hospital for the first time over a one-year period after having spent at least one night on a psychiatric bed. In order to reduce heterogeneity main diagnoses were restricted to so-called functional mental disorders including among others schizophrenia, affective and personality disorders (ICD-10: F2-F6). Organic and substance abuse disorders were excluded. Since preparatory activities had already shown limitations of such comparability because of the limited interoperability of the relevant databases (availability of variables, different granularity, different definitions) the number of predictors chosen was limited to five dichotomous person level predictors (gender, age, length of stay, psychotic diagnosis, physical comorbidity), two contextual predictors (degree of urbanicity and per capita Gross Domestic Product – GDP of the NUTS 3 region of a patient’s residence) and one continuity of care predictor (post-discharge psychiatric outpatient contact). Both first re-hospitalisations to any hospital and to a hospital with psychiatric beds over a period of 365 days and several shorter periods were chosen as outcome measures for carrying out multiple regression analyses.

3 Ascertaining interoperability of databases

An important innovative aspect and challenge of this project was that data from large national electronic health care registries from six different countries with different health care systems and different data collection routines were to be used. In contrast to most published studies on psychiatric re-hospitalisation and the related systematic reviews this approach has disadvantages, but also several major advantages.

The main disadvantage of using already collected routine data is that the types and quality of variables is restricted to what the different databases contain.

The major advantages are that very large unselected patient populations can be studied (including tens or even hundreds of thousands of participants) and that a common design and protocol can be applied to all countries, thereby counter-balancing one of the main disadvantages of systematic reviews, namely to synthesize studies with different designs and methodologies making it difficult to decide to what extent differences between study results are "real" or due to methodological differences. This dilemma is reflected in the five systematic reviews carried out in the framework of the CEPHOS-LINK project (see Endnote in Part 2 of this report). Using a common study protocol across countries and ascertaining the interoperability of databases can reduce the "methodological noise", but a tradeoff has to be made between this reduction of methodological artefacts and the potentially limited insights because of the reduced number and granularity of variables.

In order to maximise the advantages of the CEPHOS-LINK approach, efforts had to be undertaken to ascertain the interoperability between the large national electronic registries on health service utilisation. Ascertaining this interoperability was a major task, which had to be performed prior to the final CEPHOS LINK analyses. These activities are described in detail in Part 2 of the present document together with the lessons learned for establishing the final study protocol for carrying out several regression analyses in order to identify predictors of psychiatric re-hospitalisation rates in six different countries.

The activities of ascertaining interoperability are reported in four sections dealing with

- Identifying and describing national databases and their relevant variables
- Analysing unlinked hospital episodes
- Carrying out a pilot study with linked data and
- Lessons learned for the final study protocol.

The first of these addresses the identification of databases and the relevant variables in order to check for quality and interoperability. For this purpose a set of templates were developed for collecting information from each country detailing the relevant databases and the required variables including all specifics of coding rules, record linkage procedures, and access to databases with and without linked records. These tools are included in Part 7 (Methods toolkit) of the Final Scientific Report. Once a first overview was obtained on the main variables for hospital inpatient service utilisation, local analyses were carried out in each country on unlinked records of hospital episodes. This followed the usual international hospital statistics approach of counting hospital "discharges" (and not yet analysing linked records for individual patients). Based on findings from these activities pilot studies were carried out according to a common protocol, which mimicked in several aspects the final CEPHOS-LINK study. Information obtained by all three types of preparatory activities was then synthesised and discussed under the heading of "lessons learned" leading to a common protocol for the final CEPHOS-LINK study.

After obtaining preliminary knowledge on the available databases it was decided at an early stage of the project to focus on a limited number of predictors, which could reasonably be expected to be available in large national health care registries and which would be worthwhile to be checked for their availability in an interoperable form across the selected databases. In addition to the so-called pre-discharge variables age, gender, psychiatric diagnosis and length of stay, special emphasis was put on pre-discharge physical comorbidity. Two contextual variables were chosen, both related to the patients' place of residence (degree of urbanicity and GDP). Finally, post-discharge psychiatric outpatient contacts were chosen as a "continuity of care variable" and checked for availability in the national databases.

4 Results of local studies

Once interoperable files for altogether 225.600 patients in six countries characterised by quite a few predictor variables and outcome measures were available, a nearly unlimited number of different types of retrospective cohort studies could have been carried out. Only a limited array of such analyses were actually performed in order to show for selected questions thought to be relevant for health care planning, how reduction of methodological noise could help to compare findings in different countries. Main results of these analyses are reported and commented below. It has to be stressed that it is impossible to provide definitive interpretations of the findings of a cohort study, since in addition to the variables used unobserved factors might also have influenced the results. For instance, no adequate proxy for the severity of the disorder was present in the data sets. However, some "educated guesses" may not be amiss.

Study cohorts differ in size and case mix

Study cohort sizes differed to a large degree, in fact more than 20-fold, between countries, ranging from 4.536 in Slovenia to 101.834 in Romania, a fact, which has most certainly influenced inference on significance in the regression analyses. The rates per 1.000 population aged 18+ years varied in different ways, with Italy having the lowest rate (1,28‰) and Norway (4,40‰) and Romania (6,26‰) the highest. In addition to the size, also the case mix of the study cohorts varied. For instance, depression was the most frequent single diagnosis in Austria, Romania and Norway, while schizophrenia dominated the diagnostic spectrum in Finland, Italy, and Slovenia. These differences were to some extent accounted for in the regression analysis by introducing the variable psychotic diagnosis as a predictor. In Italy in addition to the public system a private (but publicly funded) sector exists which has a different diagnostic spectrum, with depression dominating, in contrast to the public sector with a large preponderance of schizophrenia. It can be suspected that specific provider payment mechanisms play a role here. Physical comorbidity, which is becoming more and more important in mental health care planning, is very differently present as an additional diagnosis, ranging from 3,9% in Norway and 5,4% in Slovenia to 37,6% in Austria and 43,1% in Romania. Whether these differences reflect epidemiological differences or are artefacts of different motivations of hospital staff to document secondary diagnoses cannot be established.

Re-hospitalisation rates differ to a substantial degree

Between one third (Slovenia: 33,6%, Italy: 35,6%) and nearly one half (Norway: 47,9%, Romania: 45,7%) of all patients were readmitted to a psychiatric inpatient service within 12 months after discharge (with Finland: 39,9%, and Austria: 40,1% in between). It is tempting to interpret these differences, but one should not rush to premature conclusions. For instance, while both Italy (with its mental health centres, CSM=Centri Di Salute Mentale) and Norway (with its district psychiatric centres, DPS= Distriktspsykiatrisk Senter) have well-developed community mental health services, the re-hospitalisation rates are very different. When analysing re-hospitalisation rates to any hospital, i.e. including in addition to psychiatric also somatic hospitals, the patterns discussed above are similar but the rates are understandably higher, but to a different extent in different countries. Austria, whose cohort had a high percentage of patients with physical comorbidity, has the largest difference to mere psychiatric re-hospitalisation rates (plus 20% at 365 days). A special phenomenon was observed for Romania. There re-hospitalisation rates follow a similar pattern to those of the other countries for the first nine months, but then start to climb substantially in the last few months of the one-year follow-up period. One explanation put forward by local experts could be that patients who are on a disability pension have to prove for the prolongation of their invalidity pension that they need a hospitalisation once a year.

A major proportion of first re-hospitalisations occur within a few weeks

While the high psychiatric re-hospitalisation rates reported above should already be a cause for concern, a second finding is even more so: Roughly one third out of all re-hospitalisations over a 12 month period occurred already within two months after discharge, in some countries even much earlier (e.g. in Austria after little more than two weeks). The highest risk for re-hospitalisation is thus concentrated in the early days and weeks after discharge, and it is there where preventive measures would be best placed by ensuring the availability of seamless transition from inpatient to community care.

Person-level predictors: Psychosis is related to higher, older age to lower re-hospitalisation rates

In the regression analyses two patient-level predictors proved to have consistent effects in the single level multiple logistic regression analyses, with rather large effects in all countries. It was found that a psychotic diagnosis increases psychiatric re-hospitalisation rates (except for Slovenia 30 days), and that age at or above the median decreases them, more so for 365 than for 30 days. Gender had no specific effect in any of the countries. Long length of stay had inconsistent effects across the six countries. A longer length of stay increased the risk of re-hospitalisation in Romania, but decreased it in Finland and Norway (in the latter two countries length of stay was differently defined than in other countries). If anything at all, physical comorbidity was found to slightly decrease psychiatric re-hospitalisation rates. Cox regression analyses for 365 days produced hazard ratios which were virtually identical to the odds ratios in both direction and size***.***

Contextual predictors: No consistent effect of urbanicity and GDP on re-hospitalisation rates

Including contextual predictors on the NUTS 3 level of the patients' residence in multilevel logistic regression analyses did not change the effect of the person-level predictors found in the standard regression analysis without context variables. Some country specific effects of the degree of urbanicity and of the regional GDP could be observed, but no consistent pattern emerged across all countries. The reason for the lack of a consistent effect may reside in the fact that these variables were not available for all countries on a lower geographical level than the NUTS 3 level, which might be too large so that differences which might exist on a smaller geographical scale are averaged out.

Continuity of care variable shows mixed effects on re-hospitalisation

The influence of continuity of care (measured as early psychiatric outpatient contact after the index discharge) on psychiatric rehospitalisation rates was studied only in Austria and the Veneto region in Italy. Two approaches were applied, a "correlational" one and a "pre-post" one. In the "correlational" approach cumulative rates of the first psychiatric outpatient contacts in the first few weeks after the index discharge were compared with the corresponding cumulative curves of the first psychiatric rehospitalisation rates. The main result was that in Veneto a large proportion of patients have early psychiatric outpatient contacts, while rehospitalisation rates are low; in Austria the opposite is found: few early psychiatric outpatient contacts and substantially higher psychiatric rehospitalisation rates. For the “pre-post” approach a special design with a smaller patient cohort was used (as described in detail in the methods section of Part 3 of the Final Scientific Report). More complex methods involving competing risk analyses were beyond the scope of the project. In this specific logistic regression no effect of early psychiatric outpatient contacts on psychiatric re-hospitalisation rates was observed in Austria, while in Veneto psychiatric outpatient contacts increased psychiatric re-hospitalisation rates. The interpretation of this finding in the Veneto region is difficult. For one, as the severity of an individual case is not captured by the data in the present study, such unobserved confounders are likely to distort the findings. It is possible that the psychiatric outpatient contacts occurred because the patient’s state was deteriorating, which then subsequently led to the outpatient contact and then to the re-hospitalisation. Lack of data (e.g. in Austria no data on contacts with single-handed psychiatrists without social health insurance contract, and no data on contacts with tax funded psycho-social services is available) may have had potentially distorting effects when comparing Austria with Veneto, where all types of psychiatric outpatient contacts were included in the database.

5 Pooling of data

In addition to performing local regression analyses on psychiatric re-hospitalisation according to a common study protocol in each country, it was also intended to pool the data of all single country study cohorts. The process of pooling is described in detail in Part 5 of the final scientific report. It involved the secure transfer, quality check, integration and analysis of defined data sets from each participating country. The anticipated added value included additional and independent quality checks, reproducing local analyses, laying out the foundation for simulation modelling and the application of more sophisticated statistical analysis on a larger and more diverse data set.

The entire pooling procedure was split into several steps. Since the pooling process covered sensitive claims data from healthcare systems in different countries, complex preparatory procedures were necessary. First, legal and organisational prerequisites had to be established. This involved obtaining acceptance from local ethical committees from all countries, approval from data owners, the exchange of data protection and non-disclosure agreements and the technical preparations of the utilised infrastructure. These activities included the coordination of diverse and potentially changing legal requirements and building a secure and adaptable infrastructure on a tight time budget. Furthermore, it included the definition of a clear and flexible approach which, on the one hand, describes the anticipated procedures thoroughly and conclusively, and which, on the other hand was required to be generally replicable and comprehensible, because of a low margin of error (e.g. concerning cryptography). These preparatory activities were the critical foundation of the entire conception. During the preparation of the pooling procedure, all participating countries agreed that patient level information without k-anonymisation can be provided. Data privacy statements and non-disclosure agreements were prepared and all partners required these documents manually signed.

Essential preparatory work also concerned attention to security aspects of data transfer and storage. The design and configuration of necessary safety procedures depicted the major part of the preparatory activities for data pooling. It can be partitioned into two principal sections, first, the secure encryption and data transfer, and second, the secure storage and processing infrastructure.

Furthermore, a comprehensive pooling protocol describing the entire process in detail had to be designed, coordinated and executed iteratively. The protocol is contained in a separate document (available on request) and consists of several sections including the file structure and format based on international standards, the variable definition based on local study protocols and system variable descriptions, and the documentation of the current status.Various data quality checks were performed during loading the delivered data sets into an integrated database. Finally, by way of example preliminary data analyses were performed with the total pooled data set of 225.600 patients.

6 Simulation modelling

One of the challenges in the CEPHOS-Link project was the analysis of the development of psychiatric re-hospitalisations in the future. Only retrospective data was available, however, the knowledge of the future burden of psychiatric diseases is essential for planning purposes of health policy makers. Three tasks were defined to address this problem:

a) How would index psychiatric hospitalisations and re-hospitalisations change in the future due to demographic change?
b) How would theoretical improvement of the care structure in certain NUTS 3 regions alter psychiatric re-hospitalisation rates?
c) What is the possible impact of rising diabetes prevalence on psychiatric re-hospitalisation rates?

As a first step a literature review was performed in order to identify currently used methods in studies about psychiatric re-hospitalisations (see endnote in Part 2 of the Final Scientific Report). Drawing on the pooled data set (see Part 4 of the Final Scientific Report) data were prepared for the modelling analyses. With the background knowledge of the available data as well as the evaluation of the modelling methods most suitable for answering the three defined questions it turned out that an agent-based model was the most promising approach. For this kind of model not only data on psychiatric patients, but also prognostic data on the observed population, as well as study results and assumptions for structural changes (e.g. decrease of distance of service in selected NUTS 3 regions) and changes in diabetes prevalence were required. Due to time restrictions only Austria, Slovenia and the Veneto region of Italy were included in the analyses.

For the defined tasks a detailed population model was built as the basis of the simulation. The agents represent individual statistical representatives of the inhabitants of an observed region. The core of the model was implemented in Python according to the Generic Population Concept (GEPOC), which was developed in DEXHELPP (supported by an unrestricted grant by FFG, project number 843550). The module for hospitalisations and re-hospitalisations was mandatory for all simulation runs. The model was parameterised for the population of Austria, Slovenia, and the Veneto region. The modules for the other two questions were implemented as being either used exchangeably or together. Subsequently the parameterisation for the three regions was performed and validated with data of the pooled analysis.

Most of the parameters of the three regions follow similar distributions, which means that the countries share the same characteristics concerning these variables. Calibration under the defined model assumptions, for reproducing the current status in each modelled country, works quite well and suggests that the used assumptions are sufficient to describe the status quo. Then the model was used to calculate prognoses for the defined tasks. The results for patients are available on the individual level, meaning that we can follow the patients over time. For the macroscopic evaluations, events of the patients are aggregated to numbers of index hospitalisations and re-hospitalisations up to the year 2039 for different patient characteristics. The aggregated outcomes show what could happen if the assumptions of the defined scenarios hold true. In all of them we observe an increase in both index-hospitalisation and re-hospitalisation rates for Austria and Veneto, especially for women and patients with psychotic diagnoses. Also, the costs in all three countries are expected to rise (e.g. especially in the Austrian age-group of the 50-59 year old people about 21 percent).

The simulation model's main benefit is the possibility of integrating extensions for the calculation of what-if scenarios corresponding to questions on system changes to provide more insight on effects of these interventions. For example, the changing diabetes prevalence has an impact on psychiatric patients' re-hospitalisations, and if the same can be assumed for other comorbidities, they should not be neglected when analysing the future development of psychiatric re-hospitalisation rates. To obtain more detailed results, the developed model provides a profound basis for integration of further modules. It is also well suited for the implementation of more sophisticated patient pathways through the system, especially including ambulatory treatment or multiple re-hospitalisations. The model is suitable to assess the impact of different kinds of interventions and due to the modular approach can be easily extended to calculate further scenarios. The results can help decision makers to plan and optimise interventions for improving the treatment for psychiatric patients under certain conditions, like ethical or budget limits.

7 Focus groups

In this qualitative focus group study, mental health service users' own positive and negative experiences of hospitalisation and re-hospitalisation and their suggestions about how one can avoid re-hospitalisations were explored. Data is based on altogether eight focus groups from all six partner countries (Romania, Slovenia, Finland, Italy, Austria and Norway) including a total of 55 service users, aged 26-65 years, with the most frequent diagnoses being psychosis (41,8%) and bipolar disorder (38,2%). Many of the participants had been in and out of mental health hospitals for several years. Half of them had been hospitalised during the last twelve months.

Overall, the participants in the focus group interviews expressed strongly negative experiences related to their hospitalisation. Many described highly dramatic and traumatic experiences, particularly in connection to their first admittance and involuntary admissions. Hospitalisation was described as something terrible and intolerable, as a shock and a trauma. These feelings were induced by both the illness, and the experiences related to the process of hospitalisation. Others described their first hospitalisation in positive terms, although to a much lesser extent. Feelings of relief after being hospitalised were also mentioned, and gaining access, a ordered structure with some describing hospitalisation as a "lifeline" or "rebirth", something that released the responsibility.

Many considered re-hospitalisation to be difficult and upsetting in many ways, although subsequent hospitalisations were experienced by many as less frightening. This was mainly because they had been through the situation before, and thus felt more in control of the situation in terms of knowing what to expect and being conscious and capable of developing coping strategies for themselves. Re-hospitalisation was not talked about in the same dramatic terms as when they described their first hospitalisation. Re-hospitalisation was often considered a relief and a means for them to obtain the necessary help. A common view among the interviewees across countries is that one must accept the need for re-hospitalisation even though it may be associated with both good and bad experiences. The interviewees perceived their illness as a chronic condition and that they would sometimes need to be re-hospitalised to ease the crisis. However, some participants described their re-hospitalisation as something happening “by default” and without any healing effect.

Most of the participants were receiving outpatient treatment, and saw their psychiatrist or psychologist as necessary for treating symptoms and controlling medication. Several participants referred to problems such as not seeing their psychiatrist often enough, or the need for a type of service to monitor mental state. They felt that something or someone more is needed—someone who could identify changes and take care of the patient when he/she cannot do so. The actions which participants considered helpful for preventing re-hospitalisation varied between participants and over time. The most important was the availability of different kinds of meeting places, day centres or activity centres with various activities, workshops and seminars.

The results indicate the importance of increased focusing more on the first hospitalisation (in addition to the problem of re-hospitalisation), as well as recognition the importance of the admission being voluntary. The results also indicate that, for avoiding re-hospitalisation, follow-up is needed to cover the patient’s social and activity needs. Ideally, this should be facilitated as a close collaboration between the hospital, municipality/primary care and mental health service user.

8 Methods toolkit

The primary methodological feature of the CEPHOS-LINK project was that a retrospective cohort study design was used with routine data available in large electronic national databases. As foreseen already at the time of the submission of the CEPHOS-LINK project, a substantial amount of time and resources had to be invested into ascertaining this interoperability. For this purpose a set of tools was developed. Part 7 of the Final Scientific Report contains this set of tools collected into a “Methods toolkit”. These tools can be adapted for examining national databases of routine health care data in different countries in order to ascertain their interoperability, if cross-country comparisons of health care systems are to be carried out - not only in the mental health care field, but in all fields of medicine. The tools were developed during the preparatory activities phase of the CEPHOS-LINK project (Part 2 of the Final Scientific Report) and the pooling of data phase (Part 4 of the final scientific report) with the intent of improving the quality of data and for ascertaining interoperability of national databases for performing the CEPHOS-LINK re-hospitalisation studies.

9 Conclusions

Rendering large national electronic health care databases interoperable and thus comparable across countries is essential for comparing patterns of pathways of health service utilisation in different countries. The CEPHOS-LINK project has carried out pioneering work in this respect. If such interoperability can be achieved, methodological noise can be reduced in studies on quality of care and cost-effectiveness in different health care systems. Thus these differences can be seen as reflecting “real differences” and not as possibly resulting from methodological discrepancies as “artefacts”. The CEPHOS-LINK project has demonstrated by using the example of re-hospitalisation of psychiatric patients that such a noise reducing methodological approach is possible. The main findings from the CEPHOS-LINK study are thus in an optimal position of being comparable across countries. They show that between one third and half of all adult psychiatric patients return to hospital within one year after the index discharge, and that a large proportion of these re-hospitalisations occur during the first few weeks. Therefore the focus of potential preventive activities should be placed there. The CEPHOS-LINK project has also produced tools which can be used for increasing interoperability of national databases in other projects. While applying these tools to national databases, the institutions running them could increase awareness for the necessity for harmonising terminology and concepts on a European level, and facilitate future cross-country health care studies with common protocols and pooled data sets. The development of linkable electronic health care records could enhance these possibilities. The CEPHOS-LINK project has also demonstrated through its focus group study including people with lived experience of psychiatric re-hospitalisation that it is a valuable approach to explore experiential, i.e. qualitative data in addition to the quantitative approach. Both the quantitative and qualitative findings have found their way into a set of policy briefs developed at the end of the project.

CEPHOS-LINK

2

Final Scientific Report

PART 2

Ascertaining interoperability of national databases

Prepared by

IMEHPS.research and the CEPHOS-LINK team

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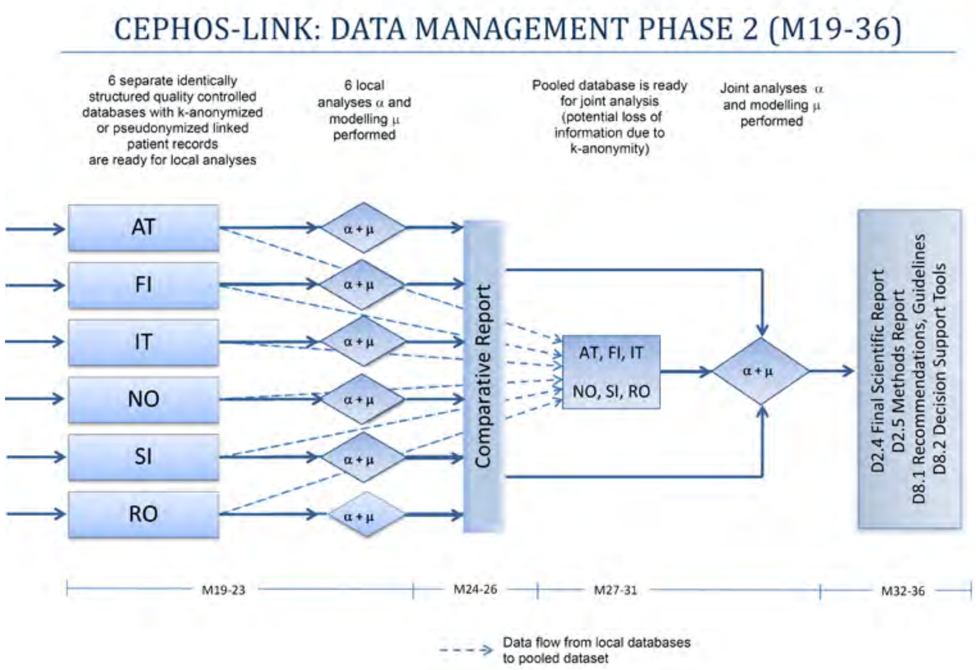
Contents

1 Introduction

The overall objective of the CEPHOS-LINK project was to compare with a common study protocol psychiatric re-hospitalisation rates in six European countries and to identify predictors by regression analyses in a retrospective cohort study design, first locally for each country dataset and then centrally with a pooled dataset (Figure 1).

Figure 1: Data flow for the CEPHOS-LINK study for six European countries



A crucial innovative aspect and challenge of this project was that observational data from large national electronic health care registries in six different countries with different health care systems and different data collection routines were to be used[1]. In contrast to most published studies on psychiatric re-hospitalisation and the related systematic reviews this approach has disadvantages, but also several major advantages.

The main disadvantage of using already collected routine data is that the types and quality of variables is restricted to what the different databases contain.

The major advantages are that very large unselected patient populations can be studied (tens or even hundreds of thousands) and that a common design and protocol can be applied to all countries, thereby attempting to counter-balance one of the main disadvantages of systematic reviews, namely the different designs and methodologies of published studies, which make it difficult to decide to what extent differences between study results are “real” or due to methodological differences. This dilemma is reflected in the five systematic reviews[i] carried out in the framework of the CEPHOS-LINK project. Using a common study protocol across countries and ascertaining the interoperability of

[1] When halfway through the CEPHOS-LINK project (April 2014 to March 2017) the so-called RECORD statement was published on „The Reporting of studies conducted using observational routinely-collected health data statement“, Benchimol et al, PLOS, October 6, 2015. Most oft the recommendations had been already taken care of in CEPHOS-LINK which reflected in the present report.

databases can reduce the “methodological noise”, but a tradeoff has to be made between this reduction of methodological artefacts and the potentially limited insights because of the reduced number and granularity of variables.

In order to maximise the advantages of the CEPHOS-LINK approach, efforts must be undertaken to ascertain the interoperability between the large national electronic registries on health service utilisation. The ascertainment of this interoperability is subject of this report, which was performed prior to the final CEPHOS-LINK study. These preparatory activities are described in detail in the present document together with the lessons learned for establishing the final study protocol for carrying out regression analyses in order to identify predictors of psychiatric re-hospitalisation rates in six different countries.

The activities on ascertainment of interoperability are reported in four sections dealing with

- Identifying and describing national databases and their relevant variables
- Analysing unlinked hospital episodes
- Carrying out a pilot study with linked data and
- Lessons learned for the final study protocol.

The first of these addresses the identification of databases and the relevant variables in order to check for quality and interoperability. For this purpose a set of templates was developed for collecting information for each country on details of the relevant databases and the variables required including all specifics of coding rules, record linkage procedures, access to databases with and without linked records. These tools will be described in Part 7 of the Final Scientific Report, CEPHOS-LINK Methods Toolkit (Objective 3 of the CEPHOS-LINK submission document). Once a first overview was obtained on main variables for hospital inpatient service utilisation, local analyses were carried out on unlinked records of hospital episodes, following the usual approach of international hospital statistics of counting hospital “discharges” (and not yet analysing linked records for individual patients). Based on findings from these activities pilot studies were carried out according to a common protocol, which mimicked in several aspects the final CEPHOS-LINK study. Information obtained by all three types of activities on ascertainment of interoperability was then synthesised and discussed under the heading of “lessons learned” leading to a common protocol for the final CEPHOS-LINK study.

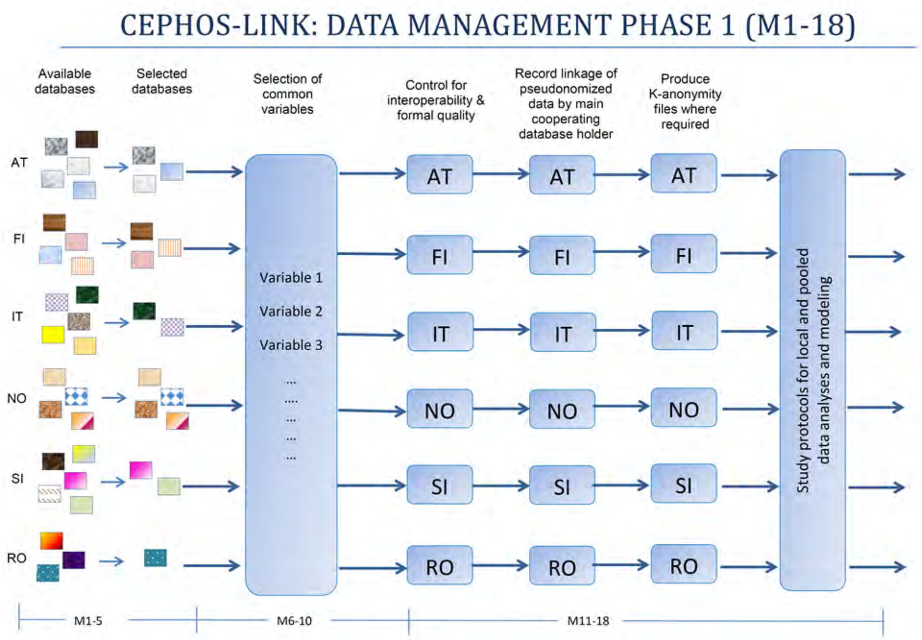
After obtaining preliminary knowledge on the available databases it was decided at an early stage of the project to focus on a limited number of predictors, which could reasonably be expected to be available in large national health care registries and which would be worthwhile to be checked for their availability in an interoperable form across the selected databases. In addition to the so-called pre-discharge variables age, gender, psychiatric diagnosis and length of stay, special emphasis was put on pre-discharge physical comorbidity. Concerning contextual variables, two were chosen related to the patients’ place of residence (urbanicity and Gross Domestic Product). Finally, post-discharge psychiatric outpatient contacts were chosen as a “continuity of care variable” and checked for availability in the national databases.

This report is not strictly chronological and incorporates to some extent findings from later stages of the project. Also, working with each country was not synchronised in a way that all steps were carried out in all countries simultaneously, but work was carried out with different speeds in different countries, and often required iterative strategies, with insights gained in one country leading to additional enquiries and analyses in other countries.

2 Identifying and describing national databases, relevant variables and coverage of services

The main objective of the CEPHOS-LINK project was to establish psychiatric re-hospitalisation rates in six different European countries and to identify predictors of these re-hospitalisation rates, by using a retrospective cohort study design with data from existing electronic health care registries. In view of the novelty of the approach of using routine data from six different countries with different health care systems and different data collection routines a major effort of the project was directed to guaranteeing the interoperability of the databases before local and pooled data analyses were carried out (Figure 2).

Figure 2: Ascertaining the interoperability of databases and variables in six European countries



This topic is dealt with here in three chapters: the first chapter is concerned with the characteristics of the databases and variables, the second addresses the important issue of which services are covered and which not in the specific country databases, the third discusses issues of record linkage, privacy and the access of the CEPHOS-LINK project teams to these databases.

2.1 Databases and variables

2.1.1 Methods of collecting information on available databases and the selected variables

In a first step in each partner country the relevant electronic databases for performing the CEPHOS-LINK study analyses had to be identified, thereby considering the availability of unique patient identifiers (UPI) and pseudonymisation techniques, procedures of complying with privacy protection regulations, the probable willingness and legal possibilities of database holders to cooperate, and the availability of probabilistic and other record linkage methods.

In order to perform this task several questionnaires were developed to be answered by each partner country. These questionnaires are contained in Part 7 of the Final Scientific Report as examples for how in other projects such tools might be designed and applied.

As a first step the CEPHOS-LINK Questionnaire on Administrative Databases (Tool 1 of the CEPHOS-LINK Methods Toolkit, Part 7) was developed and filled in by all partner countries in order to identify and describe the organisation(s) which

- own(s) the relevant database(s)/the data (database and data may have different legal owners)
- carries out pseudonymisation in case UPIs are available
- carries out record linkage by probabilistic/deterministic methods
- carries out the data analyses.

In a subsequent step identified databases in the six partner countries were checked in detail for availability and quality of variables required for the record linkage studies. For this purpose a second questionnaire was developed in order to obtain detailed information on the selected databases and to explore data inclusion requirements of the selected databases for performing the CEPHOS-LINK analyses (CEPHOS-LINK questionnaire on Master LEEARs, Tool 2 of the CEPHOS-LINK Methods Toolkit, Part 7; CEPHOS-LNK questionnaire on additional information for the continuity of care study, Tool 3 of the CEPHOS-LINK Methods Toolkit, Part 7). The databases are called below “LEEARs”, which is short for “Large Existing Electronic Administrative Registries”.

LEEARs were explored in relation to the coverage of two types of service utilisation data:
a) those directly needed for the CEPHOS-LINK analyses: inpatient and psychiatric outpatient service utilisation and b) other types of health care and non-health care service utilisation potentially relevant for psychiatric re-hospitalisation.

Part of these activities was concerned with the different steps of data flow from services to the national registries. For this pupose two tools were developed, one for the data flow of inpatient service utilisation data (Tool 5 of the CEPHOS-LINK Methods Toolkit, Part 7) and one for the data flow of outpatient service utilisation data (Tool 6 of the CEPHOS-LINK Methods Toolkit, Part 7).

a) Databases and variables on hospital inpatient and psychiatric outpatient service utilisation

As a first step information on the main databases (the so-called “Master LEEARs”) and the variables relevant for fulfilling objectives 1 and 2 was collected. Objective 1 relates to the prediction of re-hospitalisation rates by baseline variables, i.e. by variables known at the time when a patient was included in the study cohort. Objective 2 deals with continuity of care after a hospital discharge requiring the identification of post-discharge psychiatric outpatient contacts as predictor in addition to the baseline variables. Below lists are provided for the relevant items examined in this step.

Information on DATABASES:

- Full name of the database
- Date of start/end relevant for the CEPHOS-LINK analyses
- Latest validated year
- Primary purpose of the database
- Owner of database
- Owner of data
- Custodian of database
- Where is encryption performed?
- Custodian accustomed to linking within database
- Custodian accustomed to linking with other databases

At that early stage of the research process the availability and quality of potentially relevant variables were checked either directly (where partner countries had direct access to databases) or indirectly (where database owners were different from project partners) by checking documentation and getting information from the data owners. Detailed information on the variables contained in the databases and needed for the CEPHOS-LINK study were collected in each partner country as follows:

PATIENT VARIABLES

(1) Personal patient characteristics

- Unique patient identifier (UPI, needed for record linkage)
- Gender (needed as pre-discharge predictor)
- Date of birth/age (needed for defining the study cohort and as predictors)
- Place of residence (needed for deriving contextual predictor variables)

(2) Hospital inpatient service utilisation

Detailed information on the variables contained in the databases and needed for defining the study cohort and potentially explaining the re-hospitalisation outcomes of individual patients were collected in each partner country, including availability and coding of:

- Type of inpatient service (e.g. acute, chronic care; inpatient, daycare, rehabilitation, medical specialty codes)
- Diagnosis (main diagnosis, additional diagnoses, frequency of additional diagnoses) (needed as predictor, WP5 and WP6).
- Admission to hospital inpatient care (date of admission, type of admission with additional information on planned/unplanned and involuntary admission)
- Separation from hospital inpatient care (data of separation, type of separation: discharge, death, transfer)
- Hospital identifier (e.g. name and format of hospital identifier, whether a hospital identifier can relate to several hospitals, restrictions on availability of the hospital identifier)

(3) *Psychiatric outpatient service utilisation*

Availability and coding of psychiatric outpatient contacts (POC) needed for post-discharge predictors for the continuity of care study

- Ambulatory service utilisation (code, date of contact)
- Diagnosis in psychiatric ambulatory care (main diagnosis, additional diagnoses, frequency of additional diagnoses)
- Day care service utilisation (code, how contact dates with day care are documented, e.g. each day of a visit to day care; beginning and end of a day care period)
- Diagnosis in psychiatric day care (main diagnosis, additional diagnoses, frequency of additional diagnoses)
- Mobile care service utilisation (code, date of contact)
- Diagnosis in psychiatric mobile care (main diagnosis, additional diagnoses, frequency of additional diagnoses)

In addition to assessing the principal availability of the data of each of these variables, potential quality problems were assessed according to specifically defined criteria. For instance, whether pseudonymisation requirements influence the granularity and interoperability of available variables (e.g. exact date of “discharge from hospital” not available, but only “month of discharge”); or, whether record linkage based on probabilistic and other methods may violate data protection and privacy requirements and how these violations can be prevented by new methodological approaches (issues of k-anonymity, collapsing variables and code ranges, clustering methods); or, to which extent record linkage errors might occur by using record linkage methods not based on unique patient identifiers. At a later stage a Data Profiling Tool (Tool 11 of the CEPHOS-LINK Methods Toolkit, Part 7) was developed for the pooled data sets in order to assist the data quality checks - this will be described in detail in Part 4 of the Final Scientific Report.

b) Databases on other types of health care, on prescriptions, mortality and non-health care

In addition to the variables relating to inpatient hospitalisation and post-discharge psychiatric outpatient contacts it was attempted to check also the availability of data on utilisation of other health care and social services, as well as for pharmacy prescriptions and for mortality.

The CEPHOS-LINK Questionnaire on Other Health and Non-Health LEEARs (Tool 4 of the CEPHOS-LINK Methods Toolkit, Part 7) was developed in order to explore the *availability and coding* of service utilisation in national databases on

- primary care services, physician led
- primary care services, not physician led
- non-psychiatric specialist ambulatory care (“outpatient”) services
- non-psychiatric day care services
- filling of prescriptions in pharmacies.

Information was also obtained on

- databases on specific diseases (e.g. cancer registry) and
- causes of death as well as on
- other non-health, but health related data (work, education, social welfare, legal issues).

As will be shown, most of these variables could not be obtained in all participating countries or not in sufficient quality, and they were therefore not used for the regression analyses. It was especially unfortunate that comparable data on primary care services use was not available and also that the fact that a patient has died during follow-up could not be identified in a reliable way in all countries; this omission might, however, not be that important, since, in contrast to physical disorders, the mortality rate of psychiatric patients is rather low (as will be seen in the subsequent chapter on hospital episodes).

2.1.2 Results on identified and available databases and relevant variables

a) Databases on hospital inpatient and psychiatric outpatient service utilisation [2]

Table 1: Identified databases including inpatient and psychiatric outpatient care and availability for the CEPHOS-LINK data analyses (not available databases or not used in the CEPHOS-LINK study are written in italics) in six European countries

Country	Database including			
		Psychiatric Outpatient Care (POC)		
	Inpatient care	Psychiatric ambulatory care	Psychiatric day care	Psychiatric mobile care
AT	GAP-DRG & *GAP-DRG 2*	GAP-DRG & *GAP-DRG 2*	GAP-DRG & *GAP-DRG 2*	-
FI	Terveys HILMO	Terveys HILMO & Register on reimbursement paid for private care by KELA	Terveys HILMO	Terveys HILMO
IT	SDO	APT (only Veneto)	SDO & APT (only Veneto)	APT (only Veneto)
NO	NPR	NPR & *KUHR*	NPR	NPR
RO	DRG	*SIUI*	DRG & *SIUI*	-
SI	e-SBO & *Database from HIIS - new*	*Database from HIIS - new*	e-SBO & *Database from HIIS - new*	*Database from HIIS - new*

Table 1 provides an overview on the identified databases including psychiatric inpatient and outpatient service utilisation and their availability for the CEPHOS-LINK analyses of objectives 1 and 2. The databases and the included variables are described in detail in the CEPHOS-LINK Database Report 1 (available on request) and the CEPHOS-LINK Database Report 2 (available on request). An overview on the databases selected for analysing the CEPHOS-LINK objective 1 including full names in English and in the national languages, their acronyms, ownership and the primary purpose as well as a short description of the databases is provided in Table 2.

[2] In view of the fact that some of the analyses were not possible for the whole of Italy, the Veneto region was chosen instead of the whole of Italy. Therefore, information relating to the Veneto region is presented in some instances in addition to the information to the whole of Italy.

Table 2: Overview of countries, baseline years, database acronym, ownership of database, the primary purpose of the databases selected for analysing objective 1 and a short descriptive description of the databases

Country	Base line year	Acronym of the data-base	Full name of the database in English and in the national language (in brackets)	Owner of the database	Primary purpose of the database	Short description of the database
Austria	2006	GAP-DRG	General Approach for Patient-oriented Ambulant DRGs (Datenbank für Grundlagenforschung für ambulante patientenbezogene Diagnosis Related Groups)	Main Association of Austrian Social Security Institutions	reimbursement	The GAP-DRG is a pseudonymised patient registry based mainly on various claims databases for the inpatient, outpatient, pharmacy and other health sectors for the years 2006 and 2007. It includes service utilisation records of persons who are covered by the Mandatory Austrian Health Insurance System and for whom financial payment for health care utilisation was claimed. It covers nearly 100% of the Austrian population.
Finland	2012	Terveys HILMO	Care Register for Health Care (Hoitoilmoitus-järjestelmä)	THL	administration/ planing, monitoring, research	The purpose of the Care Register for Health Care is to collect data on the activities of health centres, hospitals and other institutions providing inpatient care and on the clients treated in them as well as on home-nursing clients for the purposes of statistics, research and planning. The Care Register is a continuation of the Hospital Discharge Register, which has data on patients discharged from hospitals between 1969 and 1993. The Care Register contains data on patients discharged from inpatient care, count of patients in inpatient care in health centres and hospitals at the end of the year, day surgeries, and specialised outpatient care.
Italy	2012	SDO	Register of Discharges from Hospitals (Scheda Dimissione Ospedaliera)	Ministry of health	administration/ planing, monitoring	Since 1995 the SDO is a registry to gather information on all patients who were discharged from or transferred to/from as well as who have died in public and private hospitals in the national territory. This system is active in all Italian regions, the information is collected by the hospital, then the local health districts send the data regularly every month to the Regions, and lastly, before sending the data to the Ministry of Health every Region performs quality controls and periodic checks on the data provided.
Veneto	2012	APT	Psychiatric care register (Assistenza Psichiatrica Territoriale)	Veneto Region	administration/ planing, monitoring	The APT is a registry used for collecting information on psychiatric ambulatory, residential, home visits and day care contacts in the Veneto Region of persons older than 14 years
Norway	2012	NPR	Norwegian Patient Register (Norsk pasient register)	The Norwegian Directorate of Health	administration/ planing, monitoring, research	The Norwegian Patient Registry (NPR) is a national health register containing information on all patients waiting for or having received treatment in publicly financed specialist health services. The registry was established in 1997. In February 2007, the Parliament adopted a change in the Health Registries Act to establish a person identifiable, encrypted Norwegian Patient Registry.

Country	Base line year	Acronym of the data-base	Full name of the database in English and in the national language (in brackets)	Owner of the database	Primary purpose of the database	Short description of the database
Romania	2012	DRG	Diagnostic Related Groups [3]	CNAS	reimbursement	The Romanian DRG is a national database of inpatient episodes of care to which all hospitals send data on a monthly basis for reimbursement purpuses. The DRG financing system has been implemented in Romania in 2002 for the first time and it has been adjusted several times since. The database is hosted and quality checked by the NSPHMPDB (SNSPMSPDB) on behalf of the NHIH (CNAS), who is the main payer for inpatient services in the Romanian health care system.
Slovenia	2013	e-SBO	Information system of hospital care for individual hospital episodes (Spremljanje bolnišničnih obravnav)	National Institute of Public Health	administration, monitoring, research	National Institute of Public Health as a manager of databases in the field of monitoring of hospital treatments enables from 1 January 2013 onwards the reporting of inpatient treatments at patient-level through a single monitoring information system of hospital care (called e-SBO). Slovenian hospitals routinely submit data on completed hospital episodes directly to the National Institute for Public Health once per month.

The selection of relevant databases was a complex interative process. An example for this process is provided below for one country.

In Slovenia two large electronic administrative databases were identified, (1) the database of the Health Insurance Institute of Slovenia (HIIS) - in Slovenian “Zavod za zdravstveno zavarovanje Slovenije” (ZZZS), the so-called “Database from HIIS - new” which contains inpatient and outpatient health care service utilisation data, but no information on diagnoses, and (2) the database of the National Institute of Public Health (e-SBO) which contains inpatient service utilisation data, including diagnostic information, but no data on outpatient service utilisation. For analysing the CEPHOS-LINK objective 1, where inpatient service utilisation was analysed the e-SBO was selected. For analysing the intervening influence of psychiatric outpatient contacts in objective 2 the linkage of the database “e-SBO” with the “Database from HIIS – new” was intended to be carried out. Unfortunately, at the end no permission from the Health Insurance Institute of Slovenia on the use of “Database from HIIS – new” was granted.

The primary purpose of the identified database was explored in order to better understand the data recorded and to identify possible recording artefacts. Two different types of primary purpose were found: (1) reimbursement and (2) administration/planing, monitoring, research. Both are linked to the health care financing system in the countries. The Austrian and the Romanian databases are primarily used for reimbursement purposes (both countries have an insurance based system of financing of health care). In Slovenia with an insurance based health care financing system the “Database from HIIS – new” has the primary purpose of reimbursement, but due to a lack of information on hospital discharge diagnoses it was not sufficient for the CEPHOS-LINK study, therefore the “s-SBO” database which was set up for administrative, monitoring and research

[3] The English terminology is used in Romanian therefore no national language terminology is available

purposes was used instead. Finland, Italy and Norway have a predominately tax based health care systems and databases have the primary purpose of administration/planing, monitoring and research.

After preliminary discussion with the project partners it was decided to go for a common denominator of a complete two-years dataset, a) since this was available for all countries; however, for different years in the different countries: for four countries this was 2012-2013 (Finland, Italy, Norway and Romania), 2013-2014 for Slovenia, and for Austria a database with linked record only existed for the years 2006 and 2007, and b) since it was known from the literature that most re-hospitalisations occur early on. With these two-year datasets it was possible to collect patients for the study cohort over one year and to follow-up each patient over 12 months.

b) Databases on other types of health care, prescriptions, mortality and non-health care

A detailed report on results on identified other health related databases and the included variables (primary health care, non-psychiatry ambulatory and day care, and information on filling of prescription and causes of death) was produced (available on request). These databases were not used for the CEPHOS-LINK analyses because of the lack of consistent availability in all countries. Table 3 provides an overview on the identified health related databases.

Table 3: Identified databases including physician led primary health care contact data, non-psychiatric specialist ambulatory and day care contacts, data on filling of prescriptions in pharmacies and causes of death

Country	Database on				
	Primary Care, physician led	Non- psychiatric specialist ambulatory care	Non- psychiatric specialist day care	Filling of prescriptions in pharmacies	Causes of death
AT	GAP-DRG GAP-DRG 2	GAP-DRG GAP-DRG 2	GAP-DRG GAP-DRG 2	GAP-DRG GAP-DRG 2	-
FI	Avo-Hilmo & Register on reimbursement paid for care by KELA	Terveys HILMO & Register on reimbursement paid for private care by KELA	Avo-Hilmo & Terveys HILMO & Register on reimbursement paid for care by KELA	Register on reimbursements for prescription medicines by KELA	Causes of death register-Kuolemansyyrekisteri
IT	-	SPS (only Veneto)	SPS (only Veneto)	Database on Prescription of Medications (only Veneto)	Mortality register, Regional level
NO	KUHR	KUHR & NPR	NPR	NorPD	Cause of Death Registry
RO	SIUI	SIUI	SIUI & DRG	SIPE/ISEP	-
SI	Database from HIIS - new	Database from HIIS - new	Database from HIIS - new	Database on Prescription of Medications	Database on Reports on death and causes of death

Finally, databases including potentially relevant non-health variables were explored and a report including information on

- employment
- education
- social Welfare
- the legal system
- other non-health information, e.g. socio economic status,

was produced. These databases were not used for the CEPHOS-LINK analyses.

2.2 Coverage of health care services in the databases

In addition to variables contained in the national LEEARs (definitions, coding, granularity, etc.) an important aspect by which national LEEARs can differ from one another is: which types of services are covered and which are not covered, which may even relate to the question, which types of services exist or do not exist in different countries.

Services for mental health care are specifically prone to exist in many different types in different countries. This is already true for hospital inpatient care. While for acute care the situation is more or less similar in different countries and hospitals are used, long-term care is differently organised in different countries, and often located in the non-health care sector and therefore usually not included in health care databases. The situation is even more complicated in the outpatient sector, where many different arrangements exist, both, inside and outside the health care sector. Below an attempt has been made to approach this issue without claiming completeness and 100% exactness. Thereby two approaches were used. First information on coverage of services and limitations in coverage were collected with the already mentioned methods CEPHOS-LINK questionnaire on Master LEEARs (Tool 2 of the CEPHOS-LINK Methods Toolkit, Part 7) and CEPHOS-LINK Questionnaire on Other Health LEEARs (Tool 4 of the CEPHOS-LINK Methods Toolkit, Part 7). Second, a more detailed exploration of the coverage of psychiatric inpatient services was performed by a geographical mapping tool with actual country maps.

2.2.1 Availability of different types of health care services and coverage of their utilisation in the selected databases

The CEPHOS-LINK questionnaire on Master LEEARs (Tool 2 of the CEPHOS-LINK Methods Toolkit, Part 7) and CEPHOS-LINK Questionnaire on Other Health and Non-Health LEEARs (Tool 4 of the CEPHOS-LINK Methods Toolkit, Part 7) included a section on the description of the different existing types of inpatient and outpatient services (using a service typology developed in the FP7 project REFINEMENT, http://www.refinementproject.eu/) for which an estimation on their occurrence (using a rating scale of 0=absent, 1=occasional, 2=common) had to be provided by each partner country, in order to get a picture of the service landscape of

(a) the psychiatric and non-psychiatric inpatient services
(b) psychiatric outpatient services, separated into ambulatory, day and mobile care services
(c) primary health care services
(d) non psychiatric outpatient services

Results on the coverage of the psychiatric and non-psychiatric inpatient services and psychiatric outpatient services are provided in Tables 4 to 6.

In additon, the coverage of the different in- and outpatient service utilisation and the information on filling of prescription in pharmacies and causes of death in the national database(s) were explored. Limitations concerning segments of the population covered and not covered, services and service utilisation events contained or not contained, and essential variables either missing or contained (but not in the required granularity) were explored.

For instance, in Austria accident hospitals and services owned by the provider “KFA” (which are both small provider groups) as well as private hospitals partly paid by public money (by the so-called PRIKRAF fund) were not included in the GAP-DRG database (which was used for the CEPHOS-LINK analyses). Relating these limitations to psychiatric inpatient services, this meant that services treating non-acute conditions of substance abuse disorders and services providing work related psychiatric rehabilitation were not included in the GAP-DRG database.

Exploring of the limitations of the databases at this stage of the project (when most partner did not have direct access to the data and had to rely on information provided by the data owners) were considered as a first step on ascertainment of interoperability since further limitations were found when performing the Pilot studies (see Section 4 of this document). Details on coverage and limitations of inpatient health care services are contained in the CEPHOS-LINK Database Report 1; details on coverage and limitations of psychiatric outpatient care are contained in the CEPHOS-LINK Database Report 2 and on coverage and limitations of other types of health care in the CEPHOS-LINK Database Report 3 (all 3 available on request).

This step on ascertainment of interoperability supported the CEPHOS-LINK team in (a) getting an overview on the existing health care service types in the participating countries, (b) identifying differences in service provision in the countries and (c) checking the coverage of health care service utilisation of the respective services in the selected databases. A major challenge experienced was ensuring a common understanding of the service typology.

Table 4: Estimation on occurrence of different types of psychiatric inpatient care on a scale of 0=absent, 1=occasional, 2=common and coverage in the databases of six European countries

INPATIENT CARE

Psychiatric inpatient care (patient stays overnight)

	AT		FI		IT		NO		RO		SI	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
Geographically stand-alone psychiatric hospital – acute care	2	GAP-DRG, GAP-DRG 2[4]	2	Terveys HILMO	0	-	0		1	SIUI, DRG	0	
Geographically stand-alone psychiatric hospital – long-term care	1	GAP-DRG, GAP-DRG 2	2	Terveys HILMO	1	SDO	1	-	2	SIUI, DRG	0	
Geographically stand-alone psychiatric hospital – long-term and acute care	0		2	Terveys HILMO	1	SDO	2	NPR	2	SIUI, DRG	2	Database from HIIS - new, e-SBO
Part of a psychiatric centre / community mental health centre	0		0	-	1		2	NPR	0		0	
Psychiatric departments in general hospitals (non-university)	2	GAP-DRG, GAP-DRG 2	2	Terveys HILMO	2	SDO	2	NPR	2	SIUI, DRG	0	
Psychiatric departments in general hospitals (university)	2	GAP-DRG, GAP-DRG 2	2	Terveys HILMO	1	SDO	2	NPR	2	SIUI, DRG	1	Database from HIIS - new, e-SBO
Psychiatric beds in long stay residential care homes (non-organic conditions)	2	GAP-DRG, GAP-DRG 2	2	Sosiaali-HILMO	2	SDO/APT (only Veneto)	1	NPR	2	-	2	Database from HIIS - new

[4] GAP-DRG 2 includes only patients insured by the Lower Austrian Health Insurance

	AT		FI		IT		NO		RO		SI	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
Psychiatric beds in long stay residential care homes (organic conditions)	2	GAP-DRG, GAP-DRG 2	2	Sosiaali-HILMO	2	SDO/APT (only Veneto)	1	-	2	-	2	Database from HIIS - new
Other psychiatric beds, please describe (forensic, military, psychosomatic, prison hospitals, rehabilitation, drug- and alcohol dependency …)	Forensic, prison, psychosomatic, addition psy- beds)	GAP-DRG 2 for psychosomatic	Forensic and prison	Terveys HILMO	1	Data in Forensic Hospitals Database	Beds in municipal care, private (publicly paid) substance abuse services	private substance abuse in NPR	0		1 Forensic psychiatry in Maribor	e-SBO

Table 5: Estimation on occurrence of non-psychiatric inpatient care on a scale of 0=absent, 1=occasional, 2=common and coverage in the databases of six European countries

Non-Psychiatric inpatient care (patient stays overnight)												
	AT		FI		IT		NO		RO		SI	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
Non-psychiatric inpatient care services (general hospitals, etc.)	2	GAP-DRG, GAP-DRG 2	2	TerveysHILMO	2	SDO	2	NPR	2	SIUI, DRG	2	Database from HIIS - new, e-SBO

Table 6: Estimation on occurrence of psychiatric outpatient care (ambulatory, day and mobile) on a scale of 0=absent, 1=occasional, 2=common and coverage in the databases of six European countries

PSYCHIATRIC "OUTPATIENT SERVICES" (ambulatory, day and mobile care)
Psychiatric ambulatory care services (patient comes to service)

	AT		**FI**		**IT**		**NO**		**RO**		**SI**	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
Self-employed psychiatrist, single- handed	2	GAP-DRG, GAP-DRG2	1	Partly (i.e. reimbursed visits only) covered by Register on reimbursements paid for private care by KELA	1	-	2	NPR, KUHR	2	SIUI	1	Database from HIIS - new
Self-employed psychologist/ psychotherapist, single-handed	1	-	1	Partly covered by Register on reimbursements paid for private care	1	-	2	KUHR NPR	2	-	1	Database from HIIS - new

	AT		FI		IT		NO		RO		SI	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
Self-employed psychiatrists/ psychologists/ psychotherapist, in group practice or similar	1	GAP-DRG, GAP-DRG2 but psychiatrists only	1	Partly covered by Register on reimbursements paid for private care	1	-	1	NPR, KUHR[1]	1	SIUI	0	-
Geographically stand-alone outpatient service where doctors are employed	1	-	2	Terveys HILMO	1	APT (only Veneto)	1	NPR,	1	SIUI	1	Database from HIIS - new
Outpatient service of a hospital where doctors are employed	1	-	2	Terveys HILMO	1	APT (only Veneto)	2	NPR,	2	SIUI	2	Database from HIIS - new
Outpatient service of a mental health/psychiatric centre" (with several other types of care provided), community mental health centre, community team	2	-	2	Terveys HILMO	2	APT (only Veneto)	2	NPR (District Psychiatric Centers)	2	SIUI	1	Database from HIIS - new
Other, please describe:	0	-	0	-	0	-	2 (outpatient care in municipal services, e.g.	IPLOS	0	-	0	-

	AT		FI		IT		NO		RO		SI	
Types of Services	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type	Occurrence	Database covering service type
							psychiatric nurses etc)					

Psychiatric day care services (patient comes to service)												
	AT		**FI**		IT		**NO**		**RO**		**SI**	
Integrated with inpatient section in a hospital	0	-	2	Terveys HILMO	1	SDO	2	NPR	1	DRG	2	HIIS, e-SBO
Separate organisational structure of a hospital and located in hospital	2	GAP-DRG, GAP-DRG2	2	Terveys HILMO	2	SDO	2	NPR	2	SIUI, DRG	0	-
Separate organisational structure of a hospital but not located in a hospital	1	-	2	Terveys HILMO	0	-	1	NPR	2	DRG	0	-
Part of a psychiatric centre / community mental health centre	2	-	2	Terveys HILMO	2	APT (only Veneto)	2	NPR	2	SIUI, DRG	0	-
Other, please describe: Tagesstätte, Clubs *(are not included)*	0	-	0		0	-	2 (day care in municipal services)	IPLOS	0	-	0	-

Psychiatric mobile services (service goes to patient)												
	AT		**FI**		**IT**		**NO**		**RO**		**SI**	
Organisationally part of a specialist psychiatric unit	0	-	2	Terveys HILMO	2	APT (only Veneto)	Not known	NPR	0	-	2	HIIS
Organisationally part of a community mental health team/service	2	-	2	Terveys HILMO	2	APT (only Veneto)	2 (District psychiatric senter)	NPR	0	-	1	HIIS
Organisationally part of a stand-alone community mobile mental health team/service	0	-	2	Terveys HILMO	0	-	1 (District psychiatric center)	NPR	0	-	0	-
Organisationally part of local/regional government social care services	0	-	0	-	0	-	see below		0	-	2	-
Other, please describe	0	-	0	-	0	-	2 (mobile services in the municipalities)	*IPLOS*	0	-	0	-

2.2.2 Geographical mapping of psychiatric inpatient services

To ensure consistency in data collection and comparability of data and results, information on the numbers and the types of psychiatric inpatient services and psychiatric beds were collected in detail. For this purpose, an online questionnaire for mapping psychiatric hospitals/hospital departments and psychiatric beds was developed (Tool 7, Online Form tool for Mapping of Psychiatric Inpatient Services and Beds and Tool 8, CEPHOS-LINK instructions to use the online form for mapping of psychiatric inpatient services and beds of the CEPHOS-LINK Methods Toolkit, Part 7).

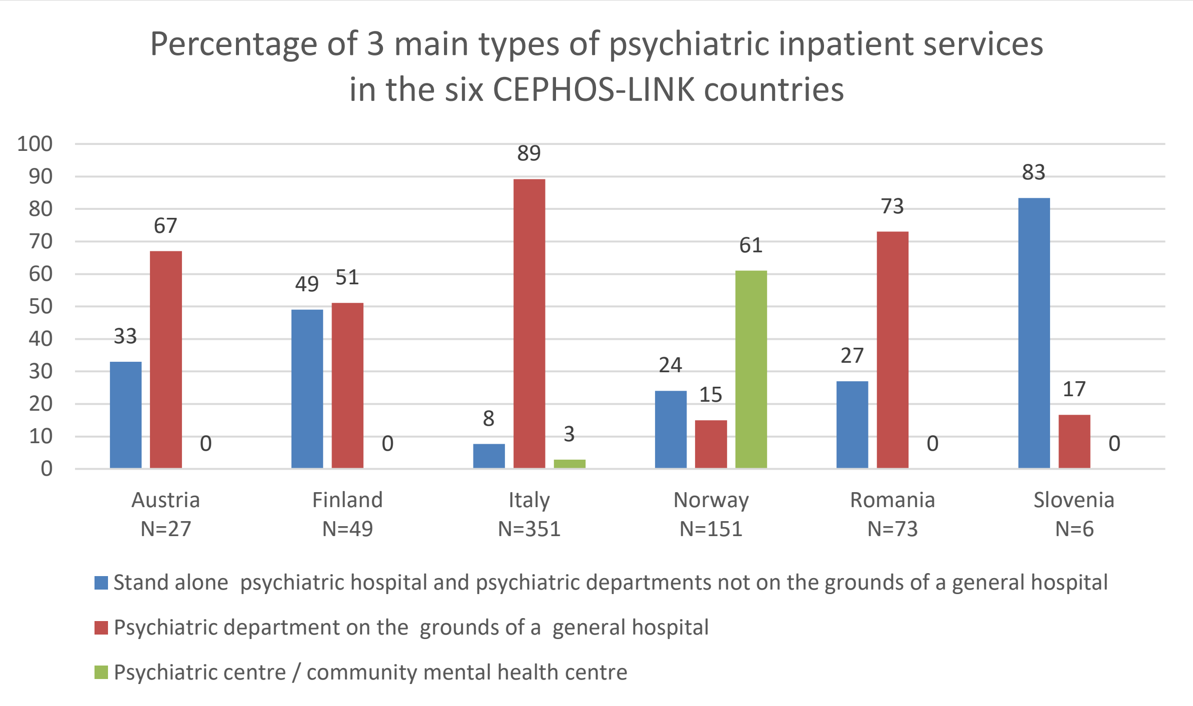
This online tool was developed in a step by step approach, including pretests and the subsequent modification of categories and terminologies in order to deal with the challenge of ensuring the same understanding of terminology used for describing services and to provide a scheme of services that capture the different realities of service types and organisation in the different countries. In the preparatory stage of the CEPHOS-LINK study it was aimed at only including psychiatric inpatient hospital services which provide acute and subacute care - this approach was called the "restricted approach" (while an unrestricted approach would refer to including any type of inpatient hospital service). Therefore, a differentiation between different types of psychiatric services, e.g. general psychiatry, substance abuse, geriatrics, psychotherapy, psychosomatic, long-term care, rehabilitation, military was used. Additionally, "acute/sub-acute" and "non-acute" hospital beds/wards/departments were differentiated. To ensure a common understanding of the terminology for the different service types detailed definitions on the psychiatric inpatient services and beds was prepared (CEPHOS-LINK – Mapping - definition of psychiatric inpatient services and beds, Tool 9 of the CEPHOS-LINK Methods Toolkit, Part 7).

Four main types of psychiatric hospital inpatient services (and a category "others") were distinguished:

(1) stand-alone psychiatric hospitals
(2) psychiatric departments of general hospitals not on the grounds of the general hospital – often traditional stand-alone psychiatric hospitals which were administratively integrated into a general hospital
(3) psychiatric departments of general hospitals on the grounds of the general hospital
(4) psychiatric inpatient services of community mental health centres.

For the purpose of reporting here (1) and (2) were collapsed into one category, so that three main types of psychiatric inpatient services remained. Figure 3 shows the distribution of these three main types of psychiatric inpatient services in the six CEPHOS-LINK countries. The patterns of these three types are very different for the partner countries. In Austria, Italy and Romania psychiatric departments on the grounds of a general hospital are the most frequent type of service, in Italy to a much higher percentage than in Austria and Romania. In Slovenia stand-alone psychiatric hospitals prevail. In Finland there is a balance between these two types of psychiatric inpatient services. In Norway psychiatric inpatient care is strongly relying on beds in local mental health centres (District Psychiatric Centres (DPS)).

Figure 3: Geographical mapping: percentage of 3 main types of psychiatric inpatient services in the six CEPHOS-LINK countries



In addition, a graphical map was developed based on open street map information visualizing each country's mapping results.

Figure 4 shows a screenshot on a very large level, comprising all six participating countries. Color codes are provided for the localization of the four types of psychiatric inpatient hospital services described earlier, plus a category "other". By zooming in or out a closer or larger picture can be obtained. Figure 5 provides a zoom into Finland, Figure 6 into Austria, Slovenia and the northern part of Italy. Then a much closer look is provided in Figure 7 where the geographical map of psychiatric inpatient services in Trieste/Italy by five different service types, including the information if a service is a university hospital or not (shown by the graduation hat) is shown. By clicking on the service symbol more detailed information on each service is provided, as shown in Figure 8 for a psychiatric department in a general hospital in Italy including information of number and type of beds.

The mapping results can be accessed at http://cephos.endel.at/mapping/CEPHOS_latest.html.

Figure 4: Overview on identified psychiatric inpatient services in the six CEPHOS-LINK countries using a typology of five different service types

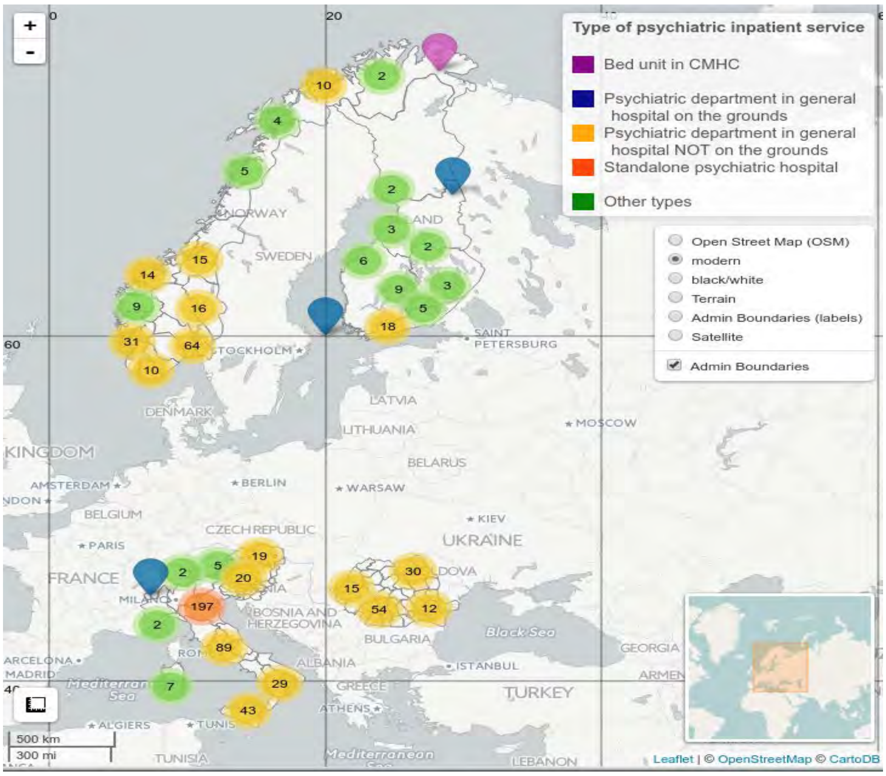


Figure 5: Geographical map of psychiatric inpatient services in the south part of Finland by five different service types

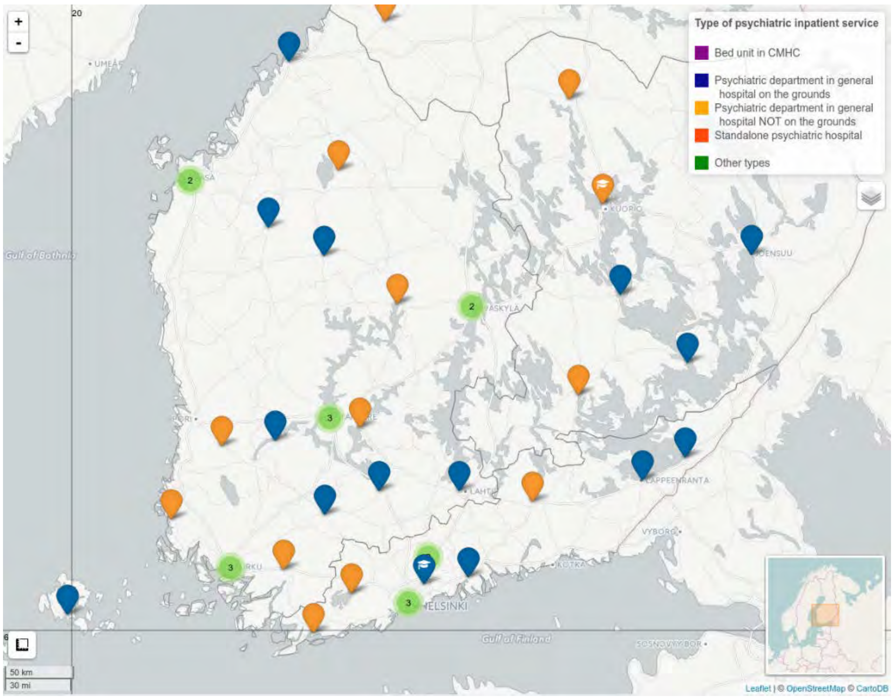


Figure 6: Geographical map of psychiatric inpatient services in parts of Austria, of Slovenia and the northern part of Italy by five different service types

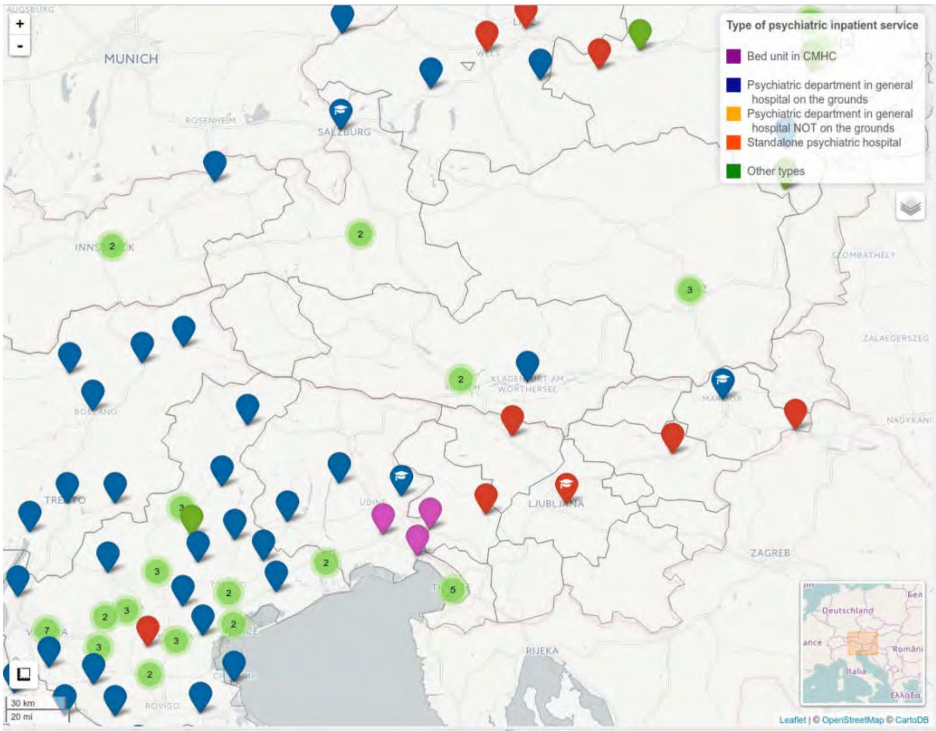


Figure 7: Geographical map of psychiatric inpatient services in Trieste/Italy by five different service types, including the information if a service is a university hospital or not (shown by the graduation hat)

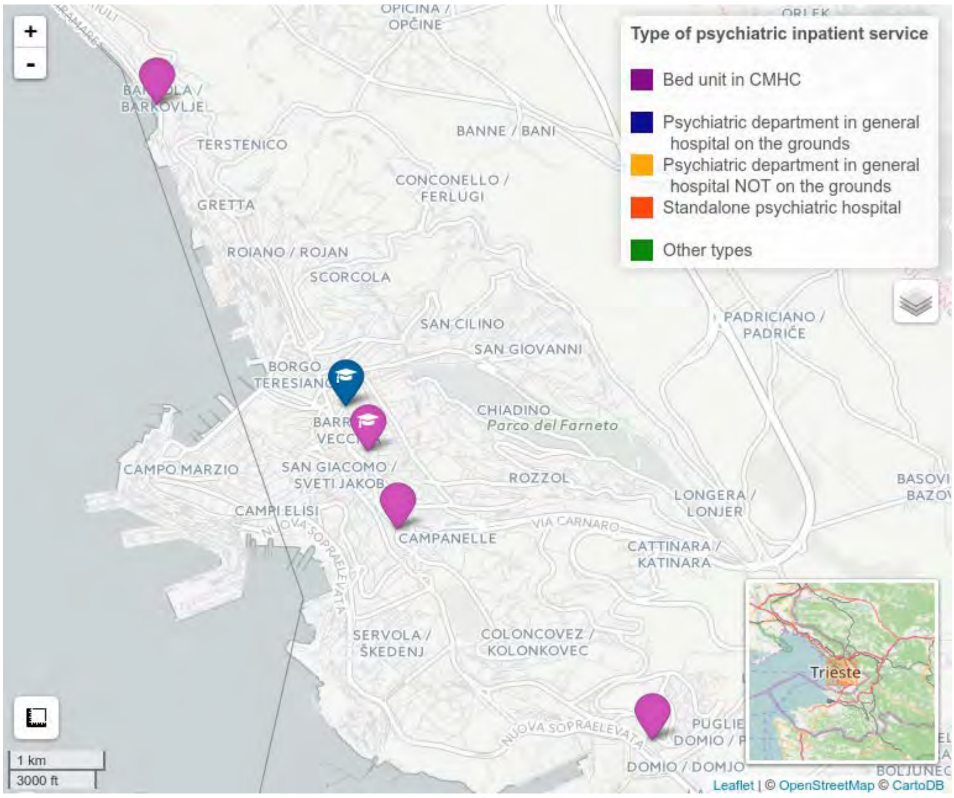
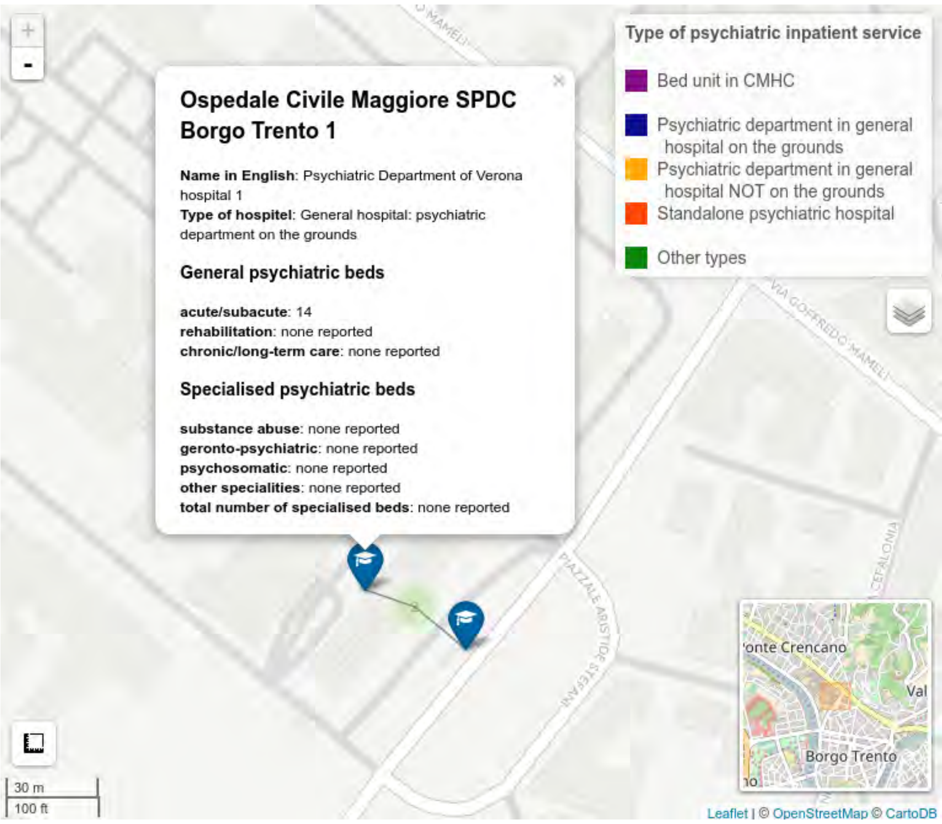


Figure 8: Geographical map of the psychiatric department in a general hospital "Ospedale Civile Maggiore SPDC, Borgo Trento 1" in Italy including information of number and type of beds



2.3 Pseudonymisation, record linkage, access to databases

Unique patient identifier, pseudonyms, record linkage

A surprising finding was that for hospital inpatient episodes in all countries the selected national databases had unique patient identifiers and were already available for the CEPHOS-LINK project with linked or linkable patient pseudonyms (encrypted patient identification). For four countries, Austria, Finland, Norway and Slovenia, and one Italian region (Veneto), also psychiatric outpatient contacts with exact dates were principally available with linkable pseudonyms (although, due to time restrictions, in the final analyses only Austria and Veneto could be included in the analyses relating to psychiatric outpatient contacts).

Access of CEPHOS-LINK partners to databases

While information about existing service utilisation databases was collected also for services not directly required for the CEPHOS-LINK study (but potentially useful for future studies, e.g., primary care, mortality registries, social care registries), the discussion on the access to databases is restricted here to databases covering hospital inpatient care and psychiatric outpatient care, which were actually used for the final data analyses in the CEPHOS-LINK study.

Austria: Direct access to the GAP-DRG database which is a specifically constructed research database for the years 2006 and 2007 and contains data from two LEEARs, (a) hospital episodes: MBDS of Ministry of Health, no pseudonym, unlinked hospital episodes; (b) psychiatric outpatient contacts: FOKO of the Main Association of Austrian Health Insurance Institutions, pseudonyms; linkable. These (and a filled prescription data base) were specifically linked by pseudonym as well as a customized deterministic linkage algorithm and could be directly accessed by the Austrian CEPHOS-LINK team. Important inpatient service contacts not included: private hospitals (PRIKRAF). Important psychiatric outpatient contacts not included: self-employed psychiatrists without a contract with Social Health Insurance, self-employed psychologist/psychotherapists single handed and group practices, outpatient services of hospitals, community mental health centres.

Finland: The national database HILMO includes hospital episodes and psychiatric outpatient contacts linkable through pseudonyms. The CEPHOS-LINK team had direct access to the unlinked data of episodes to the national database HILMO. For the main data analyses of the CEPHOS-LINK study only an "extract" of the database was provided. Not included: Occupational health care for outpatient services.

Italy: The CEPHOS-LINK team received from the Ministry of health an extract of the National SDO database for hospital episodes, linked with pseudonyms. No psychiatric outpatient contacts available

Veneto: The CEPHOS-LINK team received from the Veneto Region an extract of the Regional SDO database for hospital episodes and psychiatric outpatient contacts, linked with pseudonyms.

Norway: The CEPHOS-LINK team received an extract from the National Patient Register (NPR) containing: hospital and outpatient utilisation data, already linked with pseudonym. Not used: KUHR (KUHR is a database used for reimbursement of psychiatric outpatient services (until 2017), it contains data on all refundable psychiatric outpatient visits (ambulatory and mobile). The same information is contained in NPR and NPR is used.

Slovenia: Direct access to linked hospital episode data (e-SBO); not available: HIIS-new (outpatient database)

Romania: Direct access to hospital episode data linked by pseudonym. No access to outpatient data.

Information on ethical and legal issues is provided in Part 4 "Pooling of national data" of the Final Scientific Report.

3 The Hospital Episode Report – Hospital separations in the six national databases

3.1 Introduction

Once the six national LEEARs (large existing electronic administrative registries on health service utilisation) were identified as principally suitable for the CEPHOS-LINK re-hospitalisation study, preliminary analyses according to common protocols were carried out by each partner country with the purpose of identifying problems which might undermine the interoperability of the relevant data across the six countries.

The first of these preliminary studies, whose results are described below, aimed at describing unlinked hospital inpatient episodes, more precisely the unlinked "hospital separations", over the twelve months period of the baseline year (defined by each partner country according to the availability of a full two year set of linked service utilisation data – Austria: 2006, Finland: 2012, Italy: 2012, Norway: 2012, Romania: 2012, Slovenia: 2013). The term "hospital separation" is used here for describing all types of "ending" of a hospital episode. It comprises three main categories: a patient can be "discharged", "transferred to a different hospital" or "die" in the hospital. The term "hospital separations" avoids misunderstandings since in official statistics of the term "discharge" is sometimes used for describing all three types of ending a hospital episode.[5]

These analyses were carried out in order to (a) identify problems in defining the different types of a hospital separation in the different LEEARs (only "discharges" could be used for defining the patient cohort for a re-hospitalisation study), (b) to obtain background information for the actual study cohorts to be drawn from these data (actually the first discharge occurring within the baseline year was selected as "index discharge" on which a patient was included in the study cohorts), and (c) compare as far as possible project findings on episodes with those published in official international statistics. See CEPHOS-LINK – Questionnaire on Hospital Episodes in the Baseline Year, Tool 10 of the CEPHOS-LINK Methods Toolkit, Part 7,

It had to be made clear at an early stage in the CEPHOS-LINK project what is meant by "hospitalisation". It was determined that for the CEPHOS-LINK project at least one night had to be spent on a hospital bed, both in the definition of the hospital episodes leading to the inclusion of patients into the study cohort and in the definition of the hospital episodes to be counted as re-hospitalisation. While this may seem evident, it is not in relation to international comparisons carried out with routine service utilisation data. For instance, day care is increasingly provided in hospitals (especially in psychiatry so-called day hospitals exist) and such service utilisation had to be excluded. Another decision was to exclude military, forensic and prison hospitals, since they operate on different principles than routine health care does. Also, while the present hospital episode report starts out with all types of separations of all patients it will focus on the specific criteria of age 18+ years at the time of discharge and the so-called functional psychiatric diagnoses (ICD-10 F2 to F6, roughly "schizophrenia", "affective disorders", "neuroses", "personality disorders"). Finally, it has to be made clear that (as is the case in international statistics) the present report does not consider the specialty type of the hospital or department from which the patients were discharged (e.g. no distinction is made between psychiatric and non-psychiatric hospitals/departments). Due to small discrepancies in the databases used, minor inconsistencies of figures in different tables may occur.

3.2 Country-specific codes

As was shown in Section 2 above codes used for classifying the "end" of a hospital inpatient episode vary to a large extent between countries. Below these codes are shown for each of the six partner countries (in addition also for the Italian Region of Veneto, for which some specific CEPHOS-LINK regression analyses were carried out) together with the absolute and relative frequencies over the twelve months period of the baseline year. In view of the categories needed for including and excluding patients for the CEPHOS-LINK study cohort a colour code is applied for the main categories discharges (blue), deaths (red), and inter-hospital transfers[6] (green), and also categories which are foreseen in some countries but have to be neglected, namely intra-hospital transfer (orange) and unknown/other (yellow). For the analyses of episodes later on only discharges, deaths and inter-hospital transfers will be considered, i.e. the respective sums of the blue, red and green categories.

Discharges Deaths Inter-hospital transfers Intra-hospital transfers Unknown/other

The exact rules applied for assigning the codes to the three main categories are shown in Table 7 below.

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[5] See Health at a Glance 2015: OECD Indicators, and OECD Health Statistics 2015, Definitions, Sources and Methods: Hospital discharges by diagnostic categories

[6] For the sake of brevity, this group will be later referred to simply as "transfers".

Table 7: Country specific codes assigned to the three main categories of hospital separations (Discharge, Deaths, Inter-hospital transfers) and two excluded additional categories (“Unclear”, “Intra-hospital transfer”) in the CEPHOS-LINK project

	Included			Excluded		
	Discharge	Deaths	Inter-hospital transfers	Intra-hospital transfers	Unknown, other	% excluded of all separations
Austria (2006)	E, R, P, 4	S	T	A, H	L, V	*0,17%*
Finland (2012)	13, 14, 15, 16, 17, 18, 2, 21, 22, 23, 24, 27	3	11, 12		1	*3,24%*
Italy (2012)	2, 3, 4, 5, 7, 8, 9	1	6			*0%*
Norway (2012)	N-SEP_1: 1 N-SEP_2: 1, 6, 9, 11, 13, 14, 15	N-SEP_1: 2	N-SEP_2: 3, 16	7, 8, 12	2,5	*1,14%*
Romania (2012)	1,2	4	3			*0%*
Slovenia (2013)	1, 41, 5, 6, 9, 91, 99	82, 83	21	3, 31, 32	22, 42, 92	*6,87%*

Table 8: Hospital separations in Austria (2006); Database: GAP-DRG

E	1.925.163	95,07%	Discharge from hospital (Entlassung aus dem Krankenhaus)
T	61.135	3,02%	Transfer to another hospital (Transfer in ein anderes Krankenhaus)
S	34.548	1,71%	Death (Sterbefall)
A	60	<0,01%	Transfer within the hospital from rehabilitation and unit solely for care to general inpatient unit; intensive care unit included (Krankenhausinterne Verlegung vom Bereich der Rehabilitation)
H	2.266	0,11%	End of stay in semi-inpatient unit or transfer to semi-inpatient unit (Abschluss eines Aufenthaltes im halbstationären Bereich oder krankenhausinterne Verlegung in den halbstationären Bereich)
R	493	0,02%	Transfer within same hospital to rehabilitation unit (Krankenhausinterne Verlegung in den Bereich der Rehabilitation)
P	277	0,01%	Transfer within same hospital to a unit solely for care (Krankenhausinterne Verlegung in den ausschließlichen Bereich der Pflege)
L	1.153	0,06%	Used to code data records that are closed at the time of patients asylum status (Kennzeichen der Datensätze, die zum Zeitpunkt der Asylierung dokumentarisch abgeschlossen werden)
V	-	-	Used to code data records that are not closed cases/hospital stays at the end of the year as patients are still in the hospital (Kennzeichen für noch nicht abgeschlossene Aufenthalte von am Jahresende verbleibenden Patienten/Patientinnen)
4	-	-	Patient has left against advise of hospital staff (Entlassung gegen Revers)
Total	2.025.095	100%	All types of separations

Discharges = 1.925.933 (95,27%) Deaths = 34.548 (1,71%) Transfers = 61.135 (3,02%) **CEPOHS-LINK separations** = 2.021.616 (100%)

Table 9: Hospital separations in Finland (2012); Database: Terveys HILMO

1	31.226	3,24%	*Institutions (Laitoshoito)*
11	168.332	17,47%	*Transfer to hospital (Sairaala)*
12	68.968	7,16%	Transfer to primary care ward in community health centre (Terveyskeskus)
13	11.408	1,18%	Transfer to nursing home (Vanhainkoti)
14	532	0,06%	Transfer to institution for people with learning disability (Kehitysvammalaitos)
15	1.295	0,13%	Transfer to institution for people with substance abuse (Päihdehuollon laitos)
16	2.483	0,26%	Transfer to institution for rehabilitation (Kuntoutuslaitos)
17	2.566	0,27%	Should nowadays be coded "27", i.e. Other supported housing with 24h supervision
18	1.939	0,20%	Transfer to other institutions (Muu laitoshoito)
2	159.630	16,57%	Home and home-based care (Koti, kotihoito ja palveluasuminen)
21	82.285	8,54%	Transfer to care at home/supported housing without 24h supervision (Kotihoito/eiympärivuorokautinen palveluasuminen)
22	373.235	38,73%	Transfer to home without repeated care (Koti ilman säännöllisiä palveluja)
23	22.616	2,35%	Transfer to supported housing (24h support) for old people (Vanhusten ympärivuorokautinen palveluasuminen)
24	1.109	0,12%	Transfer to supported housing for people with learning disabilities (Kehitysvammaisten autettu asuminen)
27	6.747	0,70%	Other supported housing with 24h supervision (Muu ympärivuorokautinen palveluasuminen)
3	29.275	3,04%	Dead (Kuollut)
Total	963.646	100%	All types of separations

Discharges = 665.845 (71,41%) Deaths = 29.275 (3,14%) Transfers = 237.300 (25,45%) **CEPHOS-LINK separations** = 932.420 (100%)

Table 10: Hospital separations in Italy (2012); Database: SDO

1	235.450	3,07%	Death (Paziente deceduto)
2	6.727.462	87,74%	Discharged to patient's home (dimissione ordinaria al domicilio del paziente)
3	75.799	0,99%	Discharged to a sheltered accommodation, i.e. long term care (dimissione ordinaria presso residenza sanitaria assistenziale)
4	18.709	0,24%	Discharged to patient's home with domiciliary care, including health care: nurses and doctors (dimissione al domicilio del paziente con attivazione ospedalizzazione domiciliare)
5	207.509	2,71%	Voluntary discharge; patient's decision to terminate the admission (dimissione volontaria)
6	160.735	2,10%	Transferred to other hospital, private or public (trasferimento ad altro istituto di ricovero e cura pubblico e privato per acuti)
7	91.106	1,19%	Transferred to other regime in the same hospital (private or public) – This code is used for the transfer from an ordinary hospitalization to a day-hospital regime (trasferimento ad altro regime di ricovero nell ambito dello stesso istituto)
8	112.705	1,47%	Transferred to a rehabilitation institution, private or public (trasferimento ad un istituto pubblico o privato di riabilitazione)
9	37.955	0,50%	Discharged at patient's home with nursing domiciliary care (dimissione ordinaria con attivazione di assistenza domiciliare integrate, ADI)
Total	7.667.430	100%	All types of separations

Discharges = 7.271.245 (94,83%) Deaths = 235.450 (3,07%) Transfers = 160.735 (2,10%) **CEPHOS-LINK** separations = 7.667.430 (100%)

In view of the fact that some of the analyses were not possible for the whole of Italy, the Veneto region was chosen instead of the whole of Italy. Therefore, information relating to the Veneto region is presented in some instances in addition to the information to the whole of Italy.

Table 11: Hospital separations in the Veneto region (Italy; 2012); Database: SDO

1	21.883	4,07%	Death (Paziente deceduto)
2	479.147	87,66%	Discharged to patient's home (dimissione ordinaria al domicilio del paziente)
3	7.204	1,26%	Discharged to a sheltered accommodation, i.e. long term care (dimissione ordinaria presso residenza sanitaria assistenziale)
4	602	0,12%	Discharged to patient's home with domiciliary care, including health care: nurses and doctors (dimissione al domicilio del paziente con attivazione ospedalizzazione domiciliare)
5	2.996	0,77%	Voluntary discharge; patient's decision to terminate the admission (dimissione volontaria)
6	8.403	1,66%	Transferred to other hospital, private or public (trasferimento ad altro istituto di ricovero e cura pubblico e privato per acuti)
7	4.387	0,82%	Transferred to other regime in the same hospital (private or public) – This code is used for the transfer from an ordinary hospitalization to a day-hospital regime (trasferimento ad altro regime di ricovero nell ambito dello stesso istituto)
8	16.929	2,96%	Transferred to a rehabilitation institution, private or public (trasferimento ad un istituto pubblico o privato di riabilitazione)
9	3.906	0,68%	Discharged at patient's home with nursing domiciliary care (dimissione ordinaria con attivazione di assistenza domiciliare integrate, ADI)
Total	545.457	100%	All types of separations

Discharges = 515.171 (94,45%) Deaths = 21.883(4,01%) Transfers = 8.403 (1,54%) **CEPHOS-LINK separations** = 545.457 (100%)

Table 12: Hospital separations in Norway (2012); Database: NPR

1	725.104	83,46%	Regular home, workplace etc. (Vanlig bosted, arbeidssted mv.)
2	3	<0,01%	Injury- or find-spot (Skade- eller funnsted)
3	59.077	6,80%	Other unit within specialist health care; except DPS (Annen enhet innen spesialisthelsetjenesten; untatt DPS)
5	27	<0,01%	Abroad (Utlandet)
6	27.085	3,12%	Other (Annet)
7	700	0,08%	Other somatic unit within own health institution (Annen somatisk enhet ved egen helseinstitusjon)
8	6.819	0,78%	Other psychiatric unit within own health institution (Annen psykiatrisk enhet ved egen helseinstitusjon)
9	665	0,08%	Sick-hotel (Sykehotell)
11	32.824	3,78%	Old age home, nursing home or similar (Aldershjem, sykehjem eller lignende)
12	2.342	0,27%	Other unit within TSB (Interdisciplinary specialized treatment of substance abuse) within own health institution (Annen enhet innen Tverrfaglig spesialisert behandling av rusmisbruk ved egen helseinstitusjon)
13	535	0,06%	Intermediate/intensified nursing home (Intermediærenhet/ forsterket sykehjem)
14	6	<0,01%	Municipal emergency room (Kommunal legevakt)
15	473	0,05%	Andre kommunale eller private bo- og hejlpetiltak (Other municipal of private living- and aid projects)
16	678	0,08%	District psychiatric centers (Distriktspsykiatrisk senter, DPS)
D	12.450	1,43%	Dead (død)
Total	868.788	100%	All types of separations

Reported are N-Sep_2 codes with N-Sep_1:1 (alive).
Deaths are reported as the sum of N-Sep_2 codes with N-Sep_1:2 (dead)
Total number of hospital separations = 868.788 (excluding 1.053 cases with missing codes)

Discharges = 786.692 (91,59%) Deaths = 12.450 (1,45%) Transfers = 59.755 (6,96%) **CEPHOS-LINK separations** = 858.897 (100%)

Table 13: Hospital separations in Romania (2012); Database: DRG

1	4.089.967	95,87%	Discharged (Externat)
2	88.000	2,06%	Discharged on request (Externat la cerere)
3	30.522	0,72%	Transfer to another hospital (Transfer inter-spitalicesc)
4	57.590	1,35%	Died (Decedat)
Total	4.266.079	100%	All types of separations

Discharges = 4.177.967 (97,93%) Deaths = 57.590 (1,35%) Transfers = 30.522 (0,72%) **CEPHOS-LINK separations** = 4.266.079 (100%)

Table 14: Hospital separations in Slovenia (2013); Database: e-SBO

1	337.715	84,73%	Home (odpuščen domov)
21	5.425	1,36%	Transfer to another hospital (napoten v drugo bolnišnico v Sloveniji)
22	-	-	Transfer to another hospital outside Slovenia (napoten v drugo bolnišnico v tujini)
3	-	-	Transfer to another hospital ward in another hospital care in the same hospital (premeščen na drug tip obravnave v isti bolnišnici)
31	4.405	1,11%	Transfer to another type of care in the same hospital (premeščen na drug tip obravnave v isti bolnišnici)
32	22.467	5,64%	Other transfer in the same hospital (druga premestitev v isti bolnišnici)
41	649	0,16%	Transfered to rehabilitation in another hospital or another healthcare institution in Slovenia (napoten na rehabilitacijo v drugo bolnišnico ali drug zdravstveni zavod v Sloveniji)
42	-	-	Transfered to rehabilitation in another hospital or another healthcare institution outside Slovenia (napoten na rehabilitacijo v drugo bolnišnico ali drug zdravstveni zavod v tujini)
5	4.441	1,11%	Tranfered to a nursing home or social institution (Odpuščen v dom za ostarele ali socialni zavod)
6	294	0,07%	Discharge at your own risk and without medical advice (Odpuščen na lastno odgovornost)
9	1.557	0,39%	Other (Drugo)
91	11.705	2,94%	Planned ambulatory control (naročen na ambulantno kontrolo); only for patients from UKC Maribor
92	506	0,13%	Planned rehospitalisation (naročen na ponovno hospitalizacijo); only for patients from UKC Maribor
99	18	<0,01%	Other (Drugo); only for patients from UKC Maribor
82	1.349	0,34%	8 and Death = 2 Death – postmortem (Smrt in pacient obduciran)
83	8.041	2,02%	8 and Death = 3 Death – no postmortem (Smrt in pacient ni obduciran)
Total	398.572	100%	All types of separations

Discharges = 356.379 (96,01%) Deaths = 9.390 (2,53%) Transfers = 5.425 (1,46%) **CEPHOS-LINK separations** = 371.194

In view of the very motely pictures above a few comments are useful, before proceeding to the presentation of the analyses of hospital inpatient episodes.

In some countries 0-day stays, i.e. hospital stays where patients are admitted and discharged on the same day are included in the published statistics on hospital separations. For the CEPHOS-LINK project, stays in such "day hospitals" were excluded.

In the CEPHOS-LINK study only patients discharged in the narrow sense will be included in the study cohort. It is therefore necessary to understand how frequent different types of "separations" are. For one, death rates are important, since a higher death rate might imply fewer re-hospitalisations. Another focus will be on inter-hospital transfers and the potential error implied in different definitions in different countries. Related to this issue is the handling of *intra-hospital* transfers in different countries. In some countries, we were able to identify separation codes that potentially indicated a transfer within a hospital, but were coded as discharges. However, in the strict sense, a transfer within a hospital does not end a hospital episode in the terminology used in the CEPHOS-LINK project. Hence all episodes ending with an intra-hospital transfer were excluded from the dataset.

Some separation codes could still not be assigned to one of the subgroups, as they could indicate two or more types of separation simultaneously and were hence categorised as “unknown/other” and excluded from the data set. In some cases, these fuzzy codes were used quite frequently as e.g. code “1 = Laitoshoito (Institutions)” in Finland, which could be either a discharge to a nursing home etc., or a transfer to another hospital. In total 31.226 episodes had this code, which amounts to 3,24% of all separations.

In Slovenia, code “9 = (Others) Drugo” (13.786 cases, 3,46% of separations) is a special case with no unique pattern of usage. Field visits and talks with hospital personnel revealed that for mental health care in Slovenia, this code 9 is used mainly in the general hospital in Maribor. The code “9” is divided into three sub-codes (“91”, “92” and “99”) for the use in Maribor indicating either that patients ending an inpatient hospital episode with a code 9 have a planned re-hospitalisation (code “92”) or are referred to the outpatient department of the hospital (code “91”). As the CEPHOS-LINK project focuses on unplanned re-hospitalisations, such patients with a planned re-hospitalisation are not included in the sample. However, patients who are only referred to the outpatient department are included in our study cohort, since they still are at risk of an unplanned re-hospitalisation. Code “99” is rarely used and captures those discharges in Maribor that classify as code “9”, but do not have a planned re-hospitalisation or outpatient contact. As we found no indication that the code “9” is used for planned re-hospitalisation elsewhere in Slovenia, it is considered a discharge in the proper sense.

3.3 Demographics

In order to be able to calculate population related rates of hospital separations, the population of each partner country is shown below. The total population in the CEPHOS-LINK partner country for the respective baseline years is 100.249.516, i.e. the CEPHOS-LINK project counts over 100 million people in six countries. This number is, however, brought down to 82 million since the focus of the project is on the population of 18 years and older.

Table 15: Total population of the six CEPHOS-LINK partner countries for the baseline year by age <18/18+, row percent

	All		<18		18+	
Country (Year)	**absolute**	**row %**	**absolute**	**row %**	**absolute**	**row %**
Austria (2006)	8.267.948	100%	1.600.184	19,35%	6.667.764	80,65%
Finland (2012)	5.413.971	100%	1.080.248	19,95%	4.333.723	80,05%
Italy (2012)	59.394.207	100%	9.997.772	16,83%	49.396.435	83,17%
Norway (2012)	5.018.573	100%	1.120.561	22,33%	3.898.012	77,67%
Romania (2012)	20.095.996	100%	3.841.553	19,12%	16.254.443	80,88%
Slovenia (2013)	2.058.821	100%	355.994	17,29%	1.702.827	82,71%
All countries	**100.249.516**	**100%**	**17.996.312**	**17,95%**	**82.253.204**	**82,05%**
Veneto (2012)	4.881.756	100%	828.315	16,97%	4.053.441	83,03%

Table 16: Total population of the six CEPHOS-LINK partner countries for the baseline year by age <18/18+, column percent

	All		18+	
Country (Year)	**absolute**	**column %**	**absolute**	**column %**
Austria (2006)	8.267.948	8,25%	6.667.764	8,11%
Finland (2012)	5.413.971	5,40%	4.333.723	5,27%
Italy (2012)	59.394.207	59,25%	49.396.435	60,05%
Norway (2012)	5.018.573	5,01%	3.898.012	4,74%
Romania (2012)	20.095.996	20,05%	16.254.443	19,76%
Slovenia (2013)	2.058.821	2,05%	1.702.827	2,07%
All countries	**100.249.516**	**100%**	**82.253.204**	**100%**
Veneto (2012)	4.881.756	4,87%	4.053.441	4,93%

Table 17: Total population of the six CEPHOS-LINK partner countries for the baseline by sex

	ALL AGES				
	All	**Female**		**Male**	
Country (Year)		**absolute**	**row %**	**absolute**	**row %**
Austria (2006)	8.267.948	4.245.432	51,35	4.022.516	48,65
Finland (2012)	5.413.971	2.754.393	50,88	2.659.578	49,12
Italy (2012)	59.394.207	30.667.608	51,63	28.726.599	48,37
Norway (2012)	5.018.573	2.501.183	49,84	2.517.390	50,16
Romania (2012)	20.095.996	10.318.889	51,35	9.777.107	48,65
Slovenia (2013)	2.058.821	1.039.760	50,50	1.019.061	49,50
Veneto (2012)	4.881.756	2.503.819	51,29	2.377.937	48,71

As can be seen in Table 15 the absolute numbers of the population vary to a large degree between countries, ranging from 2 million in Slovenia to nearly 60 million in Italy, i.e. the population for Italy is almost 30 times larger than that for Slovenia. This large variation matters for the analyses to be carried out in the CEPHOS-LINK project, where in the local studies the number of cases will influence the degree of significance, and where, in the pooled analyses, strategies have to be developed to arrive at an adequate balance. The percentage of the population aged 18 or older is roughly 80%. It is lowest in Norway (77,67%) and highest in Italy (83,17%).

3.4 Results

3.4.1 Hospital separations regardless of diagnosis

3.4.1.1 All ages

The total number of separations is 16.117.636 (unclear codes are excluded, see Table 8 to Table 14). With 7.7 million, Italy has the highest absolute number, and with 371.194 the number is lowest in Slovenia. In general, the numbers of separations are in the same rank order as the total population of the countries. The picture changes when rates per 1.000 population are considered: Austria has the highest rate (with 245 per 1.000 population) and Italy the lowest (129 per 1.000 population). Since hospital separations roughly correspond to hospital admissions, this means that in Austria for each 1.000 of the population twice as many hospitalisations occurred as in Italy.

Table 18: Hospital separations for the total population in the CEPHOS-LINK baseline year (in brackets)

Country (Year)	Population	Separations	
		N	‰ Pop
Austria (2006)	8.267.948	2.021.616	244,51
Finland (2012)	5.413.971	932.420	172,22
Italy (2012)	59.394.207	7.667.430	129,09
Norway (2012)	5.018.573	858.897	171,14
Romania (2012)	20.095.996	4.266.079	212,29
Slovenia (2013)	2.058.821	371.194	180,29
Total	**100.249.516**	**16.117.636**	**160,78**
Veneto (2012)	4.881.756	545.457	111,73

A comparison with hospital separation rates per 1.000 total population as published by international organisations confirms this finding and shows that the analyses carried out for CEPHOS-LINK with the specific databases are in line with international statistics (Table 19 and Figure 9).

Table 19: Hospital separation rates per 1.000 total population in various international statistics[7] and CEPHOS-LINK

Country (Year)	OECD	ECHI	WHO	EUROSTAT	CEPHOS-LINK
Austria (2006)	276,56	276,55	276,60	n/a	244,51
Finland (2012)	177,48	180,01[a]	173,60	177,48	172,22
Italy (2012)	128,78	121,24	122,00	128,78	129,09
Norway (2012)	175,26[a]	159,31[a]	195,40	169,24[a]	171,14
Romania (2012)	n/a	218,25	207,90	220,92	212,29
Slovenia (2013)	181,51	166,27[a]	181,60	181,51	180,29
Veneto (2012)	n/a	n/a	n/a	111,85	111,73

[7] European Community Health Indicators [ECHI]: Indicator HIHSI036260 [http://ec.europa.eu/health/indicators/indicators_en]
EUROSTAT: Hospital discharges by diagnosis, in-patients, per 100.000 inhabitants [http://ec.europa.eu/eurostat/data/database]
EUROSTAT: Hospital discharges by diagnosis and NUTS 2 regions, in-patients, per 100.000 inhabitants – total [http://ec.europa.eu/eurostat/data/database]
World Health Organisation: European Health for All Database, 6010 inpatient care discharges per 100 [http://data.euro.who.int/hfadb/]

[a]Deviation in baseline year: OECD: NO (2010); ECHI: NO (2013), SI (2011), FI (2011); EUROSTAT: NO (2013)
n/a = not available

If separations are broken down into the three categories “discharge”, “death” and “transfer to another hospital”, the percentages are different for each country (Figure 10). Altogether the 16.117.636 separations are divided into 15.184.061 discharges (94,21%), 378.703 deaths (2,35%), and 554.872 transfers (3,44%) (Table 20 and Table 21). In the percentage of transfers to other hospitals, Finland shows the most marked deviation (25,45%) from other countries. Transfers to other hospitals are relevant for the CEPHOS-LINK project in several respects, one of the most salient ones being the calculation of the length of stay (which was used as a predictor in the regression analysis). The percentages of deaths in hospitals range between 1,35% (Romania) and 3,07% (Italy). While these are small figures, differences are relevant for the CEPHOS-LINK study, because the more people die in hospital, the less severely ill people are discharged with a potentially smaller risk for a re-hospitalisation. With the notable exception of Finland (71,41%) the percentages of discharges lie in a rather narrow range between 91,59% (Norway) and 97,93% (Romania).

Figure 9: Hospital separation rates per 1.000 total population in different international statistics and CEPHOS-LINK

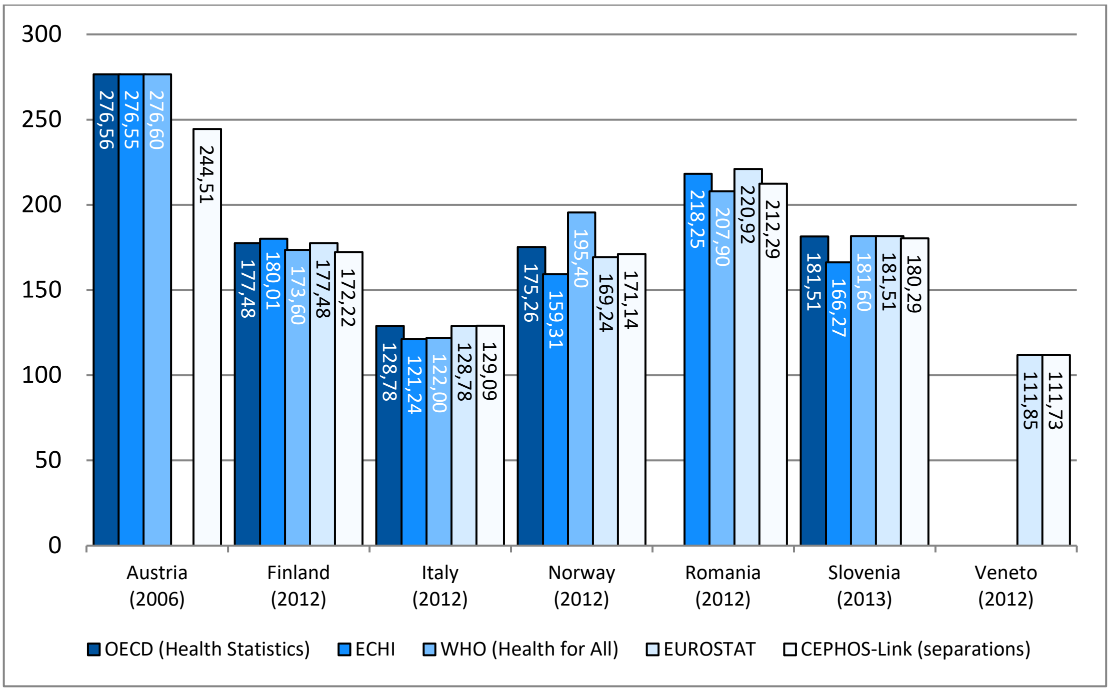


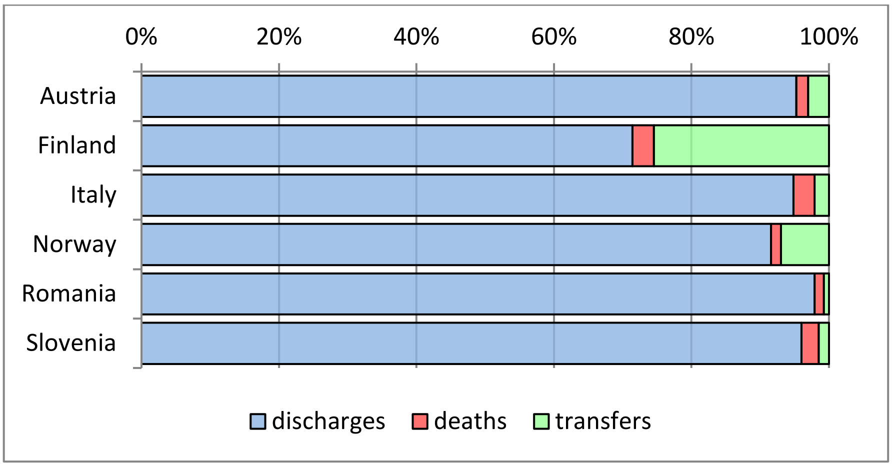
Table 20: Discharges, deaths and transfers as percentage of all separations in each country for the total population in the CEPHOS-LINK baseline year, absolute numbers

	all separations	discharges	deaths	transfers
Austria (2006)	2.021.616	1.925.933	34.548	61.135
Finland (2012)	932.420	665.845	29.275	237.300
Italy (2012)	7.667.430	7.271.245	235.450	160.735
Norway (2012)	858.897	786.692	12.450	59.755
Romania (2012)	4.266.079	4.177.967	57.590	30.522
Slovenia (2013)	371.194	356.379	9.390	5.425
All countries	**16.117.636**	**15.184.061**	**378.703**	**554.872**

Table 21: Discharges, deaths and transfers as percentage of all separations in each country for the total population in the CEPHOS-LINK baseline year, row percentages

	all separations	% discharges	% deaths	% transfers
Austria (2006)	2.021.616	95,27%	1,71%	3,02%
Finland (2012)	932.420	71,41%	3,14%	25,45%
Italy (2012)	7.667.430	94,83%	3,07%	2,10%
Norway (2012)	858.897	91,59%	1,45%	6,96%
Romania (2012)	4.266.079	97,93%	1,35%	0,72%
Slovenia (2013)	371.194	96,01%	2,53%	1,46%
All countries	**16.117.636**	**94,21%**	**2,35%**	**3,44%**

Figure 10: Discharges, deaths and transfers as percentage of all separations in each country for the total population in the CEPHOS-LINK baseline year



3.4.1.2 18 years and older

Restricting the analyses to the 18+ population gives similar results, except that the rates per 1.000 population are higher than those for the total population in all countries with the exception of Romania and Slovenia (Table 22). Regarding the percentages of the different types of hospital separations the same pattern emerges as for the total population. Again, the very high percentages of transfers to other hospitals in Finland (25%) is notable.

Table 22: Hospital separations for the 18+ population in the CEPHOS-LINK baseline year (in brackets)

Country (Year)	Population	Separations	
		N	‰ Pop
Austria (2006)	6.667.764	1.822.954	273,40
Finland (2012)	4.333.723	870.587	200,89
Italy (2012)	49.396.435	6.569.158	132,99
Norway (2012)	3.898.012	735.621	188,72
Romania (2012)	16.254.443	3.430.743	211,06
Slovenia (2013)	1.702.827	300.423	176,43
Total	**82.253.204**	**13.729.486**	**166,92**

Figure 11: Discharges, deaths and transfers as percentage of all separations in each country for the 18+ population in the CEPHOS-LINK baseline year

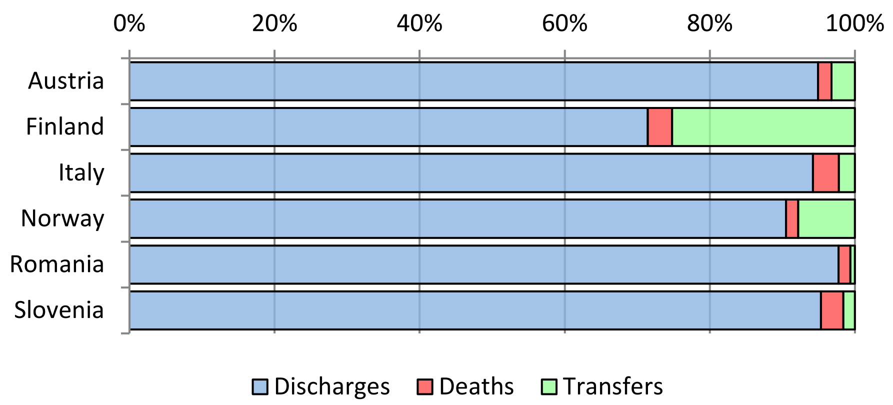


Table 23: Discharges, deaths and transfers as percentage of all separations in each country for the 18+ population in the CEPHOS-LINK baseline year, absolute numbers

	all separations	discharges	deaths	transfers
Austria (2006)	1.822.954	1.730.074	34.306	58.574
Finland (2012)	870.587	621.957	29.160	219.470
Italy (2012)	6.569.158	6.189.912	233.231	146.015
Norway (2012)	735.621	665.915	12.292	57.414
Romania (2012)	3.430.743	3.353.527	55.695	21.521
Slovenia (2013)	300.423	286.281	9.325	4.817
All countries	**13.729.486**	**12.847.666**	**374.009**	**507.811**

Table 24: Discharges, deaths and transfers as percentage of all separations in each country for the 18+ population in the CEPHOS-LINK baseline year, row percentages

	all separations	% discharges	% deaths	% transfers
Austria (2006)	1.822.954	94,90%	1,88%	3,21%
Finland (2012)	870.587	71,44%	3,35%	25,21%
Italy (2012)	6.569.158	94,23%	3,55%	2,22%
Norway (2012)	735.621	90,52%	1,67%	7,80%
Romania (2012)	3.430.743	97,75%	1,62%	0,63%
Slovenia (2013)	300.423	95,29%	3,10%	1,60%
All countries	**13.729.486**	**93,58%**	**2,72%**	**3,70%**

As a further important information the diagnostic composition of the main diagnosis of all discharges is given in Table 25. The total number of discharges in the 18+ population with any ICD-10 main diagnosis derived from separation codes in the CEPHOS-LINK project is 12.847.666. Note that in Table 25 small discrepancies in the number of discharges occur in Romania (seven episodes with either codes W, X or Y were excluded) and the Veneto region (one episode of a male patient with an O diagnosis was excluded). For Finland, there is a small discrepancy of 24 episodes between the previous and the subsequent tables.

In Table 25 and Table 26 the percentages for the first letter of ICD-10 diagnoses[8] are shown for episodes ending with a discharge in the 18+ patient population, first for the partner countries, then also separately for Italy and Veneto, with separate figures provided for public and the private hospitals (which will play a role later on when analysing the effect of predictive factors of re-hospitalisation rates): while there is some variation between countries, disease of the circulatory system, digestive system and musculoskeletal system diseases have the highest shares in most countries. For the CEPHOS-LINK project, we focused on hospital discharges with a main ICD-10 F diagnosis, i.e. a psychiatric main diagnosis. Italy (2,67%) and Slovenia (3,56%) have the lowest share of main psychiatric diagnoses in all discharges. Norway (8,37%) and Finland (8,01%) in contrast show the highest shares.

Table 27 and Table 28 give the rates per 1.000 18+ population. Here extremely large differences in the rates of main psychiatric diagnoses are observed between Italy (3.35) and all other countries (with Norway on top with 14,31).

[8] WHO International Classification of Diseases, ICD-10: Meaning of first digits (A-Z)

First letter	Chapter (Roman number) and Title
A	I Certain infectious and parasitic diseases
B	I Certain infectious and parasitic diseases
C	II Neoplasms
D	II and III Neoplasms and Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
E	IV Endocrine, nutritional and metabolic diseases
F	V Mental and behavioural disorders
G	VI Diseases of the nervous system
H	VII and VIII Diseases of the eye and adnexa and Diseases of the ear and mastoid process
I	IX Diseases of the circulatory system
J	X Diseases of the respiratory system
K	XI Diseases of the digestive system
L	XII Diseases of the skin and subcutaneous tissue
M	XIII Diseases of the musculoskeletal system and connective tissue
N	XIV Diseases of the genitourinary system
O	XV Pregnancy, childbirth and the puerperium
P	XVI Certain conditions originating in the perinatal period
Q	XVII Congenital malformations, deformations and chromosomal abnormalities
R	XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
S	XIX Injury, poisoning and certain other consequences of external causes
T	XIX Injury, poisoning and certain other consequences of external causes
V – Y	XX External causes of morbidity and mortality
Z	XXI Factors influencing health status and contact with health services
U	XXII Codes for special purposes

Table 25: Hospital discharges for the 18+ patient population by main ICD-10 diagnoses first digit in the Master LEEAR for the CEPHOS-LINK baseline year – percentages of all discharges within a country

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	**All countries**
A (infect)	1,49%	3,54%	0,91%	2,22%	2,04%	1,43%	1,49%
B (infect)	0,55%	0,27%	0,37%	0,37%	1,62%	0,22%	0,71%
C (neopl)	9,52%	5,96%	7,99%	7,31%	8,26%	8,39%	8,15%
D (blood)	2,91%	2,80%	3,41%	2,64%	3,53%	3,75%	3,31%
E (endocr)	2,96%	2,00%	2,18%	1,94%	3,20%	1,80%	2,52%
F (mental)	4,84%	8,01%	2,67%	8,37%	6,82%	3,56%	4,62%
G (nervous)	4,68%	4,20%	2,23%	4,02%	3,18%	2,36%	3,00%
H (eye/ear)	5,30%	1,12%	1,71%	1,16%	2,88%	1,67%	2,44%
I (circul)	13,86%	14,18%	17,97%	12,53%	16,18%	12,58%	16,36%
J (respir)	5,01%	7,64%	6,95%	7,09%	8,28%	5,70%	7,05%
K (digest)	10,15%	8,06%	9,94%	7,47%	10,48%	8,14%	9,85%
L (skin)	1,63%	0,83%	0,81%	0,86%	2,01%	1,06%	1,24%
M (mus/skel)	10,50%	7,76%	7,39%	6,76%	7,52%	6,26%	7,80%
N (uro)	6,68%	6,24%	6,78%	5,61%	6,56%	6,62%	6,62%
O (pregn)	6,04%	9,85%	10,98%	4,38%	8,76%	9,81%	9,31%
P (perinat)	0,01%	0,00%	0,01%	0,00%	0,00%	0,00%	0,00%
Q (congen)	0,32%	0,21%	0,50%	0,22%	0,16%	0,50%	0,36%
R (other)	3,87%	6,77%	3,50%	7,46%	1,26%	3,25%	3,32%
S (injury)	6,67%	6,28%	7,23%	5,95%	4,82%	8,48%	6,44%
T (injury)	2,52%	2,05%	1,55%	2,96%	0,76%	0,80%	1,55%
Z (influ)	0,49%	2,21%	4,93%	10,18%	1,67%	13,61%	3,82%
code missing	0,00%	0,00%	0,00%	0,51%	0,00%	0,00%	0,03%
All diagnoses	**1.730.074**	**621.933**	**6.189.912**	**665.915**	**3.353.520**	**286.281**	**12.847.635**

Table 26: Discharges from public and private hospitals for the 18+ patient population by main ICD-10 diagnoses first digit in the Master LEEAR for the CEPHOS-LINK baseline year in Italy and Veneto – percentages of all discharges

	Italy (2012)	Italy public	Italy private	Veneto (2012)	Veneto public	Veneto private
A (infect)	0,91%	1,12%	0,36%	1,00%	1,08%	0,60%
B (infect)	0,37%	0,44%	0,18%	0,32%	0,29%	0,44%
C (neopl)	7,99%	8,68%	6,27%	8,08%	8,53%	5,88%
D (blood)	3,41%	3,48%	3,26%	3,14%	3,22%	2,74%
E (endocr)	2,18%	2,02%	2,65%	2,16%	1,97%	3,09%
F (mental)	2,67%	2,73%	2,58%	3,64%	3,01%	6,77%
G (nervous)	2,23%	1,89%	3,18%	2,13%	1,86%	3,49%
H (eye/ear)	1,71%	1,80%	1,50%	1,27%	1,23%	1,45%
I (circul)	17,97%	18,23%	17,60%	17,48%	18,38%	13,06%
J (respir)	6,95%	7,72%	5,01%	7,35%	7,93%	4,48%
K (digest)	9,94%	10,77%	7,92%	9,20%	9,78%	6,33%
L (skin)	0,81%	0,74%	1,02%	0,72%	0,70%	0,81%
M (mus/skel)	7,39%	4,66%	14,79%	7,39%	5,08%	18,73%
N (uro)	6,78%	6,75%	6,99%	6,18%	6,29%	5,65%
O (pregn)	10,98%	12,32%	7,63%	11,51%	12,79%	5,24%
P (perinat)	0,01%	0,01%	0,00%	0,00%	0,00%	0,00%
Q (congen)	0,50%	0,43%	0,69%	0,42%	0,42%	0,41%
R (other)	3,50%	3,61%	3,26%	3,32%	3,60%	1,92%
S (injury)	7,23%	7,99%	5,34%	7,30%	7,74%	5,13%
T (injury)	1,55%	1,55%	1,56%	1,85%	1,83%	1,92%
Z (influ)	4,93%	3,66%	8,38%	5,55%	4,26%	11,86%
code missing	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
All diagnoses	**6.189.912**	**4.473.712**	**1.683.913**	**442.457**	**367.645**	**74.811**

Table 27: Hospital discharges per 1.000 18+ population by main ICD10 diagnoses first digit in the Master LEEAR for the CEPHOS-LINK baseline year

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	**All countries**
A (infect)	3,86	5,09	1,14	3,79	4,22	2,40	2,33
B (infect)	1,42	0,39	0,46	0,63	3,34	0,37	1,11
C (neopl)	24,71	8,56	10,02	12,48	17,05	14,11	12,72
D (blood)	7,54	4,02	4,27	4,50	7,29	6,31	5,17
E (endocr)	7,69	2,87	2,73	3,31	6,60	3,03	3,94
F (mental)	12,55	11,50	3,35	14,31	14,08	5,99	7,22
G (nervous)	12,14	6,02	2,80	6,88	6,56	3,97	4,69
H (eye/ear)	13,76	1,61	2,14	1,97	5,95	2,82	3,81
I (circul)	35,96	20,34	22,52	21,41	33,37	21,15	25,56
J (respir)	13,00	10,97	8,71	12,10	17,08	9,58	11,01
K (digest)	26,34	11,57	12,46	12,76	21,62	13,68	15,39
L (skin)	4,24	1,19	1,02	1,47	4,14	1,77	1,94
M (mus/skel)	27,26	11,13	9,27	11,55	15,51	10,53	12,19
N (uro)	17,32	8,96	8,49	9,59	13,53	11,13	10,33
O (pregn)	15,68	14,14	13,76	7,48	18,07	16,49	14,55
P (perinat)	0,02	0,00	0,01	0,00	0,00	0,00	0,01
Q (congen)	0,82	0,29	0,62	0,38	0,33	0,85	0,56
R (other)	10,05	9,72	4,38	12,74	2,59	5,47	5,19
S (injury)	17,30	9,01	9,05	10,17	9,94	14,26	10,06
T (injury)	6,55	2,94	1,94	5,05	1,58	1,34	2,43
Z (influ)	1,26	3,18	6,18	17,39	3,45	22,88	5,96
code missing	0,00	0,00	0,00	0,87	0	0	0,04
All diagnoses	**259,47**	**143,52**	**125,31**	**170,83**	**206,31**	**168,15**	**156,20**

Table 28: Discharges from public and private hospitals per 1.000 18+ population by main ICD10 diagnoses first digit in the Master LEEAR for the CEPHOS-LINK baseline year in Italy and Veneto

	Italy (2012)	Italy public	Italy private	Veneto (2012)	Veneto public	Veneto private
A (infect)	1,14	1,02	0,12	1,09	0,98	0,11
B (infect)	0,46	0,40	0,06	0,34	0,26	0,08
C (neopl)	10,02	7,86	2,14	8,82	7,74	1,08
D (blood)	4,27	3,16	1,11	3,43	2,92	0,51
E (endocr)	2,73	1,83	0,90	2,36	1,79	0,57
F (mental)	3,35	2,47	0,88	3,98	2,73	1,25
G (nervous)	2,80	1,71	1,08	2,33	1,68	0,64
H (eye/ear)	2,14	1,63	0,51	1,39	1,12	0,27
I (circul)	22,52	16,51	6,00	19,08	16,67	2,41
J (respir)	8,71	6,99	1,71	8,02	7,20	0,83
K (digest)	12,46	9,75	2,70	10,04	8,87	1,17
L (skin)	1,02	0,67	0,35	0,78	0,63	0,15
M (mus/skel)	9,27	4,22	5,04	8,07	4,61	3,46
N (uro)	8,49	6,11	2,38	6,75	5,71	1,04
O (pregn)	13,76	11,16	2,60	12,57	11,60	0,97
P (perinat)	0,01	0,01	0,00	0,00	0,00	0,00
Q (congen)	0,62	0,39	0,24	0,45	0,38	0,08
R (other)	4,38	3,27	1,11	3,62	3,26	0,35
S (injury)	9,05	7,23	1,82	7,97	7,02	0,95
T (injury)	1,94	1,40	0,53	2,02	1,66	0,35
Z (influ)	6,18	3,31	2,86	6,05	3,86	2,19
code missing	0,00	0,00	0,00	0	0	0
All diagnoses	**125,31**	**91,10**	**34,15**	**109,16**	**90,70**	**18,46**

3.4.2 Hospital discharges with a main psychiatric diagnosis for age 18+

3.4.2.1 All psychiatric disorders (F0-F9)

Table 29 and Table 30 summarise the findings obtained so far. The focus is on main psychiatric diagnoses (ICD-10 F: Mental and behavioural disorders) for age 18+, i.e. on those episodes from which the study cohorts for the CEPHOS-LINK study will be drawn.

Table 29: Hospital discharges in the 18+ population by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	Total
ICD-10 F	83.693	49.836	165.501	55.773	228.837	10.194	593.834
All discharges	1.730.074	621.933	6.189.912	665.915	3.353.527	286.281	12.847.642
% F in all discharges	4,84%	8,01%	2,67%	8,38%	6,82%	3,56	4,62%
18+ population	6.667.764	4.333.723	49.396.435	3.898.012	16.254.443	1.702.827	82.253.204
Rates of F per 1.000 18+ population	12,55	11,50	3,35	14,31	14,08	5,99	7,22

Table 30: Hospital discharges in the 18+ population in the private and public sector in Italy and Veneto by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
ICD-10 F	165.501	122.134	43.364	16.123	11.059	5.064
All discharges	6.189.912	4.473.712	1.683.913	442.457	367.645	74.811
% F in all discharges	2,67%	2,73%	2,58%	3,64%	3,01%	6,77%
18+ population	49.396.435	49.396.435	49.396.435	4.053.441	4.053.441	4.053.441
Rates of F per 1.000 18+ population	3,35	2,47	0,88	3,98	2,73	1,25

As can be expected from the widely differing sizes of the population of the partner countries, actual numbers of discharges with a main psychiatric diagnosis are very diverse, ranging from 10.194 in Slovenia to 228.837 in Romania. By and large (with the exception of Italy and Romania, which are switched) they correspond to the rank order of all discharges. It has to be underlined again that the proportion of episodes with a main psychiatric diagnosis of all episodes is very low in Italy (2,67%) and more than 8% in Finland and Norway. Also, the rates per 1.000 population are very different (3,35 in Italy, 14,31 in Norway). The rates for any main psychiatric diagnosis per 1.000 18+ population are shown in Table 29 and Table 30.

Table 32 and Table 34 show the figures for single F0 to F9 diagnoses (Table 31) for each country and for the Veneto region. For Italy and the Veneto region, separate figures for public and private hospitals are available. It can be seen that these diagnostic profiles are very different. While the CEPHOS-LINK project focuses on "functional" mental disorders (ICD-10 F2-F6) it is also interesting to know the frequencies of other important ICD-10 F categories, since the relative proportion of these other categories influences the availability of hospital beds for "functional" mental disorders studied here.

These figures also give an indication on the country-specific organisation of the mental health care system, but may also reflect the epidemiological situation. Some are of no specific importance such as mental retardation (F7) and child and adolescent mental disorders (F8, F9), since they are not frequent in the 18+ population, but are shown here nevertheless. Two diagnostic groups deserve special interest, organic mental disorders (such as dementia, F0) and substance use disorders (F1). The proportion of organic mental disorders (F0), is rather high in Finland and Romania (over 20%), but low in Italy and Norway (below 10%). Substance use disorder (F1) are near or higher than 25% in four countries (Austria, Finland, Norway and Slovenia), but very low in Italy and Romania (below 10%). The differences between countries become even more striking if rates per 1.000 18+ population are compared (Figure 13). The differences of the core group studied here, i.e. patients with a main ICD-10 F2-F6 diagnosis, are discussed below.

Table 31: WHO International Classification of Diseases, ICD-10: Mental and behavioural disorders, first two digits (F0-F9)

F0	Organic, including symptomatic, mental disorders
F1	Mental and behavioural disorders due to psychoactive substance use
F2	Schizophrenia, schizotypal and delusional disorders
F3	Mood [affective] disorders
F4	Neurotic, stress-related and somatoform disorders
F5	Behavioural syndromes associated with physiological disturbances and physical factors
F6	Disorders of adult personality and behaviour
F7	Mental retardation
F8	Disorders of psychological development
F9	Behavioural and emotional disorders with onset usually occurring in childhood and adolescence

Table 32: Hospital discharges in the 18+ patient population by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year, absolute numbers

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	Total
F0	10.501	10.132	15.097	2.764	48.938	1.298	88.730
F1	20.394	14.519	16.133	15.214	16.230	2.699	85.189
F2	11.973	10.538	45.501	10.601	51.160	2.641	132.414
F3	24.524	9.919	55.023	12.592	79.789	1.672	183.519
F4	11.435	2.846	12.363	7.707	14.261	1.257	49.869
F5	1.079	495	3.389	1.134	1.982	88	8.167
F6	3.034	966	14.694	3.993	7.776	303	30.766
F7	567	226	1.945	483	7.885	177	11.283
F8	51	106	580	431	122	9	1.299
F9	135	89	776	854	694	50	2.598
Total	**83.693**	**49.836**	**165.501**	**55.773**	**228.837**	**10.194**	**593.834**

Table 33: Hospital discharges in the 18+ patient population by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year, column percentages

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	Total
F0	12,55%	20,33%	9,12%	4,96%	21,39%	12,73%	14,94%
F1	24,37%	29,13%	9,75%	27,28%	7,09%	26,48%	14,35%
F2	14,31%	21,15%	27,49%	19,01%	22,36%	25,91%	22,30%
F3	29,30%	19,90%	33,25%	22,58%	34,87%	16,40%	30,90%
F4	13,66%	5,71%	7,47%	13,82%	6,23%	12,33%	8,40%
F5	1,29%	0,99%	2,05%	2,03%	0,87%	0,86%	1,38%
F6	3,63%	1,94%	8,88%	7,16%	3,40%	2,97%	5,18%
F7	0,68%	0,45%	1,18%	0,87%	3,45%	1,74%	1,90%
F8	0,06%	0,21%	0,35%	0,77%	0,05%	0,09%	0,22%
F9	0,16%	0,18%	0,47%	1,53%	0,30%	0,49%	0,44%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 34: Hospital discharges in the 18+ patient population in the private and public sector in Italy and Veneto by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year, absolute numbers

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
F0	15.097	11.465	3.632	1.643	1.407	236
F1	16.133	11.112	5.021	1.478	1.184	294
F2	45.501	37.098	8.403	3.592	3.048	544
F3	55.023	37.749	17.274	5.070	2.698	2.372
F4	12.363[9]	9.066	3.294	1.187	1.102	85
F5	3.389	1.865	1.524	375	130	245
F6	14.694	11.507	3.187	2.508	1.233	1.275
F7	1.945	1.198	747	110	107	3
F8	580	508	72	94	90	4
F9	776	566	210	66	60	6
Total	**165.501**	**122.134**	**43.364**	**16.123**	**11.059**	**5.064**

Table 35: Hospital discharges in the 18+ patient population in the private and public sector in Italy and Veneto by main ICD-10 F diagnoses for the CEPHOS-LINK baseline year, column percentages

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
F0	9,12%	9,39%	8,38%	10,19%	12,72%	4,66%
F1	9,75%	9,10%	11,58%	9,17%	10,71%	5,81%
F2	27,49%	30,37%	19,38%	22,28%	27,56%	10,74%
F3	33,25%	30,91%	39,83%	31,45%	24,40%	46,84%
F4	7,47%	7,42%	7,60%	7,36%	9,96%	1,68%
F5	2,05%	1,53%	3,51%	2,33%	1,18%	4,84%
F6	8,88%	9,42%	7,35%	15,56%	11,15%	25,18%
F7	1,18%	0,98%	1,72%	0,68%	0,97%	0,06%
F8	0,35%	0,42%	0,17%	0,58%	0,81%	0,08%
F9	0,47%	0,46%	0,48%	0,41%	0,54%	0,12%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

[9] 3 discharges could not be allocated to public or private hospital

Figure 12: Hospital discharges for the 18+ patient population by main ICD-10 F0-F6 diagnoses in the Master LEEAR as percentages of all discharges of each country/region with main ICD-10 F diagnosis for the CEPHOS-LINK baseline year

Austria: N=83.693 **Finland**: N=49.836 **Italy**: N=165.501 **Norway**: N=55.773 **Romania**: N= 228.837
Slovenia: N=10.194 **Veneto**: N=16.123 **Italy public**: N=122.134 **Italy private**: 43.364
Veneto public: N=11.059 **Veneto private**: N=5.064

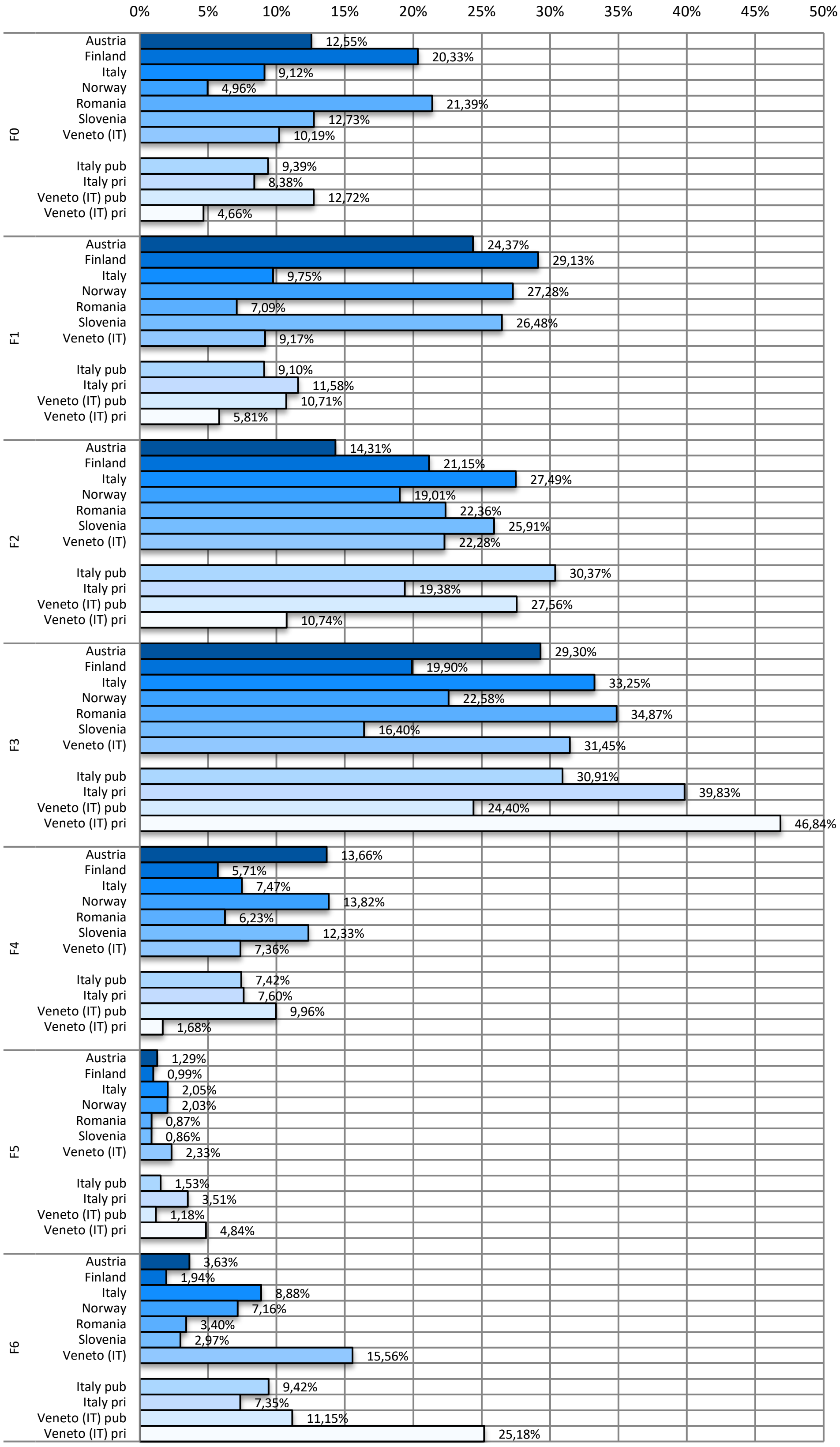
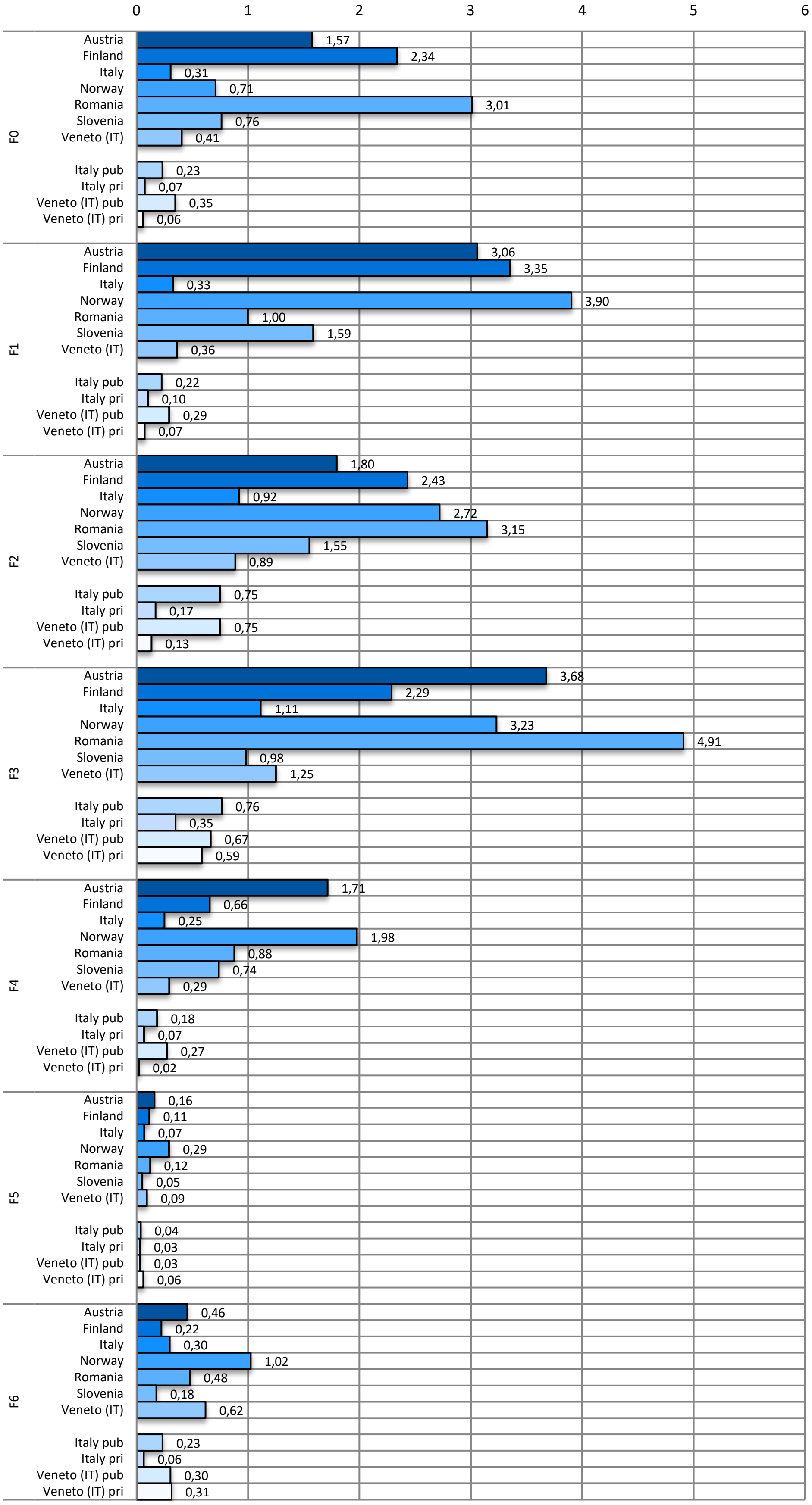


Figure 13: Hospital discharges per 1.000 18+ patient population by main ICD-10 F0-F6 diagnoses in the Master LEEAR for the CEPHOS-LINK baseline year



3.4.2.2 Functional psychiatric disorders (F2-F6)

In total, there are 404.735 discharges with an ICD-10 F2-F6 main diagnosis in the CEPHOS-LINK countries. The majority of these discharges (around 70% of episodes) occurred in Italy and Romania. Discharge rates per 1.000 18+ population were already reported in the preceding chapter in Figure 13.

The diagnostic profile of the core groups is shown in Figure 14 as percentages of episodes with single F2-F6 diagnosis of all F2-F6 diagnoses. Here important differences emerge. Schizophrenia (F2) has very high proportions (over 40%) in Finland and Slovenia. Italy follows suit (35%) but here a clear distinction has to be made between public (38 %) and private hospitals (25%). For affective disorders the picture is completely different. Here Austria (47%) and Romania (51%) dominate, together with private hospitals in Italy (52%). Concerning neurotic disorders (F4), overall percentages are clearly smaller than for schizophrenia and affective disorders, with Austria, Norway and Slovenia showing values over 20%. Frequencies for behavioural syndromes associated with physical factors (F5) are very small and differences between countries (regions) may not mean much. Finally, for personality disorders (F6), Veneto stands out with especially high rates in private hospitals (28%).

Table 36: Hospital discharges in the 18+ patient population by main ICD-10 F2-F6 diagnoses for the CEPHOS-LINK baseline year, absolute numbers

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	Total
F2	11.973	10.538	45.501	10.601	51.160	2.641	132.414
F3	24.524	9.919	55.023	12.592	79.789	1.672	183.519
F4	11.435	2.846	12.363	7.707	14.261	1.257	49.869
F5	1.079	495	3.389	1.134	1.982	88	8.167
F6	3.034	966	14.694	3.993	7.776	303	30.766
Total	**52.045**	**24.764**	**130.970**	**36.027**	**154.968**	**5.961**	**404.735**

Table 37: Hospital discharges in the 18+ patient population in the private and public sector in Italy and Veneto by main ICD-10 F2-F6 diagnoses for the CEPHOS-LINK baseline year, absolute numbers

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
F2	45.501	37.098	8.403	3.592	3.048	544
F3	55.023	37.749	17.274	5.070	2.698	2.372
F4	12.363	9.066	3.294	1.187	1.102	85
F5	3.389	1.865	1.524	375	130	245
F6	14.694	11.507	3.187	2.508	1.233	1.275
Total	**130.970**	**97.285**	**33.682**	**12.732**	**8.211**	**4.521**

Table 38: Hospital discharges in the 18+ patient population by main ICD-10 F2-F6 diagnoses for the CEPHOS-LINK baseline year, column percent

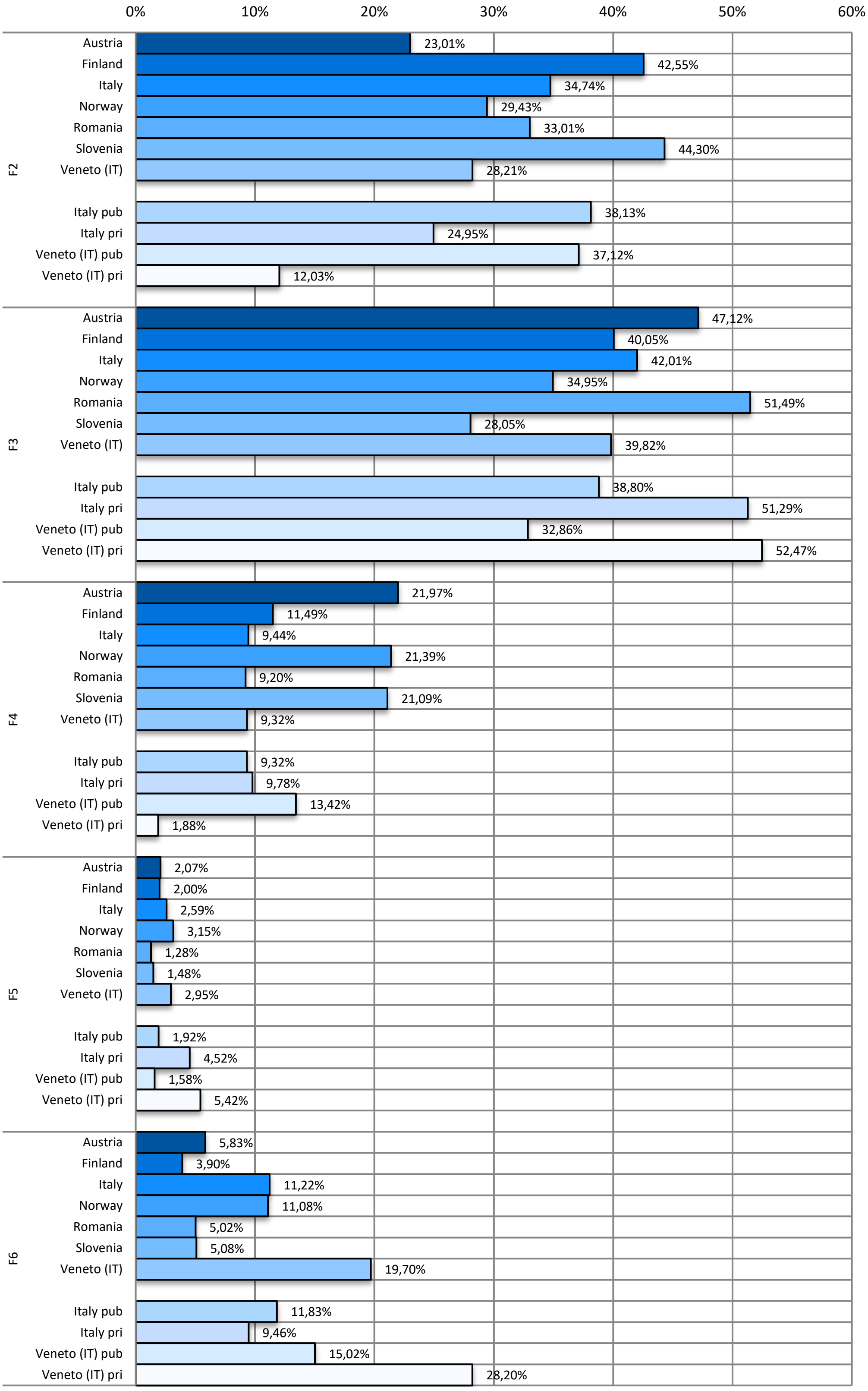
	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	Total
F2	23,01%	42,55%	34,74%	29,43%	33,01%	44,30%	32,72%
F3	47,12%	40,05%	42,01%	34,95%	51,49%	28,05%	45,34%
F4	21,97%	11,49%	9,44%	21,39%	9,20%	21,09%	12,32%
F5	2,07%	2,00%	2,59%	3,15%	1,28%	1,48%	2,02%
F6	5,83%	3,90%	11,22%	11,08%	5,02%	5,08%	7,60%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 39: Hospital discharges in the 18+ patient population in the private and public sector in Italy and Veneto by main ICD-10 F2-F6 diagnoses for the CEPHOS-LINK baseline year, column percent

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
F2	34,74%	38,13%	24,95%	28,21%	37,12%	12,03%
F3	42,01%	38,80%	51,29%	39,82%	32,86%	52,47%
F4	9,44%	9,32%	9,78%	9,32%	13,42%	1,88%
F5	2,59%	1,92%	4,52%	2,95%	1,58%	5,42%
F6	11,22%	11,83%	9,46%	19,70%	15,02%	28,20%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Figure 14: Hospital discharges for the 18+ patient population by main ICD10 F2-F6 diagnoses in the Master LEEAR as percentages of all discharges with main ICD10 F2-F6 diagnosis for the CEPHOS-LINK baseline year

Austria: N=52.045 **Finland**: N=25.861 **Italy**: N=130.970
Norway: N=36.027 **Romania**: N= 154.968 **Slovenia**: N=5.986 **Veneto**: N=13.113
Italy pubilc: N=97.285 **Italy private**: N=33.682
Veneto public: N=8.211; **Veneto private**: N=4.521



3.4.2.3 Physical comorbidity in psychiatric disorders

Another important aspect of the CEPHOS-LINK project is the physical comorbidity of mental and behavioural disorders used as a predictor. Before coming to this specific topic, a general look is provided into how frequent additional diagnoses altogether are documented in the databases used for the CEPHOS-LINK project.

Table 40 shows that the percentages with no additional diagnoses varies largely between countries from as low as 8,70% in Romania to 54,38% in Finland. Whether these differences reflect actual differences in comorbidity or just different documentation behaviours cannot be determined.

Table 40: Total number of additional diagnoses in hospital discharges for the 18+ patient population in the CEPHOS-LINK baseline year

Country	Discharges 18+ population	0 additional diagnosis (only main diagnosis)		1 additional diagnosis		2 additional diagnoses		3 or more additional diagnoses		at least one additional diagnosis
	N	N	% of all discharges	N	% of all discharges	N	% of all discharges	N	% of all discharges	% of all discharges
AT	1.730.074	546.584	31,59%	388.523	22,46%	268.233	15,50%	526.734	30,45%	68,41%
FI	621.933	338.216	54,38%	112.479	18,09%	149.893	24,10%	21.345	3,43%	45,62%
IT-VN	442.456	168.792	38,15%	128.888	29,13%	69.038	15,60%	75.738	17,12%	61,85%
RO	3.353.527	291.704	8,70%	322.177	9,61%	393.185	11,72%	2.346.461	69,97%	91,30%
SI	286.281	140.979	49,24%	91.041	31,80%	17.505	6,11%	36.756	12,84%	50,76%

Table 41 shows for selected countries the rate of additional physical diagnoses (ICD-10 A-E, G-Z) in discharges with a main ICD-10 F diagnosis (first part: F0-F9; second part: F2-F6).

In Austria (52,50%) and Romania (51,85%) every second psychiatric discharge is coded with at least one additional physical diagnosis, while it is only one in five discharges in Finland (22,86%) and one in ten in Slovenia (10,87%). In case the main diagnoses are narrowed down to ICD-10 F2-F6 (i.e. omitting among others organic and substance use disorders), the rates of episodes with additional diagnoses is reduced in all countries/regions. While the decrease in the rate is fairly moderate in Austria, Romania and Slovenia, it is substantial in Finland.

Table 41: Total number of discharges with main ICD-10 F diagnoses and at least one additional physical diagnoses (ICD-10 A-E, G-Z) by country

		Main ICD-10 F-Diagnosis	**With at least one additional ICD-10 diagnosis A-E, G-Z**	
Total (F0-F9)	Austria	83.693	43.937	52,50%
	Finland	49.836	11.394	22,86%
	Romania	228.837	118.652	51,85%
	Slovenia	10.194	1.108	10,87%
Total (F2-F6)	Austria	52.035	24.667	47,40%
	Finland	24.764	3.395	13,71%
	Romania	154.968	75.277	48,58%
	Slovenia	5.961	481	8,07%

Figure 15 shows the percentage for single main ICD-10 F diagnoses with at least one additional physical (ICD-10 A-E, G-Z) diagnosis. It goes without saying that organic mental disorders (F0) have high rates of physical comorbidity, with Austria outstanding with 88%, followed suit by substance use disorders, mood disorder and neurosis. For schizophrenia rates are generally lower.

Another interesting aspect is to identify which specific physical comorbidities are associated with certain psychiatric main diagnosis. Table 42 reports the relative frequency of selected physical additional diagnoses – endocrine, nutritional and metabolic diseases (ICD-10 E), diseases of the circulatory system (ICD-10 I), and diseases of the digestive system (ICD-10 K) – for selected main psychiatric diagnosis (ICD-10 F0-F4 and F6). These figures are not corrected for age and it is obvious that F0 organic mental disorders have the highest comorbidity rate for diseases of the circulatory system. In Austria (which has a high rate of documented physical disorders) nearly one in five patients with a substance use disorder suffers from a disease of the digestive system and in patients with schizophrenia endocrine disorders (including diabetes) are the most frequent physical comorbidity.

Table 42: Share of selected additional physical diagnostic groups in hospital discharges with a main ICD-10 F0-F4 and F6 diagnosis in the CEPHOS-LINK baseline year for selected countries

F0 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F0)
Austria	34,71%	56,94%	12,40%	15,79%	10.501
Finland	8,70%	27,64%	1,41%	4,56%	10.132
Slovenia	7,40%	13,25%	2,23%	1,54%	1.298

F1 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F1)
Austria	11,12%	11,53%	18,74%	4,73%	20.394
Finland	3,60%	5,73%	2,16%	0,99%	14.519
Slovenia	1,33%	2,37%	2,30%	0,56%	2.699

F2 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F2)
Austria	12,60%	9,59%	4,18%	3,08%	11.973
Finland	3,92%	3,47%	0,33%	0,61%	10.538
Slovenia	1,25%	1,25%	0,23%	0,23%	2.641

F3 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F3)
Austria	20,31%	25,88%	12,51%	14,31%	24.524
Finland	3,25%	4,51%	0,54%	2,04%	9.919
Slovenia	2,63%	3,53%	0,84%	0,72%	1.672

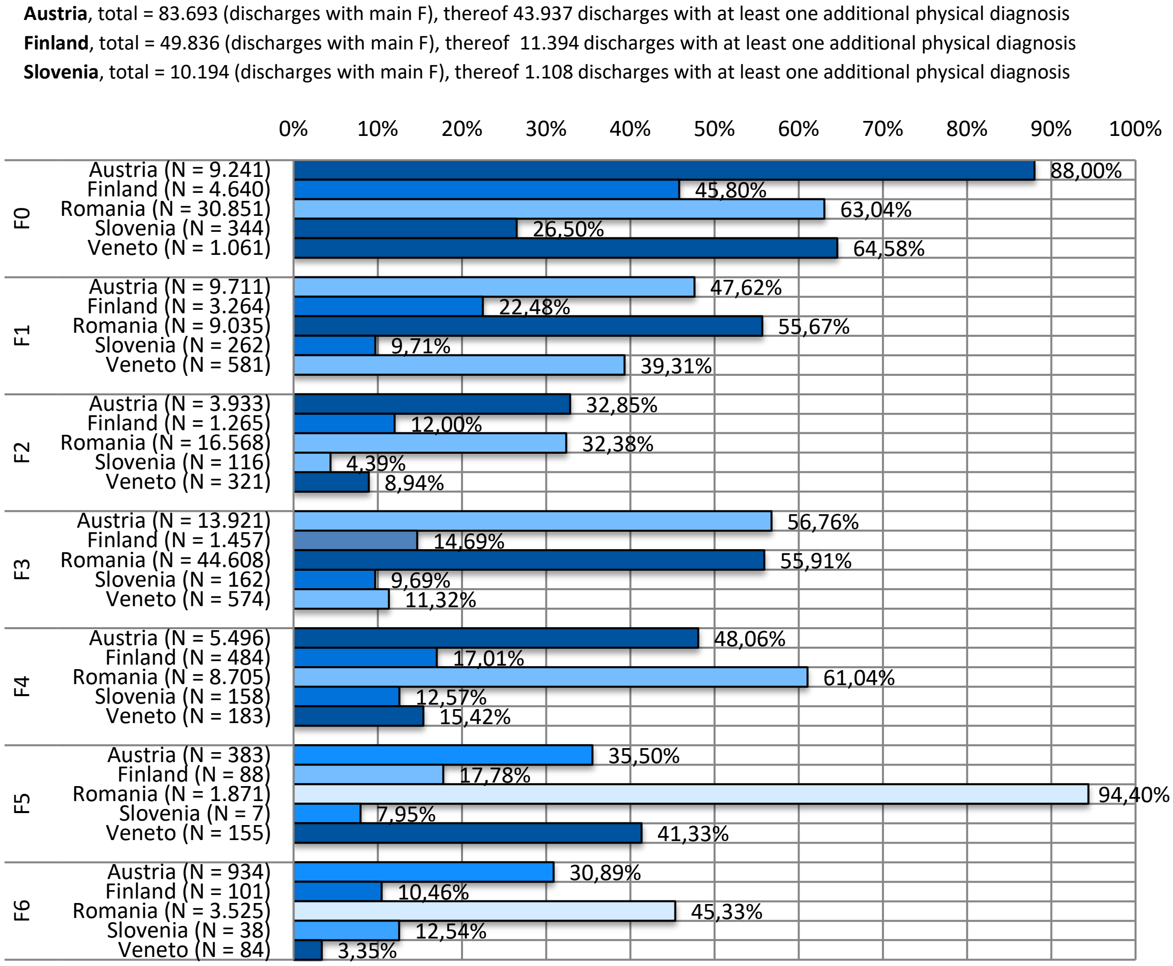
F4 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F4)
Austria	14,94%	18,99%	8,61%	9,42%	11.435
Finland	2,74%	4,74%	0,70%	2,57%	2.846
Slovenia	3,98%	2,63%	1,11%	1,03%	1.257

F6 main diagnosis

	E (endocr)	I (circul)	K (digest)	M (musco)	**N** (F6)
Austria	7,94%	4,12%	4,42%	2,21%	3.034
Finland	3,00%	0,52%	0,31%	2,07%	966
Slovenia	2,97%	0,33%	1,65%	0,66%	303

Figure 15: Hospital discharges with a main ICD-10 F diagnosis (F0-F6) for 18+ patient population: Percentage of discharges with at least one additional physical ICD-10 diagnosis (first digit A-E and G-Z) in the CEPHOS-LINK baseline year



3.5 Summary and conclusions

Table 43 and Table 44 provide summaries of the findings on hospital episodes, defined by the separation codes, for each country, and for Italy and Veneto separately divided by private and public hospitals. These figures will play a role in the analyses to be reported later – at the end of each table the study cohorts for the pilot and the final study (determined at a later stage of the project) are already inserted for easier reference.

In the six partner countries altogether (last columns in Table 43 and Table 44) 16.189.610 hospital episodes, defined by separation codes were identified in the national databases. 71.974 episodes (0,5%) could not be clearly allocated to the three main separation groups (discharge, death, transfer to a different hospital) and were thus excluded, leaving altogether 16.117.636 episodes for further analyses. Of these, 13.729.486 related to patients aged 18 or older at the time of the hospital separation, and of these 12.847.642 were classified as discharges (i.e. leaving deaths and transfers to another hospital out). Coming nearer to the episodes relevant for the CEPHOS-LINK study, 593.834 episodes had a main psychiatric diagnosis (ICD-10 F), amounting to overall 4,6% of all episodes 18+. This number is further reduced to 404.735 episodes with a main diagnosis of a functional mental disorder (ICD-10 F2-F6), which was the basis for selecting the study cohorts both for the pilot and the final CEPHOS-LINK studies. The respective cohort figures are shown at the bottom of the table for easier reference to the subsequent section of this report. Altogether the patient population analysed in the pilot study is 223.190, in the final study 225.600.

Table 43 and Table 44 show the respective figures for each country separately, for Italy and the Veneto region also separately for private and public hospitals (which is an important distinction to be made in Italy). As already mentioned, it must also be taken into consideration that the absolute numbers of hospital discharges vary substantially across countries. Due to their large populations, the sample size in Italy and Romania is much higher than in other countries. This is important for the pooled-data analyses, as potential country-specific patterns of Italy and Romania will have a stronger influence on the results than other countries.

Table 43: Number of hospital episodes included relative to hospital separations for the total population

	Austria (2006)	Finland (2012)	Italy (2012)	Norway (2012)	Romania (2012)	Slovenia (2013)	All countries
(0) All hospital separations	2.025.095	963.646	7.667.430	868.788	4.266.079	398.572	16.189.610
(1) CEPHOS-LINK sep, total	2.021.616	932.420	7.667.430	858.897	4.266.079	371.194	16.117.636
% (1) in (0)	99,83%	96,76%	100,00%	98,86%	100,00%	93,13%	99,56%
(2) Hospital sep, 18+	1.822.954	870.587	6.569.158	735.621	3.430.743	300.423	13.729.486
% (2) in (1)	90,17%	93,37%	85,68%	85,65%	80,42%	80,93%	85,18%
(3) All discharges, 18+	1.730.074	621.933	6.189.912	665.915	3.353.527	286.281	12.847.642
% (3) in (1)	85,58%	66,70%	80,73%	77,53%	78,61%	77,12%	79,71%
(4) F0-F9 discharges	83.693	49.836	165.501	55.773	228.837	10.194	593.834
% (4) in (1)	4,14%	5,34%	2,16%	6,49%	5,36%	2,75%	3,68%
(5) F2-F6 discharges	52.045	24.764	130.970	36.027	154.968	5.961	404.735
% (5) in (1)	2,57%	2,66%	1,71%	4,19%	3,63%	1,61%	2,51%
Study cohorts for pilot study and final study							
N Pilot study	21.844	13.737	63.612	17.038	102.409	4.550	223.190
N Final study	21.839	16.814	63.419	17.158	101.834	4.536	225.600

Table 44: Number of hospital episodes included relative to hospital separations for the total population in Italy and the Veneto region for public and private hospitals

	Italy (2012)			Veneto (2012)		
	Total	Public	Private	Total	Public	Private
(0) All hospital separations	7.667.430	5.721.097	1.943.008	545.457	461.237	84.220
(1) Hospital sep, total pop	7.667.430	5.721.097	1.943.008	545.457	461.237	84.220
% (1) in (0)	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
(2) Hospital sep, 18+	6.569.158	4.812.498	1.753.379	472.083	394.044	78.039
% (2) in (1)	85,68%	84,12%	90,24%	86,55%	85,43%	92,66%
(3) All discharges, 18+	6.189.912	4.499.877	1.686.880	434.210	367.645	74.812
% (3) in (1)	80,73%	78,65%	86,82%	79,60%%	79,71%	88,83%
(4) F0-F9 discharges	165.501	122.134	43.364	16.123	11.059	5.064
% (4) in (1)	2,16%	2,13%	2,23%	2,96%	2,40%	6,01%
(5) F2-F6 discharges	130.970	97.285	33.682	12.732	8.211	4.521
% (5) in (1)	1,71%	1,70%	1,73%	2,33%	1,78%	5,37%
Study cohorts for pilot study and final study						
N Pilot study	63.612	55.966	7.646	8.709	5.357	3.352
N Final study	63.419	55.607	7.812	7.239	5.062	2.177

4 Pilot Study

4.1 Introduction

The CEPHOS-LINK re-hospitalisation study aimed at two basic objectives, called Objective 1 and Objective 2. Objective 1 intended to look into the predictive power of variables known at the time when patients included into the study cohort were discharged from hospital inpatient treatment (i.e. at the time of the "index discharge"). Here two types of predictors for re-hospitalisation rates were to be used: Patient-level variables (such as age, gender, diagnosis) and contextual variables (such as urbanicity of a patient's place of residence). Objective 2 intended to identify the additional effect of psychiatric outpatient contacts after the index discharge on re-hospitalisation rates, in other words assessing the effect of "continuity of care" on re-hospitalisation rates.

Given the complexities of the CEPHOS-LINK approach of co-ordinating studies according to common protocols in six different countries[10] with six different databases and six different teams with potentially different expertise and resources, it was decided to carry out local Pilot Studies in each country. The Pilot Study addressed only Objective 1 and used a restricted set of predictor variables (age, gender, length of stay, and a diagnosis of schizophrenia/bipolar disorder called here "psychotic diagnosis"). The outcome measure was re-hospitalisation to any hospital (in the final CEPHOS-LINK study *psychiatric* rehospitalisation became prominent). The Pilot Study was designed with the experiences obtained by collecting information on the databases (LEEARs) (Chapter 2 above) and establishing the Hospital Episode Report (Chapter 3 above).

The specific purpose of the Pilot Study was to identify shortcomings and problems in the availability and interoperability of data used for identifying the CEPHOS-LINK study cohorts, the outcome measures and predictors for performing the analysis of Objective 1, in order to optimise comparability across partner countries and ensure a common strategy for performing the main analyses of the CEPHOS-LINK study. Also, by carrying out the Pilot Studies, it should become clear for each partner which resources were required for data analysis (such as programs for carrying out regression analyses, including staff expertise).

It was not completely unexpected that the Pilot Studies had to be carried out repeatedly, since the first attempt practically always showed problems which had to be discussed, especially in view of comparability across countries. Some countries could be quicker in carrying out the Pilot Studies, in some countries the process took more time. Thus, the Pilot Studies initiated a complex iterative process of discussion and clarification among the project partners at the end of which a feasible study protocol for the final CEPHOS-LINK study could be established.

The process of clarification included also field visits to partner countries, involving discussions with the database owners and custodians, as well as visits to hospitals to clarify how the documentation of data was carried out in daily routine and how the data flow from hospitals to regional and national databases was taking place.

[10] In view of the fact that some of the analyses were not possible for the whole of Italy, the Veneto region was chosen in these instances instead of the whole of Italy. Therefore, information relating to the Veneto region is presented in some instances in addition to the information to the whole of Italy.

Finally, prior to planning and carrying out of the Pilot Studies, a three-day training seminar with an internationally renowned expert, Professor David Preen of the University of Western Australia in Perth, was held in Vienna for all project partners. The topic was "Health Services Research with Linked Large Existing Electronic Administrative Registries".

Below, first the study protocol for the Pilot Study (4.2) and some figures from the Pilot Study (4.3) are presented, followed by a lengthly discussion of the needs to harmonise essential concepts and their coding in the databases, which arose out of problems with carrying out the Pilot Study (4.4).

4.2 Study protocol of the Pilot Study

Purpose of the Pilot Study

Each CEPHOS-LINK partner was requested to carry out the Pilot Study as it is described below in order to further a common understanding of the

Variables of the Master LEEAR to be used for the Pilot Study

SC Variables for the selection criteria of the Study Cohort
OC Variables as Outcome measures
PR Variables as Predictors of Outcome

Statistical methods for data analysis to be used for the Pilot Study

LOGREG Logistic regression
COXREG Cox regression

and to identify shortcomings and problems which will have to be discussed and solved before more complex analyses will be carried out ("EDA = Exploratory Data Analysis").

ATTENTION: The Pilot Study represents a selective and specific approach to Objective 1 and is not identical with the final design of the CEPHOS-LINK analyses which are described in Part 3 of the Final Scientific Report on Local Studies.

Description of the Pilot Study

Overall purpose
Identify variables which influence the one year hospital readmission rate to any hospital of adult patients who were discharged from a psychiatric hospital bed with a main diagnosis of a functional mental disorder by using logistic regression and Cox regression analyses.

Study cohort and variables

(1)a Study cohort Patients who were discharged for the first time over a period of 12 months from a hospital episode including at least one night on a psychiatric bed with a main psychiatric diagnosis of F2 to F6 and aged 18+ years at the time of the index discharge

(1)b Outcome measures: Admission to any hospital with at least one overnight stay during a 12 months follow-up period after the study cohort discharge date operationalised by a) at least one readmission and b) time to first admission over the total follow-up period

(1)c Predictor variables for the above outcome measures: "Pre-discharge" variables ("known" at the time of discharge): sex, age, main psychiatric diagnosis, LOS

The variables required for the Pilot Study are described below in detail with GENERIC NAMES. Partners are asked to use these names in their analyses and for presenting the results.

(1) Description of the variable for the Pilot Study – introducing generic names

(1)a SC Variables Study Cohort selection criteria for the Pilot Study

Here the criteria of the Master LEEAR variables to be used in each partner country for the selection of the study cohort are described. It is assumed that the two-year dataset has already been filtered out from the whole available LEEAR data set by each partner, so the baseline year is not included here as a study cohort selection criterion. Concerning the selection of hospitals with a "psychiatric bed" (see variable number SC 2 "SC-PSYBED" below) a narrow definition is suggested for the Pilot Study. This might give rise to discussions. The discharge which is defined here is called the "index discharge", the hospital episode ending with this "index discharge" is called "index episode".

All of the following must apply for selecting the study cohort

Nr	Variable Name	Definition of selection criterion	Format/ Measurement level	Criterion for selecting the Pilot Study cohort	TASK 1a: AT, FI, IT, NO, RO,SL
SC 1	SC-DISCHARGE	A hospital inpatient episode with at least one overnight stay has ended with a "discharge", i.e. not with "death" and not with a "transfer" to a different hospital. Attention: transfers within one and the same hospital are not be counted as discharges although in some countries they might administratively be counted as discharges	DICHOTOMOUS YES (Hospital discharge) vs. NO	YES	Each partner is requested to write down in a separate document the algorithms for their MASTER LEEAR which define the variables in this list Check Data Report 1 and the
SC 2	SC-PSYBED	Patient spent at least one night on a psychiatric bed during the hospital episode defined above for SC DISCHARGE	DICHOTOMOUS YES ("PSYBED") vs. NO ("NONPSYBED")	YES	

SC 3	SC-DISDATE	Date at which the above defined discharge has occurred	EXACT DATE with day month year	FIRST DISCHARGE DATE FROM A SC-PSYBED DURING THE BASELINE YEAR	CEPHOS document sent out on 30 April about country **discharge** codes
SC 4	SC-AGE	Age at first discharge as defined above is 18+	DICHOTOMOUS YES (18+) vs NO	YES	

(1)b OC Variables OutCome variables for the Pilot Study

For the Pilot Study two separate outcome measures will be used and the analyses will be carried out separately for each of the two outcome measures, one representing a dichotomous outcome and requiring a logistic regression analysis, the other one representing time to readmission and implying a Cox regression analysis.

PLEASE NOTE: In the Pilot Study we do not (yet) consider the problem that some patients of the study cohort may have died during the individual 12 months follow-up period. This problem will need specific attention at a later stage and will be especially relevant for the variant of the study cohort which includes patients discharged from a non-psychiatric bed (it can be assumed that physical comorbidity is higher in that group).

Nr	Outcome variable	Definition	Format/ Measurement level	TASK 1b AT, FI, IT, NO, RO,SL
OC 1	OC-YES12-ANYHOS	Admission to any hospital during a 12 months follow-up period after the study cohort discharge date (SC-DISDATE), starting from the day after discharge	DICHOTOMOUS YES admitted vs NO	Each partner is requested to write down in a separate document the algorithms for their MASTER LEEAR which define the variables in this list Check data report 1 and the CEPHOS document sent out on 30 April about country **admission** codes
OC 2	OC-DAY12-ANYHOS	Time to first admission to any hospital during a 12 months follow-up period after the study cohort discharge date (SC-DISDATE), starting from the day after discharge	NUMERICAL exact time interval in days between discharge and admission date	

(1)c PR Variables PRedictor variables for the Pilot Study

For the Pilot Study four pre-discharge variables are used as predictors, i.e. variables which can be assumed to be "known" at the time of the "index discharge". Gender, Age at discharge, Psychotic vs. Non-Psychotic ICD-10 F diagnosis and length of stay. Two of these are each used in two variants in order to test them out for the regression analyses:
Age at the index discharge is used a) as the real numerical value and b) grouped into young (18-44 years), middle aged (45-64 years) and old (65 years and older).

LOS (Length of stay) is counted for the "index episode" only (disregarding for the Pilot Study any days spent in a hospital from which a patient had been transferred to the hospital with the "index episode") in two variants: a) days on a psychiatric bed during the index episode, b) all days of the index episode.

The psychiatric diagnosis (we have only patients with a main ICD-10 diagnosis of F2, F3, F4, F5, F6) has been dichotomised deliberately here into "psychotic" (F2 or F30 or F31) vs the rest.

Nr	Variable name	Definition	Format / Measurement level	TASK 1c: AT, FI, IT, NO,RO,SL
PR 1	PR-SEX	Gender: female/male	DICHOTOMOUS YES (female) vs. NO (male)	Each partner is requested to write down in a separate document the algorithms for their MASTER LEEAR which define the variables in this list
PR 2a	PR-1AGE-EXACT	Exact age at "index discharge"	INTERVAL 18 years onwards	
PR 2b	PR-2AGE-123	Age at index discharge in 3 Age groups 18-44 (young), 45-64 (middle aged), 65+ (old)	ORDINAL 1, 2, 3	
PR 3	PR-PSY-MAINDIAG-PSO	Psychotic group F2 or F30 or F31 vs rest of F3 to F6	DICHOTOMOUS YES (PSO) vs NO (NONPSO)	
PR 4a	PR-LOS-PSY	Sum of days on a psychiatric hospital bed during the index hospital episode before the discharge date (SC-DISDATE)	INTERVALL 1 -.....	
PR 4b	PR-LOS-ALL	Sum of days on any type of hospital bed during the index hospital episode before the discharge date (SC-DISDATE)	INTERVALL 1 -	

TASK 2: Quality control of the variables to be used for the pilot:
Please provide basic frequencies for the variables defined for the pilot and check for the quality of the variables. Are there any values which are implausible? Are there outliers etc.? You may wish to also check the frequencies of combinations of variables for this purpose.

(2) Methods for data analysis: Two types of regression analysis

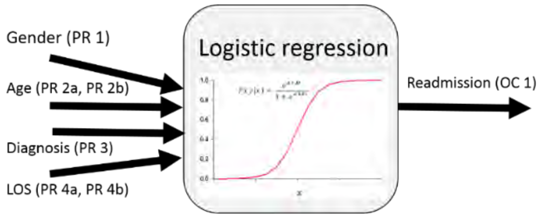
Regression models are mostly used to find out which variables influence an outcome variable. Their application field has rather an exploratory function than proving statistical significant differences between predefined groups. Depending on the measurement level of the predictor (PR) as well as the outcome (OC) variables specific methods have to be used.

When the "occurrence of an event" (yes vs. no) within a defined period of time is selected as outcome variable logistic regression LOGREG is usually applied. According to the literature research undertaken by WP 7 (Urach et al 2016) this is the most often used regression technique. If the outcome is "time to the event" (e.g. measured in days) the Cox Regression COXREG is one of the appropriate methods for such a "survival analysis" (who "survives" without being readmitted until which point in time during the follow-up period?).

(2)a LOGREG Logistic regression

In the Pilot Study, when looking at the occurrence of a readmission till the end of the follow-up time of 12 months (see OC1), a logistic regression is appropriate.

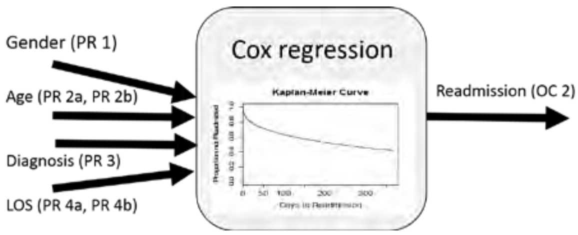
The basic structure of such a LOGREG with the variables defined for the Pilot Study is shown in the graph below. Attention: it goes without saying that for one and the same LOGREG only one of the two defined variants for Age (PR 2a or PR 2b) and for LOS (PR 4a or PR 4b) can be used.



(2)b COXREG Cox regression

Survival analysis includes a pool of methods, which investigates the time to an event. These methods can also deal with censoring issues. The Cox model is a standard solution strategy for survival analysis and therefore the second statistical strategy that is tested for Objective 1 in the CEPHOS-LINK project.

The graph below refers to the Cox regression in the Pilot Study. What has been said above about the predictor variables for the logistic regression also applies here.



(2)c How to proceed

TASK 3: Perform the regression analyses

Once the variables will have been checked, the following 4 different LOGREGs (LOG 1, LOG 2, LOG 3, LOG 4) and 4 COXREGs (COX 1, COX 2, COX 3, COX 4) should be performed in each partner country.

a) Univariate LOGREGs and COXREGs

LOGREGs and COXREGS are in general performed in a hierarchical way, i.e., first univariate regressions are carried out with each predictor and then the multivariate regressions are performed:

The univariate regressions should be carried out for all six predictor variables defined above, i.e

PR 1	PR-SEX
PR 2a	PR-1AGE-EXACT
PR 2b	PR-2AGE-123
PR 3	PSY-MAINDIAG-PSO
PR 4a	PR-LOS-PSY
PR 4b	PR-LOS-ALL

b) Multivariate LOGREGs and COXREGs

We have chosen four different combinations of variables, since we want to check how the two differently defined age variables and the two differently defined LOS variables perform. Gender and psychotic diagnosis are the same in all 4 regression analyses.

For OC1 - OC-YES12-ANYHOS, the LOGREG for the following combinations of predictors should be performed.

LOG 1	PR 1, 2a, 3, 4a	PR-SEX, PR-1AGE-EXACT, PR-PSY-MAINDIAG-PSO, PR-LOS-PSY
LOG 2	PR 1, 2b, 3, 4a	PR-SEX, PR-2AGE-123, PR-PSY-MAINDIAG-PSO, PR-LOS-PSY
LOG 3	PR 1, 2a, 3, 4b	PR-SEX, PR-1AGE-EXACT, PR-PSY-MAINDIAG-PSO, PR-LOS-ALL
LOG 4	PR 1, 2b, 3, 4b	PR-SEX, PR-2AGE-123, PR-PSY-MAINDIAG-PSO, PR-LOS-ALL

FOR OC1 - OC-DAY12-ANYHOS, the COXREG for the following combinations of predictors should be performed.

COX 1	PR 1, 2a, 3, 4a	PR-SEX, PR-1AGE-EXACT, PR-PSY-MAINDIAG-PSO, PR-LOS-PSY
COX 2	PR 1, 2b, 3, 4a	PR-SEX, PR-2AGE-123, PR-PSY-MAINDIAG-PSO, PR-LOS-PSY
COX 3	PR 1, 2a, 3, 4b	PR-SEX, PR-1AGE-EXACT, PR-PSY-MAINDIAG-PSO, PR-LOS-ALL
COX 4	PR 1, 2b, 3, 4b	PR-SEX, PR-2AGE-123, PR-PSY-MAINDIAG-PSO, PR-LOS-ALL

PLEASE NOTE: Because of the obvious high correlation between PR-1AGE-EXACT (PR 2a) and PR-2AGE-123 (PR 2b), as well as between PR-LOS-PSY (PR 4a) and PR-LOS-ALL (PR 4b) each LOGREG/COXREG can only include one predictor of the respective categories.

Three Tasks to be performed by each partner

These tasks are highlighted in the text above and are summarized here.

Task 1: Write down algorithms for extracting the SC, OC and PR variables in your data set

Task 2: Data quality control: Check for availability, plausibility, completeness, outliers for all SC, OC and PR variables by performing frequency counts for all variables

Task 3: Select study cohort and perform the suggested regression analyses

General remark: Please assure that all tasks are performed by the 4-eye-principle.

Separate analyses in Italy and the Veneto Region for public and private providers

In the explorative analyses during the preparation of the common protocol for the Pilot Study it became evident that the rather large sector of private psychiatric hospitals in Italy (especially so in the Veneto region) behaves differently from the public one in terms of hospital separations (e.g. differences in numbers of discharges), the diagnoses-spectrum (different percentages of diagnostic groups treated), the time patients spent in hospital (LOS) and the admission situation (unplanned or planned admissions. In private services most admissions are planned whereby in public services most admissions are unplanned. Therefore, the Pilot Study in Italy was conducted separately for (1) all hospitals, (2) public hospitals and (3) private hospitals. Due to regional differences in health care provision in Italy as well as due to data quality and data accessibility issues (CEPHOS-LINK Objective 2, which is to study the influence of post discharge psychiatric outpatient contacts on the risk of re-hospitalisation can only be conducted in the Veneto region) the Pilot Study was also conducted separately for the Veneto region. Additionally, separate analyses for public and private hospitals in the Veneto Region were performed. In this report the results from the Pilot Study for the whole of Italy and for Veneto are presented for private and public hospitals together (which is mental health care provided in SPDC - Servizio psichiatrico Diagnosi e Cura - as well as in private hospitals). Due to the substantial differences between private and public services in Italy and even more so in the Veneto region some results are provided separately for public and private services.

4.3 Results

4.3.1 Description of the Pilot Study cohort

Following the findings of the "CEPHOS-LINK Hospital Episode Report" above (Table 43 and Table 44 in Section 3 above) the study cohorts for the Pilot Study were selected as representing the first discharge in the baseline year.

Table 45: Comparison of Pilot Study patient cohorts and hospital discharges of patients aged 18+ with main ICD 10 F2-F6 diagnoses with an episode in a psychiatric bed in the baseline year

Country/subregion (baseline year)	Relative Pop 18+	Hospital Episode Report Episodes		Pilot Study cohort Patients		Episodes per patient
		absolute	‰ Pop	absolute	‰ Pop	
Austria (2006)	6.667.764	36.667	5,50	21.844	3,28	1,68
Finland (2012)	4.333.723	20.131	4,65	13.737	3,17	1,47
Italy[11] (2012)	49.396.435	95.631	1,94	63.612	1,29	1,50
Norway (2012)	3.898.012	31.313	8,03	17.038	4,37	1,84
Romania (2012)	16.254.443	152.931	9,41	102.409	6,30	1,49
Slovenia (2013)	1.702.827	4.551	2,67	4.550	2,67	1,00
Veneto[12] (2012)	4.053.441	10.473	2,58	8.709	2,15	1,20

Table 45 shows an overview of the number of patients in the Pilot Study cohort and its relation to the number of episodes in the six European countries Austria, Finland, Italy, Norway, Romania, Slovenia and the Veneto region in the selected study year. The table shows the absolute numbers and the rates per 1.000 population of episodes and patients aged 18+, discharged with a main "functional" psychiatric diagnosis and having stayed at least one night during the index episode in a psychiatric inpatient bed.

In relation to the population size of the six different countries, the Romanian Pilot Study cohort has an outstanding number of 102.409 patients. Italy has the second highest Pilot Study population with 63.612 patients. Slovenia has the smallest Pilot Study cohort. Norway and the Veneto region have both a population size of about 4 million population aged 18+, but differ a lot in the number of patients included in the Pilot Study cohort with Norway having a twice as large Pilot Study cohort than the Veneto region. These relationships are also reflected in the rates of patients per 1.000 population aged 18 or older.

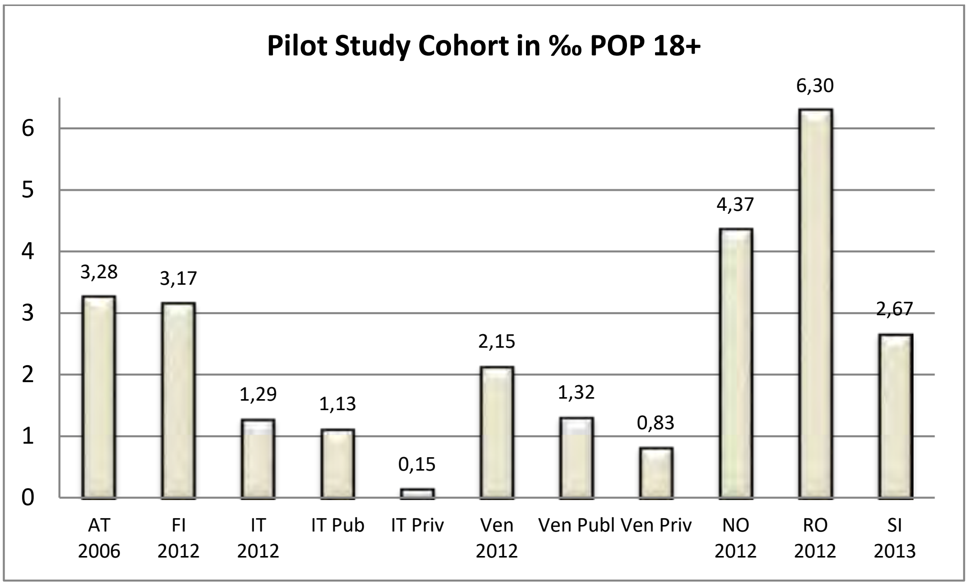
The rates of episodes (taken from the "CEPHOS-LINK Hospital Episode Report") per 1.000 population aged 18 or older are reported for discharges of patients with a psychiatric main ICD 10 F2-F6 diagnosis who had an episode in a psychiatric bed. Romania has the highest rate of episodes (9,41) followed by Norway with a rate of 8,03 and then by Austria (5,50) with over half of the Romanian

[11] In the following analyses "Italy" includes "Veneto".

[12] In the Veneto region major differences were found between public and private services in regard to the diagnostic groups treated and length of stay (but also other characteristics). These differences are reflected in an analysis for all Veneto and provide a distorted picture.

rate. Italy has the lowest rate (1,94), followed by the Veneto Region with a rate of 2,58 and Slovenia with a rate of 2,67 per 1.000 population.

Figure 16: Pilot Study Cohort in ‰ POP 18+



The rates of patients (Pilot Study cohort) per 1.000 population aged 18 or older discharged with a psychiatric main ICD 10 F2-F6 diagnosis with an episode of care in a psychiatric bed show a range from 6,3 in Romania at the higher end of the scale to 1,29 in Italy at the lower end. Rates per 1.000 population aged 18 or older for the Veneto region (2,15) and Slovenia (2,67) are rather low, for Austria (3,28) and Norway (4,37) rather high.

Figure 17: Episodes per patient in the Pilot Study Cohort

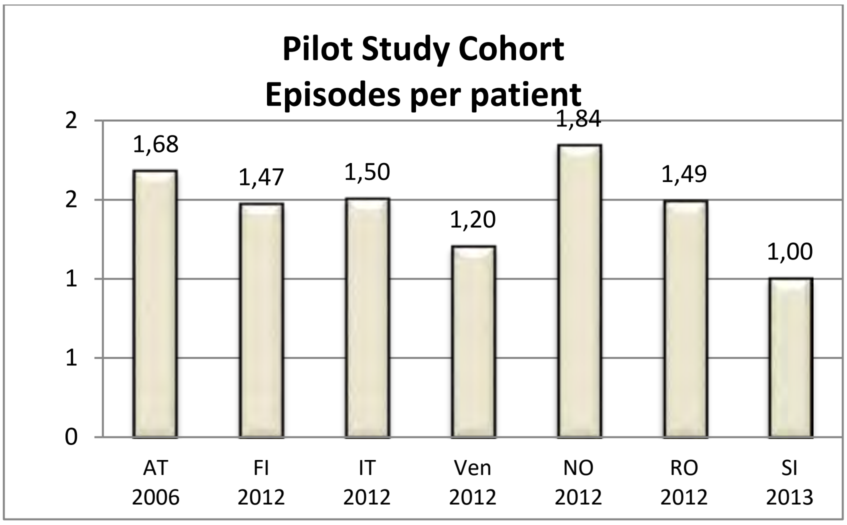


Figure 17 shows the average rate of episodes per patient. It is largest in Norway (1,84), followed by Austria with 1,68. At the lower end of the scale Slovenia is found with 1,04 episodes per patient. Finland, Romania and Italy are in the mid-range in comparison with the other countries, were patients have an average between 1,47 and 1,50 episodes in the baseline year. This rate is somehow a predictor for the re-hospitalisation frequency in the baseline year, partly anticipating the high re-hospitalisation rates in Norway and Austria and low rates in Slovenia and the Veneto region.

4.3.2 Re-hospitalisation

Figure 18: Patients in the Pilot Study Cohort and patients re-hospitalised to any hospital within one year after discharge

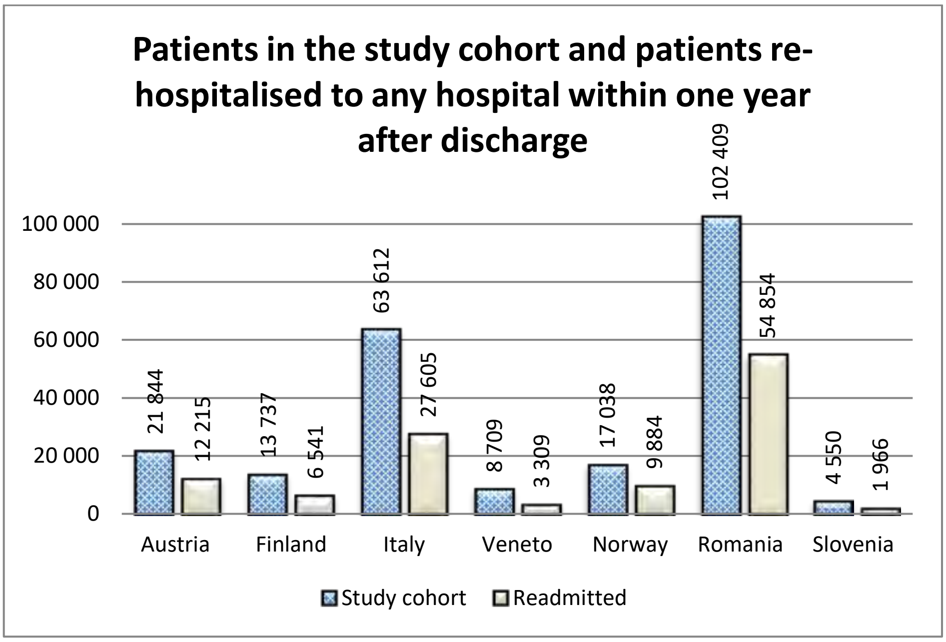


Figure 18 provides an overview of the absolute numbers of the index population (patients discharged, 18+, main ICD 10 F2-F6 diagnosis, at least one night spent in a psychiatric bed) and the outcome of re-hospitalisation to any type of inpatient bed.

Figure 19: Percentage of patients re-hospitalised to any hospital within one year after discharge

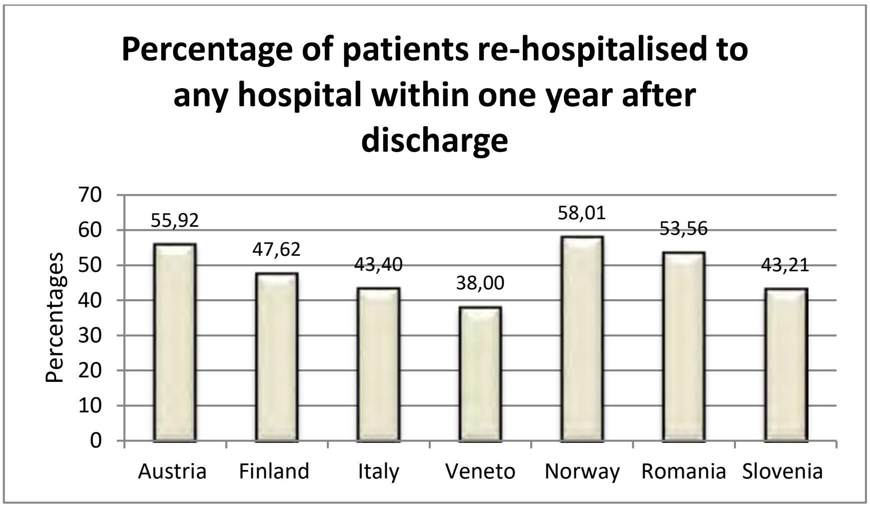
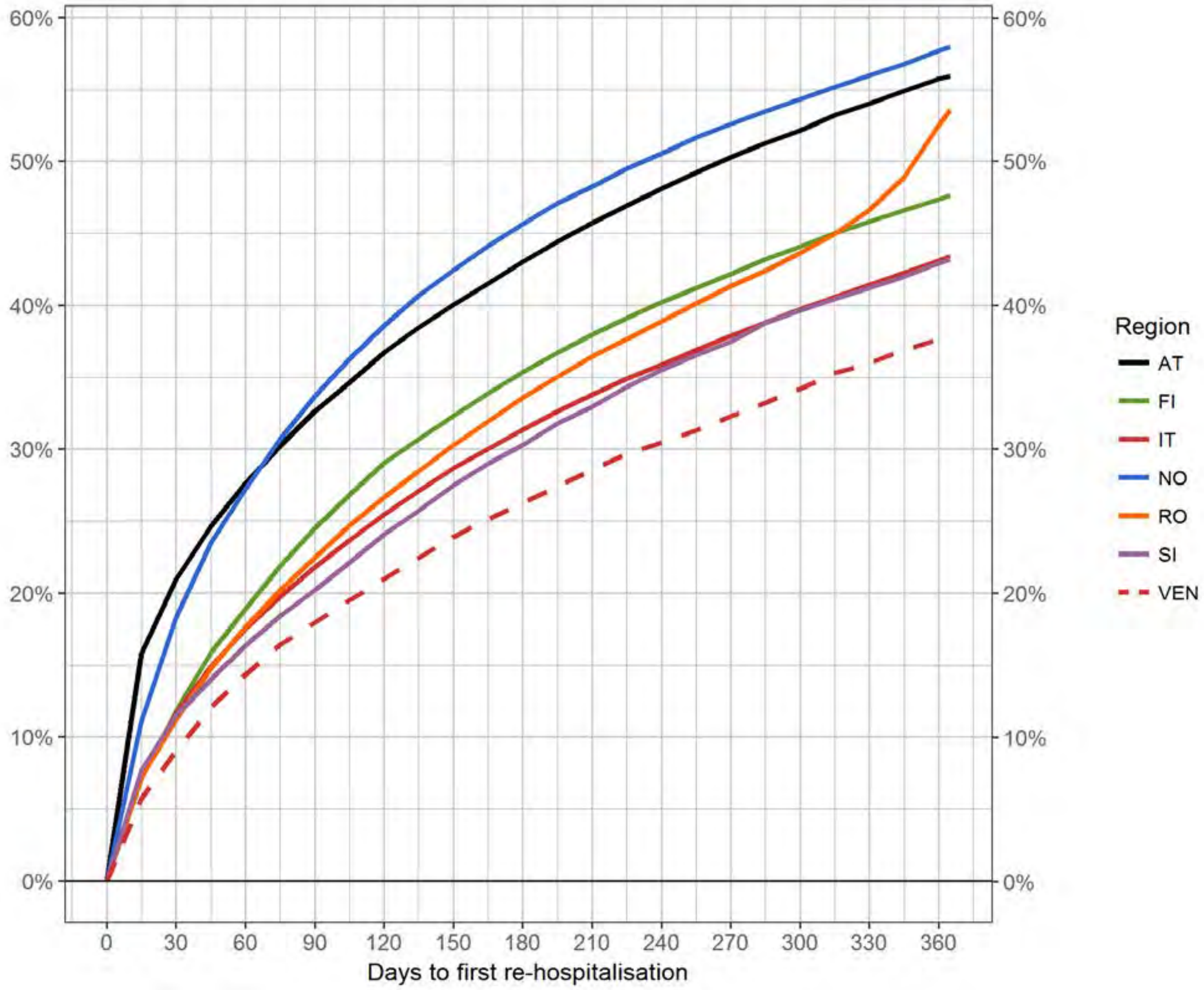


Figure 19 provides the percentages of re-hospitalised patients, showing that Norway with 58,01% has the highest re-hospitalisation rate within the one year follow-up time. In Austria and Romania more than half of the patients in the study cohort were re-hospitalised. The lowest re-hospitalisation rate is found in the Veneto Region (38%).

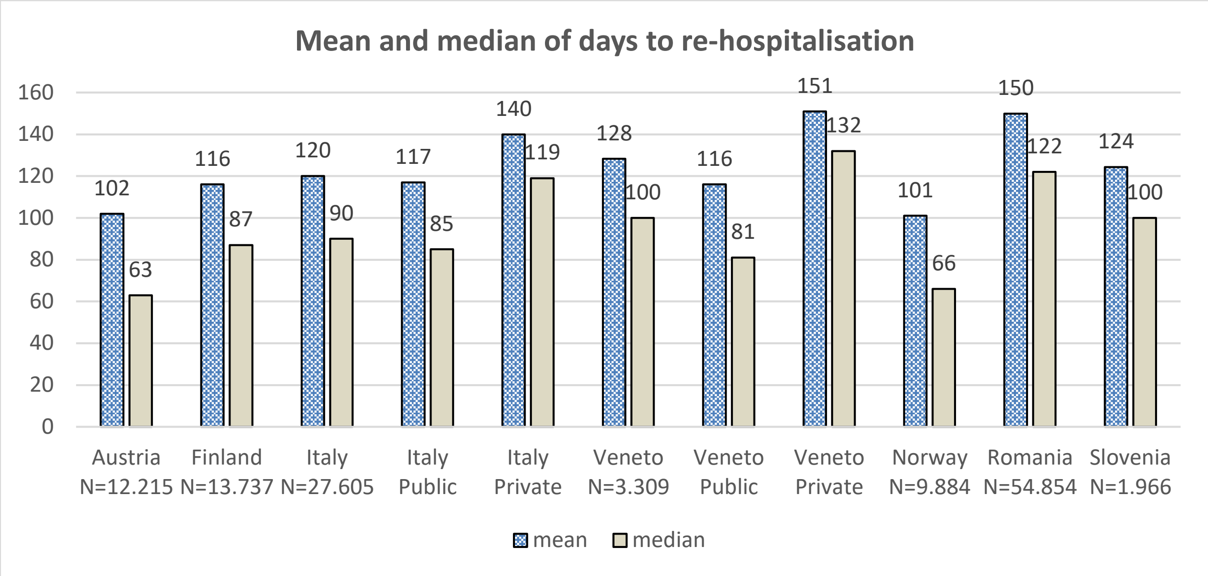
Time to re-hospitalisation

Figure 20: Cumulative percentage of all re-hospitalisations per country/region by 15 days intervals



In Austria within the first 15 days after discharge 15,81% of the discharged patients are already back in hospital. In Norway 11,10% of the discharged patients are re-hospitalised within the first two weeks. The percentage of re-hospitalisation within the first 15 days in the other countries lies between 7,69% in Slovenia and 5,72% in Veneto at the low end of the scale. Re-hospitalisations per 15 days intervals decrease continuously as time progresses. A notable exception is Romania, where at the end of the follow-up period (330 to 345 and from 346 to 360 days after discharge) a sudden increase can be found. This increase might be related to the Romanian pension system which requires patients to be hospitalised once again in order to have their invalidity/sickness pension prolonged.

Figure 21: Mean and median of days to re-hospitalisation



Austria has the lowest median of days to re-hospitalisation (63 days) followed by Norway (66 days). Romania has the highest median of days to re-hospitalisation (122 days). The median of days to re-hospitalisation in the Veneto region and in Slovenia was 100 days. The highest mean of days to re-hospitalisation is found in Romania (150 days) followed by Veneto (128 days) and Slovenia (124 days). Norway and Austria have the lowest mean to re-hospitalisation (101 and 102 days).

Looking at the mean and median of days to re-hospitalisation between public and private services in Italy and Veneto substantial differences can be observed. The meanof public services in Italy is 117 days and in private services it is 140 days; the median in public services in Italy is 85 days, in private services it is 119 days. In Veneto in public services the mean is 116 days, while in private services it is 151 days; the median in public services is 81 days vs 132 days in private services.

Information on patients of the study cohort who died during followup

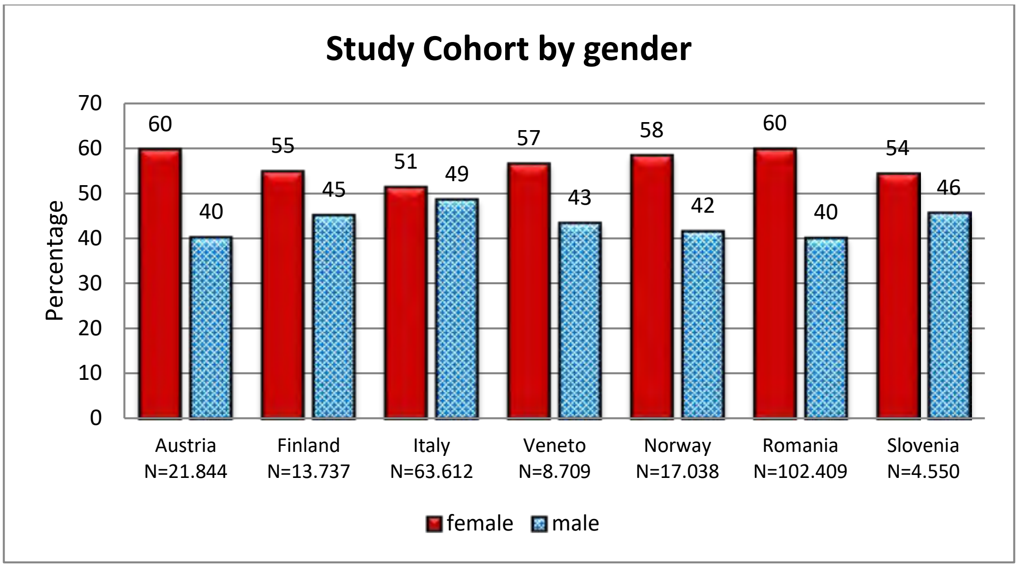
Full information on persons who had died after discharge was available in the LEEARs only for Austria, Finland, Norway and Slovenia. In Austria 574 patients (2,63%) of the study cohort died during the one year follow up. In Finland 325 patients (2,37%), in Norway 198 patients (1,16%) and in Slovenia 99 patients (2,22%) died during the follow up. The Romanian database did not include this type of information. For Italy and the Veneto Region only information on patients who died in hospitals was available (0,95% of the study cohort in Italy and 0,84% in the Veneto region) and is therefore not comparable with the other countries.

4.3.3 Description of predictor variables

In this section the four pre-discharge variables selected for the regression analyses are described.

Gender

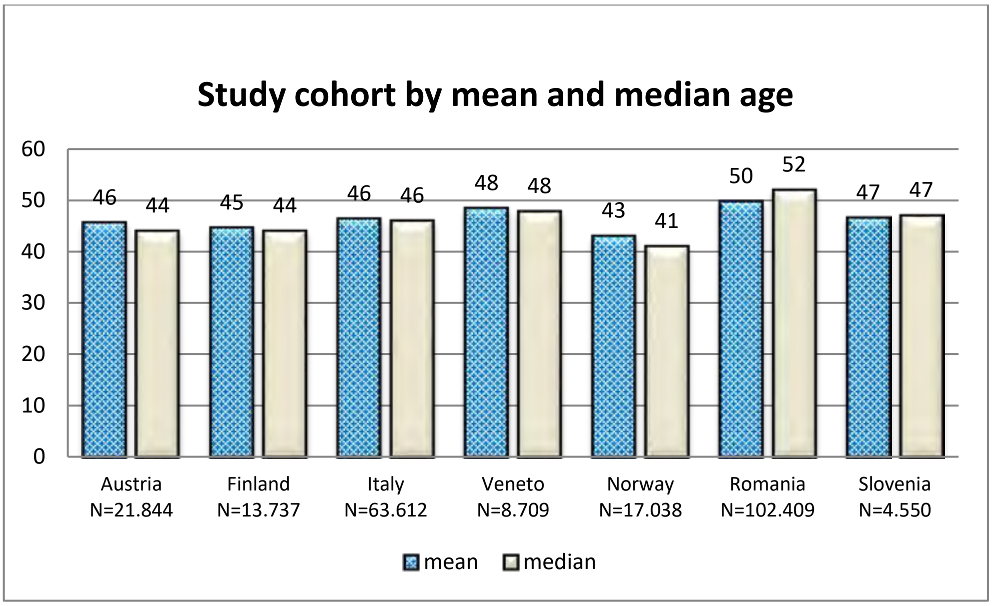
Figure 22: Pilot Study Cohort by gender



The Pilot Study cohort has more female than male patients, with the widest gender gap in Austria and Romania, both with a relation of 60% female and 40% male patients. Practically no gender gap exists in Italy (51% female and 49% male). A separate analysis of public and private services in Italy shows a complete different picture, with 50% females in public services and 59% females in private services. In the Veneto region in public services 53% are female and in private services 62% are female.

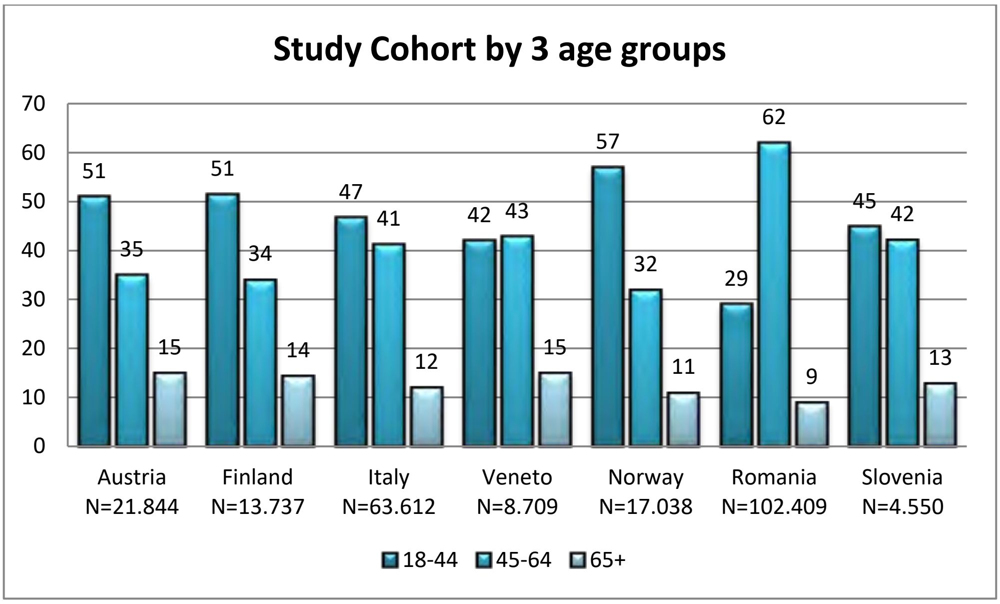
Age

Figure 23: Pilot Study Cohort by mean and median age



Except for Romania (52 years) and Norway (41 years) the median age of the Pilot Study cohort is very similar (between 44 and 48 years).

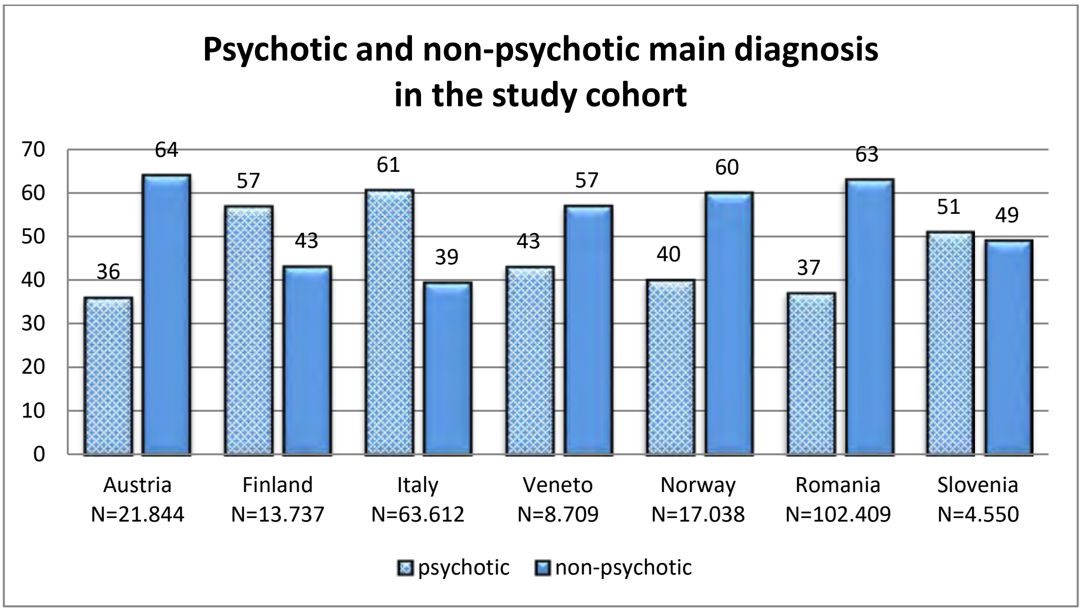
Figure 24: Pilot Study Cohort by 3 age groups



Describing the Pilot Study cohort for three different age groups provides a more different picture, with Romania having an outstandingly high percentage of patients (62%) in the age group 45-64 years. Norway, Finland and Austria have the highest percentage of patients aged 18 to 44(all over 50%). The percentage for the age group 65+ lies between 9% and 15% in all countries.

Diagnoses

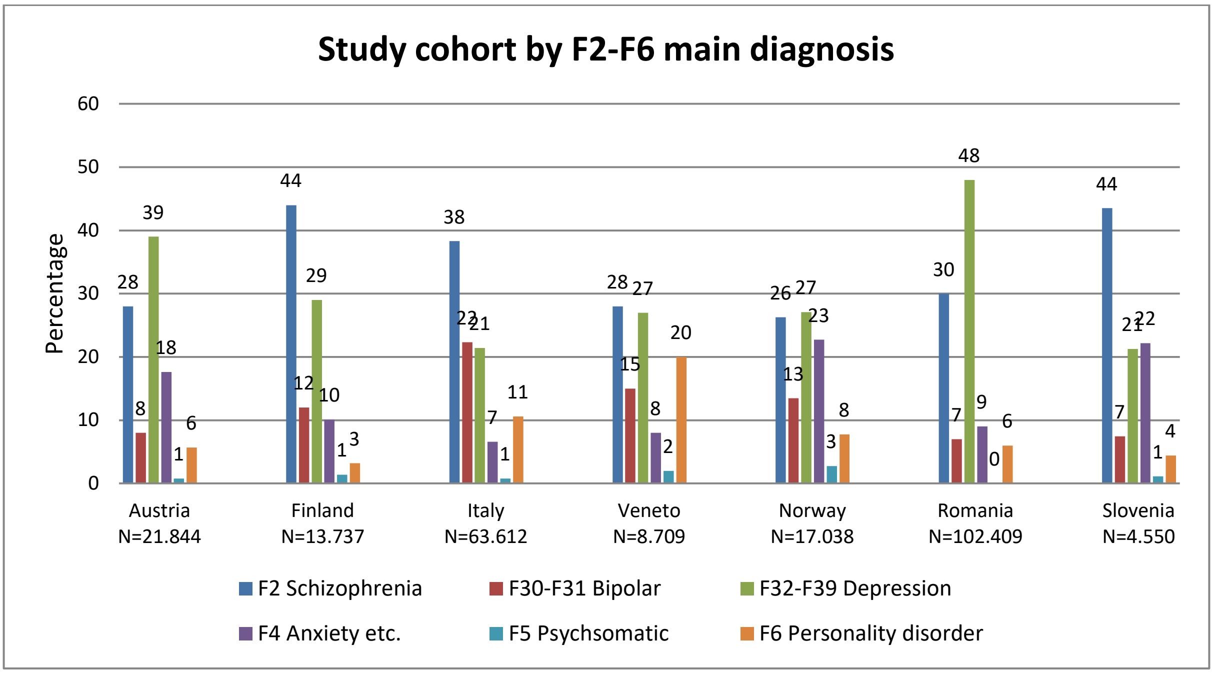
Figure 25: Psychotic and non-psychotic main diagnosis in the Pilot Study Cohort



Main diagnoses were divided into two groups, “psychotic” (F2, F30-F31) and “non-psychotic” (F32-F39, F4, F5, F6). In Austria, Norway and Romania a higher percentage of non-psychotic diagnoses is found. In Finland, Italy and Slovenia psychotic diagnoses prevail. Austria has the widest gap between non-psychotic and psychotic distribution and Slovenia the narrowest one. A completely different picture is found when Italy and Veneto are analysed separately for public and private services. In public services in Italy the rate of patients in the study cohort with a main psychotic diagnosis is 62%

and in private services it is 47%. In the Veneto region in public services we find 55% of the patients having a psychotic main diagnosis and in private services 24%.

Figure 26: Pilot Study Cohort by F2-F6 main diagnosis



A more detailed view at the ICD-10 F2 to F6 diagnoses (and a split of F3 into F30-F31 and F32-F39) is provided in Figure 26.

In Austria and in Romania depression is the most frequent diagnosis (AT: 39%, RO: 48%) - far above the percentages in other countries/regions. In Finland (44%), Italy (38%) and Slovenia (44%) schizophrenia is far above the percentages in other countries/regions. Huge differences can also be found in the distribution of the diagnosis F6/personality disorder, which is diagnosed in 20% of the Veneto patients and 4% in Slovenia at the lower end of the scale. F5/psychosomatic is the least frequent diagnosis in all countries. In fact, in public services in Veneto personality disorder is diagnosed in 13% of the patients and in private services in 29%. For Italy the gap between public and private services for the diagnosis personality disorder is a lot narrower than in Veneto with a rate of 10% in public versus 12% in private services.

Length of stay (LOS)

In the Italian dataset the variables identifying an intra-hospital transfer were not available, thus it was not possible to calculate the LOS PSY, but only the LOS ALL.

Figure 27: Median LOS ALL and LOS PSY in the Pilot Study Cohort

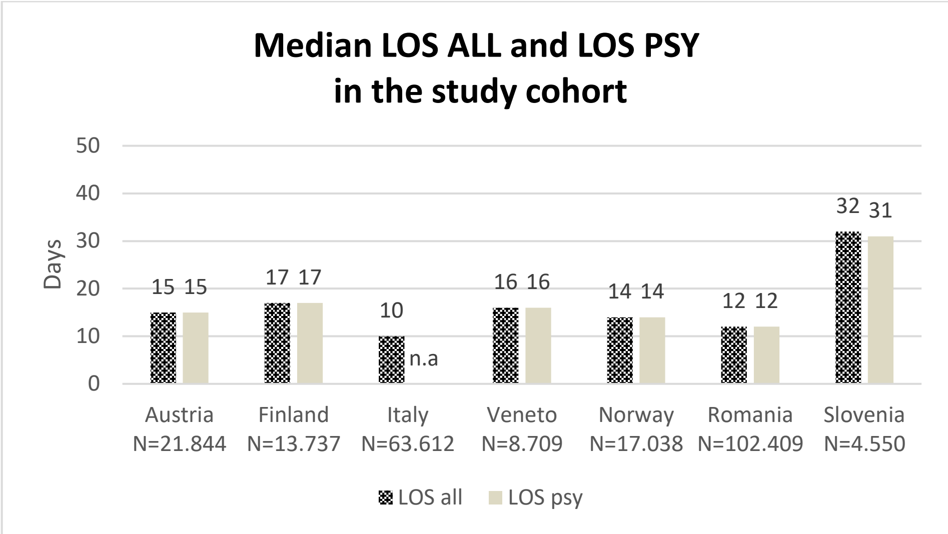
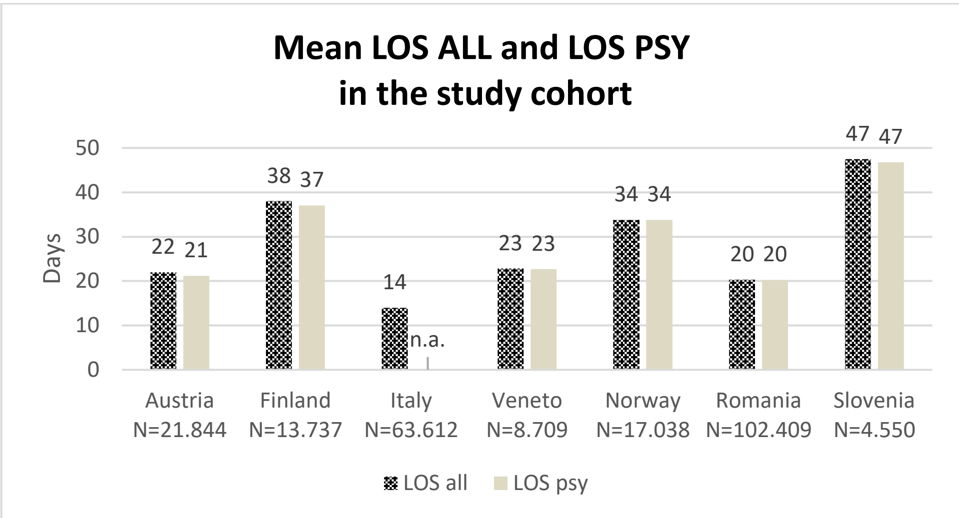


Figure 28: Mean LOS ALL and LOS PSY in the Pilot Study Cohort



On the whole, it was found that the values for the median and the mean of LOS ALL and LOS PSY are very similar.

Looking at the LOS in any type of care (LOS ALL) we find the lowest mean and median in Italy, where 50% of the patients stay up to 10 days in hospital and the mean stay is 14 days. Slovenia has the highest mean and median for both types of length of stay, there 50% of the patients had an index episode lasting up to 32 days and the average stay is 47 days (which might be due to some extreme outliers). If LOS is calculated for psychiatric beds only, the highest values were found for Slovenia (mean 47 days and median 31 days). Romania has the lowest mean and median for LOS PSY. The widest gap between mean and median is found in Norway and Finland. In the Veneto region the mean and median for both LOS ALL and LOS PSY have the same values (mean 23 days and median 16 days) but huge differences were found between public and private services.

The picture of Italy changes if public and private services are analysed separately: In Italian public services the mean LOS is 13 days, in private services it is 20 days; the median LOS in public services is 10 days and in private services it is 15 days. Even higher are the differences in the Veneto region, where the mean LOS in public services is 16 days and in private services it is 34 days; the median LOS in public services is 11 days versus 29 days in private services.

On the whole, it can be found that the pictures of the LOS over all spells within a hospital episode and LOS in psychiatry departments/wards are mostly identical.

The cumulative percentage of length of stay in any type of hospital department/ward during the index episode (i.e. added LOS for all spells during the same hospital episode) showed quite different patterns between the countries/ the Veneto region. While in Austria, Finland, the Veneto region and Norway about 50% of the patients stay up to 15 days in hospital, in Italy and Romania about 70% of the patients have a LOS of up to 15 days. Slovenia has a clearly flatter curve than all other countries/region reaching the 50% value at days 30 to 35.

The picture of the LOS PSY is almost identical with the LOS ALL. In Romania 68% of the patients have a LOS up to 15 days, in Austria and Norway around 54% of the patients stay 15 days or less. The Slovenian study cohort shows a completely different picture where 10% of the patients have a LOS for up to 5 days, then a rather low increase is found until 30 days and finally, 45% of the patients stay longer than 35 days in a psychiatric bed.

Extreme outliers were detected in Slovenia. In Slovenia 15 patients (0,33%) had a LOS PSY between 341-4042 days and 16 patients (0,35%) had a LOS ALL between 431 and 4042 days.

4.3.4 Regression analysis

It showed that all partners were able to perform logistic and COX regression analyses as foreseen in the study protocol. Different variants of the age and length of stay variables were used and also the effect of interaction terms was analysed. Results of the regression analyses are not reported here.

4.4 Harmonising essential concepts and their coding in the databases

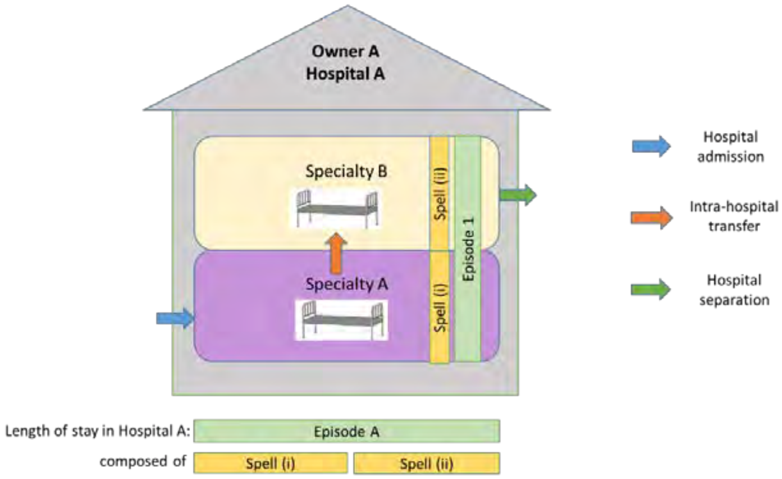
A main challenge in the CEPHOS-LINK study was to harmonise the definition and meaning of essential concepts for a re-hospitalisation (hospital, discharge, admission, transfer, medical specialty). This process started with the procedure described in Chapter 2 “Identifying and describing national databases, relevant variables and coverage of services” and Chapter 3 “The Hospital Episode Report” and was finalised once each partner had actually access to the data needed for performing the CEPHOS-LINK analyses. In addition to ensuring a common understanding of the basic concepts of a re-hospitalisation study a second major challenge was to understand how such concepts were handled and coded in the databases to ensure comparable categories and codes in order to ensure interoperability of the data. Since it turned out that intra- and inter-hospital transfers were variably coded and could be mistaken for discharges and admissions special attention was paid to these codes. Codes describing hospital discharge and admission were analysed in detail in a multiple step approach, which included the development of different templates and graphical aids (e.g. a graph to clarify the use of admission and separation codes for each country; report available on request).

Detailed analysis of concepts

Introducing the umbrella term hospital "separation"

In order to overcome the differences in definitions and meaning of the concept inpatient hospital discharge the umbrella term hospital *separation* was introduced (see also Chapter 3 "The Hospital Episode Report"). A hospital separation refers to all events that end a hospital episode. Hospital separations can be broken down into three categories of leaving the hospital (a) by discharge, implicating that a patient has left the hospital alive, (b) due to death and (c) by transfer to another hospital. Figure 29 shows the simple situation of a hospital separation from Hospital A by leaving a hospital being discharged or having died in hospital and Figure 30 shows a hospital separation from Hospital A by inter-hospital transfer and from Hospital B by discharge or death.

Figure 29: Concepts of inpatient hospital admission, intra-hospital transfer, hospital separation



Inpatient hospital discharge in the CEPHOS-LINK Study

For defining an inpatient hospital *discharge* in the CEPHOS-LINK study only "real" discharges were of interest – meaning that a patient left a hospital and was eligible for a re-hospitalisation. Therefore, patients who died in hospital were to be excluded as well as patients who were transferred to another hospital (the latter were to be included in the study cohort only at the point of their "final discharge").

Index discharge in the CEPHOS-LINK Study

In the CEPHOS-LINK study an inclusion criterion for identifying the study cohort was that a patient has spent at least one night on a psychiatric bed/specialty ward during the hospital episode where the "index discharge" took place. The index discharge was defined as "a hospital inpatient episode with at least one overnight stay ending with a discharge", i.e. not with death and not with a transfer to a different hospital, whereby transfers within the same hospital (intra-hospital transfers) were to be disregarded. It follows from this definition that a patient can be discharged both from a psychiatric or a non-psychiatric bed/specialty ward as long as she/he has spent at least one night on a psychiatric bed/specialty ward during the hospital episode.

(2) Inpatient hospital admission

Inpatient hospital *admission* means that a patient enters a hospital and stays there for some time on a hospital bed. For identifying inpatient hospital re-hospitalisation, the first "real" inpatient admission after an inpatient discharge had to be identified. For this reason, it had to be made sure that a patient did not enter a hospital or ward by an inter-hospital transfers (transfers from a different hospital) or an intra-hospital transfers (within one and the same hospital).

(3) Inpatient hospital transfers

(3a) Intra-hospital transfer

A patient might be "transferred" from one inpatient specialty department/section/ward to another inpatient specialty department/section/ward within the same hospital before leaving the hospital. Figure 29 shows the simple situation of a patient being transferred within the same hospital from one specialty department to another specialty department and being from the latter one either a) being discharged or b) having died (please note that the figure has no time implication and a patient could in fact be transferred back to the specialty department from where he/she was transferred from and be discharged there or die there). Such transfers between different specialty departments/sections/wards of one and the same hospital were called *intra-hospital transfers* in CEPHOS-LINK.

In the CEPHOS-LINK study intra-hospital transfers (transfers within one and the same hospital) were to be disregarded (i.e. not counted as discharge). In order to follow that procedure, the way such intra-hospital transfers were documented in the LEEARs had to be understood.

Depending on the purpose of documenting intra-hospital transfers, in some instances no documentation at all may exist in the databases, in other instances the specialty department/section/ward on which the patient stayed may be documented with a "functional code" (either in the order of use of such specialty department/section/ward or without such order) and/or the dates of leaving the specialty department/section/ward 1 and entering the specialty department/section/ward 2 are documented. In addition to the date of leaving one specialty department a code indicating an "intra-hospital" transfer might exist.

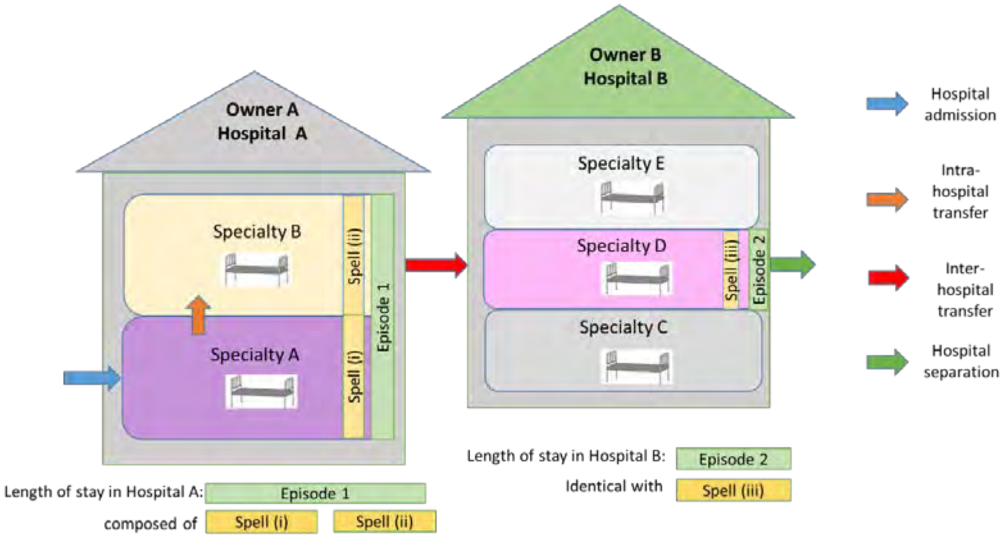
As will be shown further below by example that a *discharge* from a specialty department and an *admission* to another specialty department might be coded instead of an *intra-hospital transfer* (because e.g. different payment mechanisms apply at the first specialty department as opposed to the second specialty department to which a patient is transferred). Or because different legal situations apply to the first specialty department and not to the second department where the patient is transferred to.

In fact, the situation of intra-hospital transfers is potentially complicated by the fact that (mainly out of "economic reasons") one and the same provider might run several hospitals at different locations and regards transfers between his own hospitals as intra-hospital transfers and will be discussed below (Figure 31).

(3b) Inter-hospital transfer

An *inter-hospital transfer* is defined as the movement ("transfer") of a patient who was admitted at a hospital to another hospital from which he/she is then separated by discharge or death (of course a chain of such transfers can occur and the direction of transfers can be forward and backward). Identifying such inter-hospital transfers in the CEPHOS-LINK project was necessary in order to exclude the episode of patients who were transferred to another hospital and only include the episode in the hospital where the "final" discharge had occurred. When a patient is transferred to another hospital (inter-hospital transfer) a new hospital "episode" starts (Figure 30).

Figure 30: The concept of inter-hospital transfer



In the databases of the participating countries different documentation routines of inter-hospital transfers existed (and differences might even exist on a national level). E.g. such an inter-hospital transfer can be coded as discharge from one hospital and admission to another hospital.

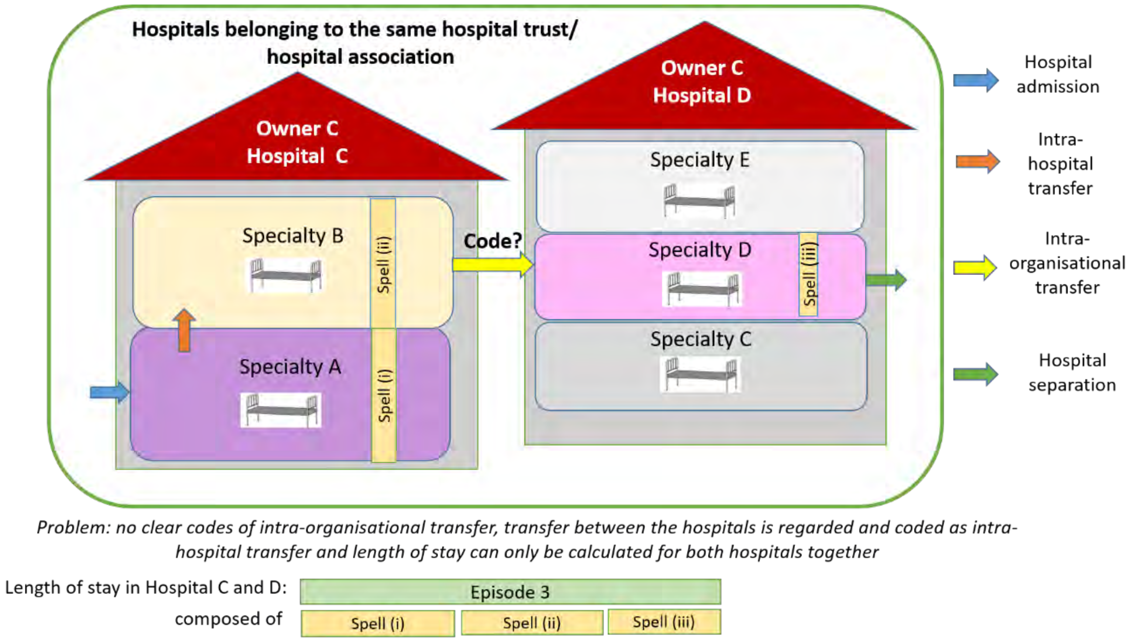
(4) What is a hospital? The implication of identifying an inpatient "hospital" in the LEEARs on a re-hospitalisation study

For a long time it was relatively clear what an inpatient hospital was in industrialised countries: an institution where a patient was admitted for at least one overnight stay (mostly longer though) for medical examination or/and medical treatment for which only the hospital could provide the necessary specialised human and logistic resources. The hospital consisted of a building or several neighbouring buildings, often with a wall or a fence around. This was especially the case for psychiatric hospitals. A hospital was defined by its physical structure and boundaries, and the three pathways of entering and leaving (discharge, inter-hospital transfer, death) an inpatient hospital were clear. Today, "hospitals" are often defined as an administrative unit, where hospitals in the traditional sense are in different geographical locations and often far away from each other, but nevertheless combined under a common administration. Several such arrangements are possible. As a rule though, such administratively defined hospitals have been formed from several historically existing physical hospitals. This concerns all medical specialties but psychiatry is especially prone to such arrangements. Such a complex issue exists when a health trust owns/serves several hospitals in a defined geographical area (Figure 31).

In case different ways of defining or identifying a hospital in different countries exist (e.g. as an individual hospital or as all hospitals of a hospital trust together) a consequence is that numbers of hospitals, numbers of beds, numbers of beds per hospital, numbers of discharges and transfers as well as length of stay are not comparable between countries.

In some European countries, inpatient care does not only occur in hospitals but also in other types of health care services (e.g. District Psychiatric Services (DPS) in Norway and Primary Health Care Centres in Finland). Such inpatient services had to be included into the data analyses of the CEPHOS-LINK study.

Figure 31: The concept of intra-organisational transfer



Different ways of coding an intra-organisational transfer

For reasons of comparability it is necessary to clarify how transfers between hospitals belonging to a hospital trust/a hospital association - for which the term *intra-organisational transfer* was created in the CEPHOS-LINK project - were coded: The experience of the CEPHOS-LINK project showed that three different ways of coding such an intra-organisational transfer are possible: (1) discharge from one hospital and admission to another hospital, (2) inter-hospital transfer or (3) intra-hospital transfer.

(5) Inpatient hospital episode and inpatient hospital spell[13]*and length of stay (LOS)*

The definitions inpatient hospital *episode* and inpatient hospital *spell* were essential in the CEPHOS-LINK study in order to define the "index episode" from which the "index discharge" took place and to calculate the length of stay in the index episode. An episode was defined as the time between the beginning and the end of the total time in one and the same hospital. It is possible and not unusual that a patient is transferred from one specialty department/section/ward within a specific hospital "episode" to another specialty department/section/ward. In that case the time period spent on a specific specialty department/section/ward was called "spell". Therefore, a hospital episode can be identical with a "spell" (see in Figure 30 the example of Hospital B, where a patient is treated in specialty D and discharged from there), but in case the patient is transferred within the hospital between specialties departments/sections/wards can contain two or more "spells" (see Figure 29: time spent in Hospital A and Figure 30: time spent in Hospital A). To sum up: a hospital episode is the time period between an inpatient hospital admission and a separation in one and the same hospital.

[13] Please note: Some producers of Hospital Episode Statistics (HES in England, Slovenian Health Care Statistics) use the terminology hospital episode in a different way, i.e. an episode is defined as a phase of care within a full stay in a hospital and a spell is the full time spent within a hospital. An example of episodes not being consistent between providers can be found in the BMJ by Aylin et al. 2004.

A hospital spell is the time period on specific medical specialty departments within one and the same hospital episode.

The calculation of length of stay (LOS) is usually done by deducting the date of an inpatient admission from the date of an inpatient discharge. This is also the way the OECD (2015) suggests the calculation of LOS[14] whereby an "inpatient discharge" in these international statistics includes people who had died and who were transferred to another hospital. In the CEPHOS-LINK study the length of stay was to be calculated for the index episode only (the "index episode" was defined as the full phase that a patient had spent in one and the same hospital) and in case of an inter-hospital or intra-organisational transfer the episode from the hospital from which the "final discharge" had occurred had to be used. The decision in the CEPHOS-LINK study to use the episode where the final discharge has occurred (in the last hospital) has also considered to stay comparable with results from international statistics.

Figure 29 and Figure 30 show the situation of calculating the LOS for a single hospital (Hospital A and Hospital B) and how the LOS is related to the definition of episode and spell in the CEPHOS-LINK project.

What is considered as a hospital admission and a discharge depends on the definition and identification of "hospitals" and the identification of inter- and intra-hospital transfer. In case individual hospitals cannot be identified and it cannot be distinguished whether an inter-organisational transfer has occurred (i.e. when such a transfer is coded as intra-hospital transfer) patients might end up with an extreme long length of stay. Such an example is shown in Figure 31, where a hospital trust owns Hospital C and Hospital D and the problem may arise that an intra-organisational transfer is coded as an intra-hospital transfer. In such a case the length of stay would be calculated including the episodes from both hospitals and comparability with other hospitals using LOS based on individual hospitals is not given.

Grouping separation and admission codes into comparable categories

In a subsequent step the variables and their codes identifying a hospital separation and admission were analysed in regards to their meanings, content and richness of information, and clustered into relevant categories. This step was done in parallel with the tasks done in Section 3 "The Hospital Episode Report". The frequencies of the separation and admission variable codes were obtained and checked for plausibility. The codes were grouped into comparable categories using graphical aids (graphs and a colour-system) and for each country "rules for identifying hospital discharge" and "rules for identifying hospital re-hospitalisation" were developed and reported in the document CEPHOS LINK Separation and Admission Codes in the Master LEEARs of six European Countries (available on request).

The challenges experienced when trying to ensure interoperability of concepts, codes and data are considered as important results of the CEPHOS-LINK study and are therefore presented here in more detail.

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[14] The length of stay of a patient should be counted as the date of discharge minus the date of admission (for example, a patient admitted on the 25th and discharged on the 26th should be counted as 1 day) (OECD 2016)

Differences in numbers and meaning of inpatient separation variables and codes

The number of variables and codes identifying an inpatient separation varied a lot between the partner countries. For example, Romania on the one hand had a separation variable with four codes which were considered quite clear in terms of their content (e.g. discharged, discharged on request, transfer to another hospital and died). Finland on the other hand had a variable with 16 codes and some of these were ambugious in relation to the definition of the CEPHOS-LINK study cohort (e.g. see the example of code "1" below). So, some codes in some countries merely described that a patient had left the hospital (e.g. discharged from hospital). In some countries codes contained the information on how a patient had left (e.g. patient left against advice of hospital staff, voluntary discharge). In some countries, the information on where a patient was discharged to (e.g. home - mostly with special emphasis on the type of institution (e.g. municipal emergency room) and/or the type of care a patient was referred to (e.g. to care at home/supported housing) was provided.

As a rule, the more codes were available for describing a hospital separation, the richer the information was, but also the more blurred was the meaning of the codes. Overall the explanatory power of the codes varied substantially and different concepts and understandings of the terminologies used to describe codes were found to exist within a country but also between countries.

Huge efforts in clarifying the meaning of each code were made by the partners including consulting data dictionaries, on-site visits and clarifying telephone calls with data owners and service provides. Codes were grouped according to their function of describing a "discharge", "inter-hospital transfer", "intra-hospital transfer" or "death" and according to whether the meaning was clear ("unknown/other") but by the time the preparatory work of defining the "Rules for identifying hospital discharge" was accomplished, not all partners had direct access to the data and therefore the Pilot Study was also a test of the usefulness and accuracy of the separation codes describing the end of a hospital stay and to adapt the defined "Rules for identifying a discharge".

Examples of efforts in clarifying separation and admission codes

The Slovenian hospital separation code "9" = „other"

In the Slovenian database in the explorative phase of the CEPHOS-LINK project a high frequency of the hospital separation code "9", meaning in its translated form "other" ("drugo" in Slovenian) was found. Altogether 13.786 episodes were coded with "9" in the year of investigation, which amounted to 3,46% of all hospital separations reported. By linking the information of the codes with hospitals providing psychiatric care it was found out that mainly one hospital used this code (in Slovenia altogether six hospitals provide inpatient psychiatric care). That respective hospital was contacted and it was found out that the code was used for a hospital-internal coding system (and not reported as such to the national database) to indicate either that a patient was discharged and given an appointment for re-hospitalisation at a later point of time within the same hospital or provided with a referral to the outpatient department of the hospital.

The Finnish hospital separation code "1" = „institution"

While the instructions for coding and reporting hospital activities may be clear in theory, a different situation is shown when checking the frequencies of the codes. Such a case was found in Finland where an overarching code "1" was supposed to only structure a coding procedure but not to be used for coding the end of a hospital stay. In fact, 31.226 episodes, which is 3,24% of all codes describing the end of a hospital stay in the baseline year for all populations and all diagnoses, were coded as “1”. The episodes coded with code “1” could therefore not clearly be assigned to a separation category as they could either describe (a) a discharge in the CEPHOS-LINK sense (leaving the hospital, not being transferred to another hospital and not being dead) or (b) an inter-hospital transfer. The problem could be solved by linking the episodes and checking for a same-day admission to another hospital. In case such a same-day admission occurred, it was considered an inter-hospital transfer. This interpretation has its weaknesses, as a “same day re-hospitalisation” may be dismissed.

High number of inter-hospital transfers in Finland – a coding artefact?

In the CEPHOS-LINK “The Hospital Episode Report” (Section 3) on hospital episodes in the databases in the participating countries it was found that in Finland 24,63% of all hospital separations were coded as inter-hospital transfers, which is in comparison with the other countries an extremely high percentage (the inter-hospital transfers from the other countries were: Austria 3,02%; Italy 2,10%; Norway 6,88%; Romania 0,72%; Slovenia 1,36%;). The question if such transfers (inter-hospital but also intra-hospital transfers) actually occurred or if they were artefacts due to coding procedures came up. So analyses of the inpatient hospital separation and admission codes in Finland were performed in order to check, whether such transfers really occurred, whether the meaning of “inter-hospital transfer” was comparable with the other CEPHOS-LINK countries and whether reporting artefacts contributed to such high rates, e.g. whether coding peculiarities due to organisational differences in the handling of transfer (inter- as well as intra-hospital) existed. It was checked whether episodes coded with inter- and intra-hospital transfers at the time of discharge and admission have either preceding or subsequent episodes. Additionally, plausibility checks were performed by cross-tabulations of the frequencies of other admission and separation variables and codes (e.g. where the patient came from, main cause for seeking help), medical specialties and diagnoses and inter- and intra-hospital transfer codes. Length of stay of the episodes was calculated as further plausibility check. It was found that for a substantial number of episodes coded as intra-hospital transfer no preceding inpatient episode was found and for episodes coded as inter-hospital transfer no subsequent inpatient episode was found, e.g. only two thirds of episodes entered with an intra-hospital transfer code were preceded by an inpatient stay and one third by some type of outpatient care. Therefore, a conclusion was that different coding practices existed (not following a logic that would be applied by simply looking at the name of the codes) and admission and discharge codes are not considered a reliable source when following patients up.

Differences in numbers and meaning of inpatient admission variables and codes

The number of variables identifying an admission and the number of codes within such variables varied a lot between the partner countries and as a rule one could say, the more codes existed the less clarity on the meaning and use of the codes was found.

Overall the explanatory power of the codes varied substantially. For example, Romania on the one hand had only one admission variable with six codes which were considered quite clear in terms of their content (e.g. admitted with referral document from a general practitioner, transfer from other hospital). Finland on the other hand had three admission variables with up to 16 codes in a variable and the meaning of the codes was not always clear (e.g. patient's origin: institution - which could be a hospital but also any other type of institution).

Vague semantic dimensions of codes (translated as e.g. "others", "elective"/"planned", "emergency", "non-acute") made it difficult to understand what codes actually stand for. E.g. it was completely unclear what type of episode was coded "others". Different concepts and understandings of the terminologies used to describe codes are expected to exist within a country but also between countries. Huge efforts in clarifying the meaning of each code were made by the partners including consulting data dictionaries, on-site visits and clarifying telephone calls with data owners and service providers.

By the time this preparatory work of defining the rules for identifying a hospital re-hospitalisation was accomplished, not all partners had direct access to the data and therefore the Pilot Study was also a test of the usefulness and accuracy of the admission codes describing a re-hospitalisation and to adapt the defined "Rules for identifying a re-hospitalisation".

Examples of efforts in clarifying admission codes

The Slovenian admission code "other"

Slovenia had altogether four admission variables, whereby there were two variables providing the basic information on admission and three variables providing additional information (e.g. type of treatment). Concerning these main two admission variables (1) "admission to hospital" (indikator sprejema; S-ADM-1) and "admission directly from other hospitals" (Napotitev iz druge bolnisnice) (S-ADM-2) especially three codes were discussed in need of further clarification: "planned admission" (S-ADM 1=1), "other" (S-ADM 1=3) and "unknown" (S-ADM 2=9). Finally, it was decided to include all three codes in the CEPHOS-LINK rule for identifying re-hospitalisation.

Here the discussion on the code "other" (S-ADM 1=3) in the admission variable "admission to hospital" (indikator sprejema; S-ADM-1) is exemplarily shown: altogether four codes existed in the admission variable S-ADM-1 (the percentage of frequencies of codes for the whole population in 2013 is shown in brackets): 1=planned admission (53,84%), 2=unplanned admission (including through emergency block) (34,58%), 3=other (10,95%), 4=unknown (0,64%). Looking at these codes it was assumed that three options exist for coding in terms of the information available on the patient's admission being planned or unplanned: either the admission is coded as a) planned (code 1) or b) unplanned (code 2) or c) unknown (code 4). Therefore, it was not clear what the code "other" (3) stands for, moreover when considering that the frequency of the code "other" (3) was quite high with over 10%. It turned out that staff in Slovenia considers unplanned admission as the consequence of emergency. In case an admission was unplanned and not urgent (e.g. for the purpose of additional diagnostic procedures or adjusting medication) the code "other" (3) was used. Such a situation would apply for example when a psychiatrist of an outpatient service called the hospital and asked for the admission of a patient. The patient would be almost immediately admitted without using a waiting list for admission and code “other” (3) would be given.

Planned admission in private services in the Veneto Region

Differences in the extent of coding “planned admissions” were found in Italy and the Veneto region between private and public services. Whereby it was not clear if these differences were partly due to different concepts and meanings of terminologies used in coding of hospital activities (as discussed above). The code “planned admission” (I-ADM 1=1) was used in private services of the Veneto region in 75% of all admissions.

Identifying individual “hospitals” in a comparative way

A precondition for identifying the “index episode” and the LOS in a comparable way across all CEPHOS-LINK countries was the identical understanding and definition of a hospital across different LEEARs. In the LEEARs of four out of six countries hospitals describe an institution with the primary function of providing inpatient diagnostic and therapeutic services for a variety of medical conditions, whereby such an institution was identical to a building or several neighbouring buildings defined by its physical structure and boundaries and with a clear geographical location.

This was not the case for Finland and Norway. In these two countries hospitals are run by regional trusts/ Helseforetaks (Norway) or hospital districts (Finland) (Norway: 19 Helseforetaks, Finland: 21 Hospital districts); in Finland hospitals are also run by municipalities and universities. Where regional trusts or hospital districts run hospitals it could not be ascertained that inter-hospital transfers and *intra*-hospital transfers within one and the same hospital trust or district could be reliably distinguished in the national databases. (This might have been possible at the level of the hospital trust databases, but these were not accessible in time). More specifically, in Norway codes on individual hospital on lower levels were available, but not consistent on whether they refer to an organisational unit which may cover more than one geographcal location or to a geographical location. This meant for the Pilot Study approach, in which hospital separation and admission codes were used for identifying an inpatient hospital discharge and re-hospitalisation, that patient movements between different specialty wards and hospitals belonging to one and the same hospital provider/trust could not be clearly identified as inter- or intra-hospital transfers. Such transfers were partly not coded at all, or as inter- or intra-hospital transfer or even as discharge. For identifying the index episode and the LOS on the index episode in a comparable way with the other four European countries/regions each movement between different hospitals/inpatient services needed to be identified. Even by using record linkage this problem could not be solved as for the case that individual hospitals were not identifiable it could not be distinguished whether a transfer was intra- or inter-hospital and patients ended up with longer length of stay compared to other countries where the index episode was the final episode in one and the same hospital.

This issue became also important for defining hospital related system variables as predictors for multilevel regression analyses and when data was to be pooled. Hospital level variables had to be prepared/constructed using the same hospital identification variable as in preparing the patient-level, i.e. all patients discharged from the same hospital had to have the same value for the hospital level variables.

A critical remark to the procedure of using “individual” hospitals and the final episode in one and the same hospital in the CEPHOS-LINK study is that to some extent it denies the reality of health care provision in the Nordic countries, where inter- and intra-hospital transfer are very frequent. For instance, patient X in Finland is first treated in a psychiatric ward with a diagnosis of F2 in a specialty hospital and then transferred on the same day to a primary health care center for further treatment. The situation in Finland and Norway is described in more detail:

The Finnish experience in identifying individual hospitals

Finland is divided into 21 hospital districts responsible for the organisation and coordination of specialist health care (including psychiatry). The hospital districts are federations of municipalities and each municipality must belong to one hospital district. Hospital districts typically maintain one to three hospitals, with one of the hospitals being the central hospital (keskussairaala/ centralsjukhus). In hospital districts with medical faculties, the central hospital equals the university central hospital. Thus, in five hospital districts the leading hospital is a university central hospital, in 16 hospital districts it is a central hospital.

In the Finnish LEEAR the exact hospital codes were not provided, instead, two variables existed which should support the identification of hospitals but proved to be rather difficult in handling:

(1) The variable “PALTU” (“palvelun tuottaja”) described the provider of the health care service, not the hospital. In secondary care the service provider was usually a “hospital district”, and this typically meant that a general hospital and a free-standing psychiatric hospital (which can be in a quite different location) had the same “PALTU” code. So in many cases this variable described a kind of administrative unit more than the actual hospital. In some cases, the codes referred clearly to a certain hospital (especially in smaller towns, where a particular service provider has only one unit), like Niuvanniemi hospital, in some cases one single “PALTU” code covered several large hospitals – for the HUS area for example only one “PALTU” code was provided (covering the hospitals Jorvi, Peijas, HYKS, etc.) - and the same code could also include many different types of institutions, not only hospitals but also social services, etc.

(2) The variable “PALTUTARK” (“palvelun tuottajan tarkennin”) included more detailed information about the place of care. This variable was included in the national LEEAR but the Finnish partner did not have a key to this code as all “PALTU” units (providers) use their own codes, some use numbers, some use names, some use some combinations, etc., solely for their own administrational purposes. “PALTUTARK” units were also not on hospital level but on a more detailed ward level – the HUS area alone used up to 2.000 “PALTUTARK” codes.

The patients in the Pilot Study cohort had approximately 560 different “PALTU” + “PALTUTARK” combinations regarding their index episodes. The Finnish team received a key of the “PALTU” + “PALTUTARK” codes from the HUS area which was used as a pilot trying to figure out whether these codes can be used for identifying the actual hospitals. A new identifier was created in the database for the HUS inpatient services and efforts showed that most but not all hospitals could be identified.

The Norwegian experience in identifying individual hospitals

Health care in Norway is organised in a semi-decentralised fashion with three layers: municipalities (primary health care and long term nursing and care), regions and state (specialist (secondary) health care). The state is the owner of specialist health care and the administration is carried out by four Regional Health Authorities (RHFs, Regionalt Helseforetak). Moreover, the RHFs are the owners of the 19 Health Enterprises or Hospital Trusts (Helseforetak, HF), organizing the publicly owned hospitals. Also, a substantial number of private hospitals exist, but they are not part of the HF model, however, they (typically) have contracts (avtale) with one or more RHFs. Each HF comprises several “institutions” and hospitals and virtually all HFs are active in both somatic and mental health care, as well as substance abuse. Concerning the coding of inter- and intra-hospital transfers it was not clear whether a transfer within one and the same HF was coded as a discharge, inter- or intra-hospital transfer (same problem as in Finland) and internal checks by the Norwegian team showed inconsistencies in coding.

A characteristic of the Norwegian health care system is that patients admitted to psychiatric inpatient care tend to be transferred to other wards before being discharged. In some cases, patients are transferred between a psychiatric hospital ward and a district psychiatric centre with inpatient beds (DPS) numerous times. In the case a patient who was admitted to a psychiatric ward has an acute somatic event and therefore is transferred to a somatic ward, he/she would either be transferred back to the psychiatric ward, or discharged from the somatic ward.

Norway used for the Pilot Study the agreed discharge codes to identify intra- and inter-hospital transfers (tilSted variable). But the quality of the variable and its codes was considered very poor as it was not always clear what was coded as a discharge, an inter- or an intra-hospital transfer. E.g. if a person was “transferred” from an inpatient bed in a District Psychiatric Service (DPS) to a hospital and then sent back to the DPS within one and the same Helseforetak this could be handled as any of the three types of separations. Also, it was not known in case an inter-hospital transfer was coded, whether the “transfer” was within a Helseforetak or not.

The challenge with the dataset the Norwegian partner received from the data owner (an excerpt from the LEEAR) was

a) that the data was merged from separate files for somatic, psychiatric adult, psychiatric child and youth, and addiction services. And these services did not have the same id-number even if they were co-located, or had the same number even if they were not co-located.

b) There existed more than one institution-id with different aggregation levels, but there was not a standardised way of how the aggregation logic was used.

c) The institution identity did often not identify location.

The Norwegian team received additional codes (for treatment place, service place, department type) in their LEEAR excerpt that supported to identify locations. They looked at all combinations of codes for all services (somatic, psychiatric adult, psychiatric child and youth, and addiction services). However again, how these codes were used varied a lot. In many cases these codes helped to identify locations (in combination with using the information from a service mapping performed prior to the Pilot Study, the web pages of the health enterprises, and using Google Maps to see where the services were located) and the Norwegian team used them to separate and/or merge services. In other cases, the codes could not be used to separate services that operate at several locations.

Finally for the final CEPHOS-LINK analyses a separate analysis for the LOS in Norway and Finland was decided linking all uninterrupted spells and episodes within and between hospitals. The LOS variable for Finland and Norway was denoted as LOSALL_LONG Y/N FIN and LOSALL_LONG Y/N NOR in order to differentiate them from the variables LOSALL-LONG used in the group of the other countries.

5 Lessons learned for the final CEPHOS-LINK study

As has been already planned in the submission of this project and shown in Figure 2 above, a substantial amount of time of the CEPHOS-LINK project was foreseen for "data management", i.e. for ascertaining interoperability of the six national databases. The present report has documented these efforts by describing in detail national databases, analysing hospital episodes, and carrying out local pilot studies. It is now the place to draw conclusions on the lessons learned for developing the final CEPHOS-LINK study protocol.

The overall conclusion is that it is in fact possible to carry out retrospective cohort studies on psychiatric re-hospitalisation across different countries by using historical data of large existing electronic administrative health care utilisation registries; but that the advantage of being able to analyse quasi unselected total patient populations is offset, first, by the restricted choice of variables (mostly a minimum data set for paying providers or for gross statistical purposes, and often not available in all countries) and, second, by different definitions of actually available variables, even of crucial ones such as hospital discharge, hospital transfers and length of stay.

The activities on ascertainment of interoperability of the CEPHOS-LINK project aimed at getting the most out of the databases despite these adversities and arriving at the largest possible common pool of comparable and meaningful variables in order to define a common protocol for psychiatric re-hospitalisation studies across countries, whose results are less invalidated by "methodological noise" than studies usually analysed and compared in systematic reviews. Below the most important lessons learned for arriving at such a pool of comparable variables are briefly described. For a detailed discussion the reader is referred to the preceding sections.

	Problem identified	***How to deal with this problem in the final CEPHOS-LINK study***
	A. Identifying the study cohorts for a re-hospitalisation study	
A1	Identifying a hospital inpatient discharge cohort is essential for defining the study cohort of a rehospitalisation study. However, codes for inpatient hospital discharge are not suitable for identifying in a comparable way an inpatient discharge in different countries. (E.g. in some countries inter-hospital transfer codes turned out to be discharges).	An inpatient hospital discharge can be identified in a reliable way only by linking records of individual patients, thereby excluding patients who by the end of a hospital episode had started a new hospital episode on the same day on which the previous hospital episode has ended (in addition to excluding patients who have died in hospital).
A2	Psychiatric hospital inpatient services are of many different types, e.g. acute, rehabilitation, substance abuse and gerontopsychiatric services; departments in general hospitals and specialised stand-alone psychiatric hospitals. Originally a "restricted approach" of selecting psychiatric services that provide acute/sub-acute care was planned. However, this proved to be a too complex undertaking that could not be accomplished in the time-frame of the CEPHOS-LINK project.	The idea of using a "restricted approach" of psychiatric service selection was dropped. But by using an unrestricted approach the problem of comparability of some types of services/types of care has to be taken into account.

A3	Originally it was planned to also define and follow-up patients with a main functional psychiatric diagnosis who were discharged from a hospital without having spent at least one night on a psychiatric bed. However, the number of such patients was very low in most countries.	Only patients with a main functional psychiatric diagnosis who had spent at least one night on a psychiatric bed were included.
A4	Diagnostic mix of patients differed to a substantial degree between the countries – e.g. share of depression, schizophrenia.	Diagnostic differences have to be considered in the interpretation of results.
A5	The coverage of service provision in the LEEARs differs due to different payment mechanisms or the allocation of services to the social or health sector and depends on the purpose of a LEEAR (e.g. reimbursement of health care paid by health insurance). Differences in coverage of service providers in the LEEARs may hamper comparability.	Limitations were explored and pointed out. The exclusion of specific health and social services in a LEEAR means that patients admitted to such services are not available for follow-up. Knowledge of the health care system, its organisation and payment mechanisms is essential in order to check plausibility and interpret results.
A6	Inpatient care is not only provided in hospitals in Norway and in Finland.	In Norway patients discharged from and admitted to “District Psychiatric Services” and in Finland those from “Primary Health Care Centres” were included in the CEPHOS-LINK analyses.
A7	So-called “difficult to treat” patients in Finland and patients treated in “secure wards” in Norway with no comparable situation found in the other European partner countries have an extremely long length of stay.	“Difficult to treat” patients from Finland were excluded from the final analyses of the CEPHOS-LINK study. In Norway “secure wards” exist both at a regional and a country level, but only regional wards could be identifi ed and hence excluded from the study.
B. Identifying re-hospitalisations		
B1	Inpatient hospital admission codes are not suitable for identifying a re-hospitalisation.	Re-hospitalisation was to be identified by checking for the subsequent first entry (admission) to an inpatient hospital, whereby episodes of patients who started a new hospital episode on the same day on which the previous hospital episode had ended were disregarded (they were considered as implying an “inter-hospital” transfer) which may unfortunately also include cases of real re-hospitalisation (to the same or a different hospital).
B2	Originally a “restricted approach” of selecting psychiatric services that provide acute/sub-acute care was planned (see A2 above) also for following patients up. However, this proved to be a too complex undertaking that could not be accomplished.	The idea of using a “restricted approach” of psychiatric service selection was dropped. But by using an unrestricted approach the problem of comparability of some types of services/types of care has to be taken into account.

B3	Information on whether a re-hospitalisation was unplanned or planned was not available in many countries.	No distinction could be made between unplanned and planned re-hospitalisations.
B4	Information on whether a patient had died during follow-up was not consistently available across all countries.	Patients who died during follow-up were included, no competing risk analyses were performed.
C. Identifying predictors of re-hospitalisation		
C1	Length of stay in psychiatric departments/wards/beds (LOS PSY) was very similar to the length of stay in any type of departments/wards/beds during the index episode (LOS ALL). In one country only LOS ALL could be calculated due to data restrictions.	In the final CEPHOS-LINK analyses only LOS ALL (length of stay in all specialty departments/wards/beds including psychiatric and non-psychiatric ones during the index episode in a hospital) was used as a predictor.
C2	Length of stay should have been calculated for the "index episode" which is depending on the definition of "hospital". In Finland and Norway individual "hospitals" could not be identified consistently in the databases in a way which is comparable with the other countries.	For the final CEPHOS-LINK analyses a separate analysis for these two country groups was decided, whereby the LOS variable for Finland and Norway was denoted as LOSALL_LONG Y/N FIN and LOSALL_LONG Y/N NOR in order to differentiate them from the variables LOSALL-LONG used in the group of the other countries.
C3	Length of stay values showed different distributions in different countries with partly extensive outliers.	Not the actual values of length of stay were used but the dichotomised variable "below median LOS" versus "median LOS and above".
C4	Age values showed different distributions in different countries with partly extensive outliers.	Not the actual values of age were used but the dichotomised variable "below median AGE" versus "median AGE and above".
C5	Diagnostic profiles of country cohorts differed largely.	In order to capture differences in the diagnostic profiles a dichotomised variable "psychotic diagnosis" was introduced (covering ICD-10 F2, F30 and F31).

Considering these problems and solutions a final study protocol for the CEPHOS-LINK study was developed for three different study concepts, which will be detailed in Part 3 of the Final Scientific Report.

(1) using five patient-level demographic and clinical predictors
(2) adding two contextual predictors to the five patient-level predictors
(3) adding post-discharge psychiatric outpatient contact to the five patient-level predictors.

[i] CEPHOS-LINK systematic reviews:

1) Statistical methods and modelling techniques for analysing hospital readmission of discharged psychiatric patients: a systematic literature review https://www.thl.fi/documents/189940/2732416/Urach+stats_modelling.pdf/c988bcd5-66dd-4b6e-b57c-156b6127950b

2) Psychiatric readmissions and their association with environmental and health system characteristics: a systematic review of the literature https://www.thl.fi/documents/189940/2732416/Kalseth+rehosp_postdis.pdf/1b70914f-e640-4b6e-8e8f-f537bdc08263

3) Pre-discharge factors predicting readmissions of psychiatric patients: A systematic review of the literature https://www.thl.fi/documents/189940/2732416/Donisi+et+al.pdf/9723398c-e84e-443a-88e4-2c06e4cd3233

4) Psychiatric readmissions and their association with physical comorbidity: A systematic literature review https://www.thl.fi/documents/189940/2732416/Sprah+rehosp_comorbidity.pdf/26ba40e0-46d1-4d6f-81ec-4309df11848a

5) Overview of post-discharge predictors for psychiatric re-hospitalisations. A systematic review of the literature (in preparation)

3

Final Scientific Report

PART 3

Local Regression Analyses of Re-Hospitalisation

Prepared by
IMEHPS.research and the CEPHOS-LINK team
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Contents

Introduction

The main innovation of the CEPHOS-LINK project was the development of a methodology allowing to compare across different European countries the results of retrospective cohort studies with data from country specific large electronic health care registries. The preparation of common study protocols and the establishment of comparable data sets give rise to the hope that the re-hospitalisation results – both the re-hospitalisation rates and their predictors – reflect "real" findings and are not determined by methodological artefacts.

In the preceding document (FS2) the activities for ascertaining interoperability of the national databases were described, while here the actual study methodology and the results are presented in four sections: 1 Methods, 2 Description of the study cohorts, 3 Results, 4 Summary and conclusion.

1 Methods

As a result of the activities on ascertaining interoperability of the national databases described and discussed in Part 2 of the Final Scientific Report and considering a compromise between desirability, availability and comparability of variables across databases, study protocols were developed

a) for identifying the study cohorts, the outcome measures, and the predictors agreed upon and
b) for defining the regression analyses to be carried out by each partner country.

Technically, the studies were what is often called "retrospective cohort studies", "retrospective" meaning that existing data were analysed by defining study cohorts and following them up in the electronic database in terms of which variables predict re-hospitalisation rates. This approach required data linked on a patient-level, a topic discussed in its technical, logistic, legal and ethical perspective in FS2.

The methods section is divided into five chapters, covering the study concepts (1.1), the definition of the study cohorts (1.2), the outcome measures, i.e. the re-hospitalisation rates (1.3), the predictors chosen (1.4) and the regression analysis methods applied (1.5). While in the methods section these different methodological aspects are discussed one after the other, with some necessary overlap occurring, methodological aspects will show up also in sections on the study cohorts, and again in a brief and consolidated form in the results section (3). Issues of the analysis with data pooled across all countries will be discussed in FS4.

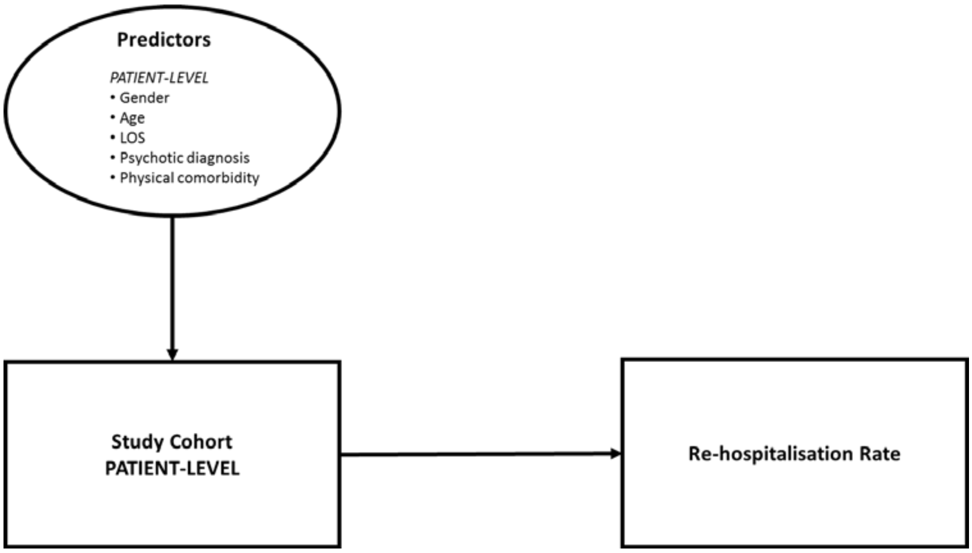
1.1 Study concepts

In accordance with the submission of the CEPHOS-LINK study three different study concepts were applied, whereby concepts 1 and 2 correspond to objective 1, and concept 3 to objective 2 in the project submission.

Concept 1: Using five patient-level demographic and clinical predictors

A first concept, using single level ("standard") multiple logistic regressions and Cox regressions, analysed the predictive potential of five patient-level variables, two demographic ones (gender, age) and three clinical ones (length of stay, psychotic diagnosis, physical comorbidity), which were used in the format of categorical yes/no variables. They were all available at the time of the inclusion of a patient into the study cohorts, i.e. at the time of the "index discharge" and called "pre-discharge variables" in the submission and physical comorbidity. Outcome measures used were psychiatric re-hospitalisation rates and rates of any type of re-hospitalisation at 30 and 365 days after the index discharge.

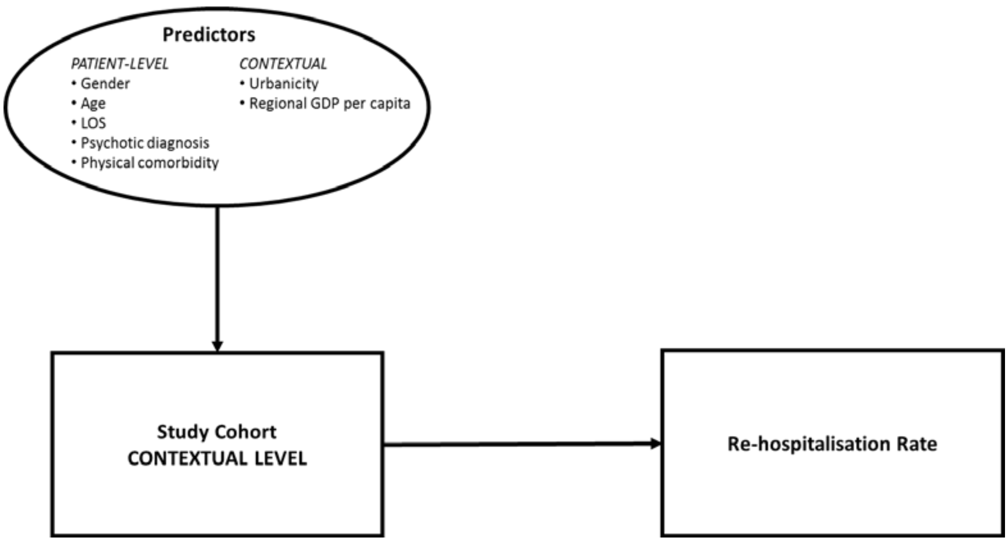
Figure 1: Concept 1 – using five patient-level predictors



Concept 2: Adding two contextual predictors to the five patient-level predictors

In a second concept, two contextual variables, characterising the patients' place of residence were added to the patient-level predictors, and multilevel logistic regression was applied. The contextual variables are urbanicity (predominantly urban, intermediate, predominantly rural) and per capita Gross Domestic Product (GDP) measured in 1.000 Purchasing Power Standard (PPS), both used at the NUTS 3 level. A random-intercept logistic regression model was applied. The same outcome measures as in concept 1 were used.

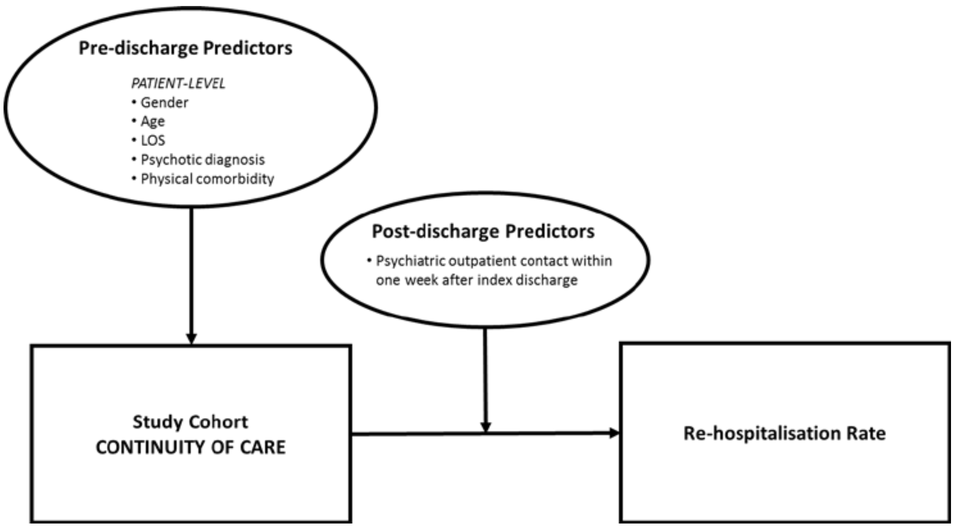
Figure 2: Concept 2 – adding two contextual predictors



Concept 3: Adding post-discharge psychiatric outpatient contact to the five person level predictors

In concept 3 the issue was addressed, whether “continuity of care”, measured as at least one psychiatric outpatient contact within one week after the index discharge (post-discharge variable) influenced re-hospitalisation rates. Here the variable psychiatric outpatient contact was added to the five patient-level predictors and a single level (“standard”) multiple logistic regression approach was used. Only psychiatric re-hospitalisation and only within nine weeks after start of the concept 3 study cohort was applied as outcome measure. The design of the continuity of care study was fundamentally different from the other two designs. A kind of shortcut was used as a first approach to analysing the effect of continuity of care on re-hospitalisation rates. First, of all patients included in the study cohorts for concept 1 and 2 those patients who had a re-hospitalisation between day 1 and 6 were excluded, leaving a smaller cohort on day 7, which was followed up for a potential re-hospitalisation for 9 weeks starting on day 7. For this reduced study cohort it was determined whether a patient had at least one psychiatric outpatient contact on days 0 to 6 after the index discharge. This variable was then used as a predictor of psychiatric re-hospitalisation for the new study cohort for a total of 9 weeks. The follow-up time was restricted to nine weeks, since a potential modifying effect of a psychiatric outpatient contact on re-hospitalisation might diminish with time.

Figure 3: Concept 3 - adding a continuity of care predictor



1.2 Study cohorts

The main selection criterion for inclusion in the study cohort was “adult patients with a functional psychiatric disorder” discharged from a hospital inpatient episode for the first time over a period of 12 months (“baseline year”), whereby “adult” was defined as 18 years or older at the time of this index discharge, and “functional psychiatric disorder” as having a main ICD-10 diagnosis of F2 or F3 or F4 or F5 or F6, thereby excluding organic (F0), substance abuse (F1) and mental retardation as well as child/adolescent/developmental psychiatric disorders (F7 to F9). The 12 months period of collecting patients for the study cohort was based on the following considerations: the originally planned follow-up time of 18 months had to be reduced to 12 months after checking the availability of databases in each partner country, because the maximum time period of linked data available for some countries was only 24 months, allowing the collection of patients over a 12 months period (and not less in order to get sufficiently large study cohorts) and their individual follow-up over 12 months.

Following the problems with the lack of validity of the separation codes in the LEEARs which was discussed in Part 2, Ascertaining interoperability of national databases (FS2), the only method of identifying an index discharge as described above was to use record linkage methodology in the way that patients were only included if they did not begin a new hospital episode on the same day on which a previous hospital episode had ended. The implication of this approach was that “real” re-hospitalisations on the day of discharge were not identified (see chapter about re-hospitalisation measures below).

When selecting the study population, peculiarities of the hospital situation in different countries may have played a role. Military and forensic hospitals were generally excluded (with a special issue in Finland concerning “difficult to treat patients”, who are not forensic cases in the usual sense of the word; in Norway so-called “secure wards” exist both at a regional and a country level, but only regional wards could be identified and hence excluded from the study). In Italy a public and a private system of psychiatric inpatient care exist, which were analysed jointly, although substantial differences in the diagnostic composition of the respective patient populations were found. The results are mainly presented for the joint analyses, but differences between the private and the public system will be considered occasionally when discussing the Italian results below. In Norway, in addition to psychiatric hospitals and departments in general hospitals a substantial number of so-called district psychiatric centres (DPS) with a small number of beds are scattered around the country. In Finland municipal primary health care centres with general beds exist. These inpatient beds in Norway and Finland were included in the CEPHOS-LINK analyses.

For analysing continuity of care in addition to the usual baseline cohort a restricted study cohort was used. It was derived from the main study cohort in the following way: patients who were re-hospitalised between day 1 and day 6 were excluded, meaning that day 0 for studying the influence of psychiatric outpatient care was day 7 after the index discharge. This means that for one approach the continuity of care study a smaller cohort was used, whereby psychiatric outpatient contacts on the days 0-6, i.e. in the week preceding the new day zero, were identified as potential predictors for re-hospitalisation rates in the subsequent nine weeks.

The original intention to perform all studies for two principally different cohorts of patients, (a) for patients who had spent at least one night on a psychiatric bed during the index hospital episode and (b) for patients without such a psychiatric bed stay involved had to be dropped, since the percentage of patients belonging to (b) differed largely between countries and was generally rather small (which can be seen in the table below). Therefore, all patients in the study cohort were required to have spent at least one night on a psychiatric bed during the index hospital episode.

Table 1: Percentage of all inpatient episodes with an ICD-10 F2-F6 diagnosis from a hospital without an episode of care in a psychiatric bed in six European countries

	% of all episodes with an ICD-10 F2-F6 diagnosis discharged from a hospital without an episode of care in a psychiatric bed
Austria	29,5%
Finland	18,7%
Italy	13,6%[1]
Norway	4,8%
Romania	1,3%
Slovenia	21,0%

Patients who died during the follow-up period could not be identified in all countries (especially not in the two largest countries, Italy and Romania), and they are therefore included in all study cohorts. For those countries for which the death rate during the 12 months follow-up period was available, it was found that it was rather small (ranging from 1,38% to 2,60%). It is nevertheless not clear whether the inclusion of patients who have died influences the study results.

In a cohort study where patients are followed up over 12 months it can be expected that a certain proportion of these patients dies during the follow-up period, i.e. their time at risk for a re-hospitalisation is shorter than for those who have not died. There are three ways of handling this issue: (1) If the date of death is known one could reduce the time at risk accordingly, (2) if it is known that a person has died but the date is not known, one could exclude these patients from follow-up, and (3) if neither the fact nor the date of death are known one would have to include these patients in the follow-up study. The latter approach was used in this analysis. This implies that those who have died are included as if they had lived through the whole 12 months risk period for re-hospitalisation, thus reducing the re-hospitalisation rates in relation to the situation where the dead would have been taken care of more accurately. However, as the percentages of such patients who have died during follow-up are rather low, the chosen approach might not distort the results by much.

Table 2: Percentages of patients of the study cohorts in six European countries who died during the one year follow up period

	% of patients of study cohort who died during follow-up
Austria	2,60
Finland	2,40
Italy	Information not available
Norway	1,38
Romania	Information not available
Slovenia	2,31

[1] The percentage in Italy could be slightly underestimated as it is based on prefinal data.

1.3 Re-hospitalisation rates as outcome measures

The primary outcome measure was the re-hospitalisation rate (RHR, equivalent to percentage of re-hospitalisation) of at least one re-hospitalisation with at least one night on a psychiatric bed. This outcome measure is the one usually applied in psychiatric re-hospitalisation studies identified in the literature reviews (see document FS2). Where we report study results below it is abbreviated as PSY-REHOS. For the logistic regression analyses follow-up periods of a) 30 days and b) 365 days were used. Cumulative RHRs are also reported for follow-up periods of 60, 90 and 180 days, and in figures cumulative first re-hospitalisation rates are shown on a daily basis – which was a requirement for the Cox regression analyses anyhow. The variable used in the data set is "days to first psychiatric re-hospitalisation".

Given the fact that patients can also be hospitalised to a non-psychiatric hospital/department during the follow-up period, a second outcome measure was introduced, which captures re-hospitalisation to any type of hospital (including also psychiatric re-hospitalisaton). This outcome measure is abbreviated as ANY-REHOS where results are reported below for 30 and 365 days follow-up periods. A corresponding variable for the days to the first re-hospitalisation was used for showing cumulative RHR on a daily basis and for the Cox regression. It has to be stressed that during periods in which patients were hospitalised in a somatic hospital they are not at risk for admission to a psychiatric bed (unless inter-hospital transfers were counted which was beyond the scope of the present possibilities of analysis in this project).

1.4 Predictors of re-hospitalisation rates

Altogether eight predictor variables were selected as feasible for cross-country comparisons. They correspond, so to say, to the largest possible common denominator for the participating countries, being a compromise between their availability and interoperability across countries and their potential meaningfulness for predicting re-hospitalisation rates. Still, as will be seen below, some restrictions applied. Five predictors are so-called pre-discharge variables (patient-level demographic and clinical variables available at the time of the index discharge), two are contextual in the sense that they characterise the geographical region of a patient's place of residence. For analysing the influence of continuity of care post-discharge psychiatric outpatient contacts were included among the predictors. Unfortunately three variables of interest – previous hospitalisations, involuntary admission, and geographical proximity of the hospital inpatient service – could either not be identified at all or not in a reliable way and were not included in the regression analyses.

1.4.1 Patient-level demographic and clinical predictors

Five patient-level predictors were chosen on the basis of the results of the activities on ascertaining interoperability of national databases. They were available for the time of the index-discharge for each patient in the study cohort. Two are demographic and three clinical. The abbreviations will be used in the results section.

Demographic predictors

(1) Gender: FEM = female gender
(2) Age: AGEOLD = age is higher or equal to the median (within each country)

Age was dichotomised since a) the distribution of single years differs substantially between countries and b) single years would have provided only very small odds ratios in the regression analyses to be carried out.

Clinical predictors

(1) Length of stay: LOSALL_LONG = length of stay of the index episode is higher or equal to the median (within each country)
LOS was dichotomised since a) the distribution of single LOS differs substantially between countries and b) single LOS would have provided only very small odds ratios in the regression analyses to be carried out.
The ALL component in the acronym signifies that in the case of intra-hospital transfers between hospital departments/sections/wards with different specialties both days on psychiatric and non-psychiatric beds were summed up. Length of stay was only to be measured for the index episode in one and the same hospital and not for potentially occurring preceding hospital episodes in different hospitals, from which the patient had been transferred to the index episode hospital. For Finland and Norway it turned out that given the structure of the hospital organisation in these countries the above definition of length of stay could not be clearly followed. In these two countries hospitals are run by regional trusts (Norway) or hospital districts (Finland); in Finland hospitals are also run by municipalities and universities. Where regional trusts or hospital districts run hospitals it could not be ascertained that inter-hospital transfers and *intra*-hospital transfers within one and the same hospital trust or district could be reliably distinguished in the national databases. (This might have been possible at the level of the hospital trust databases, but these were not accessible in time). This lack of comparability of the Finnish and Norwegian length of stay variables had two consequences. First, the length of stay variable got different names for Finland and Norway (LOSALL_LONG_FI and LOSALL_LONG_NO); second, results involving the length of stay variable for Finland and Norway are reported in separate tables and figures to stress the problem of comparability with other countries.

(2) Psychotic diagnosis: PSO = main diagnosis at the index discharge was
ICD-10 F2 (schizophrenia) or F30 (manic episode) or F31 (bipolar disorder)
The rest of the main diagnoses required for the inclusion into the study cohort can be characterised as "non-psychotic" and comprise F32-F39 (depression), F4 (neurotic, stress-related and somatoform disorders), F5 (behavioural syndromes associated with physiological disturbances and physical factors) and F6 (disorders of adult personality and behaviour).

(3) Physical comorbidity: PHY_COM = at least one physical comorbidity diagnosis defined as at least one of the following ICD-10 diagnoses was coded at the index discharge as an additional/secondary diagnosis A or B or C or D or E or (G00-G26) or (G35-G99) or H or I or J or K or L or M or N or (O00-O29) or (O95-O99) or S or T or (X60-Y34) or (Y40-Y98) (for details see Table 4 in Section 2: Study cohorts).
Patients with a physical comorbidity were defined as having at least one additional ICD-10 physical diagnosis in the national databases. The single ICD-10 categories selected are shown in Table 4 of Section 2 (study cohorts). The rationale for the selection of ICD-10 categories was to include only "real" physical comorbidities and therefore excluding diagnoses, which do not represent a physical status which can be considered as comorbid as well as diagnoses which do not necessarily refer to physical comorbidity in terms of physical disease/disorders, e.g. excluding categories V01–X59 which are used for coding accidents.

1.4.2 Contextual predictors

In addition to the five patient-level predictors, two so-called contextual predictors where chosen, in order to find out whether, in a multilevel approach of data analysis, factors beyond the individual patient-level could play a role for predicting re-hospitalisation rates. As was the case for the patient-level predictors, also here compromises had to be made between desirability and the availability of appropriate data. Originally two types of contextual variables were considered, on the one hand variables characterising the geographical region of the patients' place of residence and on the other aspects of the health care organisation and system.

The intention of including specific aggregate hospital data (e.g. average length of stay in a hospital) as contextual covariate had to be dropped, since single hospitals could not be identified in a similar way across countries. Also, system variables characterising the health care system of a country (such as "tax-based" or "insurance-based", or financial incentives in provider payment mechanisms) would have been of interest. However, given that only six countries took part in the project, the variation of these system variables is too small for meaningful analyses to be performed. Also, such variables would correlate heavily with other country variables, and it would thus be hard to say whether any observed effects were due to the specific variable or other country specific factors. In Part 2 (Ascertaining interoperability of national databases) of the final scientific report of CEPHOS-LINK a description of the different health care systems of the partner countries is provided, which might be used to put some of the empirical findings obtained by the regression analyses into perspective.

The decision was made to include two variables characterising the context of the patients' home address on a NUTS 3 level, degree of urbanicity and Gross Domestic Product (GDP), not the least because these were available for all countries in the EUROSTAT database (Urban-rural typology: http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology_update; GDP: http://ec.europa.eu/eurostat/web/regions/data/database). Information on a smaller scale level (e.g. municipalities) would have been desirable, but joint analyses were not possible due to missing information identifying municipality in the patient-level data in several countries.

(4) Urbanicity: Three urban-rural categories (predominantly urban PU, intermediate IN, PR predominantly rural) were collapsed to two variants:
URBAN = PU (vs. rest),
RURAL = PR (vs. rest)

(5) Per capita GDP, measured in 1.000 Purchasing Power Standard (PPS)

In some countries not all patients could be allocated to a NUTS 3 region, and these patients had to be omitted from the respective study cohorts for analysing the influences of the contextual variables (for details see section 2 on study cohorts).

1.4.3 Post-discharge psychiatric outpatient contacts as continuity of care predictor

Seamless transition from hospital to community care is regarded as a main factor for increasing the quality of care of psychiatric patients who have been hospitalised. If such community psychiatric contacts are contained in linkable health care databases, their potential effect on re-hospitalisation rates can be studied.

In modern health care systems four types of psychiatric outpatient (in the sense of contrary to inpatient care) contacts can be distinguished. Ambulatory visits to a psychiatrist or a psychiatric community team, psychiatric day care, and mobile visits of psychiatric services seeing the patients at home or in other places. The fourth possibility is contact by telephone, email and social media. While the latter are usually not contained in health care databases the face to face psychiatric outpatient contacts usually are. It was attempted to identify

(6) Psychiatric Outpatient Contacts (POC): ANYPOC = any type of psychiatric outpatient care (AC_POC ambulatory care, DC_POC day care, MC_POC mobile care). For this predictor the exact number of days until the first ANYPOC was required, the respective variable was called ANY_POC_1DATE.

Only Austria and the Veneto Region fulfilled this requirement (for Finland and Norway information on POC was available but analyses could not be performed in the agreed timeframe). Only for Veneto all types of psychiatric outpatient contacts (ambulatory, day, mobile) were available and given the public sectorised community psychiatric system in Italy, these recordings are complete in the Veneto LEEAR. In contrast, the Austrian health care system is fragmented, with single handed psychiatrists in offices (with or without a contract with health insurance institutions; only psychiatrists with health insurance contracts are in the LEEAR), tax funded psychosocial services (all types of POC, but they are not in the LEEAR), and day-hospital contacts, which in turn, are contained in the LEEAR.

1.5 Regression analyses

1. **Single level ("standard") multiple logistic and Cox regression analyses for five patient-level demographic and clinical predictors of re-hospitalisation rates**

The key task in the CEPHOS-LINK project is to identify and compare the re-hospitalisation outcome of patients discharged with a primary psychiatric diagnosis (ICD-10: F2-F6) from a psychiatric hospital or department in the six partner countries. The main outcome in this case is hence defined as the *"occurrence of the event"*, i.e. whether a re-hospitalisation occurred within the defined follow-up period. For such dichotomous outcomes, a logistic regression is commonly applied. Alternatively, outcome can be defined in terms of first re-hospitalisation as *"time to the event"* (e.g. measured in days). For such *"survival analyses"* Cox regressions are a common method. In the CEPHOS-LINK project multiple logistic regressions were used to model the effects of the predictor variables on the outcome "at least one psychiatric re-hospitalisation (PSY-REHOS)" for observation periods of 30 and 365 days. Additional analyses were carried out with multivariate Cox regression for 365 days follow-up with the variable "time to first re-hospitalisation for PSY-REHOS". Comparable analyses were carried out for the outcome "any type of re-hospitalisation (ANY-REHOS)". The five patient-level predictors were all dichotomous yes/no variables. In the results section (3) the odds ratios (logistic regression) and the hazard ratios (Cox regression) are reported. Additionally, the lower (2,5%) and upper (97,5%) boundaries of the 95% confidence interval of the odds and hazard ratio, and the p-value are shown. No corrections were applied for multiple testing. Also, here and in the subsequent analyses not interaction terms were considered, since the Pilot Study, in which interaction terms were used showed mostly no additional effect and were difficult to interpret.

2. Multilevel multiple logistic regression for two contextual predictors and five patient-level predictors for re-hospitalisation rates

Here seven predictor variables are used for the same outcomes as used above, the five demographic and clinical predictors and two contextual predictors, the degree of urbanicity and the per capita GDP of the NUTS 3 region of a patient's residence. The introduction of contextual-level variables gives rise to the issue that the analysed data is drawn from different populations. In the following analyses patients are clustered using geographical characteristics, i.e. the NUTS 3 region in which the patient resides. It is not improbable that there is inter-cluster heterogeneity of the variance of the standard-errors. Moreover, the existence of a random intercept is also possible. These issues were tackled in the CEPHOS-LINK study by carrying out three types of regression analyses and comparing the different results:

a) standard logistic regression
b) clustered logistic regression at the NUTS 3 level using heteroscedasticity robust standard errors
c) random effects logistic regression.

To clarify, the term *random effects* refers here to a model form with random intercept and fixed slope(s). That is, all covariates used in the model are considered as *fixed effects*, with the exception of the NUTS 3 regions. This random effect of the NUTS 3 regions is captured by the inclusion of a random intercept. The two group variables that are included are urbanicity and per-capita GDP, grouped at the NUTS 3 level. The regression analyses are carried out in two variants. First, the influence of residency in an urban region (PU) is tested against non-urban regions (IN + PR). Then, the influence of residency in a rural region (PR) is tested against non-rural regions (IN + PU).

Disregarding information on which NUTS 3 region a patient resides in would be equivalent to assuming independence of individuals within certain NUTS 3 regions. That is, no new information from observations of a given cluster is deduced with respect to other observations of the same cluster. This can lead to biased standard errors. In particular, standard errors are usually underestimated which would lead to invalid inference on the results, as p-values would too often indicate significance of coefficients. Moreover, if variables are not equally distributed across clusters, the estimates of the coefficients themselves might be biased due to the association caused by the violation of the exogeneity assumption on the regressors.

Two approaches could be tested to circumvent this issue. First, cluster-robust standard errors can be used to relax the assumption of within-cluster independence – allowing arbitrary and heterogeneous correlation within each cluster – typically resulting in an increase of the error term (as both within- and between-cluster variance are included in the error term). However, as the method gains precision with increasing cluster size, it might not be optimal in the context of the local studies, as the number of NUTS 3 regions per country is in most cases comparatively small. Moreover, as only standard errors but not estimates of the coefficients differ from the standard logistic regression, the issue of potentially biased coefficient estimates is not solved.

This issue is addressed by introducing a random effects model with a random intercept (and fixed slope) which allows for cluster-level unobserved heterogeneity at the estimation stage, reducing the individual error. The model assumes a specific functional form, requiring intra-cluster correlation to be equal across clusters, normal distribution of the random effect and no correlation between the cluster-specific error and the observed covariates. If all assumptions hold, the random effect model is more efficient than all other unbiased estimators. However, in case the assumptions do not hold, the estimates are generally biased. For the random effects model, too, a small number of clusters can cause estimation problems, i.e. the model fails to converge. Finally, only the random effects logistic regressions with a random intercept and fixed slope are reported in the results section. No corrections were applied for multiple testing.

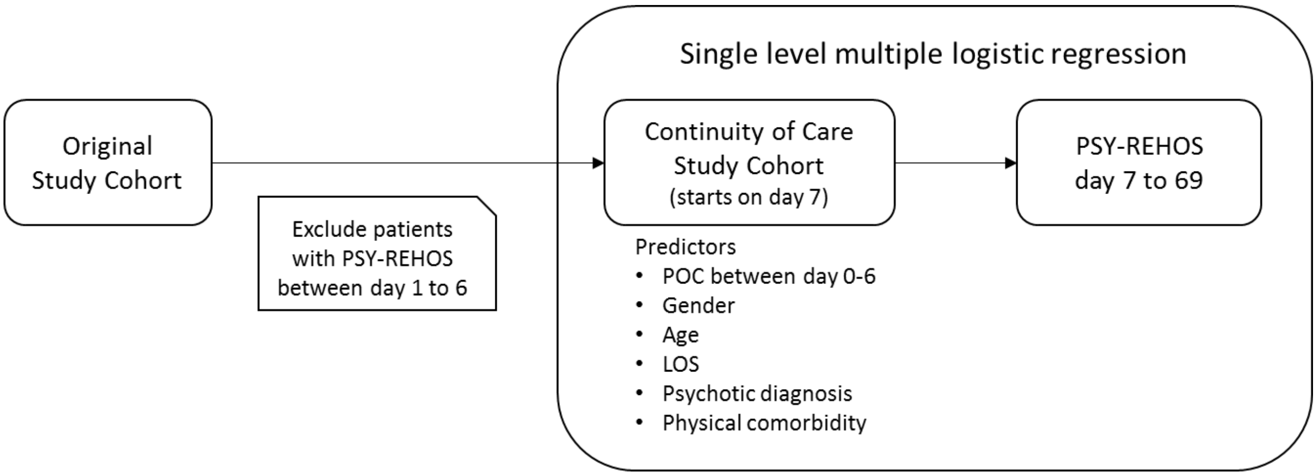
3. **Single level ("standard") multiple logistic regression for the continuity of care variable and five patient-level predictors**

In order to find out whether continuity of care (defined by the first psychiatric outpatient contact after the index discharge) was a predictor of re-hospitalisation, two approaches were used. In addition to a "correlational approach" (iuxtapositon of rates of cumulative first psychiatric outpatient contacts and of rates of first psychiatric re-hospitalisations) in a narrow (weekly) time grid, a specific "pre-post" approach was chosen.

In this "pre-post" approach all patients who had a psychiatric re-hospitalisation between day 1 and day 6 after the index discharge were excluded, i.e., the study cohort used for the continuity of care regression analyses started with a cohort of those who had not had a psychiatric re-hospitalisation before day 7. This study cohort is therefore smaller than the one used for patient-level and contextual predictors.

For this continuity of care cohort the first psychiatric outpatient contacts before the start of the follow-up period (i.e. psychiatric outpatient contacts between day 0 and day 6 after the index discharge) were identified and introduced as predictor variable in addition to the five patient-level predictors previously used). Single level multiple logistic regression analyses were carried out for days 7 to 69 (i.e.nine weeks, corresponding to a follow-up period between day 0 and day 63 of the continuity of care study cohort) for the outcome of psychiatric re-hospitalisation (PSY-REHOS). No corrections were applied for multiple testing.

Figure 4: Derivation of the continuity of care study cohort for the single level multiple logistic regression



2 Description of the study cohorts

In this section the study cohorts derived in each of the six partner countries by following the study protocol are described. It has to be noted that the size of these study cohorts not only differs substantially between countries (mainly, but not only, due to the large differences in population size), but that the numbers may also decrease within a country when proceeding from using as predictors for the basic regression analyses demographic (age, gender) and clinical (length of stay, psychotic diagnosis, physical comorbidity diagnosis) variables to the next step of including contextual variables (NUTS 3 urbanicity and Gross Domestic Product per capita) of a patient's place of residence. In the latter case for some countries smaller cohorts have resulted due to the lack of information in the national databases on allocating some patients to specific NUTS 3 regions. The study cohorts for studying the effect of post-discharge psychiatric outpatient contacts on re-hospitalisation were available for only one whole country (Austria). For Italy it was at least possible to study this issue in the database of a sub-region, the Veneto Region.

2.1 Absolute numbers and population rates of the baseline study cohorts

In Table 3 the study cohorts as identified for the six European CEPHOS-LINK partner countries are shown alongside the population figures and the resulting rates for 1.000 of the 18+ population.

Table 3: The general population 18+ years and the study cohorts in the study baseline year

Country/region (baseline year)	Population 18+	Psychiatric beds[1] (per 1.000 population)	Study cohorts		
			Absolut	‰ of Population 18+	% who died during Follow-up
Austria (2006)	6.667.764	0,61	21.839	3,28	2,60
Finland (2012)	4.333.723	0,69	16.814	3,88	2,40
Italy (2012)	49.396.435	0,10	63.419	1,28	Not known
Norway (2012)	3.898.012	1,21[2]	17.158	4,40	1,38
Romania (2012)	16.254.443	0,82	101.834	6,26	Not known
Slovenia (2013)	1.702.827	0,66	4.536	2,66	2,31
All countries	82.253.204		225.600	2,74	Not known

1) Data sources for the baseline year: Austria, Finland, Italy, Norway, Slovenia: OECD, Health at a Glance 2014; Romania: ECHI
2) corrected value from Statistics Norway: 1,04
https://www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=speshelse&CMSSubjectArea=helse&checked=true

There are very large differences concerning the population at risk, i.e. the general population aged 18+, varying between 1,7 million in Slovenia and nearly 50 million in Italy. These differences are only to some extent reflected in the study cohort numbers, which vary between 4.536 in Slovenia and 101.834 in Romania. The rate of the patients per 1.000 of the population at risk also varies widely – between 1,28 in Italy and 6,26 in Romania, reflecting the higher and lower number of hospital episodes in different countries/regions (Table 3). As was discussed in the methods patients who have died during follow-up could not be identified in some countries. Therefore, such patients were not excluded for the study cohorts.

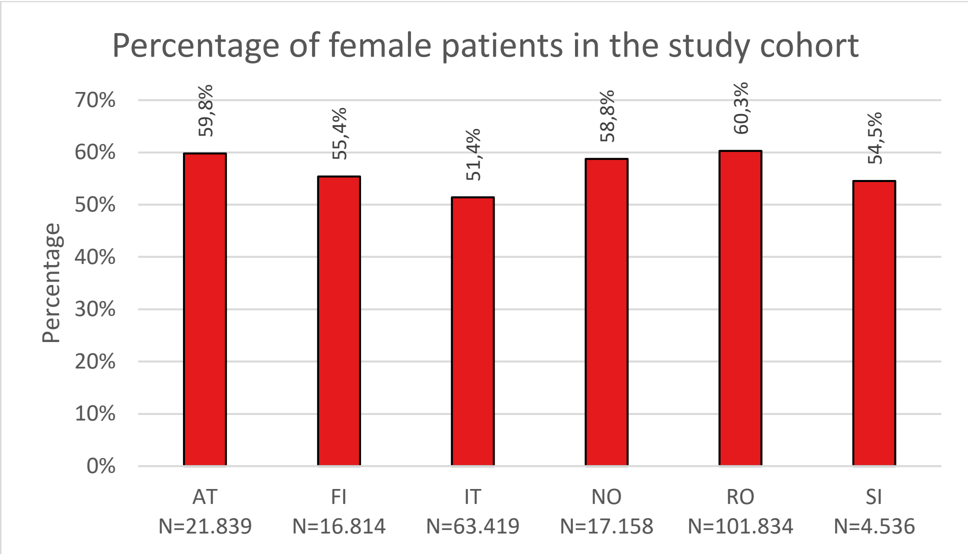
2.2 Demographic and clinical variables at the time of the index discharge (Objective 1)

Five pre-discharge variables were chosen for the purpose of capturing demographic and clinical aspects of the study cohort: gender, age, length of stay of the index hospital episode, psychotic diagnosis and physical comorbidity as measured by at least one additional physical diagnosis at the index discharge.

2.2.1 Gender

All study cohorts (Figure 5) contain more female than male patients, with the widest gender gap in Austria, Norway and Romania (female to male ratio is around 3 to 2). In Italy the percentages of female and male patients are nearly equal (51% women, 49% men).

Figure 5: Percentage of female patients



2.2.2 Age

One finding of the exploratory pilot study was that not only the median but also the shapes of distributions of age were markedly different. The decision was therefore made that a variable AGEOLD was defined as comprising all patients with age equal to the median value or older to be used as a predictor variable for the regression analyses.

Figure 6 shows that the median age varies substantially between countries and ranges between 42 years in Norway and 52 years in Romania. Women are consistently older than men (Figure 7).

Figure 6: Median age of patients

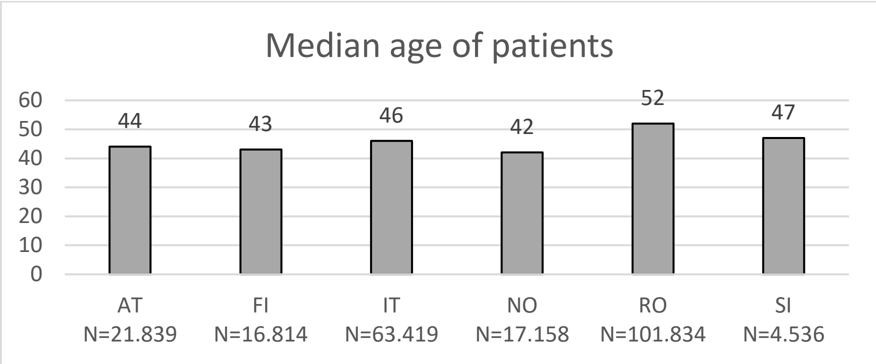
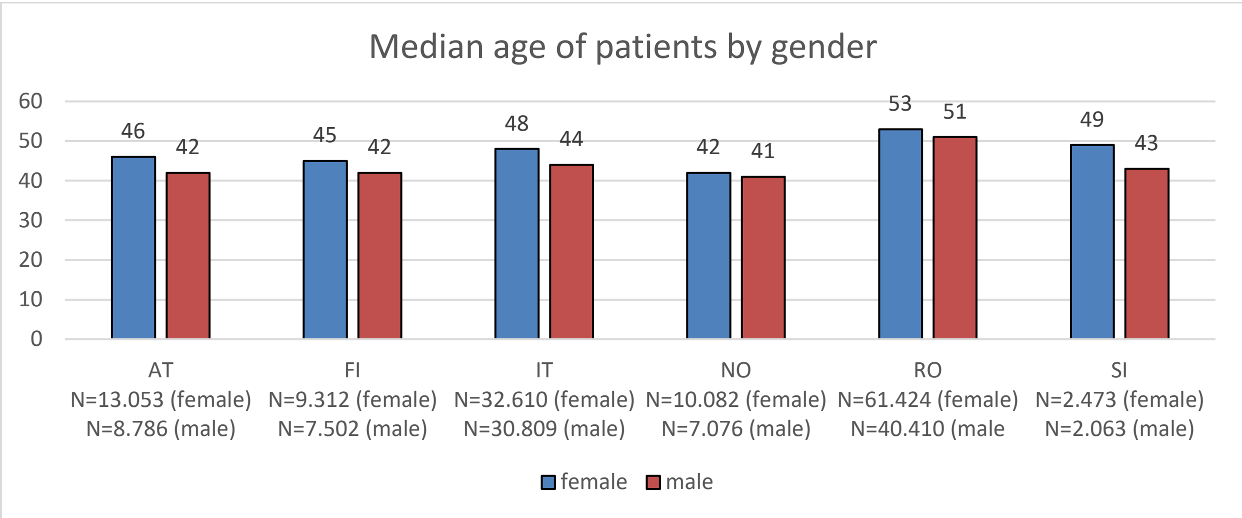


Figure 7: Median age of patients by gender



2.2.3 Length of stay

Length of stay was calculated in four countries (Austria, Italy, Romania and Slovenia) for the index episode only ("at least one night on a psychiatric bed") as the sum of days on any type of hospital bed in one and the same hospital during the index episode before the first discharge date. Inter-hospital transfers were not considered. As reported in the document FS2 (Part 2, Ascertaining interoperability of national databases), it was not possible in Finland and Norway to calculate the length of stay in the same way as it was calculated in the other countries, since in Norway and Finland no clear difference could be made in the databases between intra- and inter-hospital transfers, because it was not possible to identify hospitals in a comparable way. Therefore, the complete uninterrupted length of stay in any type of inpatient care was calculated for Finland and Norway, and calculations with length of stay were regarded as not comparable between Austria, Italy, Romania and Slovenia on the one hand, and Finland and Norway on the other. The variable used for the regression analysis was length of stay equal to or above median vs. the rest (LOSALL_LONG).

Figure 8: Median LOS calculated for the index episode (only the last episode before the index discharge) for AT, IT, RO and SI

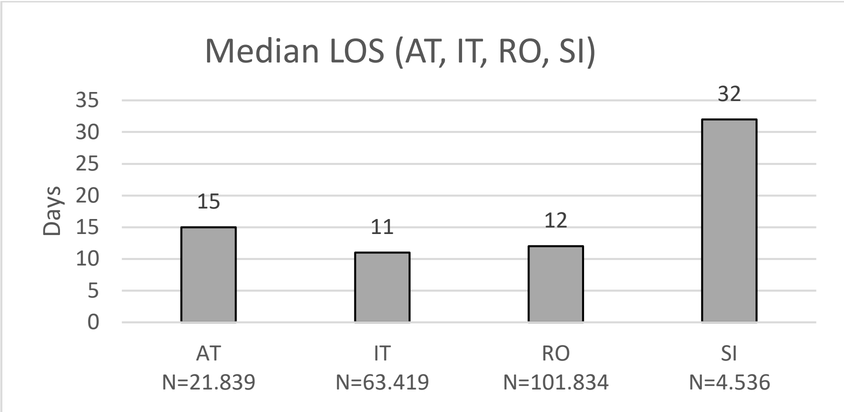


Figure 8 shows that among the southern countries Slovenia is an outlier with more than double the length of stay (32 days) than the other countries (11, 12 and 15 days). This difference may be related to the payment mechanism of psychiatric hospital stays in Slovenia, where with a given number of psychiatric beds the payment contract with the social health insurance requires a specific number of patients to be admitted over a one year period. In Figure 9 a small difference in the length of stay is shown between men and women for all countries except Romania (where the median values for the two gender-groups coincide), with the median for women being 1 or 2 days higher than that for men. Figure 10 shows the respective figures separately for Finland and Norway, for which LOS was differently defined.

Figure 9: Median LOS calculated for the index episode (only the last episode before the index discharge) by gender for AT, IT, RO and SI

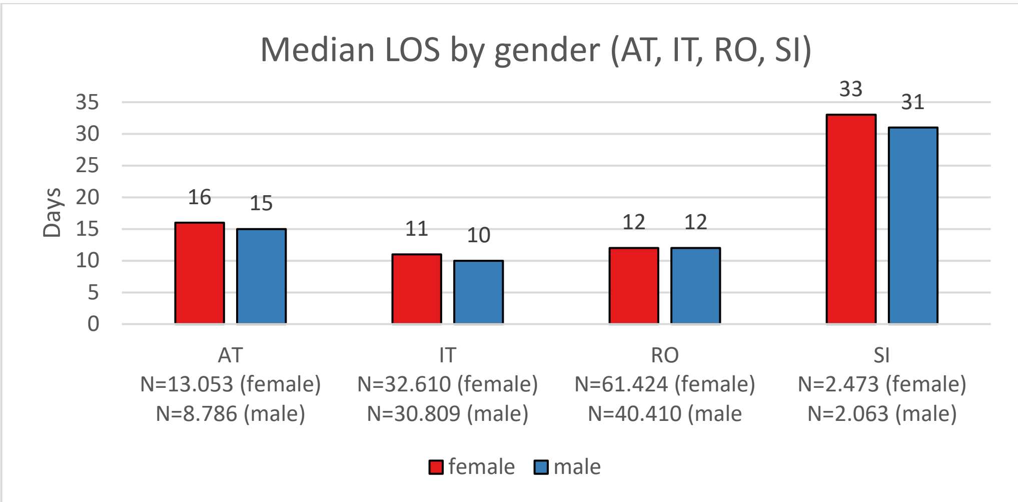
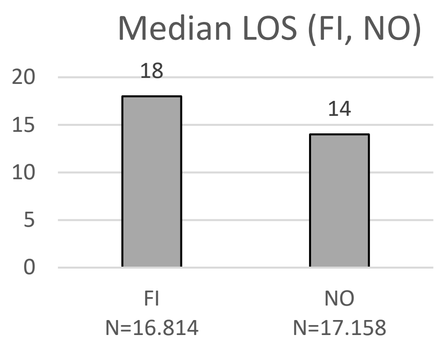
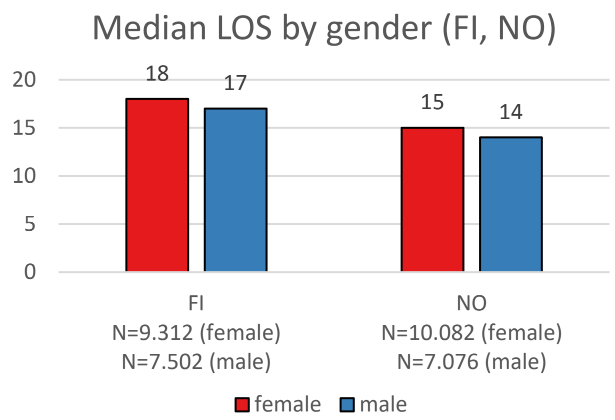


Figure 10: Median LOS (total and by gender) calculated for all consecutive connected episodes before the index discharge for FI and NO, total (left) and by gender (right)



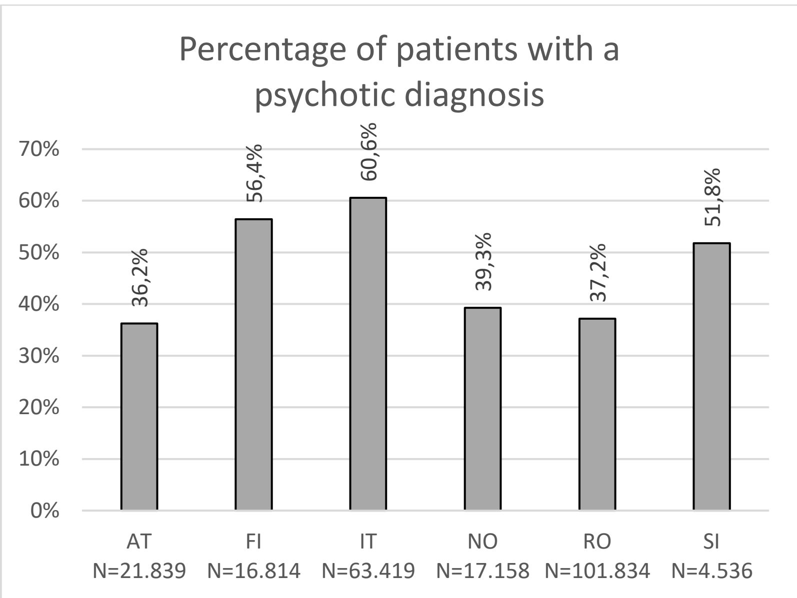


2.2.4 Main psychiatric diagnosis

Psychotic diagnosis

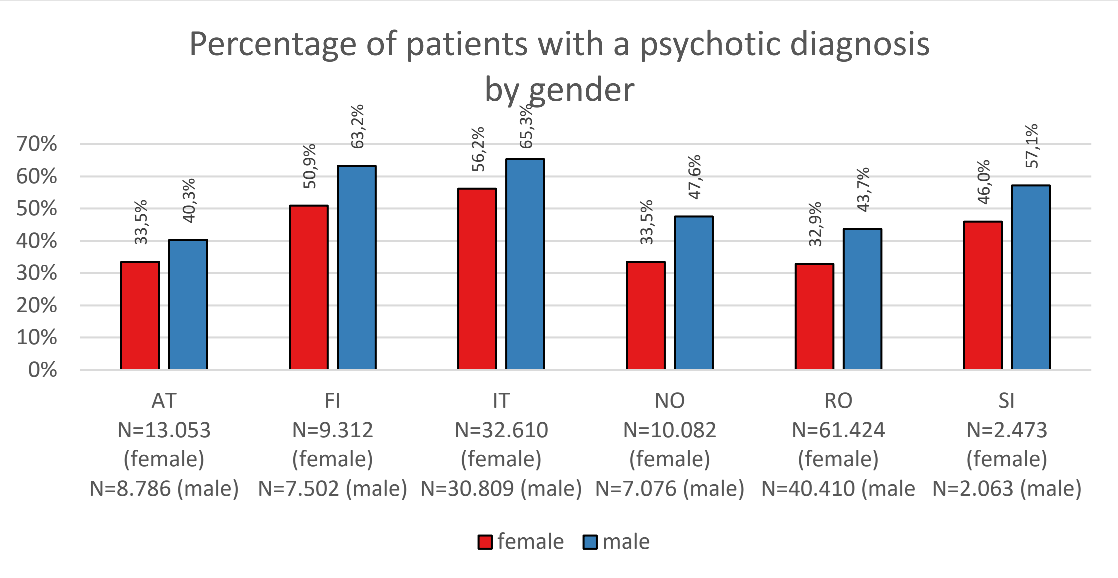
The so-called functional mental disorders used for defining the study cohort comprise the ICD-10 groups F2-F6. From the total group of F diagnoses were therefore excluded the groups F0 (organic brain disorders, including dementia), F1 (substance abuse disorders) and F7-F9 (psychiatric disorders related to children), since they have separate service systems in several countries. The remaining categories were subdivided into two groups of main diagnoses out of clinical considerations – a "psychotic" group comprising F2 (schizophrenia) and F3.0 and F3.1 (bipolar disorder, previously called "manic-depressive illness"), and the rest ("non-psychotic" disorders, which could be approximately called "neurotic and personality disorders"). The variable used for the regression analyses was whether a patient had a psychotic diagnosis or not.

Figure 11: Percentage of patients with a diagnosis psychotic at discharge



In Austria, Norway and Romania non-psychotic diagnoses clearly prevail with more than 60%. In contrast, in Italy and Finland psychotic diagnoses are clearly more frequent. In Slovenia the shares of these two diagnostic groups are nearly equal (Figure 11). In all countries the proportion of psychotic patients is substantially higher in men than in women (Figure 12).

Figure 12: Percentage of patients with diagnosis psychotic by gender



Details for selected single main ICD-F diagnoses

Figure 13: Percentage of patients with diagnosis F2, F30/F31, F32-F39, F4, F5, F6

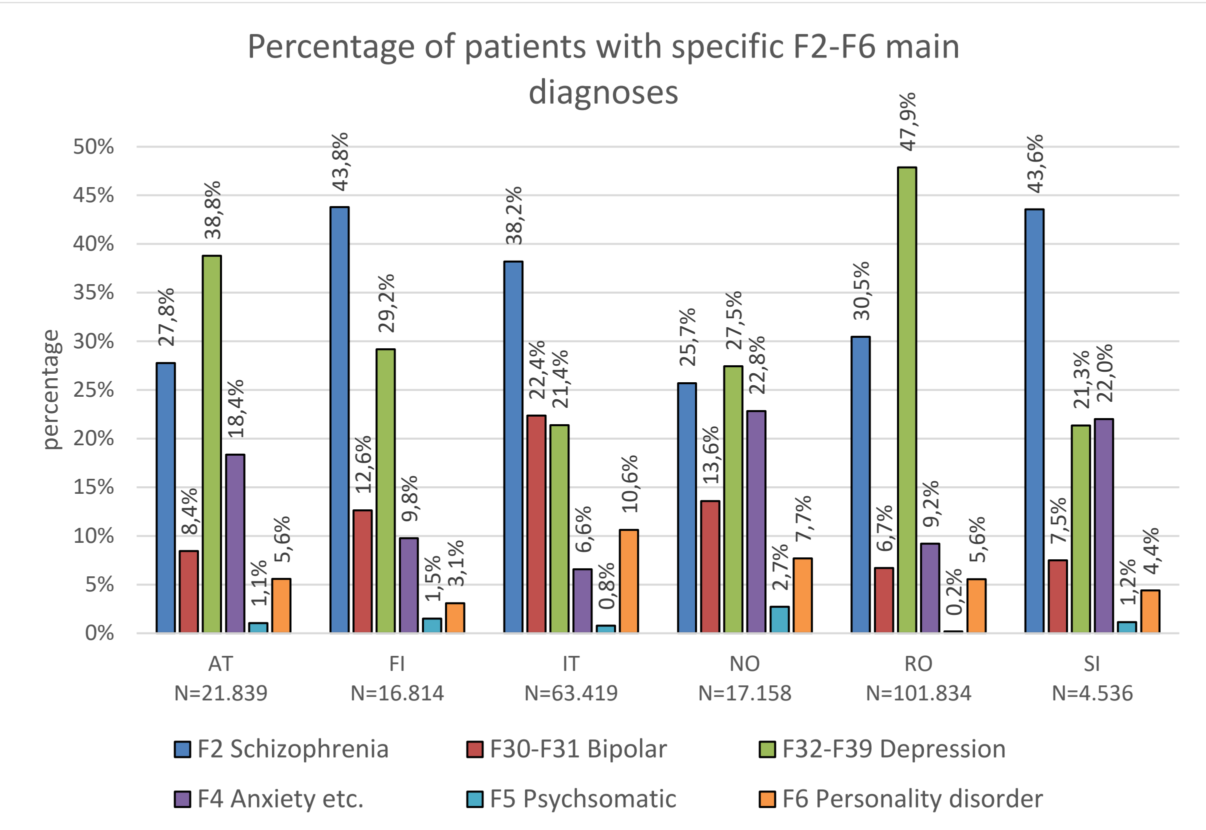
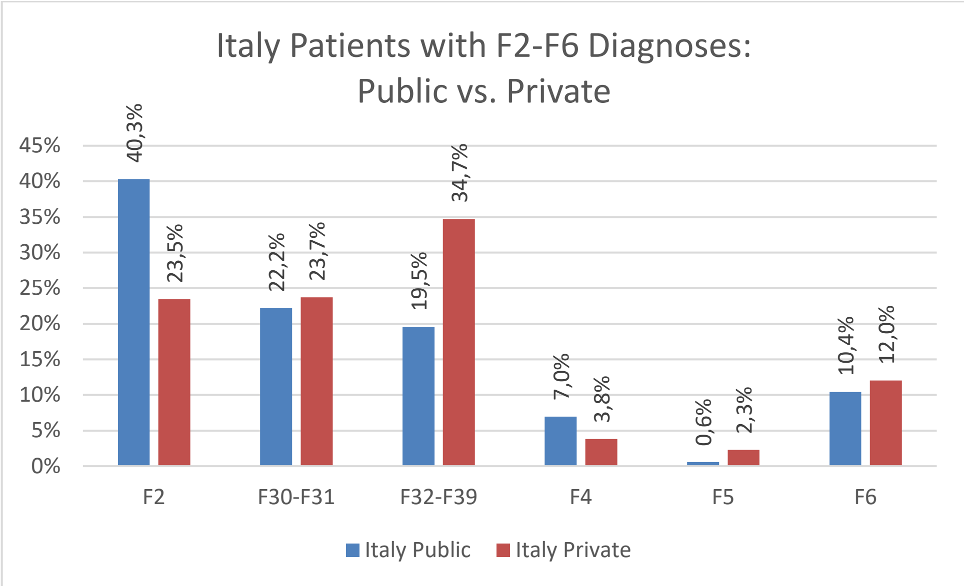


Figure 13 shows the spectrum of detailed diagnostic ICD-10 F categories for each country. Roughly three types of spectra can be distinguished if the most frequent diagnosis is taken as a lead. In two countries, Austria and Romania, depression is by far the most frequent diagnosis; in Finland, Italy and Slovenia schizophrenia dominates. In Norway these two diagnoses have nearly similar frequencies.

For Italy the values presented in Figure 13 are composed from including both public and private hospitals. Figure 14 shows the diagnostic frequencies separately for these two groups of hospitals demonstrating that the diagnostic spectra are quite different, with schizophrenia dominating in public hospitals (40,3% public vs. 23,5% private) and depression in private ones (19,5% public vs. 34,7% private). One of the potential reasons for the difference is the payment system with its incentive structure for depression and personality disorders in private hospitals.

Figure 14: Percentage of patients with main diagnosis F2, F30/F31, F32-F39, F4, F5, F6 separately for public and private hospitals in Italy



2.2.5 Physical Comorbidity

In Table 4 the frequencies of all single additional physical ICD-10 categories selected for inclusion in the physical comorbidity variable are presented (if at least one of these was present, physical comorbidity = yes). Despite large differences across countries in the percentages of patients with at least one of these physical comorbidity diagnoses in all countries two diagnostic groups dominate the spectrum of comorbidity diagnoses – endocrine, nutritional and metabolic diseases (ICD-10 E, which includes diabetes) and diseases of the circulatory system (ICD-10 I) as can be seen in the highlighted lines in Table 4.

Table 4: Physical comorbidity by ICD-10 categories

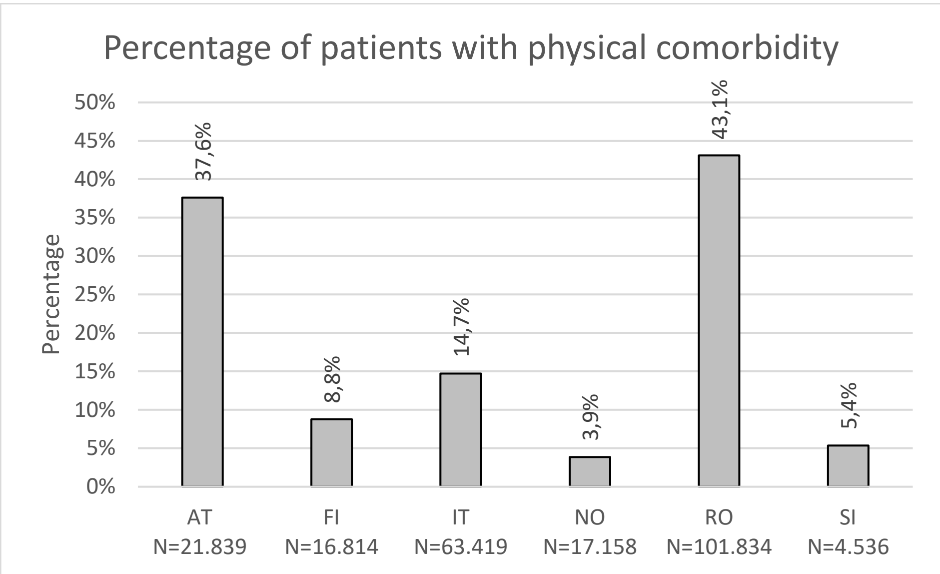
Patients with at lease one additional diagnosis in the ICD-10 groups below		Austria N=21.839	Finland N=16.814	Italy N=63.419	Norway N=17.158	Romania N=101.834	Slovenia N=4.536
A (infect)		0,43%	0,07%	0,08%	0,03%	0,30%	0,02%
B (infect)		1,81%	0,61%	0,68%	0,13%	1,74%	0,09%
C (neopl)		0,88%	0,33%	0,19%	0,09%	0,37%	0,11%
D (blood)		2,34%	0,24%	0,89%	0,19%	2,37%	0,37%
E (endocr)		17,68%	2,75%	5,34%	1,10%	18,26%	2,18%
G (nervous)[1]		6,80%	1,97%	1,57%	0,69%	4,98%	0,55%
H (eye/ear)		4,91%	0,33%	0,33%	0,14%	2,75%	0,29%
I (circul)		17,83%	2,46%	4,58%	0,72%	20,67%	1,81%
J (respir)		4,42%	0,86%	1,01%	0,36%	4,06%	0,29%
K (digest)		6,83%	0,45%	1,33%	0,21%	9,48%	0,51%
L (skin)		2,98%	0,14%	0,42%	0,10%	0,68%	0,18%
M (mus/skel)		7,34%	1,35%	0,61%	0,29%	9,30%	0,55%
N (uro)		0,00%	0,28%	0,99%	0,29%	3,45%	0,53%
O (pregn)[2]		0,09%	0,04%	0,04%	0,03%	0,02%	0,02%
S (injury)		1,97%	0,22%	0,79%	0,12%	0,57%	0,18%
T (injury)		2,75%	0,23%	1,17%	0,13%	0,59%	0,09%
V, X, Y (extern)[3]		0,00%	0,00%	0,00%	0,42%	1,36%	0,06%
Total number of diagnoses		17.268	2.071	12.696	864	107.379	355
Patients with at least one diagnosis	absolute	8.206	1.477	9.349	663	43.901	243
	% of all	37,62%	8,78%	14,74%	3,86%	43,11%	5,36%
Average number of additional diagnoses per patient		2,10	1,40	1,36	1,30	2,45	1,46

1) without Alzheimer, etc. (G30-G32)

2) without delivery and puerperium related issues (O30-O94)

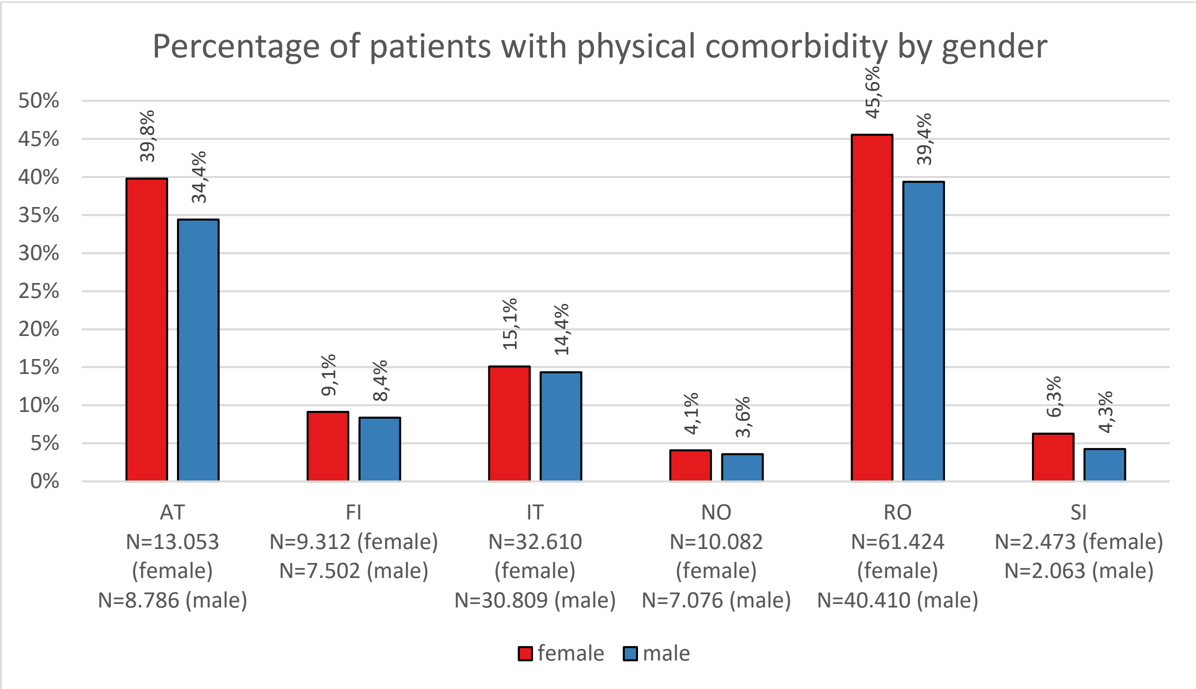
3) without accidents (V01-X59) and injuries due to legal interventions or operations of war (Y35-Y36)

Figure 15: Percentage of patients with physical comorbidity



The proportion of patients with at least one physical comorbidity diagnosis in the study cohort varies more than tenfold between countries, ranging from 3,86% (663 patients) in Norway to 43,11% (43.901) in Romania (Figure 15). The reasons for these large differences are unknown. They could consist in differences in recording practices on the country or hospital level, different organisational and payment arrangements of psychiatric vs. somatic care, but they might also be "real", which seems rather improbable. When looking into gender differences (Figure 16), women have consistently higher rates of physical comorbidity than men. This difference is more pronounced in Austria, Slovenia and Romania than in Finland, Norway and Italy.

Figure 16: Percentage of patients with physical comorbidity by gender



2.2.6 Overview of patient-level variables

In Table 5 an overview is given on the characteristics of the study population using the five variables chosen as predictors for the first round of regression analyses (concept 1), which do not consider contextual variables.

Table 5: Summary of description of study cohorts by demographic and clinical predictor variables

	N	Demographic variables		Clinical variables		
		% Female	Median age	Median LOS[2]	% Psychotic diagnosis	% Physical comorbidity
Austria	21.839	59,80%	44	15	36,22%	37,62%
Finland	16.814	55,38%	43	18	56,41%	8,78%
Italy	63.419	51,42%	46	11	60,60%	14,74%
Norway	17.158	58,78%	42	14	39,30%	3,86%
Romania	101.834	60,32%	52	12	37,17%	43,12%
Slovenia	4.536	54,52%	47	32	51,80%	5,36%

[2] For Austria, Italy, Romania and Slovenia the LOS refers to the index episode. For Finland and Norway the LOS refers to all consecutive connected episodes before the index discharge (for details see 1 Methods above).

2.3 Geographical/contextual variables (Objective 1)

By way of example and as a compromise two geographical/contextual variables which were available to a large extent for all partner countries were selected on the level of NUTS 3 regions. Municipality level data would have been more useful, but were not available for all countries.

(1) The degree of urbanicity of the place of residence of patients in the original study cohort on the level of the NUTS 3 regions, measured in three categories: predominantly urban (PU), intermediate (IN), and predominantly rural (PU)

(2) The Gross Domestic Product measured in Purchasing Power Standard per inhabitant for the NUTS 3 region in which a patient of the study cohort was resident.

Since the place of residence could not be unequivocally identified for all patients the study cohort for the regression analyses carried out with the geographical/contextual variables is somewhat smaller in some countries than the full study cohort described above. In Table 6 the differences and the new study cohorts are shown. Austria has the largest number of missing cases (1.235 = 5,7% of the original study cohort. All the other countries had smaller reductions, with Romania having no missing cases at all.

Table 6: CEPHOS-LINK study cohorts without and with system variables, absolute numbers and rate per 1.000 population

Country and baseline year	Study cohort without system variables		Patients with missing NUTS 3 allocation	Study cohort with system variables		Number of NUTS 3 regions
	absolute	‰ Pop	absolute	absolute	‰ Pop	
Austria (2006)	21.839	3,28	1.235	20.604	3,09	35
Finland (2012)	16.814	3,88	134	16.680	3,85	19
Italy (2012)	63.419	1,28	1	63.418	1,28	110
Norway (2012)	17.158	4,40	11	17.147	4,40	19
Romania (2012)	101.834	6,26	0	101.834	6,26	42
Slovenia (2013)	4.536	2,66	39	4.497	2,64	12
All countries	225.600		1.420	224.180		237

All together 237 NUTS 3 regions exist in the six partner countries (Table 6), whereby the number for each country is roughly correlated with the population size of each country. Both the classifications of the degree of urbanicity of single NUTS 3 regions and the GDP values were taken from EUROSTAT database. Urban-rural typology: http://ec.europa.eu/eurostat/statistics-explained/index.php/Urban-rural_typology_update; GDP: http://ec.europa.eu/eurostat/web/regions/data/database

2.3.1 Urbanicity

Figure 17: Urbanicity of patients in the study cohort in the six European countries

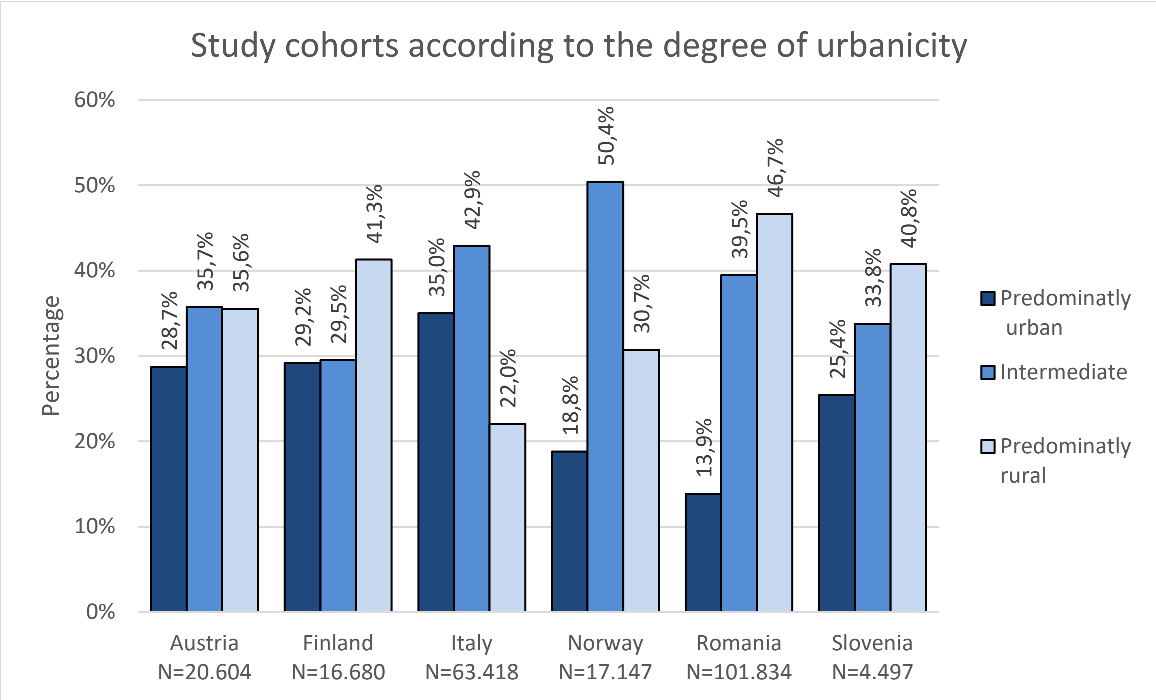


Figure 17 shows for each country the percentage of patients of the study cohort with residence in predominantly urban, intermediate and predominantly rural NUTS 3 regions. The intermediate category has substantial numbers, especially in Norway, where this category includes more than 50% of the study cohort. The large size of the intermediate category is a consequence of having had to choose the rather large NUTS 3 regions.

2.3.2 Per capita Gross Domestic Product (GDP)

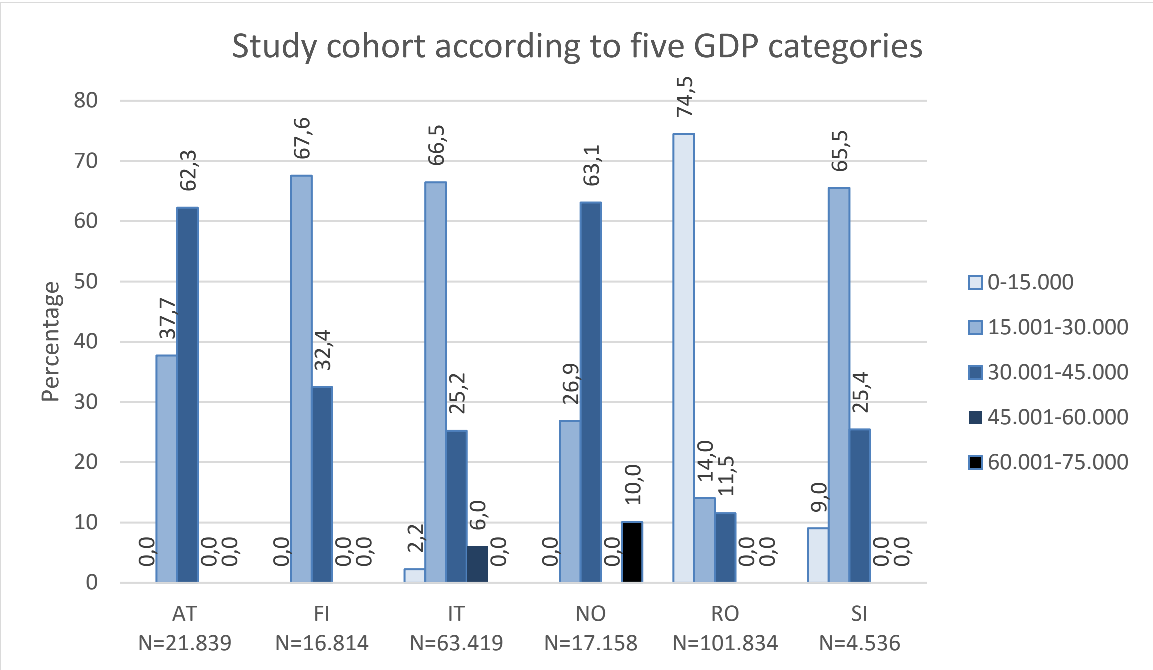
Per capita GDP per NUTS 3 region (measured in Purchasing Power Standard, PPS, to facilitate cross-country comparisons) differs substantially between the CEPHOS-LINK partner countries. As expected somewhat of a north-south divide can be observed. Norway is the wealthiest country with a median GDP per capita of 34.800 PPS, more than three times higher than the lowest median GDP per capita in the sample in Romania. Table 7 summarises mean and median per capita GDP of the study cohort. For the purpose of the regression analysis, the variable values were expressed as thousand PPS to allow for meaningful interpretation. In the regression analyses, effects are presented for one-unit changes in the predictor variables. Expressed as thousand PPS, one unit corresponds to one thousand PPS. Conversely, without transformation to thousand PPS, the reported effects would only reflect a negligible change in per capita GDP of one PPS.

Table 7: Mean and median GDP per capita of the study cohort in the six European countries

Country	Study cohorts	Mean GDP in PPS	Median GDP in PPS
Austria	20.604	31.423	32.400
Finland	16.680	30.589	28.000
Italy	63.418	27.357	28.100
Norway	17.147	37.162	34.800
Romania	101.834	14.581	11.200
Slovenia	4.497	21.423	19.500

Countries of the former Eastern bloc (Romania and Slovenia) have clearly the lowest values, very much below the other countries (Table 5). This is also shown when the proportions of each country's study cohort are graphically represented in categories of 15.000s (Figure 18).

Figure 18: Percentage of study cohorts in GDP categories of 15.000 PPS



2.4 Post-discharge psychiatric outpatient contact as moderating factor for psychiatric re-hospitalisation – the continuity of care study (Objective 2)

The concept of continuity of care after hospital discharge has been around for a long time in mental health services planning and research. In the strict sense the concept means that follow-up outpatient contacts are planned at the time of discharge and adhered to by the patient. In the observational data sets used in the CEPHOS-LINK project it can only be verified whether a psychiatric outpatient contact has taken place or not, but it cannot be determined whether it was a planned visit or an unplanned emergency contact. In addition, record linkage between inpatient and outpatient service use was not achieved at all or not easily achieved in time in many partner countries, so that for this analysis only data sets for Austria and a large sub-region of Italy (Veneto; 4.053.441 inhabitants aged 18+ in 2012) could be obtained in time. In Austria with its many social health insurance companies it turned out that it was possible for some of them to identify the fact that a psychiatric outpatient contact had taken place during a specified time period (one month or three months), but not to determine the exact date of that visit. Since the exact time sequence of psychiatric outpatient contact and re-hospitalisation is essential for the continuity of care analyses, i.e. finding out whether psychiatric outpatient contact functions as a predictor for psychiatric re-hospitalisation, these patients had to be excluded from the study cohort. In Table 8 and Table 9 the derivation of the new study cohort for Austria is shown alongside that for Veneto.

Table 8: Derivation of the continuity of care study cohort – step 1

	Austria	Veneto
(1) Original study cohort	21.839	7.239
(2) Patients without a date for psychiatric outpatient contact (POC)	1.744	0
(3) Study cohort 2	20.095	7.239

For the continuity of care study a specific concept has been developed (see 1 Methods section above, the “pre-post” approach). It was decided for this approach to eliminate all patients who had a psychiatric re-hospitalisation on day 1-6 after the index discharge, which was 1.835 patients in Austria (9,13% of study cohort 2) and 180 in Veneto (2,49% of study cohort 2; Table 9). This leaves 18.260 patients for Austria and 7.059 patients for Veneto. These cohorts are called study cohorts 3 here.

Table 9: Derivation of the continuity of care study cohort and the moderator variable POC – step 2

	Austria	Veneto
(3) Remaining baseline study cohort (study cohort 2)	20.095	7.239
(4) Patients with psychiatric re-hospitalisation day 1-6 after the index discharge	1.835	180
(5) Study cohort 3 for continuity of care analyses (Objective 2)	18.260	7.059
(6) Patients of study cohort with at least one POC between days 0 and 6	1.200	1.787

For each of these two patient cohorts psychiatric outpatient contacts (any type: ambulatory, day or mobile care) between days 0 and 6 after the index discharge were identified and used as predictors for re-hospitalisation between days 7 and 69 (corresponding to day 0 to day 63 of the continuity of care study cohort 3). Table 9 shows that 1.200 patients of the Austrian study cohort 3 (6,57% of 18.260) and 1.787 of the Veneto study cohort 3 (25,32% of 7.059) had at least one outpatient contact in days 0-6. Table 10 provides an overview of the description of the Austrian and the Veneto “pre-post” study cohort by demographic and clinical predictor variables. The Veneto study cohort is also shown separately by discharges from public and private providers.

Table 10: Description of the continuity of care study cohort by demographic and clinical predictor variables in Austria and all providers of Veneto, as well as separately by public and private providers

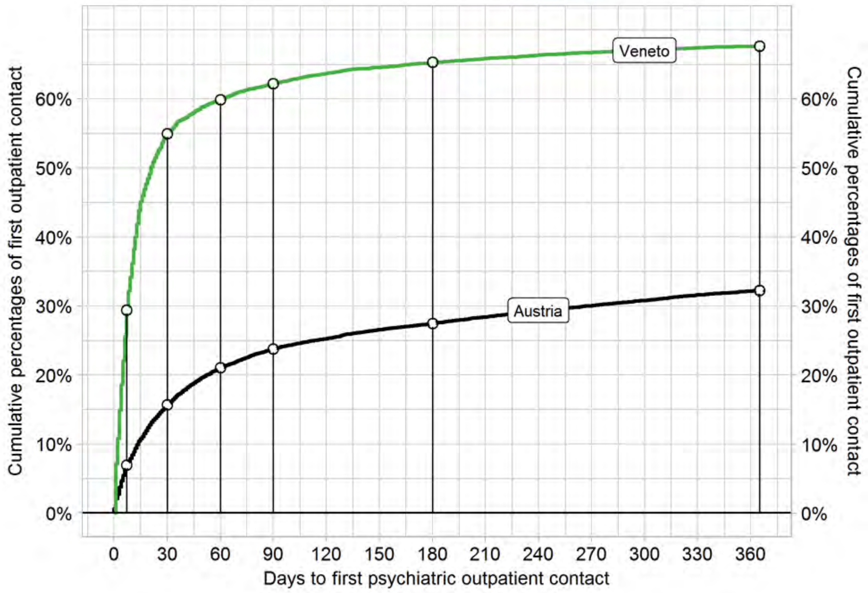
	N	Demographic variables		Clinical variables		
		% Female	Median age	Median LOS	% Psychotic diagnosis	% Physical comorbidity
Austria	18.260	59,2%	44	15	36,5%	38,2%
Veneto	7.059	56,1%	48	16	45,1%	8,1%
Veneto public	4.904	53,3%	46	11	54,9%	9,4%
Veneto private	2.155	62,6%	51	30	22,9%	5,2%

The study cohort in Veneto consists of 56% women compared to 59% in Austria. The median age is higher in Veneto (48 years) than in Austria (44) while median LOS is 15 days in Austria and 16 days in Veneto. More patients in Veneto (45%) have psychotic diagnoses than in Austria (37%), but physical comorbidity is much more frequently coded in Austria (38%) compared to Veneto (8%).

Huge differences are found between the study cohorts of public and private providers in the Veneto Region. Patients in public services have a more balanced gender relation (53% in public versus 63% in private services), are younger (median age of 46 years in public versus 51 years in private services), have a much lower LOS (11 days in public versus 30 days in private services) , are to a much higher percentage psychotic (55% versus 23%) and have a higher percentage of physical comorbidity (9,4% versus 5,2%). For respective regression analyses the POC variable was added to the already known five demographic and clinical predictors.

As a general information Figure 19 shows for the original baseline cohort that in Veneto a much higher proportion of patients had at least one POC over 365 days after the index discharge (67%) than the patients of the Austrian study cohort (32%), which is less than half of the Veneto rate. In addition to other reasons (in Austria some psychiatric outpatient care is not funded under “health” but under “social care” and it is therefore not contained in the health care database analysed here), the different organisation of the health care systems – integrated hospital and community care in Veneto and a fragmented system in Austria – might be a reason for this difference,

Figure 19: First psychiatric outpatient contact (ANYPOC) in the 365 days following the index discharge, cumulative percentages of patients in Study cohort 2 (Austria: N = 20.095, Veneto: N = 7.239)

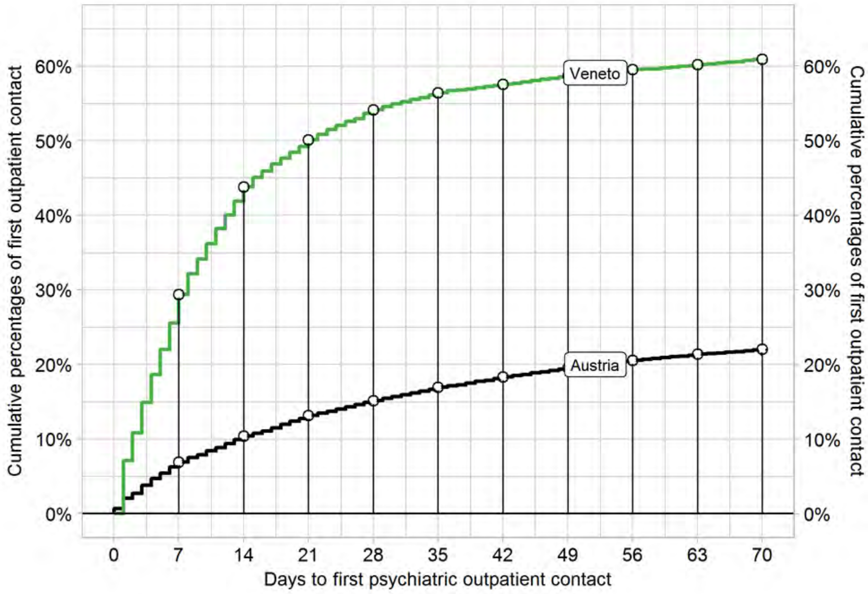


CC	Country/region	n	7d	30d	60d	90d	180d	365d
AT	Austria	20.095	6,93%	15,69%	21,03%	23,79%	27,46%	32,25%
VN	Veneto	7.239	29,37%	54,95%	59,87%	62,18%	65,27%	67,61%

Cumulative frequencies of first ANYPOC

In fact, less than 7% of patients in Austria had a POC in the first week after discharge, while the respective figure for Italy is nearly 30%, which is an important finding in itself without considering re-hospitalisation rates. In order to provide a more detailed picture of the early phase after the index discharge Figure 20 shows the cumulative percentages of first outpatient contacts of patients of the Study cohort 2 up to 70 days after discharge. 3 weeks days after the index discharge more than 50% of the patients in the Veneto study cohort 2 had a least one psychiatric outpatient contact, while this is the case for only 13,2% of the Austrian Study cohort 2.

Figure 20: First psychiatric outpatient contact (ANYPOC) 70 days following the index discharge, cumulative percentages of patients in Study cohort 2 (Austria: N = 20.095, Veneto: N = 7.239)

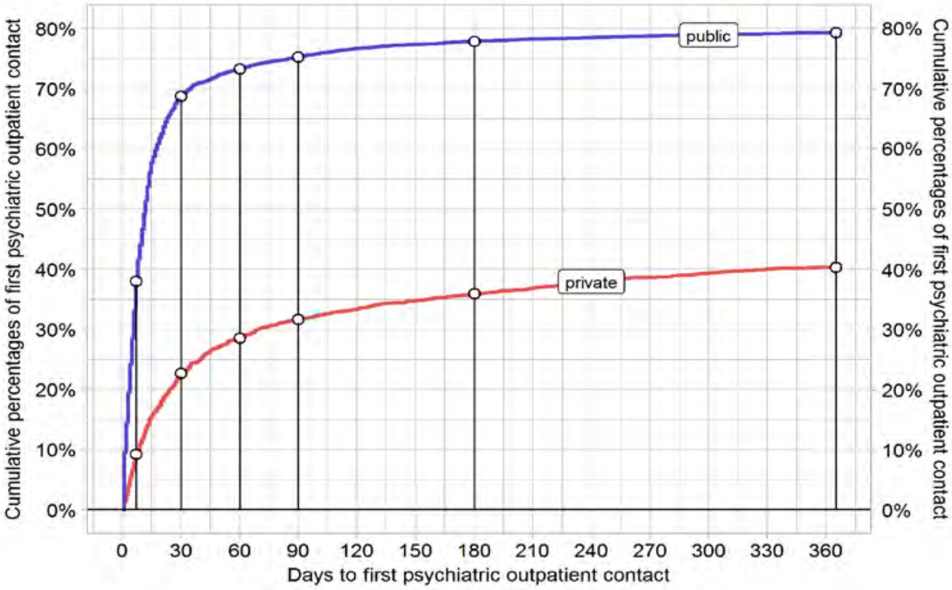


Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	20.095	6,93%	10,42%	13,16%	15,17%	16,95%	18,33%	19,56%	20,55%	21,38%	22,05%
Veneto	7.239	29,37%	43,80%	50,15%	54,16%	56,44%	57,59%	58,74%	59,55%	60,20%	60,95%

Cumulative frequencies of first ANYPOC 70d

Since it is known that in the Veneto region (as in the whole of Italy) a rather large private hospital sector (funded from public funds) exists, which functions differently from the small psychiatric departments in public general hospitals (the SPDCs which are integrated with local community psychiatric services), the first psychiatric outpatient contacts after the index discharge were also analyses separately for public and private psychiatric inpatient services Figure 21 and Figure 22 provide the respective information and show substantial differences between the rates of first psychiatric outpatient contact after discharge from public and private inpatient services. After 365 days only 40% of patietns discharged from private hospitals had at least one psychiatric outpatient contact, while this rate is twice as high after discharge from from public hospitals. The difference is especially high after 7 days, with 38% in the public and only 9% in private sector.

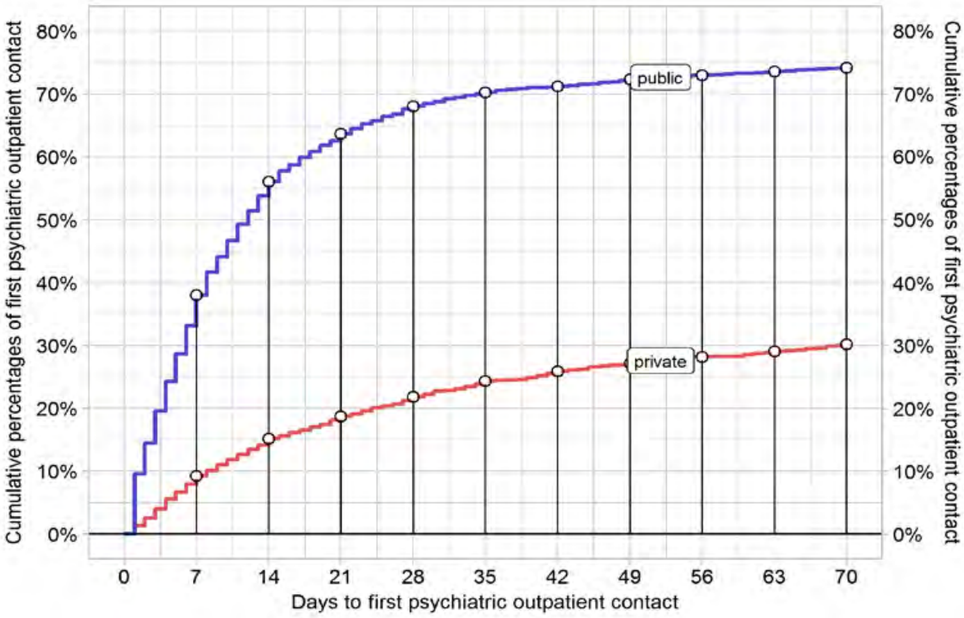
Figure 21: First psychiatric outpatient contact (ANYPOC) in the 365 days following the index discharge, cumulative percentages of patients in Study cohort 2 in Veneto for public and private providers (public: N=5.062, private: N= 2.177)



Veneto	N	7d	30d	60d	90d	180d	365d
private	2.177	9,28%	22,74%	28,57%	31,69%	35,92%	40,33%
public	5.062	38,01%	68,81%	73,33%	75,29%	77,89%	79,34%

Cumulative frequencies of first ANYPOC

Figure 22: First psychiatric outpatient contact (ANYPOC) 70 days following the index discharge, cumulative percentages of patients in Study cohort 2 in Veneto for public and private providers (public: N=5.062, private: N= 2.177)



Veneto	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
private	2.177	9,28%	15,20%	18,70%	21,86%	24,35%	25,91%	27,15%	28,20%	29,08%	30,18%
public	5.062	38,01%	56,10%	63,67%	68,06%	70,25%	71,22%	72,32%	73,03%	73,59%	74,18%

Cumulative frequencies of first ANYPOC 70d

3 Results

Multiple logistic regression analyses (LOGREG) for 30 and 365 days outcomes and Cox regression analyses (COXREG) for 365 days outcomes were employed. Two types of outcome measures were chosen: rates of psychiatric re-hospitalisation (PSY-REHOS; patient had to be at least one night on a psychiatric bed during the re-hospitalisation episode), and re-hospitalisation to any hospital (ANY-REHOS) where this restriction was not applied, i.e. re-hospitalisations to both non-psychiatric and psychiatric hospitals are included in ANY-REHOS. These rates mean that at least one re-hospitalisation of these specific types has occurred. Re-hospitalisation rates are abbreviated as RHR.

The results section is organised into three chapters according to the types of variables used as predictors for the regression analyses, which partly also influenced the choice of methods applied. The first chapter considers *demographic and clinical predictors on the patient-level*, the second adds *characteristics* of the NUTS 3 region of the patients' residence and applies a multilevel analysis approach, the third analyses the influence of *continuity of care* on re-hospitalisation rates by adding post discharge variables.

Each of these chapters begins with describing the re-hospitalisation rates for selected follow-up periods, both in tables and in figures, in the first chapter to a larger extent than in the subsequent two chapters and then goes on to reporting and discussing results of the regression analyses, especially comparing 30 to 365 day follow-up periods, as well as psychiatric re-hospitalisation to any type of re-hospitalisation. For a thorough description of the study designs, the methods applied and the characteristics of the study cohorts, see sections 1 Methods and 2 Study cohorts.

The first chapter (3.1) looks into the effect of the five patient-level demographic and clinical predictors chosen because they were available in most partner countries to a reasonable degree of quality for the time of the index discharge: gender, age, psychotic diagnosis, physical comorbidity; with length of stay only comparable between Austria, Italy, Romania and Slovenia, so that Finland and Norway had to be regarded separately (while Finland and Norway are comparable in the way length of stay was calculated). In the second chapter (3.2) the influence of two additional contextual variables - degree of urbanicity and Gross Domestic Product of the NUTS 3 region in which the patient lives at the time of the index discharge - is examined in conjunction with the five patient-level predictor variables analysed in the first chapter. Multilevel regression methods were applied in this analysis. Finally, the third chapter (3.3) analyses the effect of post index discharge psychiatric outpatient contacts on re-hospitalisation rates. A specific concept was developed for these analyses (described in the Methods and Study cohort sections above). Only Austria and a region of Italy (Veneto) could take part in this analysis, because of difficulties in obtaining or linking data for psychiatric outpatient contacts with hospitalisation data in time. Patients who have died during follow-up are included in the study cohort since in several countries linkable data on the occurrence of death and the date of death were missing.

As already discussed in the Methods section, it was not possible to identify either at all or not to a sufficient degree of clarity whether a hospitalisation was planned or unplanned. Finally, it has to be stressed again that only inpatient hospital episodes were considered, i.e. a patient had to be at least one night on a hospital bed, excluding discharges from and admissions to day care.

For each country the analyses provided below should be regarded as unique for that specific country. The fact that a common protocol was used should not deter from this fundamental fact. The results for each country separately would make each a publication of its own in the traditional sense. Such single studies, either on a country level (mostly though below the country level) or for a specific institutional setting (say a hospital or several hospitals under a common jurisdiction or ownership) constitute the bulk of re-hospitalisation studies summarised in systematic reviews. The fundamental drawback of such systematic reviews is that coverage of hospitals, selection of variables and study designs are all different, rendering the task of providing a valid synthesised body of knowledge so difficult. Relating to the fact that all results presented here are rooted in individual countries (despite having been carried out with a common protocol), the results have to be looked at, first from the single country perspective, which is the reason why a large volume of individual "local" country results are provided in the tables summarising the results in the regression analyses - these are for vertical comparisons within each country. In a second step only, country comparisons should be carried out, according to horizontal comparisons. Because of the different definition of length of stay in Finland and Norway tables for these two countries (called below in some instances "northern countries") are as a rule kept separate from the summary tables of the other countries (Austria, Italy, Romania, Slovenia – called "southern countries").

3.1 Patient-level demographic and clinical predictors

Five potential predictors were selected, all in a dichotomised form. Two are demographic – gender (female, FEM) and age (equal or older than the median, AGEOLD); three are clinical – length of stay during the hospital episode leading to the index discharge, with all spells, psychiatric and non-psychiatric, during that episode added up (LOSALL_LONG), psychotic diagnosis (F2 or F30 or F31, PSO) and at least one physical comorbidity as an additional diagnosis (PHY_COM). For details, see the Methods section 1.

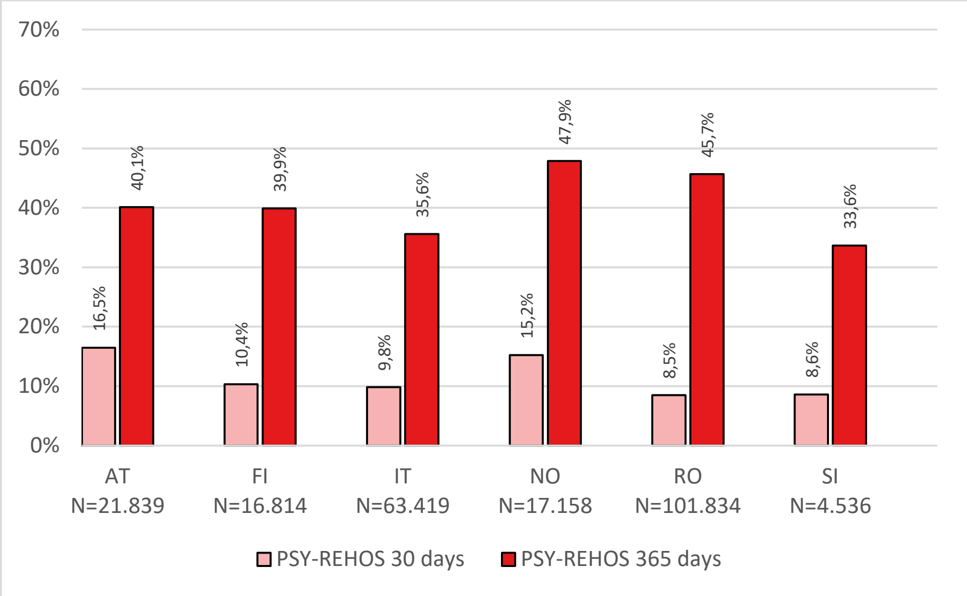
3.1.1 Re-hospitalisation rates for 30 and 365 days

In Table 11 the re-hospitalisation rates for 30 and 365 days, both for psychiatric re-hospitalisation and any type of re-hospitalisation (including psychiatric re-hospitalisation) are shown for each partner country. For easier comparability rates are presented pairwise in Figure 23 to Figure 26.

Table 11: Re-hospitalisation rates for 30 and 365 days: a) psychiatric re-hospitalisation (PSY-REHOS) and b) any type of re-hospitalisation (ANY-REHOS)

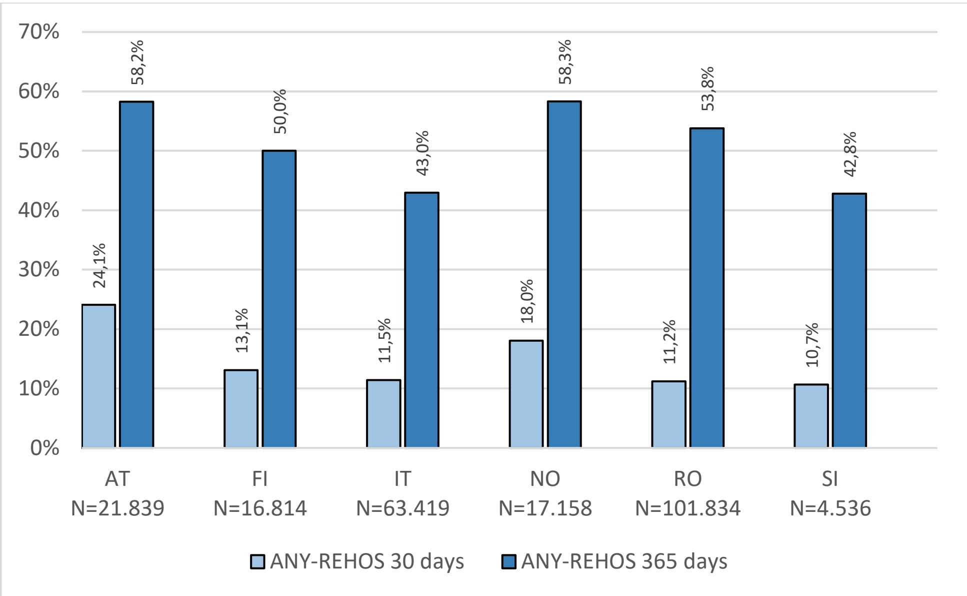
	Re-hospitalisation Rates				
Country	Study cohort	PSY-REHOS		ANY-REHOS	
		30 days	365 days	30 days	365 days
Austria	21.839	16,46%	40,13%	24,08%	58,24%
Finland	16.814	10,35%	39,92%	13,11%	50,01%
Italy	63.419	9,83%	35,60%	11,45%	42,98%
Norway	17.158	15,22%	47,87%	18,03%	58,32%
Romania	101.834	8,47%	45,68%	11,22%	53,81%
Slovenia	4.536	8,62%	33,64%	10,69%	42,81%
CEPHOS-LINK	225.600	10,28%	41,80%	13,18%	51,03%

Figure 23: Rates of psychiatric re-hospitalisation for 30 and 365 days



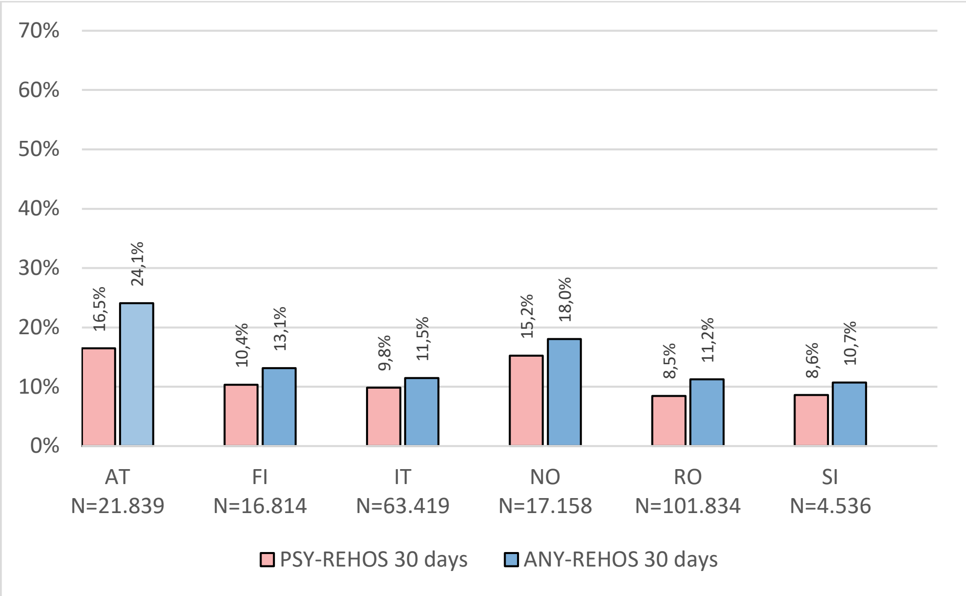
While 30 days psychiatric re-hospitalisation rates (Figure 23) are around 10 percent for four countries (Finland, Italy, Romania, Slovenia) they are above 15 percent in Austria and Norway. The 365 days RHR are highest in Norway and Romania, with both countries not much below 50 percent.

Figure 24: Rates of any type of re-hospitalisation for 30 and 365 days



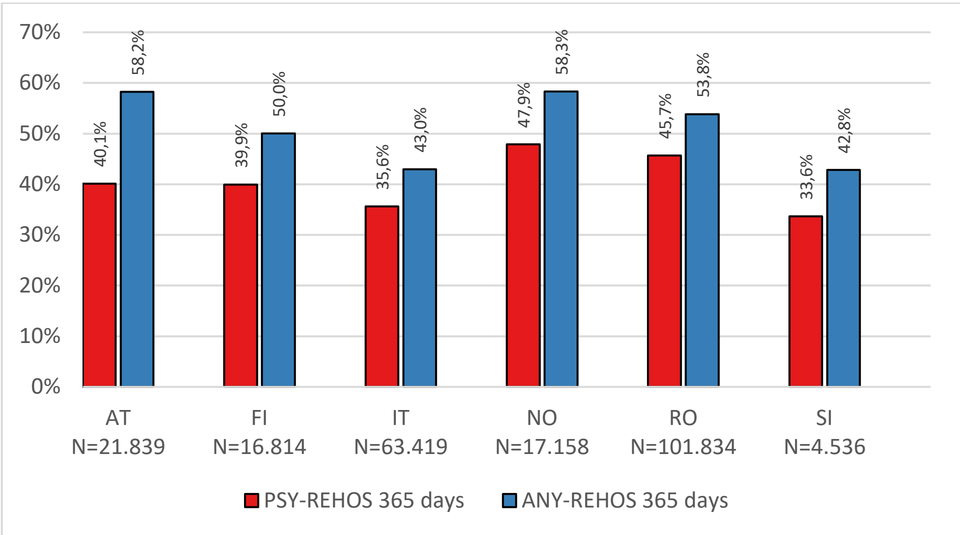
While rates for any type of re-hospitalisation are understandably higher (Figure 24), they show a nearly identical pattern as psychiatric RHR in terms of country differences, with Austria and Norway again having the highest 30 days RHR, and Norway and Romania (plus Austria in this case) the highest 365 days RHR.

Figure 25: Rates for 30 days psychiatric versus any type of re-hospitalisation



For the 30 day follow-up period for Austria a rather large difference can be seen between psychiatric re-hospitalisation (16,5%) and any type of re-hospitalisation (24,1%). Italy has the smallest difference. The differences between percentages for 365 days are much larger than for 30 days in all countries.

Figure 26: Rates for 365 days psychiatric versus any type of re-hospitalisation

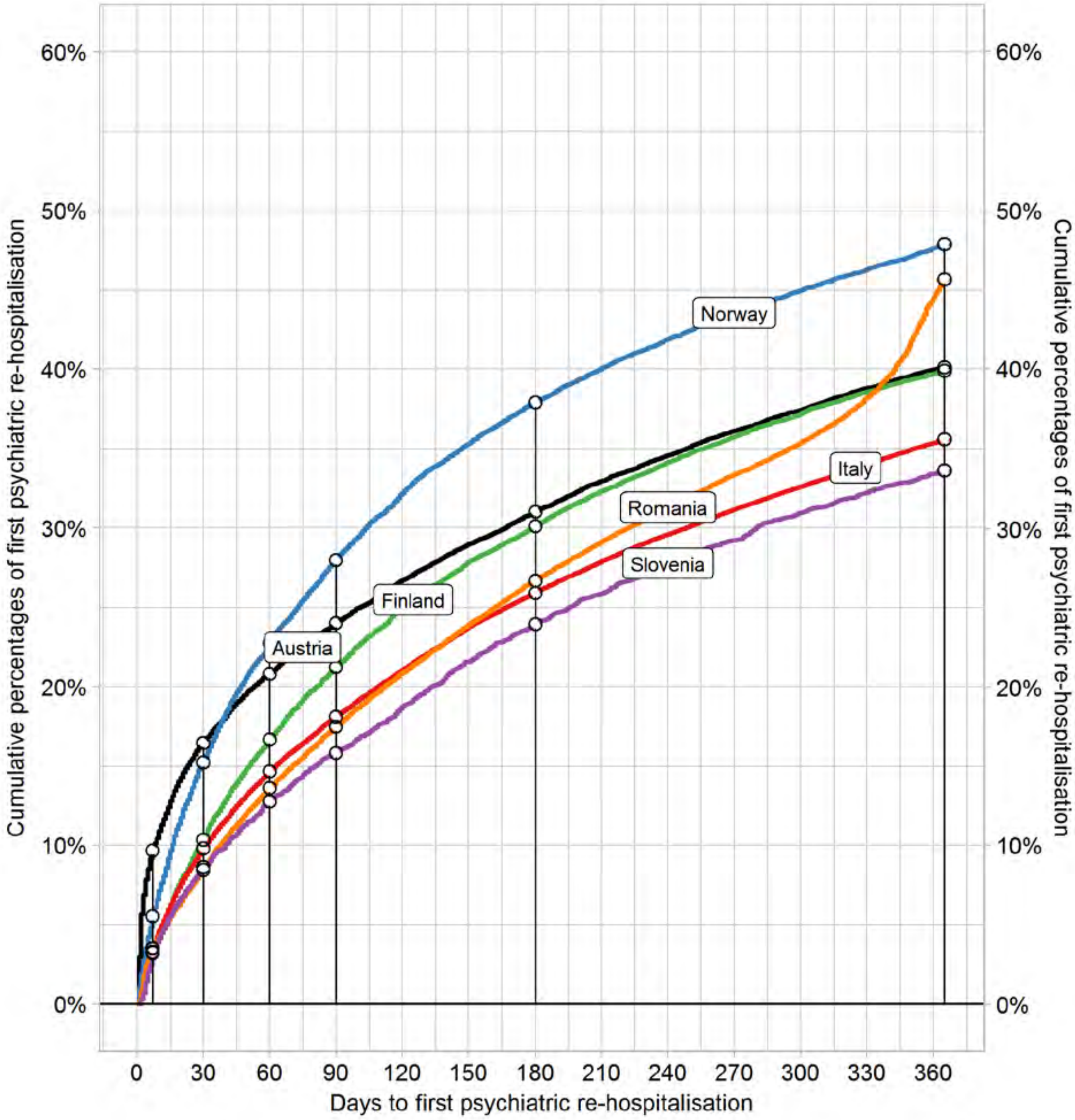


3.1.2 Detailed cumulative percentages of first re-hospitalisation up to 365 days

Here more detailed information is provided concerning the course of RHRs, starting with psychiatric RHR, first overall, then by the five predictor variables for each country. Finally, the corresponding figures are presented for all types of re-hospitalisation as well.

3.1.2.1 Psychiatric re-hospitalisation (PSY-REHOS)

Figure 27: Cumulative percentages of first psychiatric re-hospitalisation up to 365 days for the six CEPHOS-LINK partner country cohorts (100% = baseline study cohort of each country)



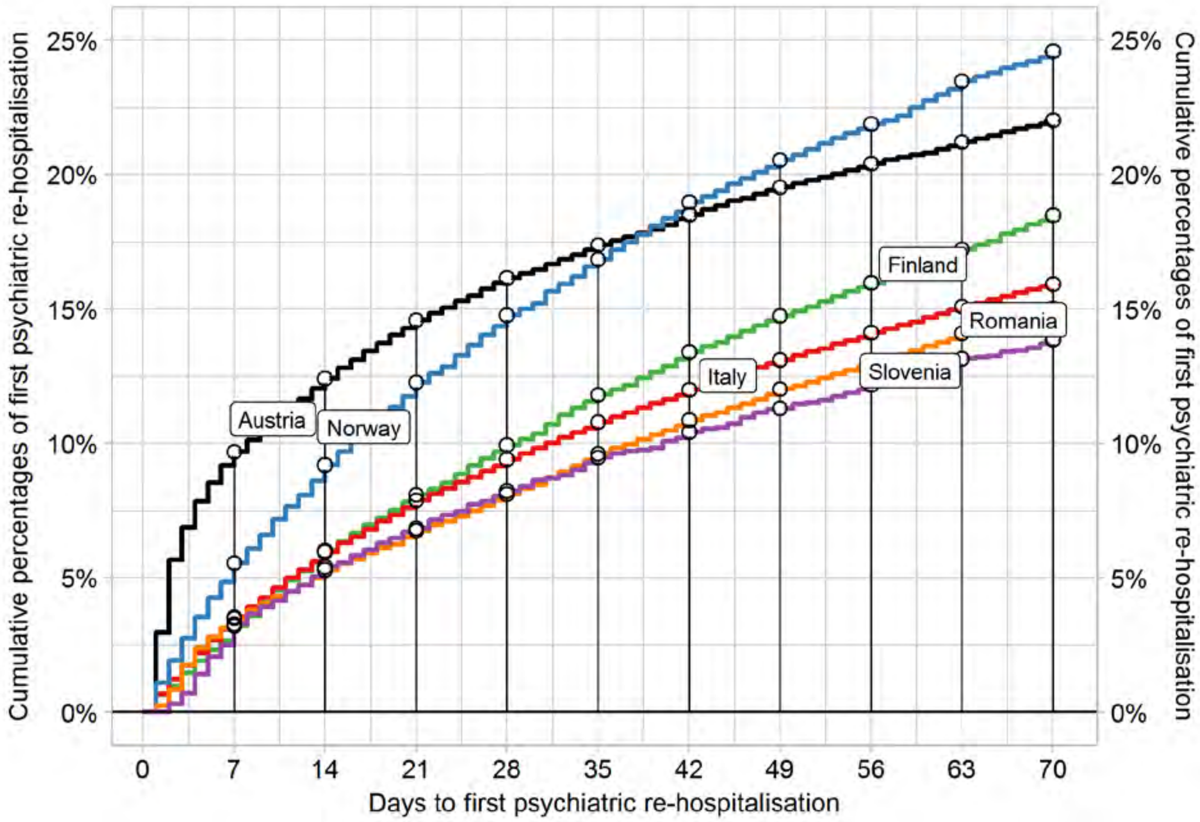
CC	Country	n	30d	60d	90d	180d	365d
AT	Austria	21.839	16,46%	20,81%	24,00%	31,01%	40,13%
FI	Finland	16.814	10,35%	16,67%	21,23%	30,10%	39,92%
IT	Italy	63.419	9,83%	14,67%	18,13%	25,92%	35,60%
NO	Norway	17.158	15,22%	22,75%	27,98%	37,91%	47,87%
RO	Romania	101.834	8,47%	13,61%	17,49%	26,69%	45,68%
SI	Slovenia	4.536	8,62%	12,79%	15,83%	23,94%	33,64%

Cumulative frequencies of first PSY-REHOS

In Figure 27 the cumulative percentages of first psychiatric re-hospitalisation up to 365 days for the six CEPHOS-LINK partner country cohorts (100% = baseline study cohort of each country) are shown.

In addition to the 30 days and 365 days re-hospitalisation rates the intermediate values are shown so that more detailed comparisons of the course can be performed. By superficial inspection three patterns can be identified. Pattern 1: Austria and Norway have both steeply increasing curves in the first few weeks after the index discharge, and remain high until the end of the 365 days follow-up period, Norway more so than Austria. Pattern 2: Slowly increasing curve but high at the end (Finland, Romania). Pattern 3: Slowly increasing rates and low at the end (Italy, Slovenia). A specific situation can be observed for Romania. There, in contrast to all other countries, the re-hospitalisation rates increase very much over the last few months of the one year follow-up period – a finding which, reportedly, may be due to the regulation that for the continuation of an existing invalidity pension it must be shown that at least one hospitalisation took place over a one year period.

Figure 28: Cumulative percentages of first psychiatric re-hospitalisation up to 70 days for the six CEPHOS-LINK partner country cohorts (100% = baseline study cohort of each country)

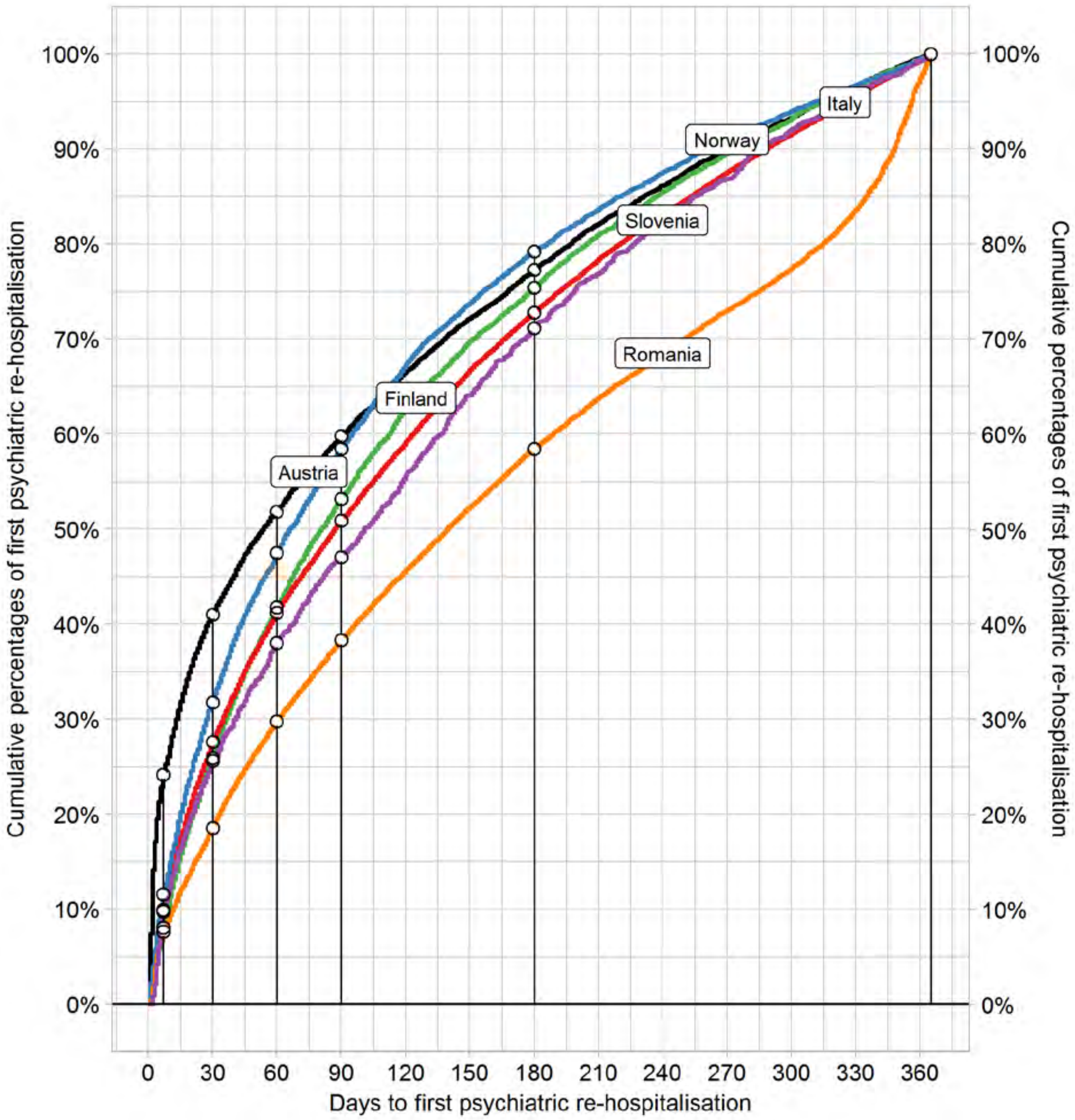


Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	21.839	9,70%	12,41%	14,60%	16,15%	17,38%	18,52%	19,53%	20,41%	21,21%	22,03%
Finland	16.814	3,22%	6,01%	8,09%	9,95%	11,82%	13,42%	14,74%	15,97%	17,23%	18,50%
Italy	63.419	3,54%	5,97%	7,89%	9,41%	10,81%	12,00%	13,11%	14,12%	15,10%	15,92%
Norway	17.158	5,55%	9,21%	12,27%	14,77%	16,86%	18,98%	20,54%	21,88%	23,48%	24,60%
Romania	101.834	3,50%	5,29%	6,75%	8,12%	9,63%	10,88%	12,02%	13,06%	14,09%	15,03%
Slovenia	4.536	3,28%	5,42%	6,83%	8,22%	9,48%	10,43%	11,31%	12,19%	13,16%	13,87%

Cumulative frequencies of first PSY-REHOS 70d

In Figure 28 the cumulative percentages are shown for the first 70 days in order to provide a more detailed picture.

Figure 29: Cumulative percentages of first psychiatric re-hospitalisation up to 365 days for the six CEPHOS-LINK partner country cohorts (100% = total number of first psychiatric re-hospitalisations for each country)



CC	Country	all (n)	n	30d	60d	90d	180d	365d
AT	Austria	21.839	8.764	41,02%	51,86%	59,80%	77,28%	100,00%
FI	Finland	16.814	6.712	25,94%	41,76%	53,19%	75,40%	100,00%
IT	Italy	63.419	22.576	27,61%	41,21%	50,92%	72,80%	100,00%
NO	Norway	17.158	8.213	31,79%	47,52%	58,46%	79,19%	100,00%
RO	Romania	101.834	46.513	18,55%	29,79%	38,29%	58,44%	100,00%
SI	Slovenia	4.536	1.526	25,62%	38,01%	47,05%	71,17%	100,00%

Cumulative frequencies of first PSY-REHOS (100% re-hospitalisation)

Figure 29 provides a different perspective on the cumulative percentages of the first psychiatric re-hospitalisation. Here for each country the total number of first re-hospitalisations is taken as 100% and it is shown how many percent of these were re-hospitalised until specific shorter time periods. Here, with the exception of Romania, the curves are nearer to each other than in the preceding figure. The figure shows more clearly that a substantial proportion of first re-hospitalisations occur very early on after the index discharge. In Austria 41% have occurred already within 30 days, in Norway 32% and in Italy, Finland and Slovenia more than 25%. This finding should be concern of alarm and requires further analysis. Interpretation is not easy. Some of the many factors which could play a role, are insufficient treatment during the hospital stay and insufficient provision of continuity of care. Fifty percent of first re-hospitalisation occur before day 60 post discharge in Austria, and before day 110 in Slovenia, with other countries (except Romania) in between.

Figure 30 to Figure 35 on the following pages show the cumulative psychiatric re-hospitalisation rates for each country, separately for each expression (true-false) of the 5 dichotomous person-level predictors.

Gender as a single variable does not make a difference for PSY-REHOS in most countries, i.e. the curves are identical. For physical comorbidity the curves are identical in four countries (Finland, Italy, Norway and Slovenia). In Austria and Romania physical comorbidity is in fact associated with lower psychiatric RHR. The influence of length of stay is inconsistent across countries, with no effect in Austria, Italy and Slovenia, and different effects in the other countries. The most consistent finding is that a psychotic diagnosis has an ever increasing effect on RHR over time, i.e. the difference to the RHRs of non-psychotic patients gets larger with time. Other country specific findings can be obtained by inspection of the figures.

Figure 30: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Austria

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

AUSTRIA (study cohort: N=21.839): RHR for PSY-REHOS

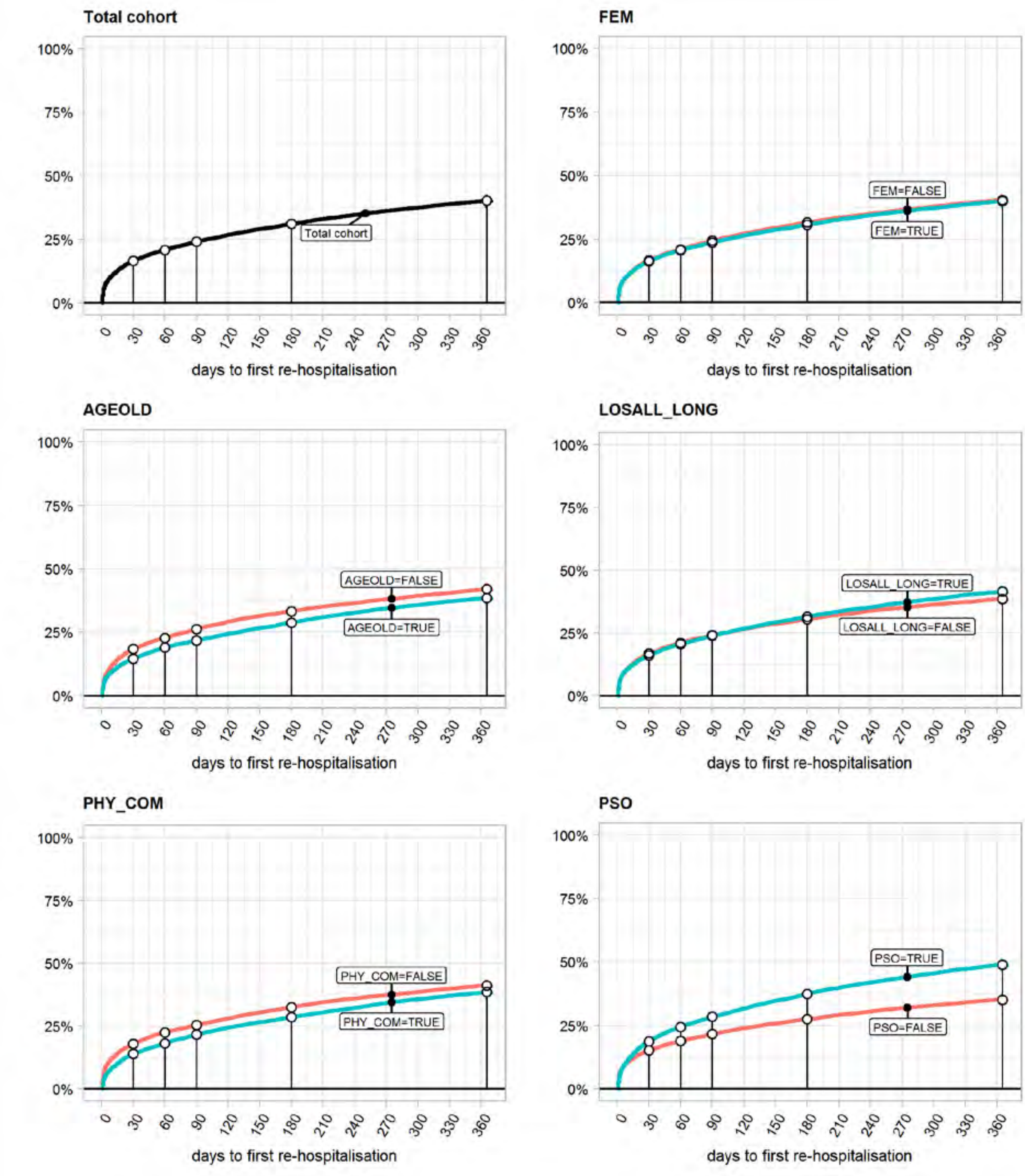


Figure 31: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Finland

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

FINLAND (study cohort: N=16.814): RHR for PSY-REHOS

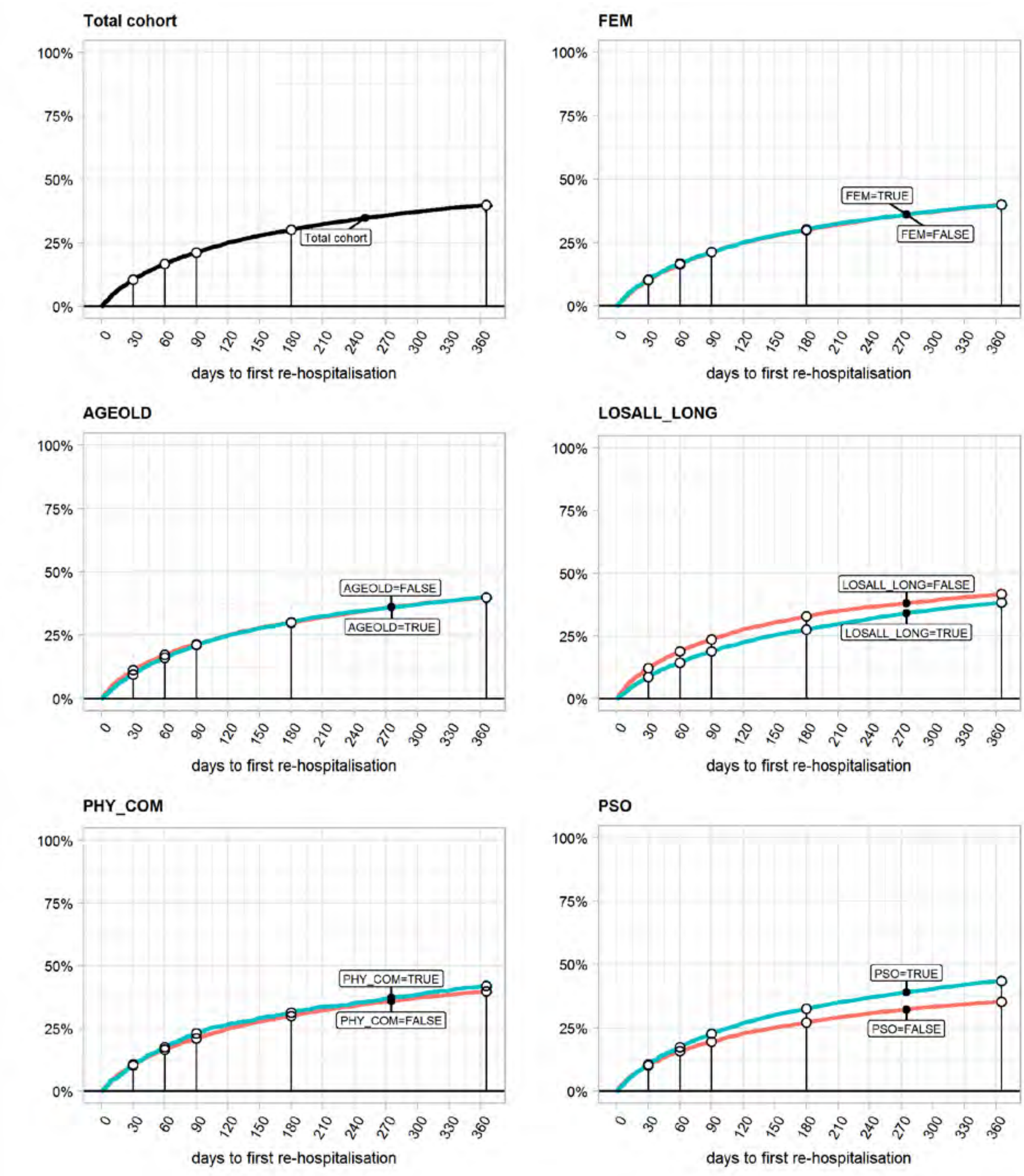


Figure 32: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Italy

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

ITALY (study cohort: N=63.419): RHR for PSY-REHOS

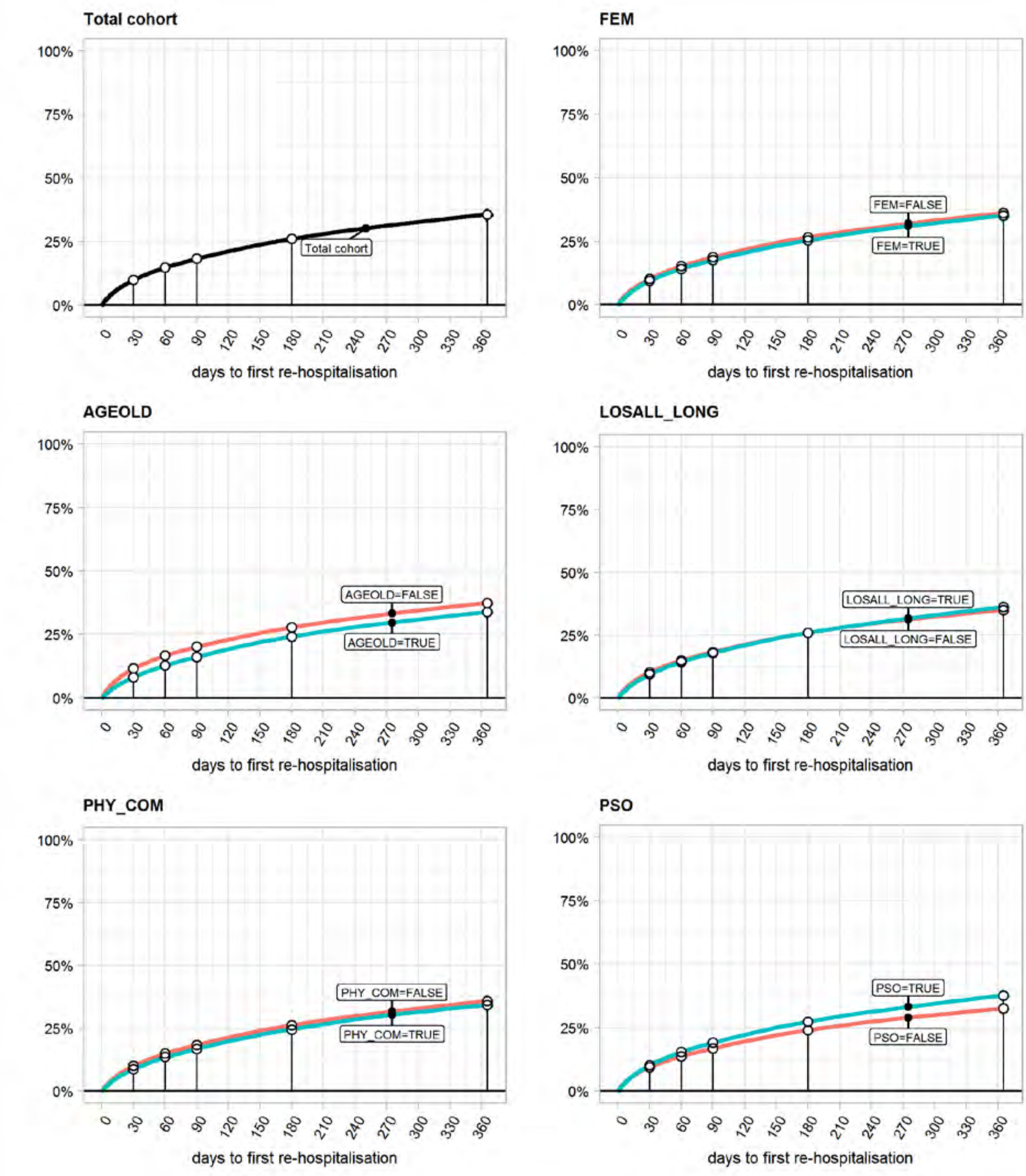


Figure 33: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Norway

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

NORWAY (study cohort: N=17.158): RHR for PSY-REHOS

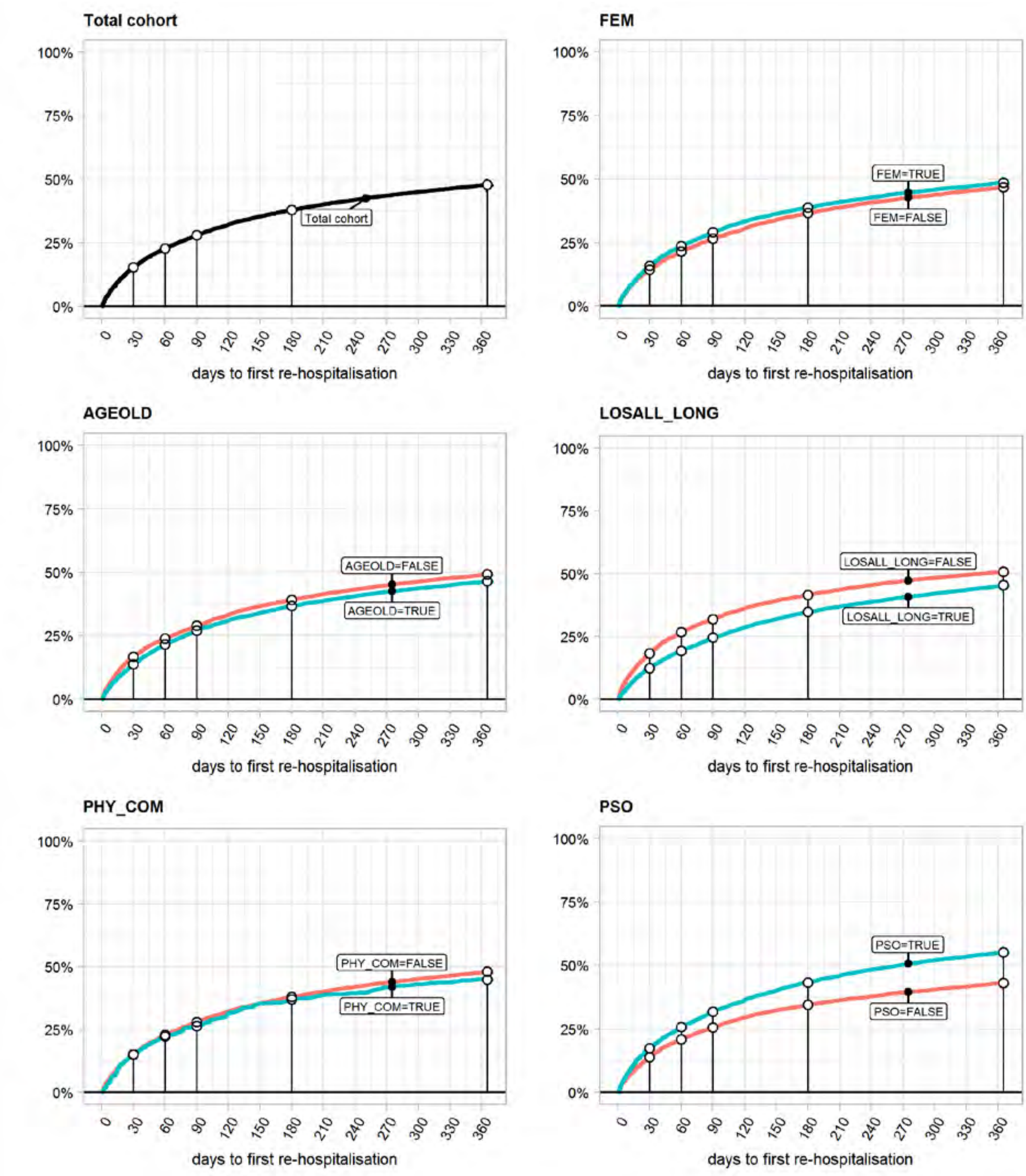


Figure 34: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Romania

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

ROMANIA (study cohort: N=101.834): RHR for PSY-REHOS

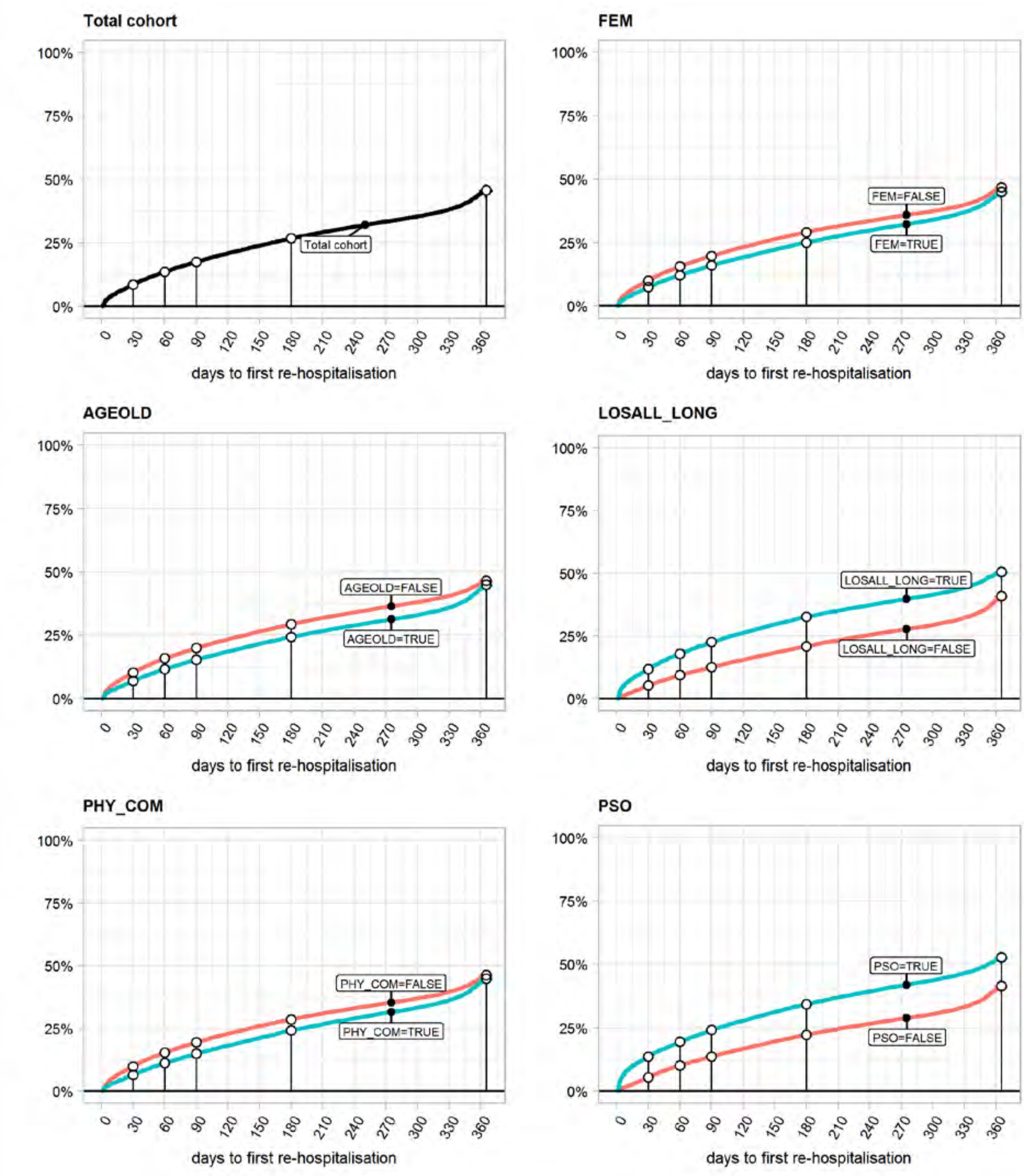
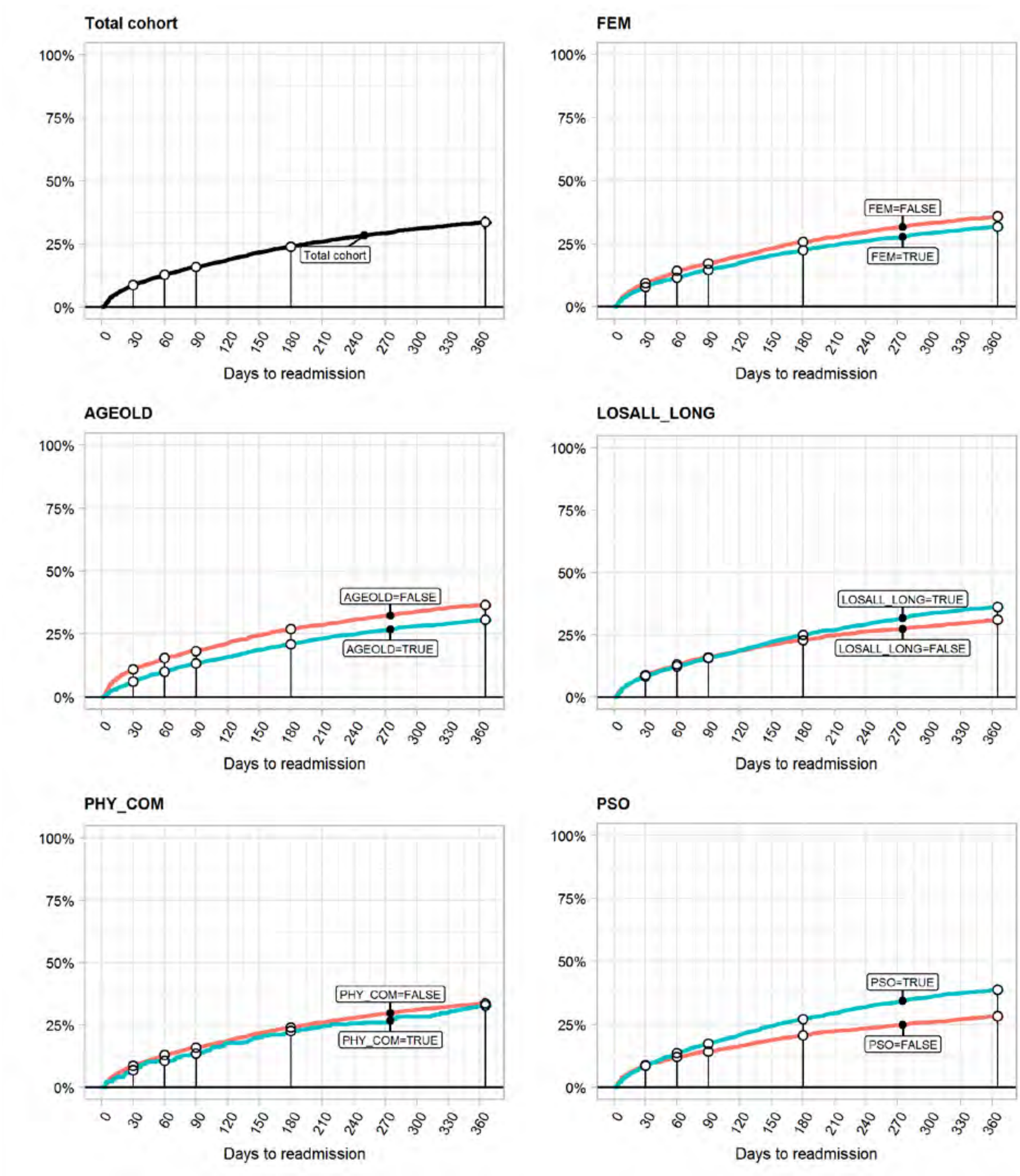


Figure 35: Cumulative first psychiatric re-hospitalisation rates up to 365 days by patient-level demographic and clinical predictors in Slovenia

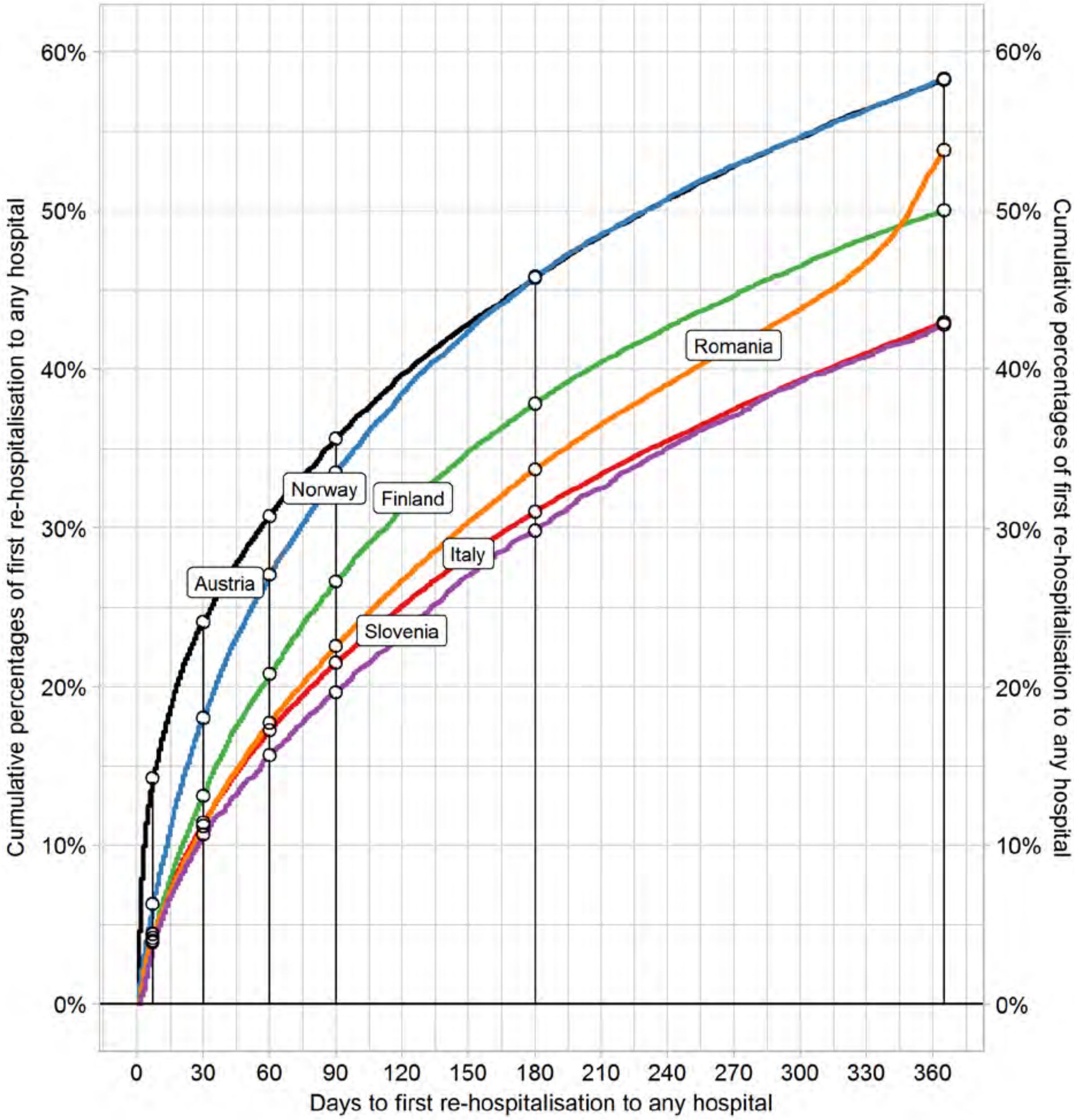
FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

SLOVENIA (study cohort: N=4.536): RHR for PSY-REHOS



3.1.2.2 Any type of re-hospitalisation (ANY-REHOS)

Figure 36: Cumulative percentage of any type of re-hospitalisation up to 365 days for the six CEPHOS-LINK partner country cohorts (100% = baseline study cohort of each country)

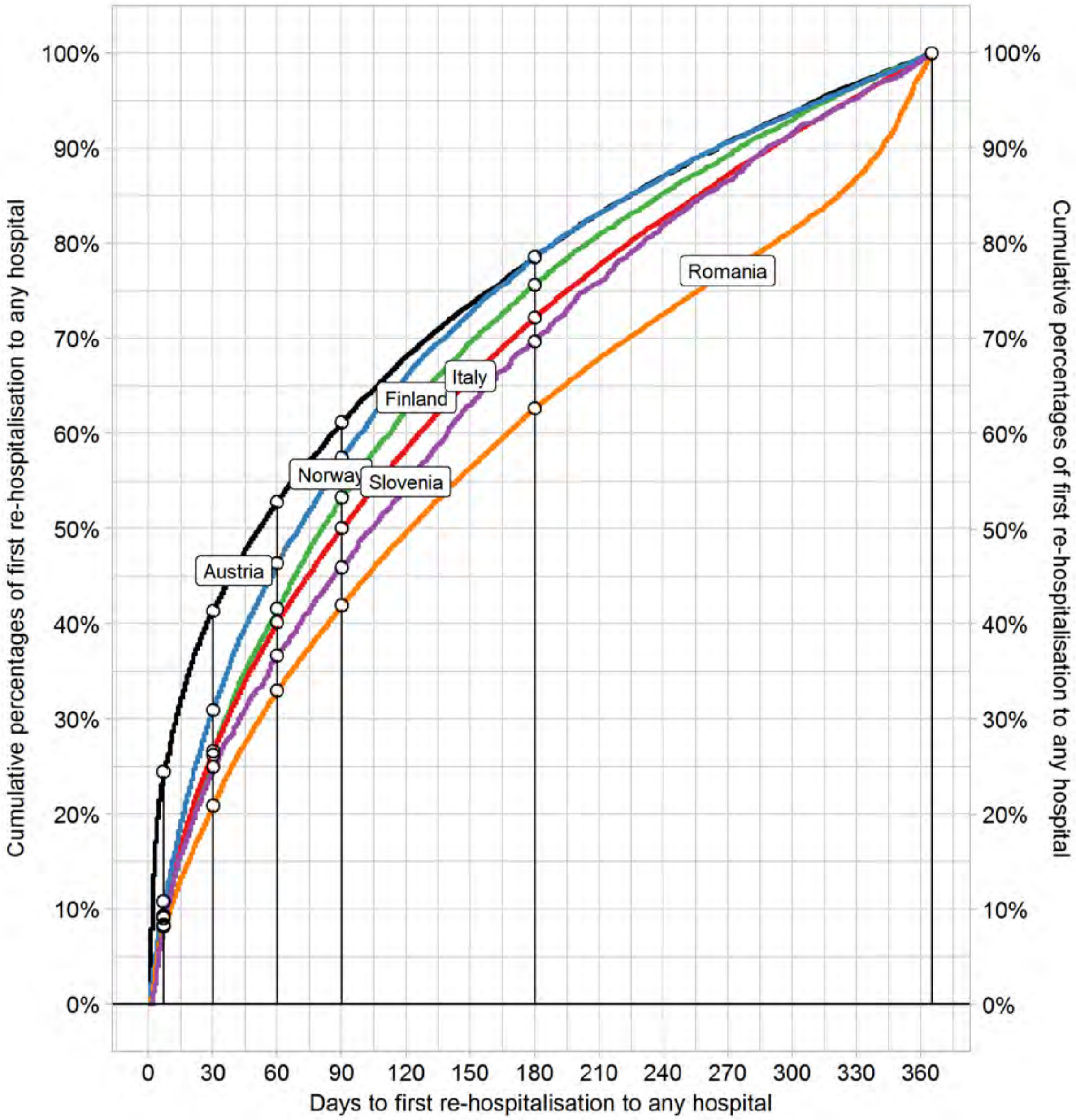


CC	Country	n	30d	60d	90d	180d	365d
AT	Austria	21.839	24,08%	30,75%	35,63%	45,77%	58,24%
FI	Finland	16.814	13,11%	20,81%	26,66%	37,84%	50,01%
IT	Italy	63.419	11,45%	17,28%	21,52%	31,03%	42,98%
NO	Norway	17.158	18,03%	27,06%	33,51%	45,83%	58,32%
RO	Romania	101.834	11,22%	17,74%	22,56%	33,71%	53,81%
SI	Slovenia	4.536	10,69%	15,70%	19,66%	29,83%	42,81%

Cumulative frequencies of first ANY-REHOS

As can be expected rates for any type of re-hospitalisation are higher than the ones for psychiatric re-hospitalisation (Figure 36). Otherwise the curves are similar here to those found for psychiatric re-hospitalisation. Also here a very large proportion of re-hospitalisations occurs early on (Figure 37).

Figure 37: Cumulative percentages of any type of first re-hospitalisation up to 365 days for the six CEPHOS-LINK partner country cohorts (100% = total number of any type of first re-hospitalisation for each country)



CC	Country	all (n)	n	30d	60d	90d	180d	365d
AT	Austria	21.839	12.718	41,34%	52,81%	61,18%	78,59%	100,00%
FI	Finland	16.814	8.408	26,21%	41,62%	53,31%	75,67%	100,00%
IT	Italy	63.419	27.256	26,64%	40,20%	50,07%	72,19%	100,00%
NO	Norway	17.158	10.006	30,92%	46,40%	57,46%	78,59%	100,00%
RO	Romania	101.834	54.797	20,85%	32,97%	41,93%	62,65%	100,00%
SI	Slovenia	4.536	1.942	24,97%	36,66%	45,93%	69,67%	100,00%

Cumulative frequencies of first ANY-REHOS (100% re-hospitalisation)

On the following pages (Figure 38 to Figure 43) similarly detailed figures for any type of re-hospitalisation for the five dichotomous predictor variables have been prepared. A remarkable but not unexpected finding is that rates are larger for patients with physical comorbidity.

Figure 38: Cumulative rates for any type of first re-hospitalisation up to 365 days by patient-level demographic and clinical predictors in Austria

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

AUSTRIA (study cohort: N=21.839): RHR for ANY-REHOS

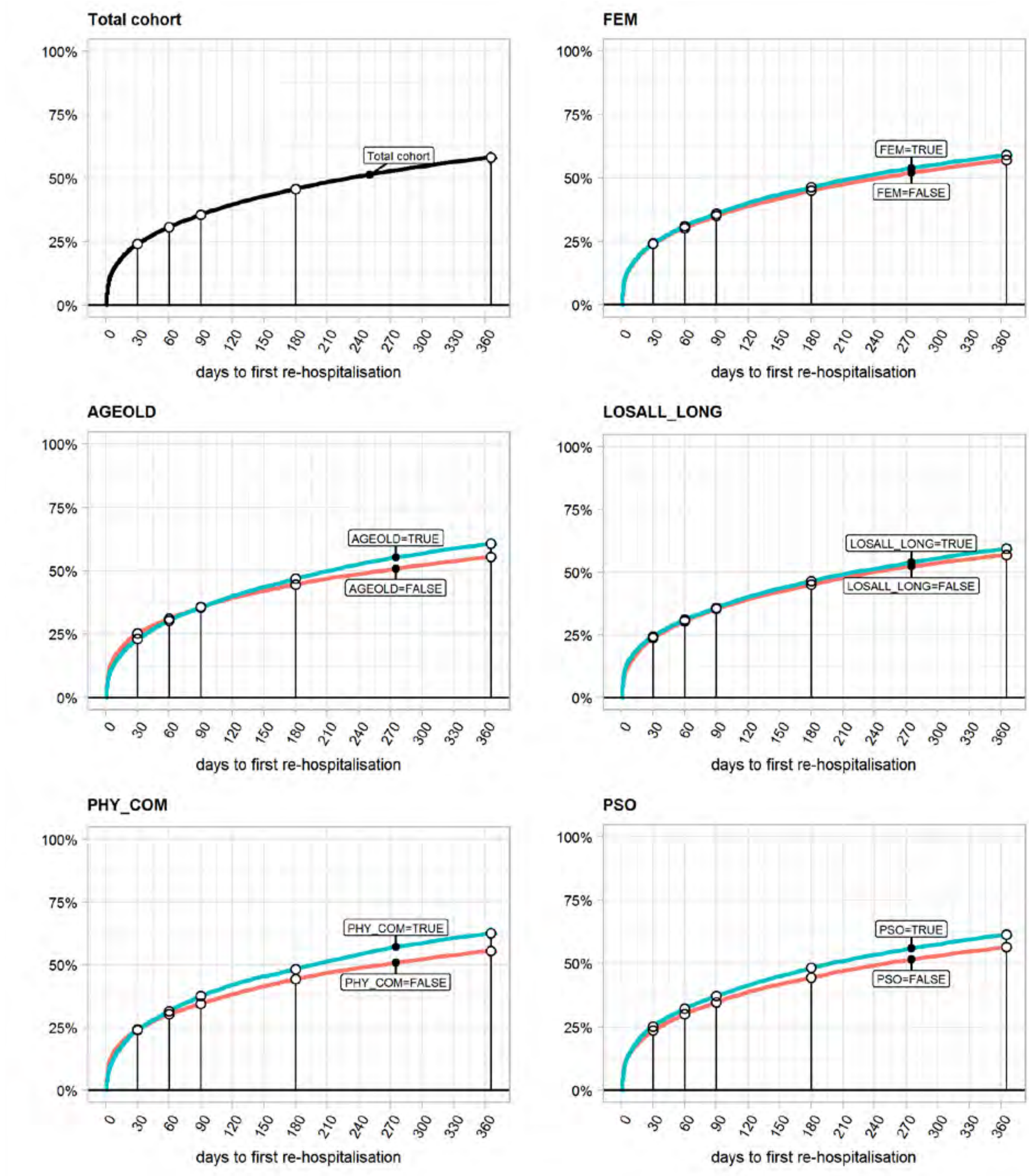


Figure 39: Cumulative rates for any type of first re-hospitalisation up to 365 days by patien-level demographic and clinical predictors in Finland

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

Finland (study cohort: N=16.814): RHR for ANY-REHOS

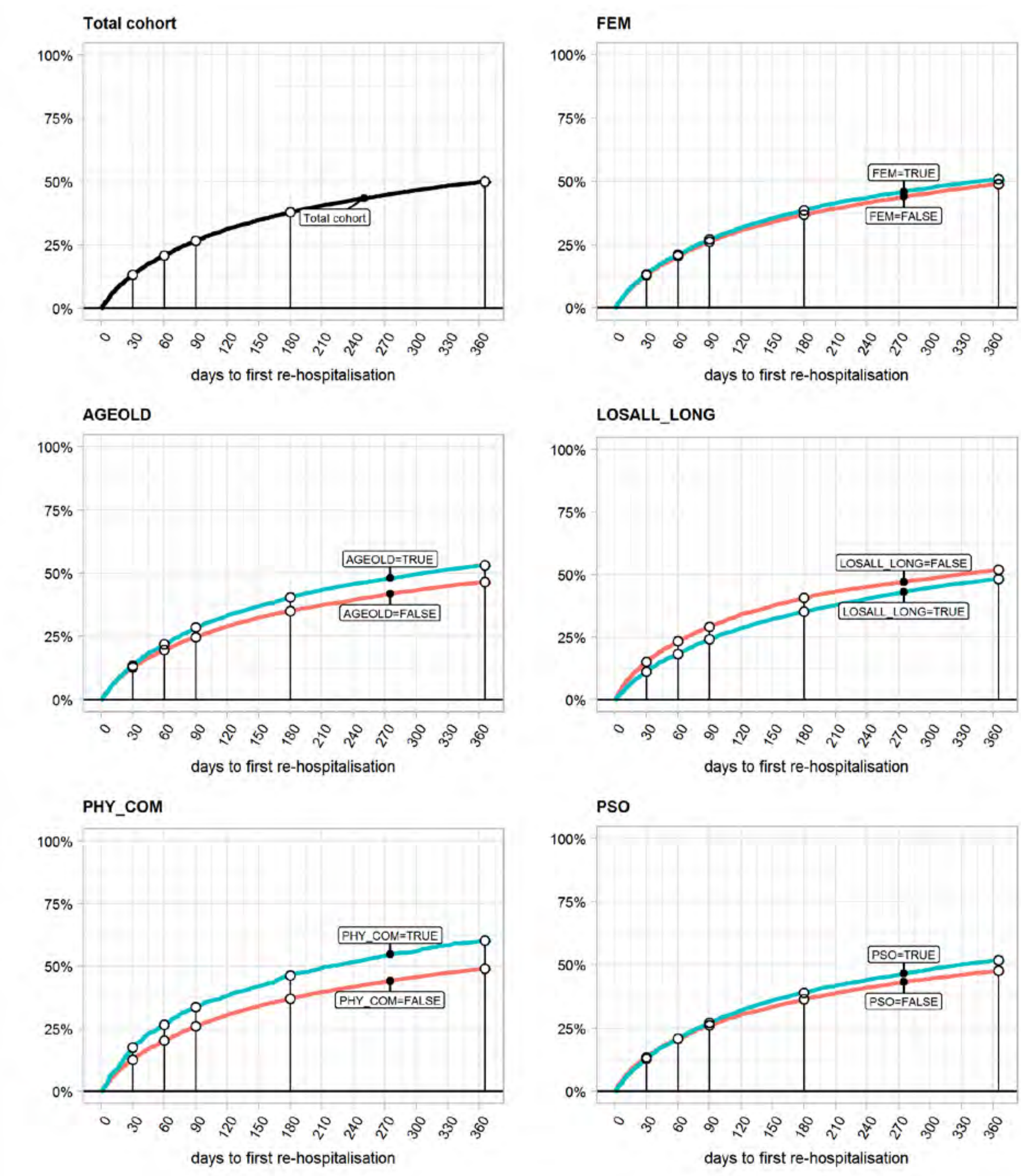


Figure 40: Cumulative rates for any type of first re-hospitalisation up to 365 days by patient-level demographic and clinical predictors in Italy

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

Italy (study cohort: N=63.419): RHR for ANY-REHOS

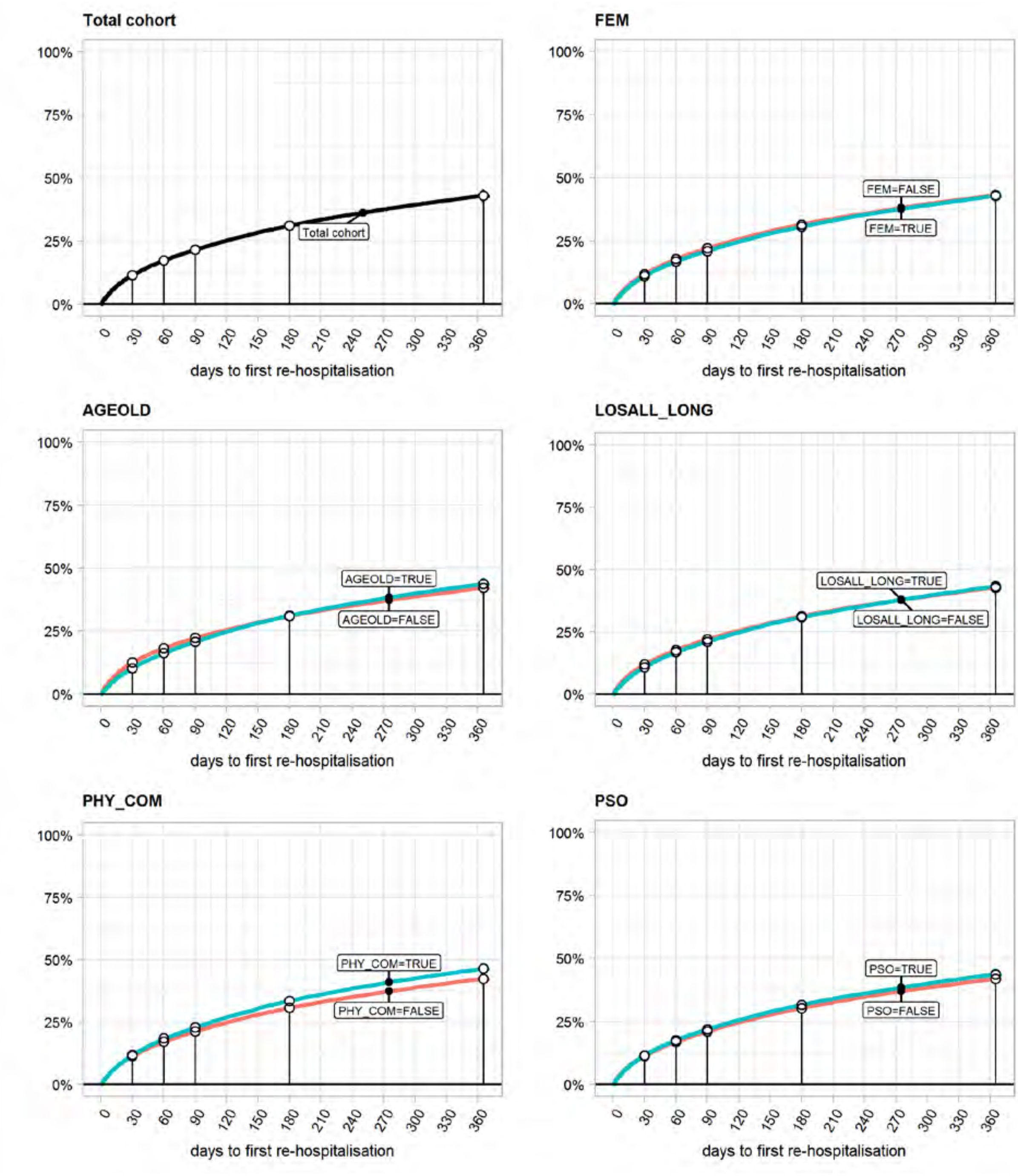


Figure 41: Cumulative rates for any type of first re-hospitalisation up to 365 days by patient-level demographic and clinical predictors in Norway

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

Norway (study cohort: N=17.158): RHR for ANY-REHOS

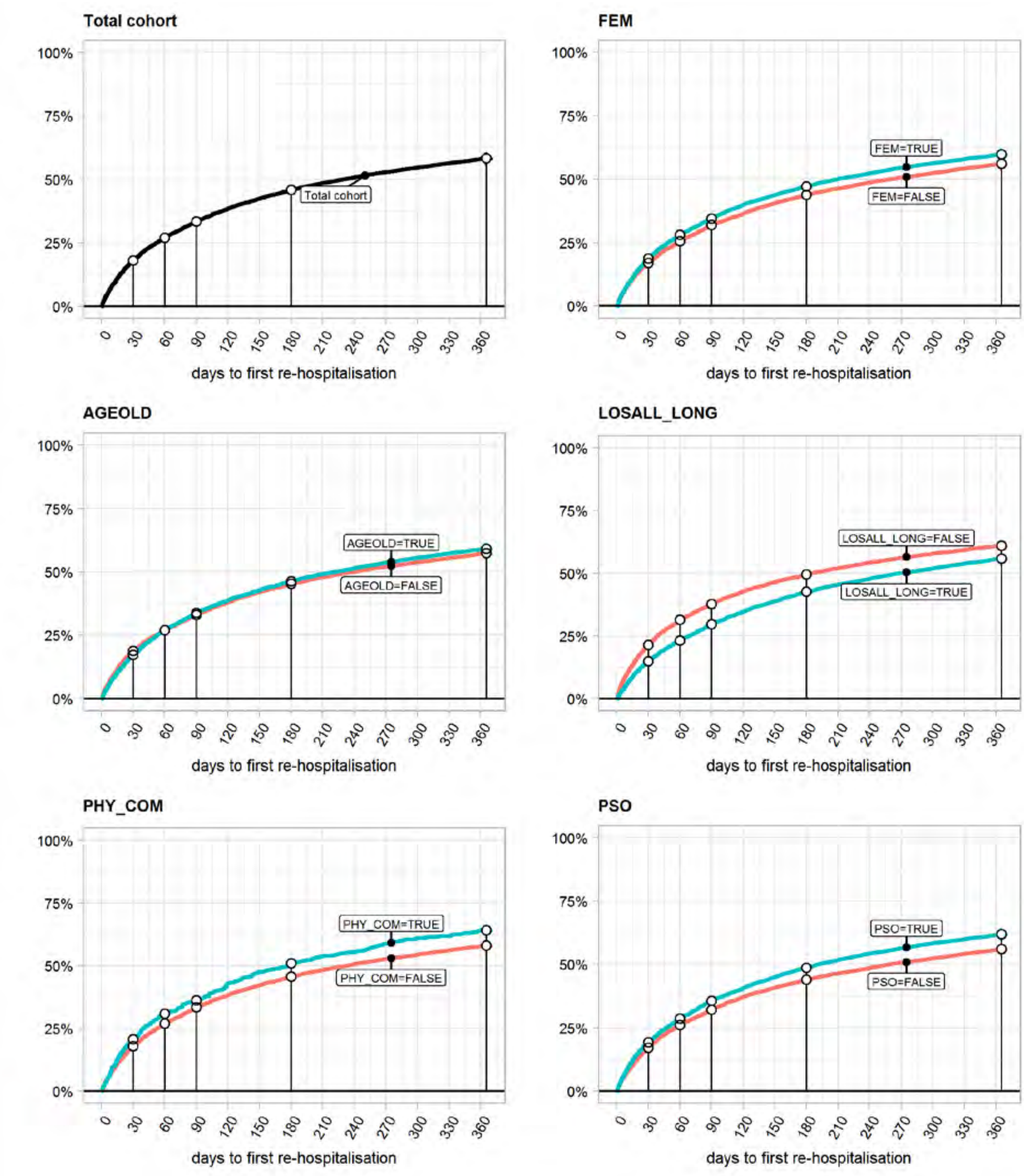


Figure 42: Cumulative rates for any type of first re-hospitalisation up to 365 days by patient-level demographic and clinical predictors in Romania

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

Romania (study cohort: N=101.834): RHR for ANY-REHOS

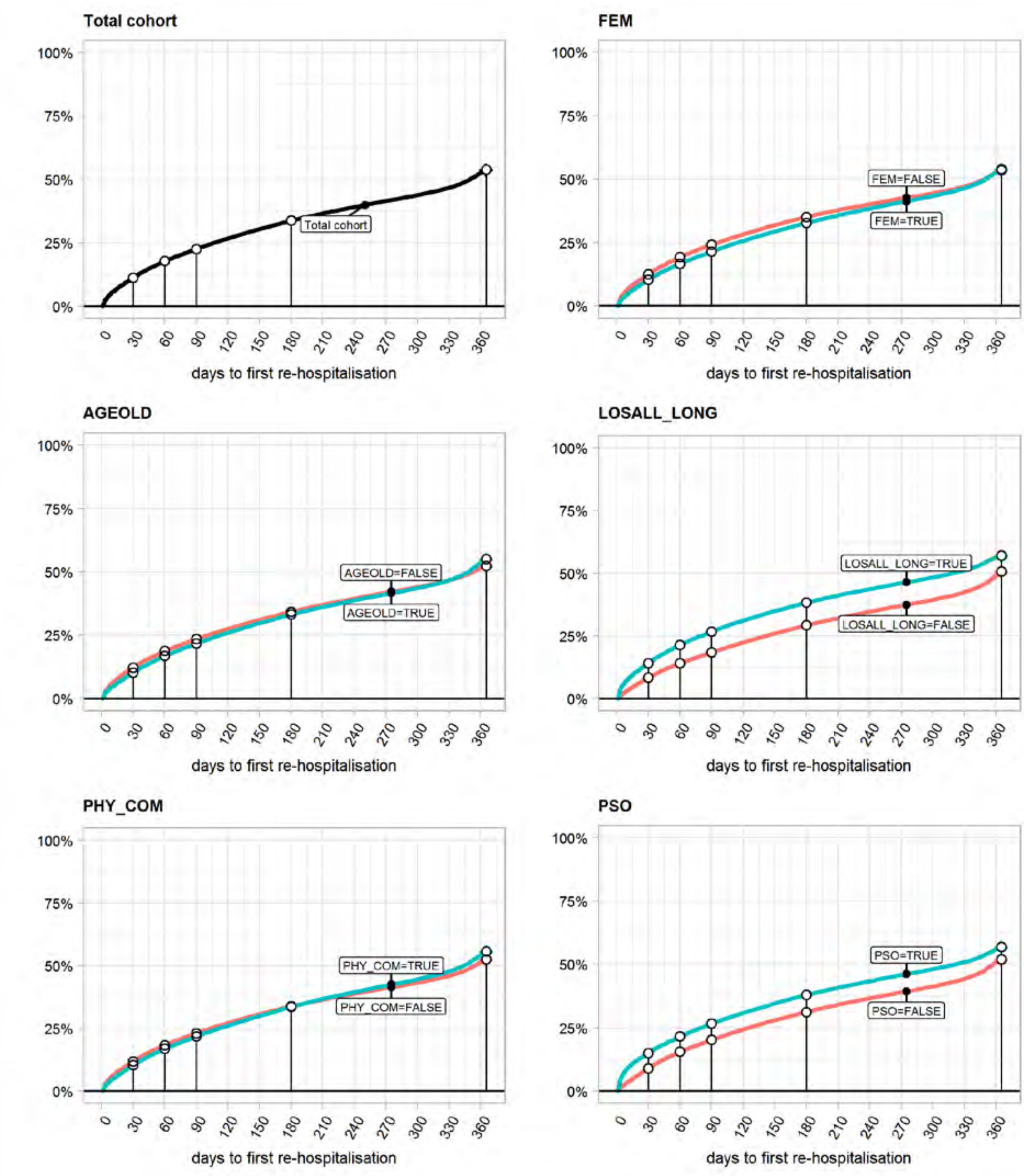
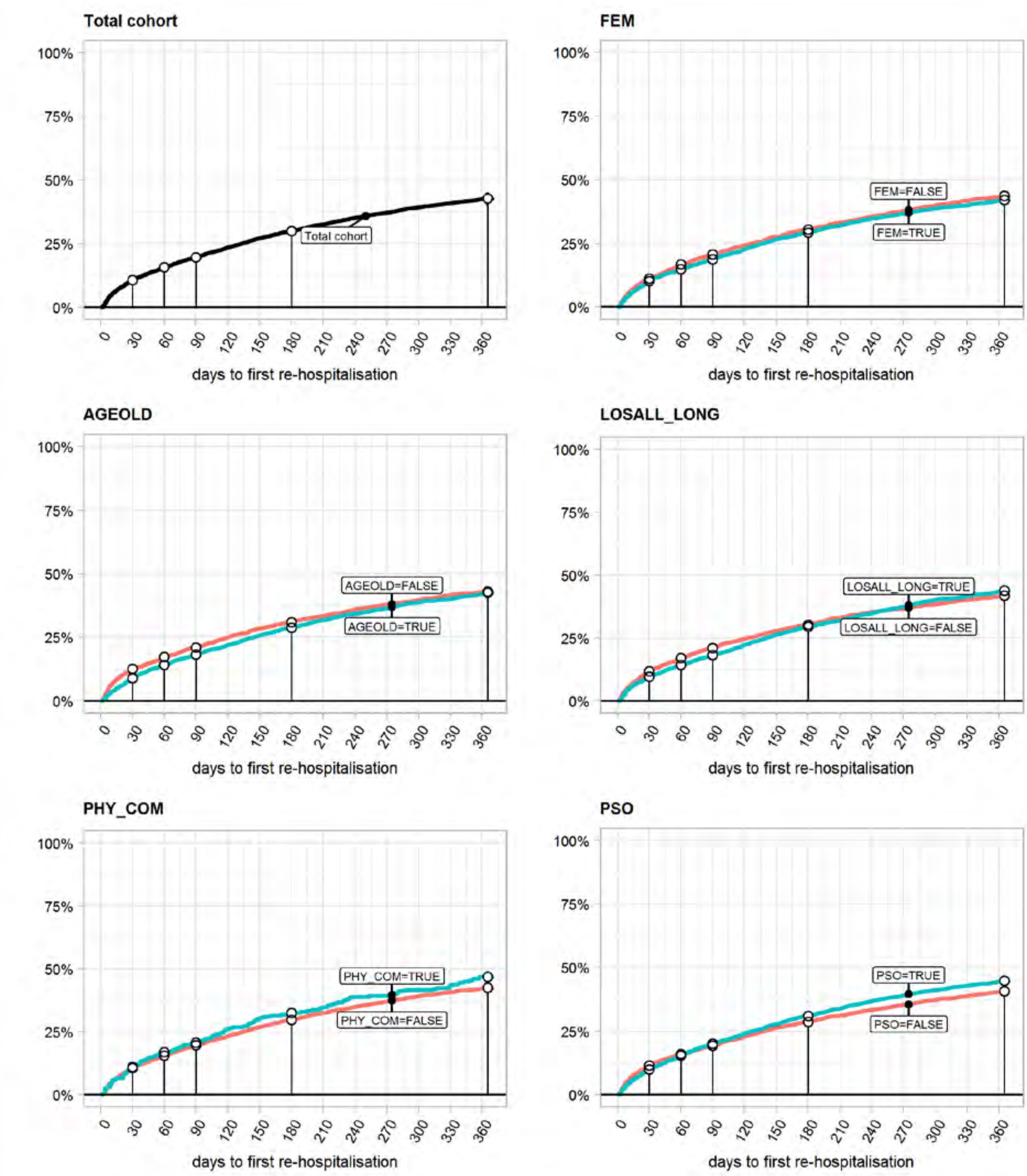


Figure 43: Cumulative rates for any type of first re-hospitalisation up to 365 days by patient-level demographic and clinical predictors in Slovenia

FEM = female gender, AGEOLD = age ≥ median, LOSALL_LONG = length of stay ≥ median, PHY_COM = at least one physical comorbidity diagnosis, PSO = diagnosis ICD-10 F2 or F30 or F31

Slovenia (study cohort: N=4.534): RHR for ANY-REHOS



3.1.3 Predicting re-hospitalisation by patient-level demographic and clinical baseline variables

As described in the Methods section (1) both multiple logistic regression and Cox-regression analyses were carried out, here with five predictors, two demographic (gender, age) and three clinical (length of stay, psychotic diagnosis, physical comorbidity). All predictor variables are used in a dichotomised format (see Methods section 1). Odds and hazard ratios are provided separately in two different tables, one for Austria, Italy, Romania and Slovenia (referred to here as "southern countries") and one for Finland and Norway (referred to as "northern countries"). As discussed in the methods and study cohort sections, Finland and Norway had to use a definition of length of stay, which is different from the protocol.

3.1.3.1 Multiple logistic regression analyses

Single level ("standard") regression analyses were carried out separately for 30 and 365 days follow-up periods, and for each of these two follow-up periods with the outcome measure "at least one psychiatric re-hospitalisation (PSY-REHOS)" on the one hand, and "at least one re-hospitalisation to any hospital (ANY-REHOS)" on the other. In the tables and figures below the term "at least one" is omitted for easier readability. No correction for multiple testing is applied. Odds ratios, confidence intervals and p-values are provided.

As was discussed in the Methods Section 1, the results of each country have to be regarded on their own and each country should be described on its own. We will only comment on some of the specific country results, but will focus mainly on comparing country results for specific predictors. Results for the northern countries Finland and Norway are presented in separate tables to underline the fact that, while all other variables are comparable with those of other countries, length of stay had to be defined differently in these countries.

Outcome: Psychiatric re-hospitalisation (LOGREG, PSY-REHOS)

a) 30 days psychiatric re-hospitalisation (PSY-REHOS 30d)

Table 12: Results of logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 30d RHR for southern Countries

Variable	AT N=21.839	IT N=63.419	RO N=101.834	SI N=4.536
FEM	1,02 (0,95-1,10)	0,97 (0,92-1,03)	0,80*** (0,77-0,84)	0,90 (0,73-1,12)
AGEOLD	0,81*** (0,75-0,87)	0,68*** (0,65-0,72)	0,87*** (0,83-0,91)	0,53*** (0,43-0,66)
LOSALL_LONG	0,97 (0,90-1,04)	0,93** (0,88-0,98)	2,23*** (2,12-2,34)	0,97 (0,79-1,21)
PSO	1,27*** (1,17-1,36)	1,09** (1,04-1,16)	2,27*** (2,16-2,38)	0,93 (0,75-1,16)
PHY_COM	0,80*** (0,74-0,86)	0,94 (0,87-1,02)	0,80*** (0,76-0,84)	0,89 (0,52-1,44)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

In southern countries, three predictors, old age, psychotic diagnosis and physical comorbidity have consistent effects, whereby old age and physical comorbidity decrease the 30d RHR in all countries, while psychotic diagnosis increases the 30d RHR in all but one country (no effect in Slovenia). Gender and length of stay show inconsistent effects. For Romania the odds ratios are very different from 1 and all are highly significant (the latter issue depending most probably on the very large number of patients in the Romanian study cohort).

Table 13: Results of logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 30d RHRs for northern countries

Variable	FI [(1)] N=16.814	NO [(1)] N=17.158
FEM	1,06 (0,96-1,17)	1,20*** (1,10-1,31)
AGEOLD	0,84*** (0,76-0,93)	0,79*** (0,72-0,85)
LOSALL_LONG FI, NO	0,67*** (0,61-0,74)	0,61*** (0,56-0,67)
PSO	1,14* (1,03-1,26)	1,45*** (1,33-1,58)
PHY_COM	1,11 (0,93-1,32)	1,07 (0,86-1,33)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

[(1)] Length of stay not comparable with other countries (see Section 2 Study Cohorts)

Northern countries show a slightly different pattern. While old age decreases and psychotic diagnosis increases the 30d RHR, physical comorbidity has practically no effect. However, long length of stay strongly decreases the 30d RHR. In Norway female gender increases the 30d RHR. In sum, the most consistent findings are that a) older age decreases the 30d RHR for PSY-REHOS and that b) a psychotic diagnosis increases the 30d RHR. The effect of gender is inconsistent across countries and generally rather small. On the basis of the findings above it cannot be determined whether the obvious differences between southern and northern countries in terms of the effect of length of stay are due to the different definitions of length of stay in northern countries.

b) 365 days psychiatric re-hospitalisation (PSY-REHOS 365d)

Table 14: Results of logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 365d RHR for southern countries

Variable	AT N=21.839	IT N=63.419	RO N=101.834	SI N=4.536
FEM	1,03 (0,97-1,09)	0,99 (0,96-1,03)	0,97* (0,94-0,99)	0,89 (0,78-1,01)
AGEOLD	0,87*** (0,82-0,92)	0,86*** (0,84-0,89)	1,05*** (1,03-1,08)	0,80*** (0,71-0,91)
LOSALL_LONG	1,08* (1,02-1,14)	1,04* (1,01-1,08)	1,40*** (1,37-1,44)	1,16* (1,02-1,32)
PSO	1,75*** (1,65-1,85)	1,24*** (1,20-1,28)	1,54*** (1,50-1,58)	1,50*** (1,32-1,71)
PHY_COM	0,96 (0,90-1,01)	0,96 (0,91-1,00)	1,03* (1,00-1,05)	1,05 (0,79-1,39)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

For both southern and northern countries, the pattern for 365d RHR is by and large the same as that found for the 30d RHR, however for some predictors less, for others more pronounced. Older age decreases the 365d RHR to a lesser degree than for the 30 RHR, while a psychotic diagnosis increases the 365d RHR to a much larger extent than it does for 30 days (again except for Romania). Concerning length of stay northern countries show the same effect of longer length of stay lowering the RHR, but less so for 365d than for 30d. Southern countries show the (mostly small) opposite effect. Finally, the effect of physical comorbidity is more inconsistent for 365d than for 30d. Gender shows inconsistent effects across all six countries as it already did for the 30d RHR.

Table 15: Results of logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 365d RHR for northern countries

Variable	FI [1] N=16.814	NO [1] N=17.158
FEM	1,05 (0,99-1,12)	1,17*** (1,10-1,25)
AGEOLD	0,97 (0,91-1,03)	0,87*** (0,82-0,92)
LOSALL_LONG FI, NO	0,81*** (0,76-0,87)	0,77*** (0,72-0,81)
PSO	1,48*** (1,38-1,58)	1,73*** (1,63-1,85)
PHY_COM	1,13* (1,01-1,26)	0,92 (0,78-1,07)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

[1] Length of stay not comparable with other countries (see Section 2 Study cohorts)

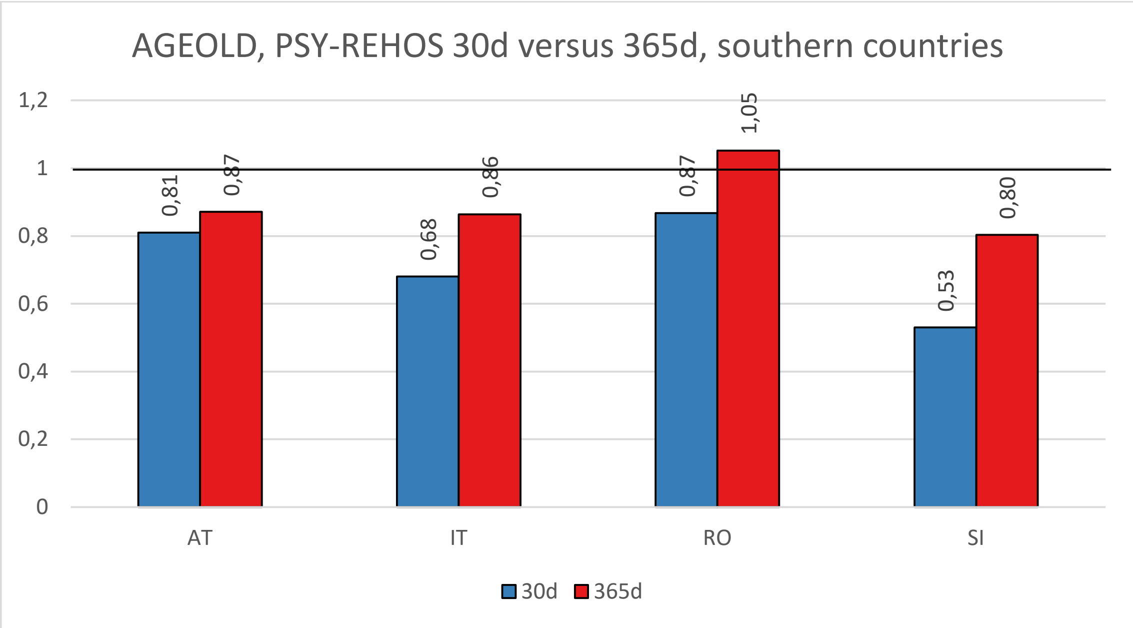
For 365d RHR the most consistent findings are that, with the notable exception of Romania, older age decreases RHR (but less so than for 30d) and that psychotic diagnosis increases RHR to an even larger extent than for 30d with the notable exception of Romania.

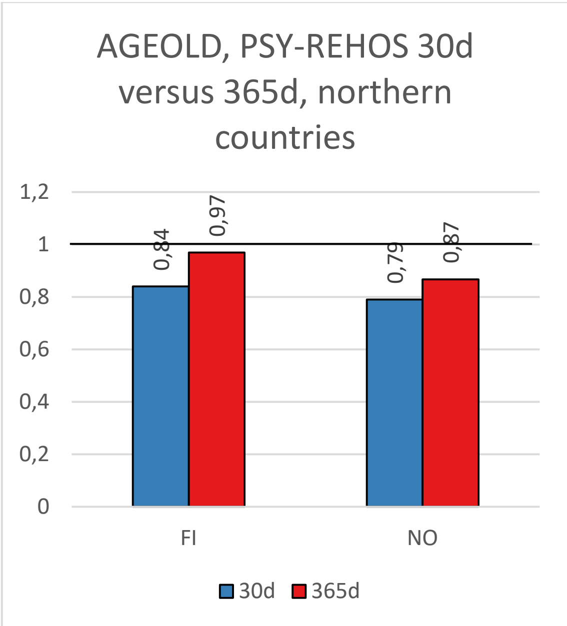
Gender has small and inconsistent effects again (as for 30d RHR). Longer length of stay decreases 365d RHR in northern countries but increases them in southern countries. The effect of physical comorbidity is small and inconsistent across countries.

c) Within country comparisons of 30 and 365 days psychiatric re-hospitalisation (PSY-REHOS 30d vs. 365d)

The odds ratios in the tables above are shown in the figures below without confidence intervals and p-values for three selected predictors (old age, psychosis, physical comorbidity) in order to visualise differences between 30d and 365d psychiatric re-hospitalisation rates. As a rule the 365 day odds ratios for AGEOLD are below one but less so than for 30 days. In contrast, for psychotic diagnosis they are above one, but (except for Romania) considerably higher than for 30 days. For physical comorbidity the picture is less consistent for psychiatric re-hospitalisation.

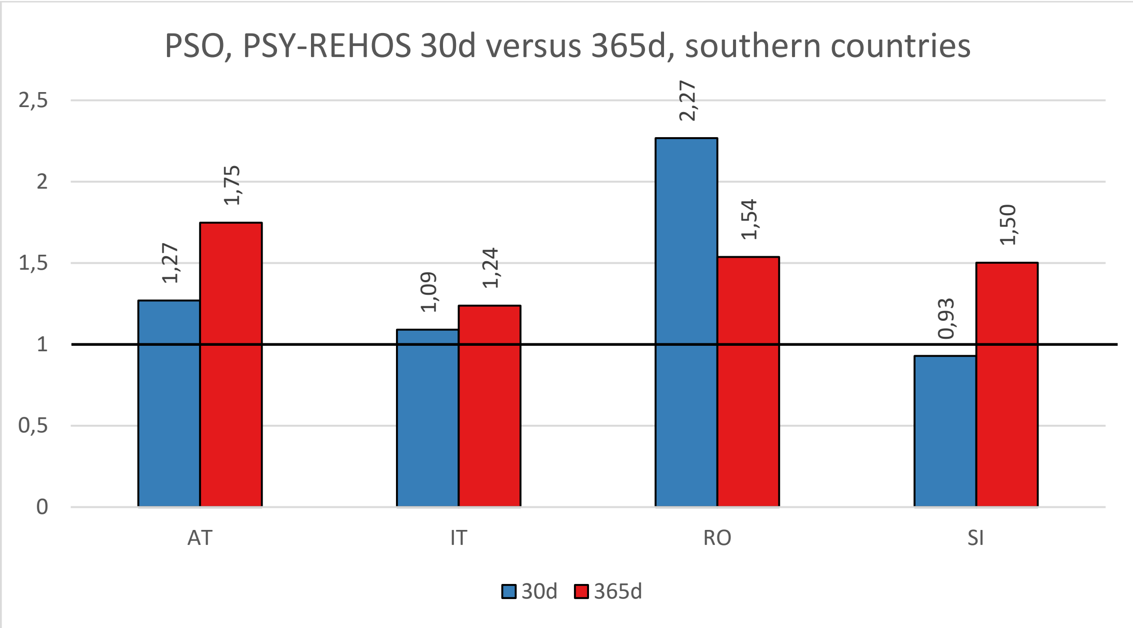
Figure 44: Age (AGEOLD) - Psychiatric re-hospitalisations 30d versus 365d

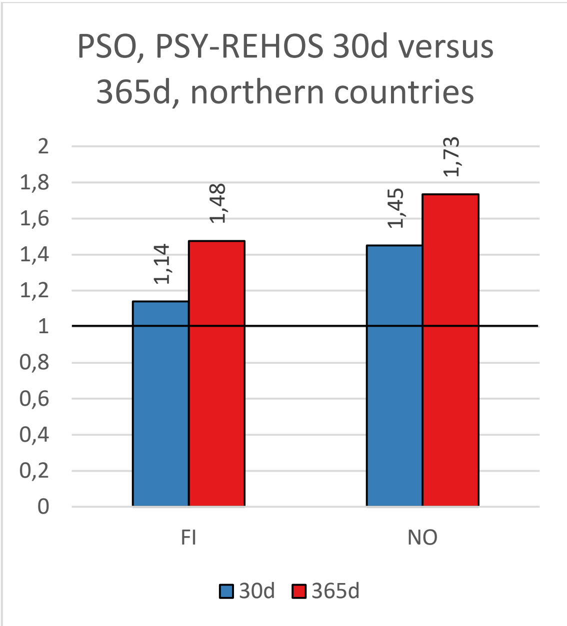




Except for Romania the effect of AGEOLD on reducing re-hospitalisation rates remains, but odds ratios deviate less from odds ratio 1.

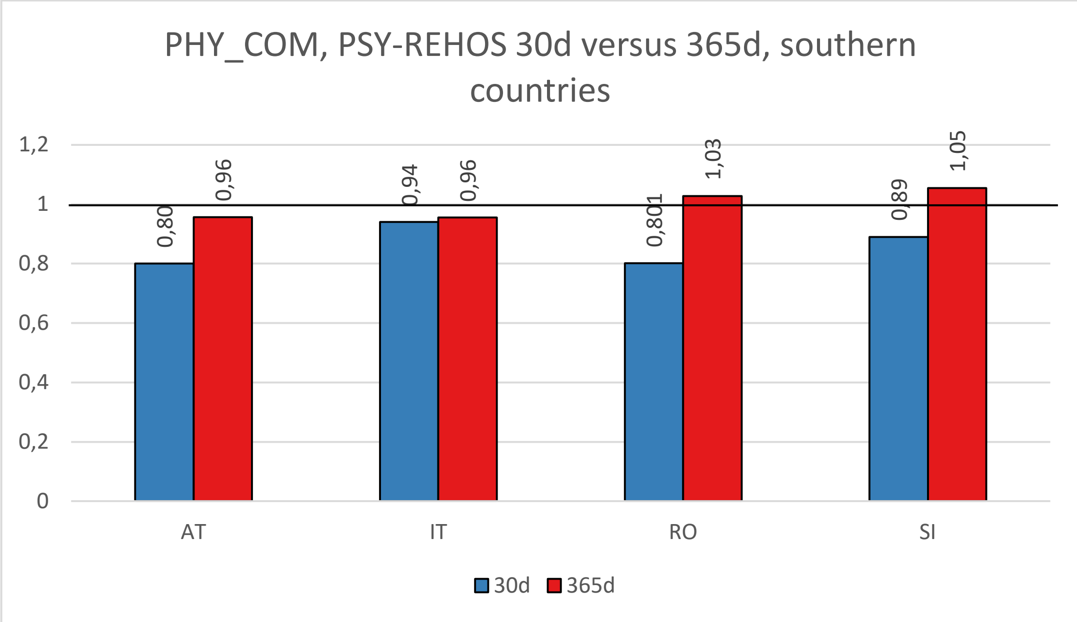
Figure 45: Psychotic diagnosis (PSO) - Psychiatric re-hospitalisations 30d versus 365d

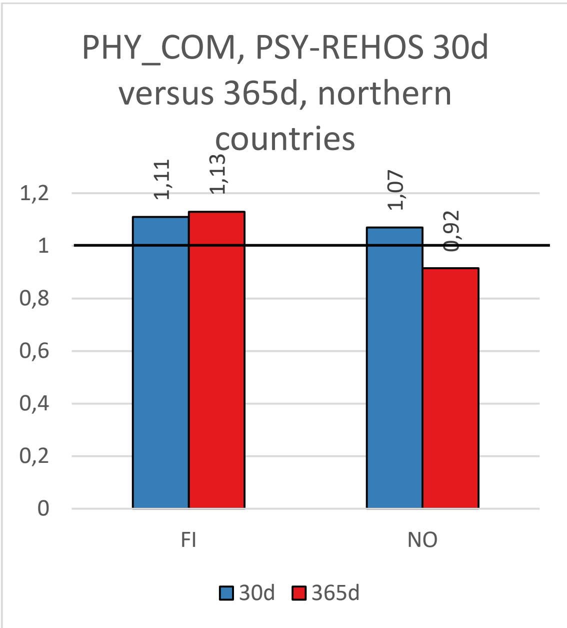




Except for Romania all countries show the same pattern for 30d and 365d, i.e., a psychotic diagnosis increased the psychiatric re-hospitalisation rates, and does clearly more so for the 365d follow-up period than for the 30d period.

Figure 46: Physical comorbidity (PHY_COM) - Psychiatric re-hospitalisations 30d versus 365d





For the 30 to 365d differences the physical comorbidity variable shows less consistent results as can be seen above.

In Table 16 the results for the multiple logistic regression analyses are schematically summarised, showing that, in general, AGEOLD decreases psychiatric re-hospitalisation rates (more so for 30 than for 365 days), and a psychotic diagnosis at the index discharge increases psychiatric re-hospitalisation rates (more so for 365 days than for 30 days).

Table 16: Comparisons of effects of five person level predictors on psychiatric re-hospitalisation effect in a single level multiple logistic regression across countries

0 = odds ratios near 1 in all/most countries,
+ = odds ratios clearly above 1 in all/most countries, ++ = odds ratios strongly above 1 in all/most countries
- = odds ratios clearly below 1 in all/most countries, -- = odds ratios strongly below 1 in all/most countries

	RHR PSY-REHOS in southern countries		RHR PSY-REHOS in northern countries	
30/365d	**30d**	**365d**	**30d**	**365d**
FEM	**0**	**0**	**0**	**0**
AGEOLD	**- -**	**-**	**- -**	**-**
LOSLONG_ALL	**0**	**0**	**- -**	**-**
PSO	**+**	**++**	**+**	**++**
PHY_COM	**-**	**0**	**0**	**0**

Outcome: Any type of re-hospitalisation (LOGREG, ANY-REHOS)

a) 30 days any type of re-hospitalisation (ANY-REHOS 30d)

Table 17: Results of logistic regression for outcome any type of re-hospitalisation (ANY-REHOS) for 30 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

ANY-REHOS 30d RHR for southern countries

Variable	**AT N=21.839**	**IT N=63.419**	**RO N=101.834**	**SI N=4.536**
FEM	1,01 (0,95-1,08)	0,95 (0,91-1,00)	0,85*** (0,82-0,89)	0,94 (0,78-1,14)
AGEOLD	0,88*** (0,82-0,94)	0,80*** (0,76-0,84)	0,96 (0,92-1,00)	0,68*** (0,56-0,83)
LOSALL_LONG	1,04 (0,97-1,10)	0,91*** (0,86-0,95)	1,69*** (1,62-1,76)	0,84 (0,69-1,02)
PSO	1,10** (1,03-1,17)	1,03 (0,98-1,08)	1,64*** (1,57-1,71)	0,86 (0,71-1,05)
PHY_COM	1,04 (0,97-1,11)	1,11** (1,03-1,19)	0,99 (0,95-1,03)	1,12 (0,72-1,66)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

The pattern of odds ratios for 30 day ANY-REHOS RHR is similar to that for 30 day PSY-REHOS, at least concerning the direction of the effect but not necessarily the size of the effect.

Table 18: Results of logistic regression for outcome any type of re-hospitalisation (ANY-REHOS) for 30 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

ANY-REHOS 30d RHR for northern countries

Variable	**FI (1) N=16.814**	**NO (1) N=17.158**
FEM	1,05 (0,96-1,15)	1,19*** (1,09-1,29)
AGEOLD	1,06 (0,96-1,16)	0,91* (0,84-0,98)
LOSALL_LONG FI, NO	0,69*** (0,63-0,75)	0,63*** (0,58-0,68)
PSO	1,01 (0,92-1,11)	1,26*** (1,16-1,36)
PHY_COM	1,50*** (1,29-1,73)	1,28* (1,05-1,56)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

b) 365 days any type of re-hospitalisation (ANY-REHOS 365d)

Table 19: Results of logistic regression for outcome any type of re-hospitalisation (ANY-REHOS) for 365 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

ANY-REHOS 365d RHR for southern countries

Variable	AT N=21.839	IT N=63.419	RO N=101.834	SI N=4.536
FEM	1,07* (1,01-1,13)	0,99 (0,96-1,02)	1,02 (0,99-1,04)	0,95 (0,85-1,08)
AGEOLD	1,15*** (1,09-1,22)	1,06*** (1,02-1,09)	1,16*** (1,13-1,19)	0,99 (0,88-1,12)
LOSALL_LONG	1,03 (0,97-1,09)	1,00 (0,97-1,03)	1,25*** (1,22-1,29)	1,05 (0,93-1,18)
PSO	1,25*** (1,18-1,33)	1,08*** (1,04-1,11)	1,28*** (1,25-1,32)	1,17* (1,03-1,32)
PHY_COM	1,30*** (1,23-1,38)	1,16*** (1,11-1,22)	1,17*** (1,14-1,20)	1,21 (0,94-1,58)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 20: Results of logistic regression for outcome any type of re-hospitalisation (ANY-REHOS) for 365 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

ANY-REHOS 365d RHR for northern countries

Variable	FI (1) N=16.814	NO (1) N=17.158
FEM	1,10** (1,03-1,17)	1,23*** (1,15-1,31)
AGEOLD	1,26*** (1,19-1,34)	1,06 (0,99-1,12)
LOSALL_LONG FI, NO	0,81*** (0,76-0,86)	0,77*** (0,73-0,82)
PSO	1,21*** (1,14-1,29)	1,34*** (1,26-1,43)
PHY_COM	1,52*** (1,36-1,70)	1,31** (1,11-1,54)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

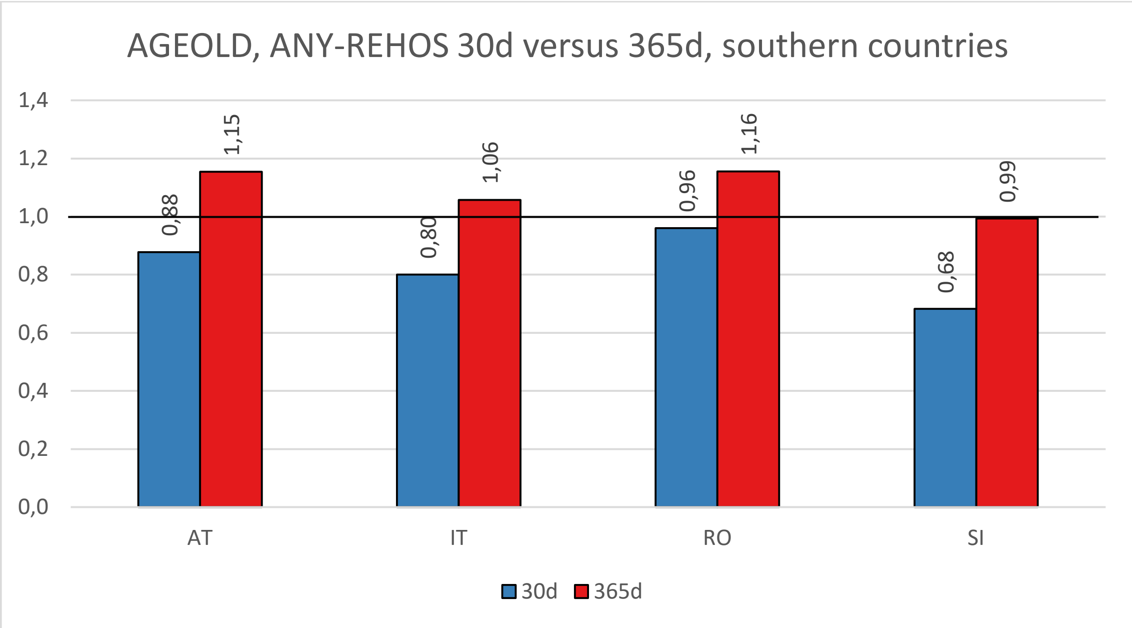
(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

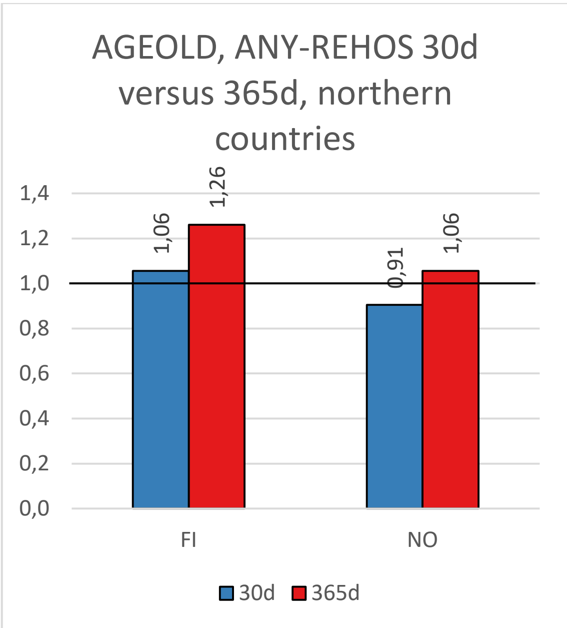
For 365d re-hospitalisation to any hospital the RHR are increased for older age (apart from Slovenia) and for physical comorbidity in all countries, which makes sense for the ANY-REHOS outcome measure. Since in ANY-REHOS also psychiatric re-hospitalisations are included, it is plausible that the effect of main psychotic diagnosis (increased RHR) also shows in the ANY-REHOS outcome measure (it is also generally larger than for 30 days). For length of stay findings are inconsistent for southern countries, for northern countries the effect is the same as found so far in all outcome measures: long length of stay decreases RHR. For gender again no consistent effect exists across countries.

c) Within country comparisons of 30 and 365 days of any re-hospitalisation (ANY-REHOS 30d vs. 365d)

The odds ratios in the tables above are shown in the figures below without confidence intervals and p-values for three selected predictors (old age, psychosis, physical comorbidity) in order to visualise differences between 30d and 365d re-hospitalisation rates to any type of hospital.

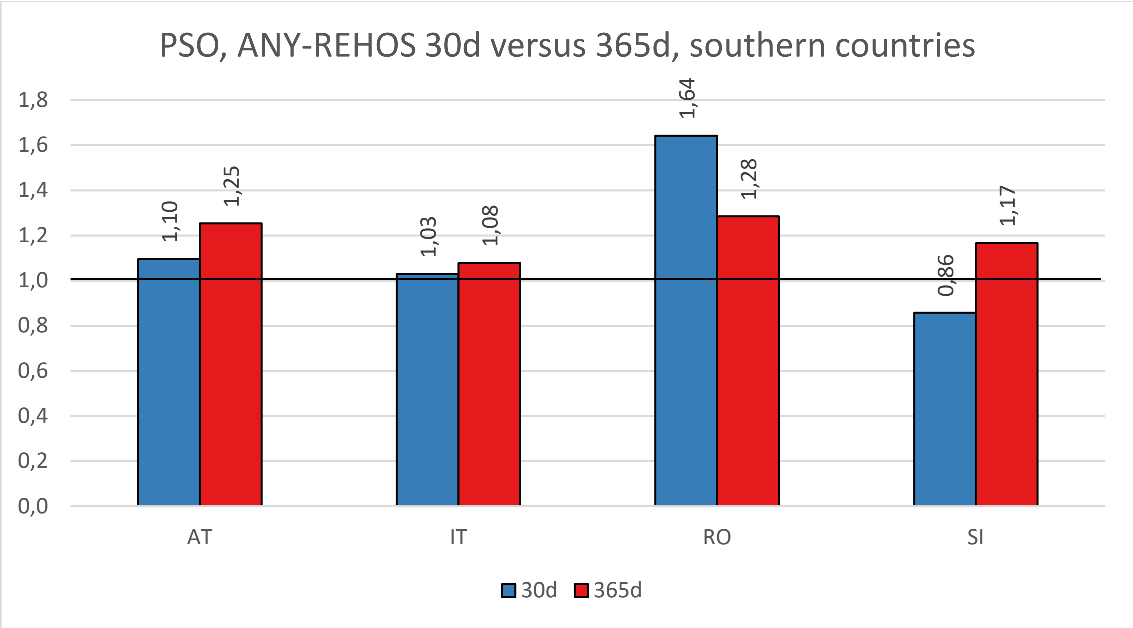
Figure 47: Age (AGEOLD) - Any type of re-hospitalisation 30d versus 365d

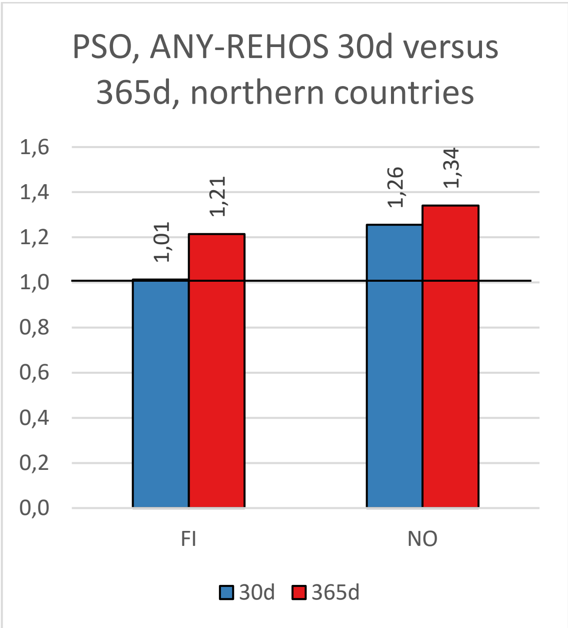




The largely negative effect of old age on re-hospitalisation rates found for 30 days disappears or even becomes slightly positive for 365 days.

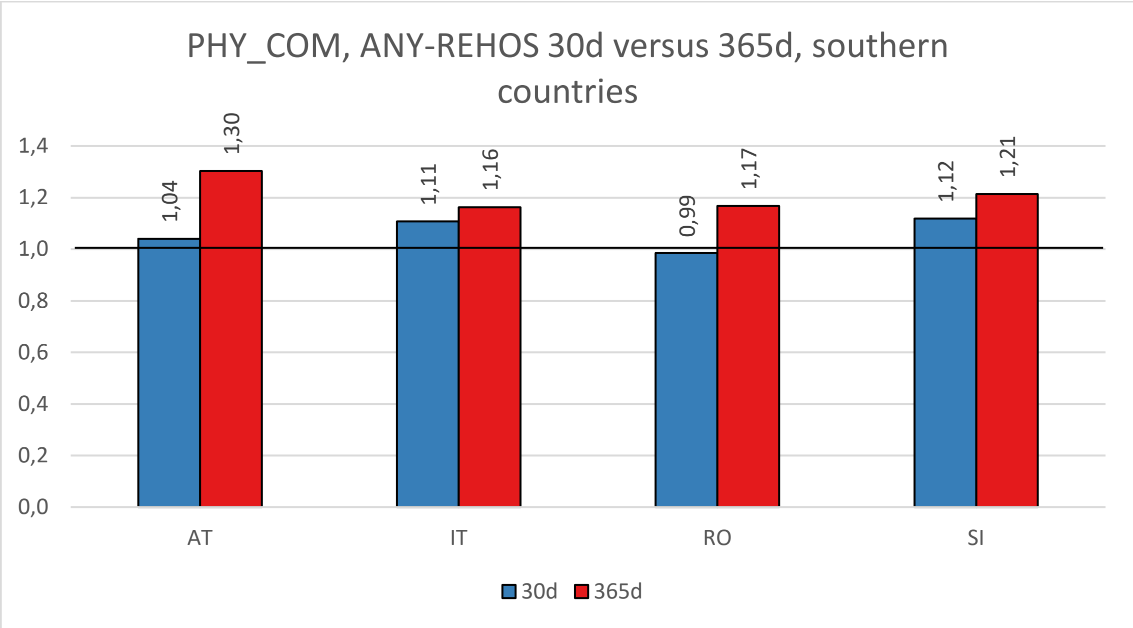
Figure 48: Psychotic diagnosis (PSO) - Any type of re-hospitalisation 30d versus 365d

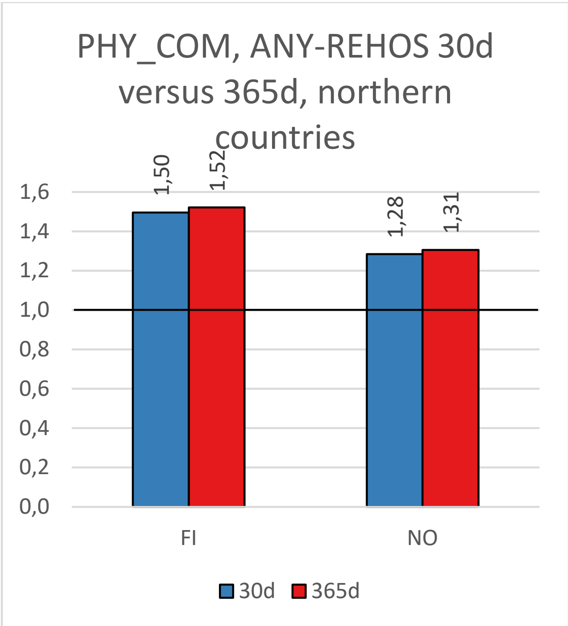




Except for Romania the effect of a psychotic diagnosis is slightly increased for 365 days in relation to 30 days.

Figure 49: Physical comorbidity (PHY_COM) - Any type of re-hospitalisation 30d versus 365d





Physical comorbidity increases re-hospitalisation rates for any type of rehospitalisation in all countries, and the effect is slightly larger for 365 days than for 30 days.

3.1.3.2 Cox regression analyses

Cox regression analyses were all carried out for the 365 days follow-up period.

Outcome: Psychiatric re-hospitalisation (COXREG, PSY-REHOS 365d)

Table 21: Results of Cox regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Reported are hazard ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 365d for southern countries

Variable	AT N=21.839	IT N=63.419	RO N=101.834	SI N=4.536
FEM	1,03 (0,98-1,07)	0,99 (0,97-1,02)	0,96*** (0,94-0,97)	0,91 (0,82-1,01)
AGEOLD	0,89*** (0,85-0,93)	0,88*** (0,85-0,90)	1,01 (0,99-1,03)	0,83*** (0,75-0,92)
LOSALL_LONG	1,04 (1,00-1,09)	1,02 (1,00-1,05)	1,36*** (1,34-1,39)	1,11 (1,00-1,23)
PSO	1,49*** (1,43-1,56)	1,18*** (1,15-1,21)	1,42*** (1,40-1,45)	1,37*** (1,23-1,52)
PHY_COM	0,95* (0,90-0,99)	0,96 (0,93-1,00)	1,00 (0,98-1,01)	1,03 (0,82-1,29)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 22: Results of Cox regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Reported are hazard ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 365d for northern countries

Variable	FI [(1)] N=16.814	NO [(1)] N=17.158
FEM	1,04 (0,99-1,09)	1,13*** (1,08-1,18)
AGEOLD	0,97 (0,93-1,02)	0,90*** (0,86-0,94)
LOSALL_LONG FI, NO	0,82*** (0,78-0,86)	0,79*** (0,75-0,82)
PSO	1,35*** (1,28-1,42)	1,47*** (1,41-1,54)
PHY_COM	1,10* (1,01-1,20)	0,96 (0,85-1,07)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

[(1)] Length of stay not comparable with other countries (see Section 2 Study cohorts)

The first psychiatric re-hospitalisation hazard ratios for the Cox regression analyses (Table 21 and Table 22) are very similar to (sometimes identical with) the odds ratios for the respective logistic regressions. The only exception is “psychotic diagnosis”, where hazard ratios (except for Romania) are consistently smaller (but still above 1) than those found for the logistic regressions. For any type of re-hospitalisation basically the same is true (hazard ratios and odds ratios are very similar) with the additional exception that also the effect of physical comorbidity and older age gets smaller here.

Outcome: Any type of re-hospitalisation (COXREG, ANY-REHOS)

Table 23: Results of Cox regression for outcome any type of re-hospitalisation (ANY-REHOS) for 365 days follow-up. Reported are hazard ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

ANY-REHOS 365d for southern countries

Variable	AT N=21.839	IT N=63.419	RO N=101.834	SI N=4.536
FEM	1,04* (1,00-1,08)	0,99 (0,96-1,01)	0,99 (0,97-1,01)	0,96 (0,88-1,06)
AGEOLD	1,06** (1,02-1,10)	1,02 (1,00-1,05)	1,08*** (1,06-1,10)	0,97 (0,89-1,06)
LOSALL_LONG	1,02 (0,98-1,06)	0,99 (0,97-1,02)	1,23*** (1,21-1,25)	1,01 (0,92-1,11)
PSO	1,14*** (1,10-1,18)	1,06*** (1,03-1,08)	1,22*** (1,20-1,24)	1,11* (1,01-1,22)
PHY_COM	1,15*** (1,11-1,20)	1,12*** (1,08-1,16)	1,09*** (1,07-1,11)	1,15 (0,95-1,39)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 24: Results of Cox regression for outcome any type of re-hospitalisation (ANY-REHOS) for 365 days follow-up. Reported are hazard ratios and the respective 95%-confidence intervals (in brackets): FI, NO

ANY-REHOS 365d for northern countries

Variable	FI (1) N=16.814	NO (1) N=17.158
FEM	1,06** (1,02-1,11)	1,14*** (1,10-1,19)
AGEOLD	1,17*** (1,12-1,23)	1,02 (0,98-1,07)
LOSALL_LONG FI, NO	0,83*** (0,80-0,87)	0,80*** (0,77-0,84)
PSO	1,14*** (1,09-1,19)	1,21*** (1,17-1,26)
PHY_COM	1,33*** (1,24-1,43)	1,19*** (1,08-1,31)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

3.2 Contextual predictors: Adding NUTS 3 characteristics of patients' place of residence

As discussed already in Section 1 Methods and 2 Study cohorts it was possible (with some minor exceptions) to allocate patients' residence in each country to NUTS 3 regions. Smaller geographical units would have been desirable, but were not available in all countries. For urbanicity, patients were divided into three categories: predominantly urban, intermediate and predominantly rural. To capture the economic status of a region, each patient was assigned the value of his/her residency's NUTS 3 region for per capita GDP measured in thousand purchasing power standard (PPS).

3.2.1 Re-hospitalisation rates for 30 and 365 days

Since some patients could not be allocated to a NUTS 3 region the study cohorts are slightly different for some countries. Therefore, parts 3.2.1 and 3.2.2 present the re-hospitalisation rates for the new study cohorts. Only tables are shown, since figures for the total population are not very different from those shown above in 3.1.2 for the study cohort used for the five pre-discharge predictors.

Table 25: Re-hospitalisation rates for 30 and 365 days: a) psychiatric re-hospitalisation (PSY-REHOS) and b) any type of re-hospitalisation (ANY-REHOS)

Country	Study cohort	Re-hospitalisation Rates			
		PSY-REHOS		ANY-REHOS	
		30 days	365 days	30 days	365 days
Austria	20.604	16,60%	40,34%	24,27%	58,53%
Finland	16.680	10,37%	40,08%	13,14%	50,20%
Italy	63.418	9,83%	35,60%	11,45%	42,98%
Norway	17.147	15,22%	47,86%	18,03%	58,32%
Romania	101.834	8,47%	45,68%	11,22%	53,81%
Slovenia	4.497	8,56%	33,60%	10,65%	42,78%
CEPHOS-LINK	224.180	10,26%	41,85%	13,14%	51,04%

3.2.2 Cumulative percentages for first re-hospitalisation rates up to 365 days

Table 26: Cumulative rates of psychiatric re-hospitalisation (PSY-REHOS) for 30, 60, 90, 180 and 365 days

Country	Study cohort	PSY-REHOS				
		30 days	60 days	90 days	180 days	365 days
Austria	20.604	16,60%	20,98%	24,15%	31,19%	40,34%
Finland	16.680	10,37%	16,70%	21,29%	30,20%	40,08%
Italy	63.418	9,83%	14,67%	18,13%	25,92%	35,60%
Norway	17.147	15,22%	22,75%	27,99%	37,92%	47,86%
Romania	101.834	8,47%	13,61%	17,49%	26,69%	45,68%
Slovenia	4.497	8,56%	12,74%	15,74%	23,88%	33,60%

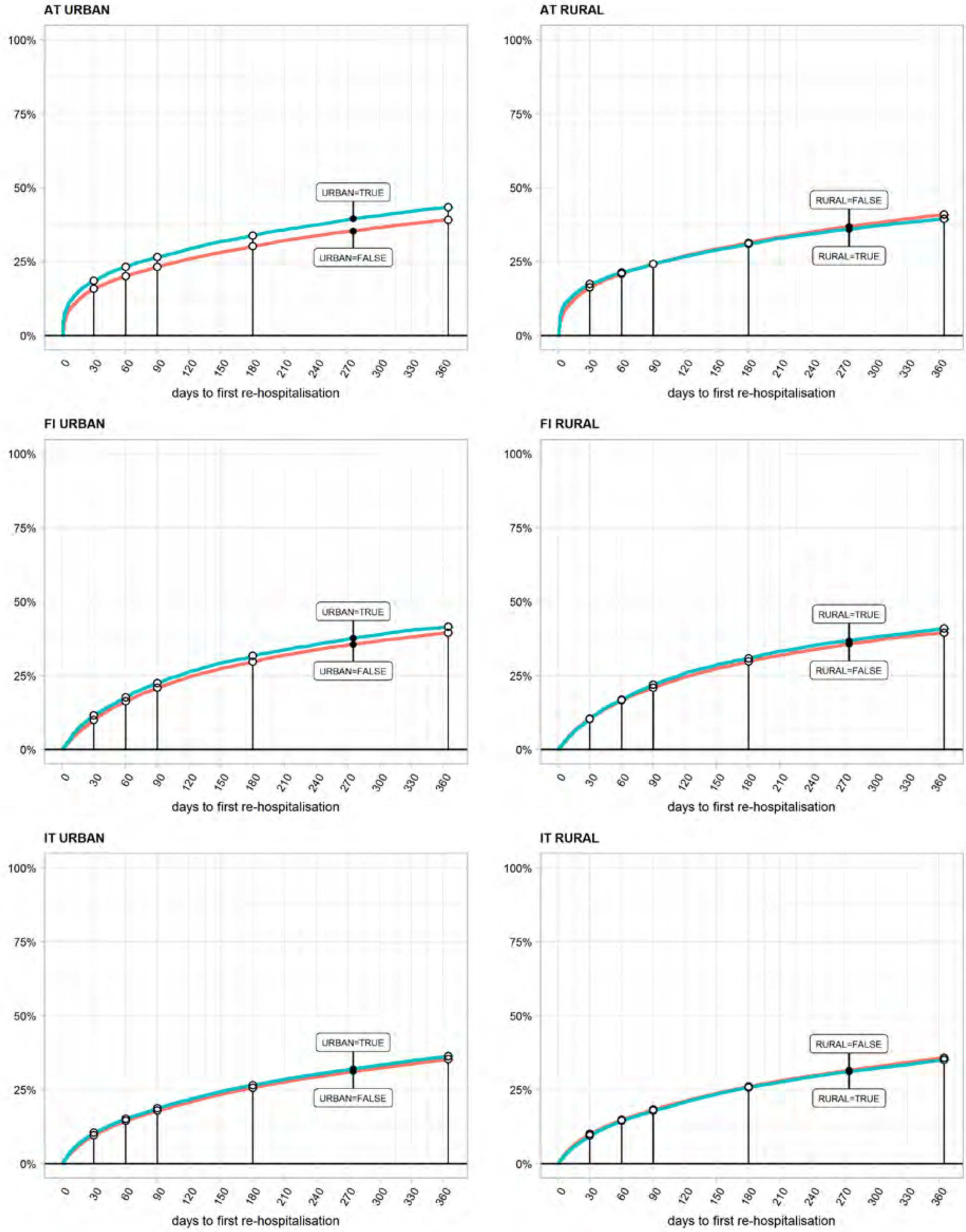
Table 27: Cumulative rates of any type of re-hospitalisation (ANY-REHOS) for 30, 60, 90, 180 and 365 days

Country	Study cohort	ANY-REHOS				
		30 days	60 days	90 days	180 days	365 days
Austria	20.604	24,27%	31,03%	35,90%	46,08%	58,53%
Finland	16.680	13,14%	20,86%	26,73%	37,96%	50,20%
Italy	63.418	11,45%	17,28%	21,52%	31,03%	42,98%
Norway	17.147	18,03%	27,07%	33,52%	45,84%	58,32%
Romania	101.834	11,22%	17,74%	22,56%	33,71%	53,81%
Slovenia	4.497	10,65%	15,68%	19,61%	29,78%	42,78%

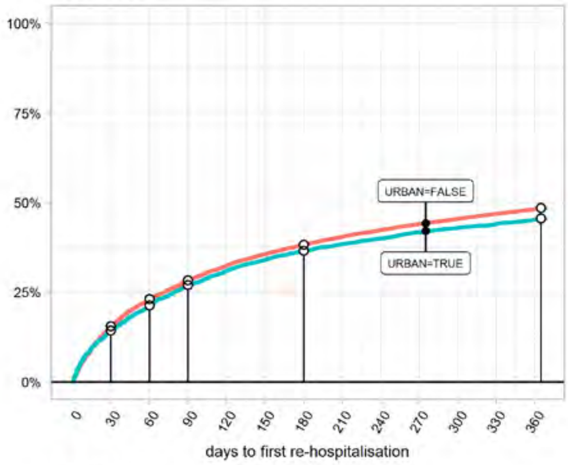
Below the cumulative psychiatric RHRs are shown graphically for the urbanicity variable (predominantly urban on the left side, predominantly rural on the right side) for all partner countries, As can be seen differences between urban and rural residence are very small.

Figure 50: Cumulative psychiatric re-hospitalisation rates up to 365 days by urbanicity by partner country
Urbanicity of the NUTS 3 region in which the patient is resident,
PU: predominantly urban, IN: intermediate, PR: predominantly rural
URBAN = predominantly urban vs. rest, RURAL = predominantly rural vs. rest

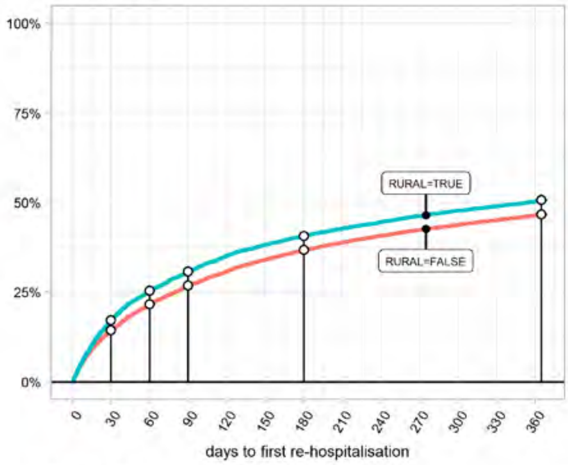
Austria (N=20.604), Finland (N=16.680), Italy (N=63.418)
Norway (N=17.147), Romania (N=101.834), Slovenia (N=4.497)



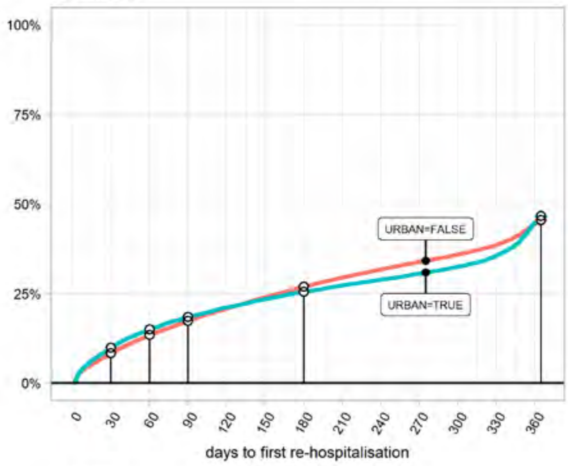
NO URBAN



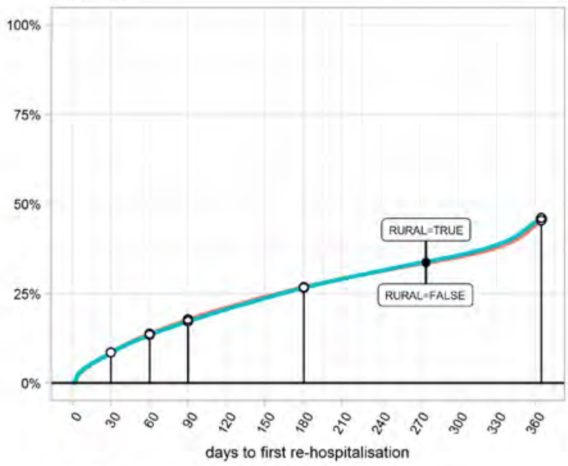
NO RURAL



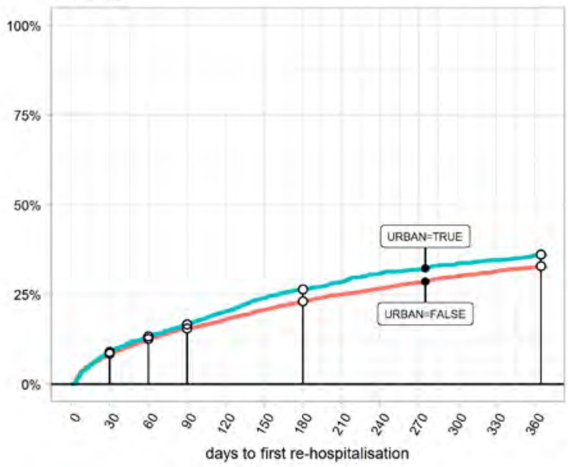
RO URBAN



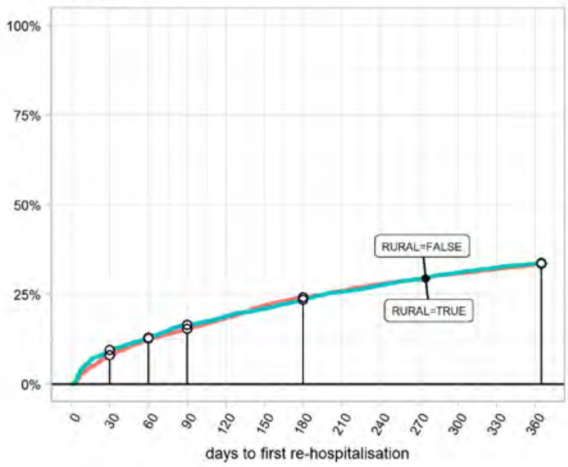
RO RURAL



SI URBAN



SI RURAL



3.2.3 Predicting psychiatric re-hospitalisation by adding the contextual variables Urbanicity and GDP to patient-level demographic and clinical variables

Below all variants of the multilevel logistic regression analysis are presented for PSY-REHOS for 30 and 365 days and each for predominantly urban and predominantly rural place of residence.

a) 30 days psychiatric re-hospitalisation (30 PSY-REHOS)

(i) VARIANT URBAN (PU versus IN + PR) for 30 PSY-REHOS

Table 28: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Variant URBAN (PU versus IN + PR). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 30d for southern countries

Variable	AT N=20.604	IT N=63.418	RO N=101.834	SI N=4.497
FEM	1,02 (0,94-1,10)	0,97 (0,92-1,02)	0,82*** (0,78-0,86)	0,90 (0,72-1,11)
AGEOLD	0,77*** (0,71-0,83)	0,68*** (0,64-0,72)	0,88*** (0,84-0,92)	0,54*** (0,44-0,68)
LOSALL_LONG	1,05 (0,97-1,13)	0,94* (0,89-0,99)	2,35*** (2,23-2,47)	0,98 (0,79-1,22)
PSO	1,39*** (1,29-1,51)	1,11*** (1,05-1,17)	2,24*** (2,13-2,36)	0,91 (0,73-1,13)
PHY_COM	0,82*** (0,75-0,89)	0,95 (0,88-1,03)	0,80*** (0,76-0,84)	0,95 (0,56-1,61)
URBAN	0,93 (0,54-1,60)	1,10 (0,99-1,23)	2,06 (0,94-4,52)	1,00 (0,39-2,57)
GDP	1,17 (0,94-1,45)	1,00 (1,00-1,01)	0,82 (0,62-1,08)	1,02 (0,69-1,52)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 29: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Variant URBAN (PU versus IN + PR). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 30d for northern countries

Variable	FI [(1)] N=16.680	NO [(1)] N=17.147
FEM	1,07 (0,96-1,18)	1,21*** (1,10-1,31)
AGEOLD	0,84*** (0,76-0,93)	0,79*** (0,72-0,86)
LOSALL_LONG FI, NO	0,68*** (0,61-0,75)	0,62*** (0,57-0,68)
PSO	1,15* (1,03-1,27)	1,45*** (1,33-1,58)
PHY_COM	1,12 (0,93-1,33)	1,08 (0,86-1,34)
URBAN	1,00 (0,54-1,85)	0,90 (0,65-1,25)
GDP	1,06 (0,84-1,34)	0,99 (0,87-1,12)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

[(1)] Length of stay not comparable with other countries (see Section 2 Study cohorts)

(ii) VARIANT RURAL (PR versus IN + PU) for 30 PSY-REHOS

Table 30: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Variant RURAL (PR versus IN + PU). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 30d for southern countries

Variable	**AT N=20.604**	**IT N=63.418**	**RO N=101.834**	**SI N=4.497**
FEM	1,02 (0,94-1,10)	0,97 (0,92-1,02)	0,82*** (0,78-0,86)	0,89 (0,72-1,10)
AGEOLD	0,77*** (0,71-0,83)	0,68*** (0,64-0,72)	0,88*** (0,84-0,92)	0,55*** (0,44-0,68)
LOSALL_LONG	1,05 (0,97-1,13)	0,93* (0,89-0,99)	2,35*** (2,23-2,47)	0,98 (0,79-1,21)
PSO	1,39*** (1,29-1,51)	1,11*** (1,05-1,17)	2,24*** (2,13-2,36)	0,91 (0,73-1,13)
PHY_COM	0,82*** (0,75-0,89)	0,95 (0,88-1,03)	0,80*** (0,76-0,84)	0,99 (0,59-1,67)
RURAL	1,38 (0,88-2,15)	0,95 (0,86-1,05)	1,04 (0,78-1,38)	1,31* (1,02-1,69)
GDP	1,27 (1,00-1,61)	1,00 (1,00-1,01)	1,00 (0,80-1,26)	1,11 (0,98-1,26)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 31: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 30 days follow-up. Variant RURAL (PR versus IN + PU). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 30d for northern countries

Variable	FI [(1)] N=16.680	NO [(1)] N=17.147
FEM	1,07 (0,96-1,18)	1,21*** (1,10-1,32)
AGEOLD	0,84*** (0,76-0,93)	0,78*** (0,72-0,85)
LOSALL_LONG FI, NO	0,67*** (0,61-0,75)	0,62*** (0,57-0,68)
PSO	1,15* (1,03-1,27)	1,45*** (1,33-1,58)
PHY_COM	1,12 (0,94-1,33)	1,07 (0,86-1,34)
RURAL	1,15 (0,93-1,42)	1,25** (1,07-1,46)
GDP	1,10 (0,95-1,27)	1,01 (0,93-1,10)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

b) 365 days psychiatric re-hospitalisation (365 PSY-REHOS)

(i) VARIANT URBAN (PU versus IN + PR) for 365 PSY-REHOS

Table 32: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Variant URBAN (PU versus IN + PR). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 365d for southern countries

Variable	AT N=20.604	IT N=63.418	RO N=101.834	SI N=4.497
FEM	1,03 (0,97-1,09)	1,00 (0,96-1,03)	0,96*** (0,93-0,98)	0,89 (0,78-1,01)
AGEOLD	0,85*** (0,80-0,91)	0,85*** (0,83-0,88)	1,04** (1,01-1,07)	0,80*** (0,71-0,91)
LOSALL_LONG	1,11*** (1,05-1,18)	1,05** (1,01-1,08)	1,50*** (1,47-1,54)	1,17* (1,02-1,33)
PSO	1,86*** (1,75-1,98)	1,25*** (1,21-1,30)	1,51*** (1,46-1,55)	1,49*** (1,30-1,69)
PHY_COM	0,97 (0,91-1,03)	0,95* (0,91-1,00)	1,06*** (1,03-1,09)	1,11 (0,82-1,50)
URBAN	1,01 (0,73-1,39)	1,07 (0,98-1,17)	1,69* (1,02-2,81)	1,08 (0,65-1,79)
GDP	1,14* (1,01-1,30)	1,00 (0,99-1,00)	0,80* (0,67-0,96)	1,02 (0,82-1,27)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 33: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Variant URBAN (PU versus IN + PR). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 365d for northern countries

Variable	FI (1) N=16.680	NO (1) N=17.147
FEM	1,06 (0,99-1,13)	1,17*** (1,10-1,25)
AGEOLD	0,97 (0,91-1,03)	0,86*** (0,81-0,92)
LOSALL_LONG FI, NO	0,82*** (0,76-0,87)	0,77*** (0,73-0,82)
PSO	1,50*** (1,40-1,60)	1,75*** (1,64-1,86)
PHY_COM	1,14* (1,02-1,27)	0,93 (0,79-1,09)
URBAN	0,85 (0,50-1,44)	0,87 (0,66-1,14)
GDP	1,11 (0,92-1,34)	0,99 (0,89-1,09)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

(ii) VARIANT RURAL (PR versus IN + PU) for 365 PSY-REHOS

Table 34: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Variant RURAL (PR versus IN + PU). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): AT, IT, RO, SI

PSY-REHOS 365d for southern countries

Variable	AT N=20.604	IT N=63.418	RO N=101.834	SI N=4.497
FEM	1,03 (0,97-1,09)	1,00 (0,96-1,03)	0,96*** (0,93-0,98)	0,89 (0,78-1,01)
AGEOLD	0,85*** (0,80-0,91)	0,85*** (0,83-0,88)	1,04** (1,01-1,07)	0,80*** (0,71-0,91)
LOSALL_LONG	1,11*** (1,05-1,18)	1,05** (1,01-1,08)	1,50*** (1,47-1,54)	1,16* 1,02-1,32)
PSO	1,86*** (1,75-1,98)	1,25*** (1,21-1,30)	1,51*** (1,46-1,55)	1,49*** (1,30-1,69)
PHY_COM	0,97 (0,91-1,03)	0,95* (0,91-1,00)	1,06*** (1,03-1,09)	1,13 (0,84-1,52)
RURAL	1,25 (0,96-1,63)	0,95 (0,88-1,03)	1,00 (0,83-1,20)	1,10 (0,93-1,29)
GDP	1,22** (1,06-1,41)	1,00 (0,99-1,00)	0,92 (0,79-1,07)	1,08 (1,00-1,17)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Table 35: Results of multilevel (with random intercept) logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 365 days follow-up. Variant RURAL (PR versus IN + PU). Reported are odds ratios and the respective 95%-confidence intervals (in brackets): FI, NO

PSY-REHOS 365d for northern countries

Variable	FI (1) N=16.680	NO (1) N=17.147
FEM	1,06 (0,99-1,12)	1,17*** (1,10-1,25)
AGEOLD	0,97 (0,91-1,03)	0,86*** (0,81-0,92)
LOSALL_LONG FI, NO	0,81*** (0,76-0,87)	0,77*** (0,73-0,82)
PSO	1,49*** (1,40-1,60)	1,75*** (1,64-1,86)
PHY_COM	1,14* (1,02-1,27)	0,92 (0,79-1,08)
RURAL	1,22* (1,03-1,44)	1,20** (1,05-1,36)
GDP	1,12 (1,00-1,27)	0,99 (0,92-1,07)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

(1) Length of stay not comparable with other countries (see Section 2 Study cohorts)

The main observation for adding the contextual predictors on a NUTS 3 level to the patient-level predictor is that overall – with small exceptions here and there – both urbanicity and GDP have no or only small effects on re-hospitalisation rates. Furthermore, in relation to the single level logistic regressions reported above practically no differences can be found for the odds ratio of any of the five demographic and clinical predictors. As was discussed earlier NUTS 3 regions might be too large for discovering differences, but data for a smaller level, such as county or municipalitiy were not available for all partner countries.

3.3 Continuity of care: Adding post-discharge psychiatric outpatient contacts as a predictor

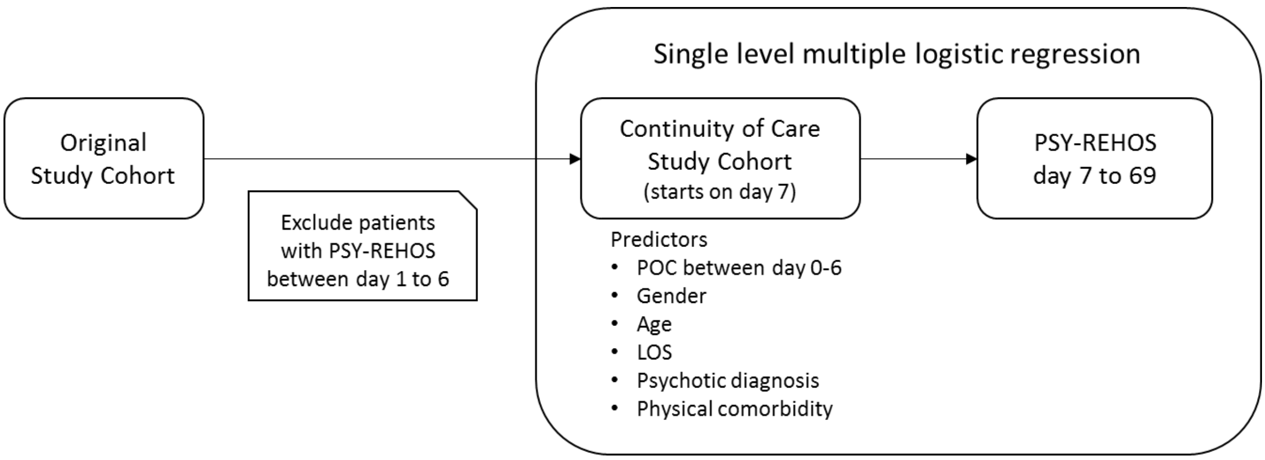
Of the original Austrian study cohort of the patient-level predictor study (21.839), 1.744 patients had no useable information on the date of the first post-discharge psychiatric outpatient contacts and were excluded, leaving 20.095 patients with valid dates for these psychiatric outpatient contacts. In Veneto for all 7.239 patients included in the patient-level predictors study dates for outpatient contacts were available. For Finland and Norway dates for the psychiatric outpatient contacts were available, but could not be included in time into the continuity of care analyses.

Two approaches were applied in order to analyse the potential effect of post-discharge psychiatric outpatient contacts on psychiatric rehospitalisation rates. For both approaches the first such post-discharge contact was identified and, given that proximity in time is essential for "continuity of care", the time period checked for these and for the first psychiatric rehospitalisation was limited with 70 days.

In a first approach two separate analyses were carried out, one for determining the cumulative percentages of the first psychiatric outpatient contacts (POC) and one on the cumulative percentages of first psychiatric re-hospitalisations.The results were iuxtaposed and compared in a graphical form (see 3.3.1 below).

In a second approach it was attempted to clarify the time relationship on a patient level between the first psychiatric outpatient contact and the first psychiatric re-hospitalisation. For this second approach all patients with a psychiatric re-hospitalisation during days 1-6 post-discharge were excluded (Austria: 1.835 = 9,1%, Veneto 180 = 2,5%), leaving 18.260 patients for Austria and 7.059 for Veneto) for a logistic regression analyses for the outcome "first psychiatric re-hospitalisation"ed for the continuity of care study cohort. For the logistic regression analyses over the subsequent 9 weeks the already applied five patient-level predictors were used, together with the first psychiatric outpatient contact on days 0 to 6 of the original study cohort, i.e. the new study cohort starting on day 7 was characterized according to whether a psychiatric outpatient contact had taken place in the week before day 7.The the study design of this second approach as presented already in the methods section is shown here again. For details see the methods section above.

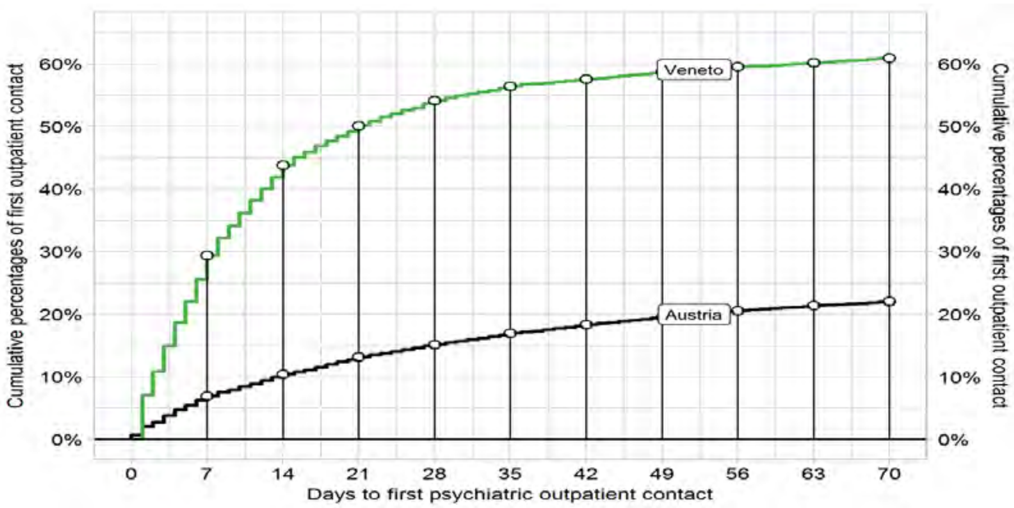
Figure 51: Derivation of the continuity of care study cohort for the single level multiple logistic regression



3.3.1 Comparing cumulative first psychiatric outpatient contacts and first psychiatric rehospitalisations – the “correlational approach”

The figures below on findings in the 70 days period post-dscharge demonstrate that Veneto has a much higher percentages of psychiatric outpatient contacts than Austria and a much lower percentages of psychiatric re-hospitalisations, whereas in Austra the pattern is exactly the opposite.

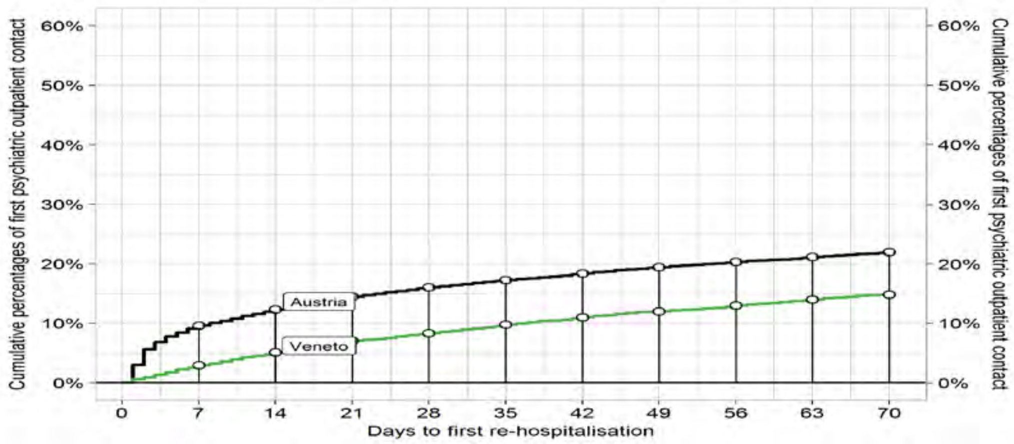
Figure 52: First psychiatric outpatient contact (ANYPOC) 70 days following the index discharge, cumulative percentages of patients in Study cohort 2 (Austria: N = 20.095, Veneto: N = 7.239)



Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	20.095	6,93%	10,42%	13,16%	15,17%	16,95%	18,33%	19,56%	20,55%	21,38%	22,05%
Veneto	7.239	29,37%	43,80%	50,15%	54,16%	56,44%	57,59%	58,74%	59,55%	60,20%	60,95%

Cumulative frequencies of first ANYPOC 70d

Figure 53: First psychiatric re-hospitlisation over 70 days following the index discharge, cumulative percentages of patients in study cohort 2 (Austria: N = 20.095, Veneto: N = 7.239)



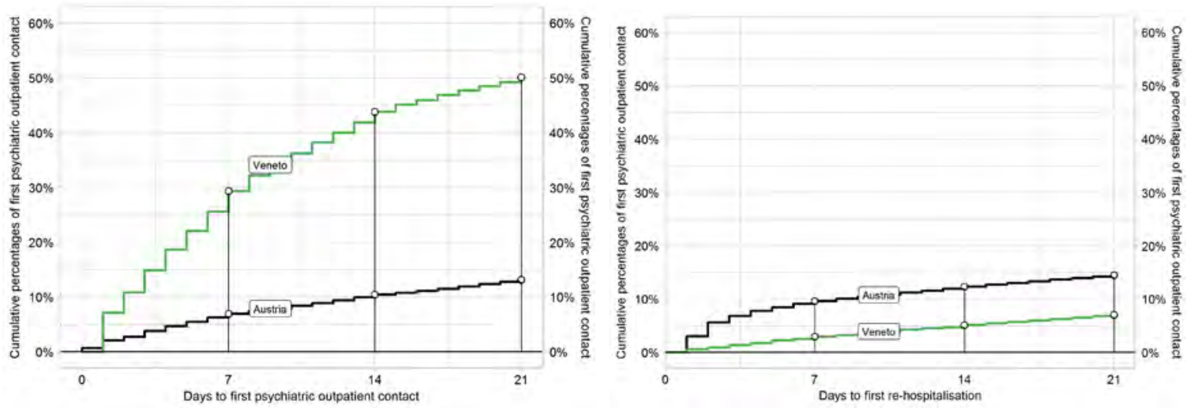
Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	20.095	9,62%	12,31%	14,49%	16,04%	17,25%	18,38%	19,43%	20,30%	21,12%	21,96%
Veneto	7.239	2,96%	5,10%	7,03%	8,34%	9,75%	11,00%	12,02%	12,97%	14,01%	14,79%

Cumulative frequencies of first PSY-REHOS 70d

These findings on a country/region level that low frequencies of post-discharge psychiatric outpatient contacts correlate with high re-hospitalisaton rates and vice versa suggests that psychiatric outpatient contacts may contribute to the prevention of re-hospitalisation – however such correlations on an aggregate level are no proof of causality – for this a pre-post desing would be more apprpopriate. It is possible, though, to zoom in on the first few weeks after discharge, since, after all, continuity of care only makes sense if the outpatient contacts take plase rather early on after the index discharge.

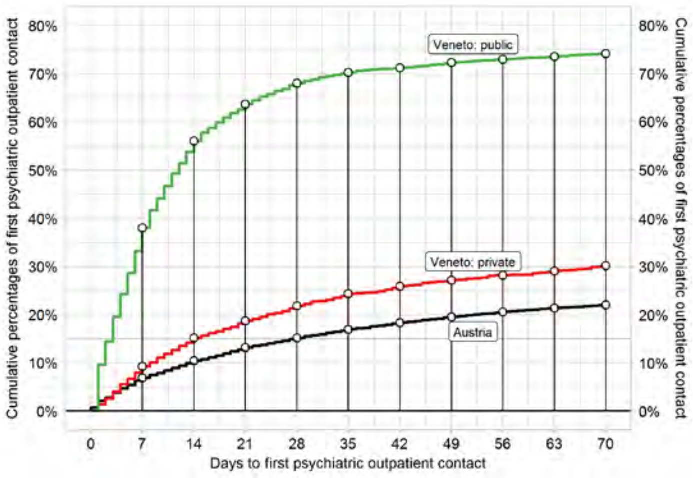
As can be seen in Figure 54 stretching over a 70 day period, the decisive difference in re-hospitalisation rates between Austria and Veneto occurs already in the first week after the index discharge, the week in which psychiatric outpatient contacts show a steep rise in Veneto, but are more or less negligeable in Austria. This becomes especially apparent if the first 3 weeks after the inex discharge are zoomed out (Figure 55). This narrow time grid finding is even more suggestive for a preventive effect of psychiatric outpatient contacts, but again not a definite prove.

Figure 54: First psychiatric re-hospitlisation over 21 days following the index discharge, cumulative percentages of patients in study cohort 2 (Austria: N = 20.095, Veneto: N = 7.239)



A futher specification of these correlational findings is possible for Veneto, where two systems of psychiatric hospital care exist. One system is the public system with small psychiatric departments in general hospital (Servizio Psichiatrico Dignosi e Cura) and integration into local community mental health care centers with catchment areas and high permeability between hospital and outpatient care on a local level. The second system consists of privately owned (but publicly funded) standalone specialist psychiatric hospitals (sometimes called “Casa di Cura”) which work on a larger geographical level without regular contact to outpatient services. These two systems also differ in terms of the diagnostic spectrum, with psychoses dominating in the public sector, and depression and personaliy disorders in the private sector, and also mostly in terms of planned admissions (Private hospitals usually have waiting lists, while the public hospitals also take acute and unplanned admissions). In Figure 56 to Figure 58 below the analyses performed for the total of Veneto are repeated separately for patients discharged form public (N=5.062) and from public (N=2.177) hospitals. The first finding is that for the public hospital cohort the percentages of early psychiatric outpatient contacts is higher than in the private hospital cohort, the latter being in fact near to the low figures found for Austria with its fragemented system between inpatient and outpatient care (Figure 56 and Figure 57). Re-hospitalisation rates are lower for private than than for public hospital cohorts, but the difference in re-hospitalisation rates between Austria (higher) and Veneto public is still substantial. No further attempt is made to interprete these observational findings, but the analyses are given as an example for which further important questions can arise when analysing linked observational data sets.

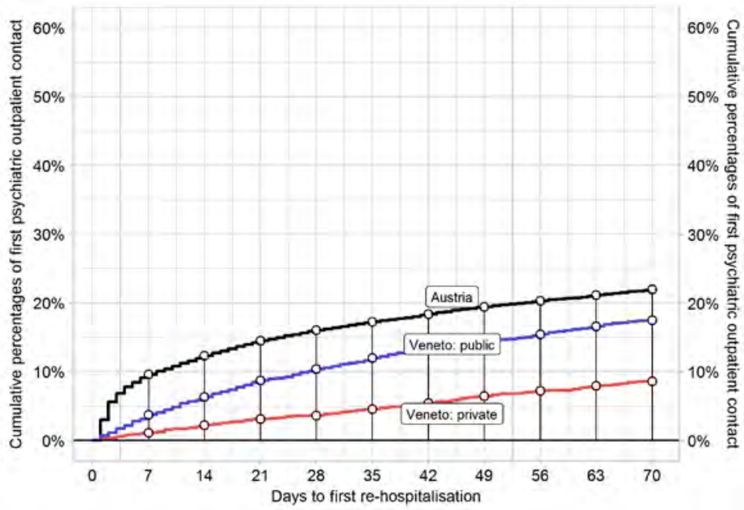
Figure 55: First psychiatric outpatient contact (ANYPOC) 70 days following the index discharge, cumulative percentages of patients in Study cohort 2 (Austria: N = 20.095, Veneto private: N = 2.177, Veneto public: N=5.062)



Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	20.095	6,93%	10,42%	13,16%	15,17%	16,95%	18,33%	19,56%	20,55%	21,38%	22,05%
Veneto pri	2.177	9,28%	15,20%	18,70%	21,86%	24,35%	25,91%	27,15%	28,20%	29,08%	30,18%
Venrto pub	5.062	38,01%	56,10%	63,67%	68,06%	70,25%	71,22%	72,32%	73,03%	73,59%	74,18%

Cumulative frequencies of first ANYPOC 70d

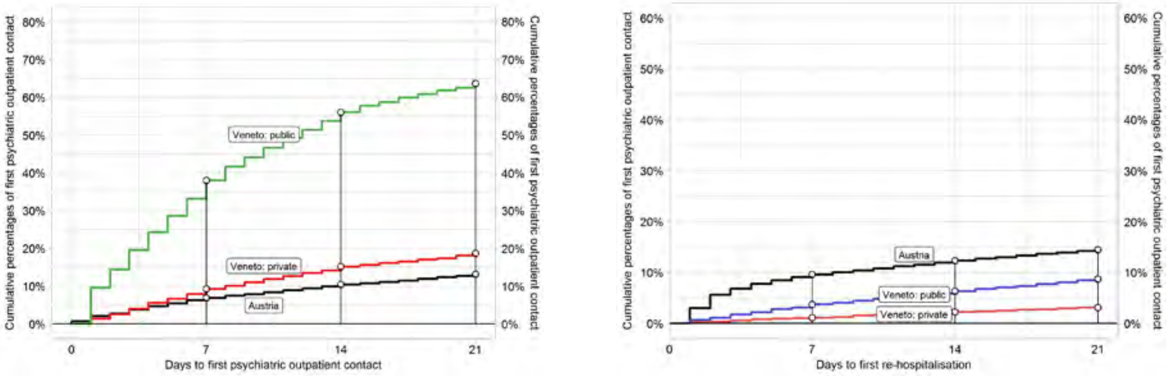
Figure 56: First psychiatric re-hospitalisation over 70 days following the index discharge, cumulative percentages of patients in study cohort 2 (Austria: N = 20.095, Veneto private: N = 2.177, Veneto public: N=5.062)



Country	N	7d	14d	21d	28d	35d	42d	49d	56d	63d	70d
Austria	20.095	9,62%	12,31%	14,49%	16,04%	17,25%	18,38%	19,43%	20,30%	21,12%	21,96%
Veneto:	2.177	1,10%	2,25%	3,12%	3,63%	4,55%	5,42%	6,43%	7,21%	7,95%	8,59%
Veneto:	5.062	3,75%	6,32%	8,71%	10,37%	11,99%	13,39%	14,42%	15,45%	16,61%	17,46%

Cumulative frequencies of first PSY-REHOS 70d

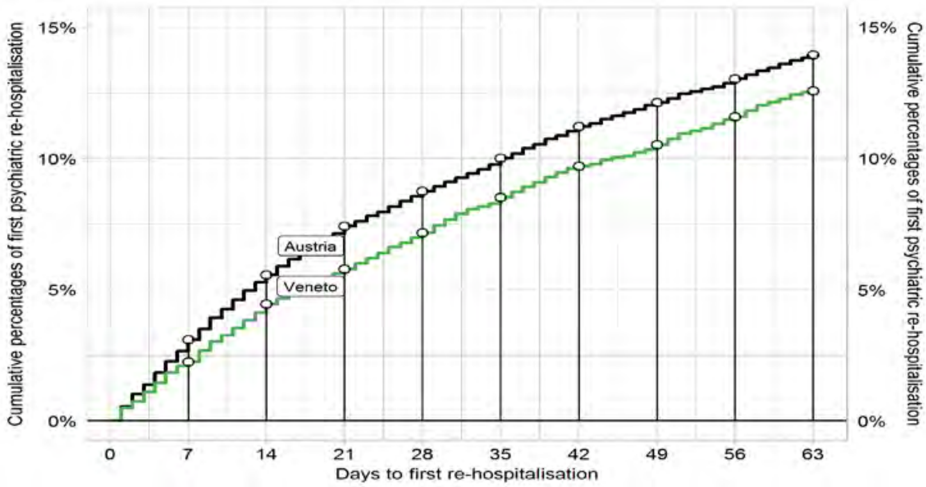
Figure 57: First psychiatric re-hospitalisation over 21 days following the index discharge, cumulative percentages of patients in study cohort 2 (Austria: N = 20.095, Veneto private: N = 2.177, Veneto public: N=5.062)



3.3.2 First psychiatric out-patient contact as a predictor for psychiatric rehospitalisation – the "pre-post" approach

For each patient in the new two study cohorts for Austria and Veneto starting at day 7 (which is now day zero), the first psychiatric re-hospitalisation was identified. For a first overview weekly cumulative percentages are presented for a time period of 9 weeks (Figure 59Figure 58). It shows that all rates are slightly higher in Austria than in Vento, and that the gap increases slightly with time, but the difference is not as large as found above, when re-hospitalisation rates were determined also for the original week one. It seems that the most part of the difference between Austria and Veneto goes back to the very first week post-discharge, where rehospitalisation rates for Austria literally soar in comparison to Veneto (see Figure 53, Figure 54, Figure 55, Figure 56 to Figure 58), and that starting the new cohorts on day 7 flattens out the differences.

Figure 58: Cumulative percentage of first psychiatric re-hospitalisation between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) for Austria (upper curve) and Veneto (lower curve)



Country/region	N	7d	14d	21d	28d	35d	42d	49d	56d	63d
Austria	18.260	3,09%	5,56%	7,42%	8,75%	10,01%	11,23%	12,14%	13,03%	13,95%
Veneto	7.059	2,25%	4,45%	5,78%	7,17%	8,51%	9,70%	10,53%	11,59%	12,58%

Cumulative frequencies of first PSY-REHOS

In order to get an oveview on how each of the six predictor variables influences psychiatric rehospitalisation rates, the cumulative rates of first psychiatric rehospitalisation are shown below for each of the six predictor variables separately, both for Austria and for Veneto.

Figure 59: Cumulative rates of first psychiatric re-hospitalisation rates in weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge)by gender: Austria (left), Veneto (right)

Gender

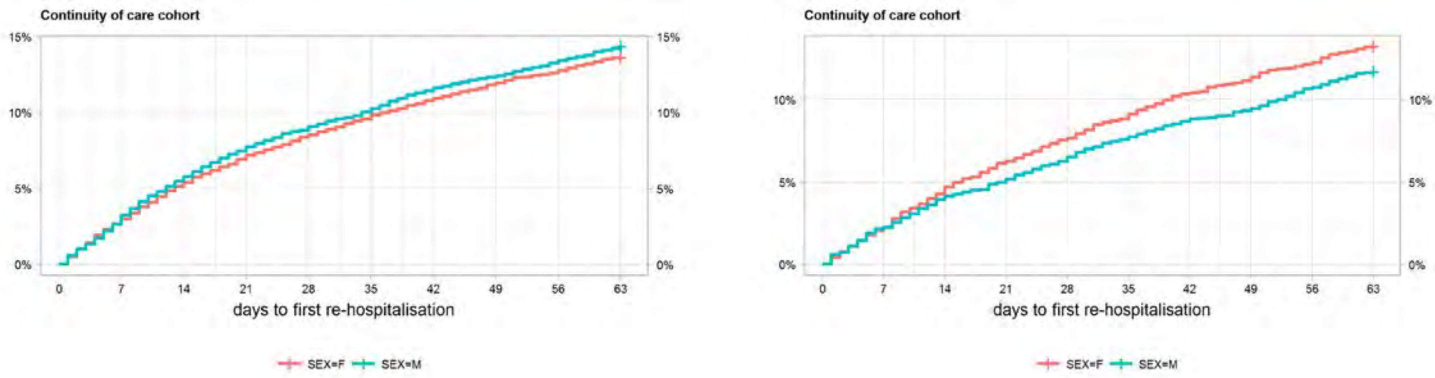


Figure 60: Cumulative rates of first psychiatric re-hospitalisation rates in weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) by age: Austria (left), Veneto (right)

Age

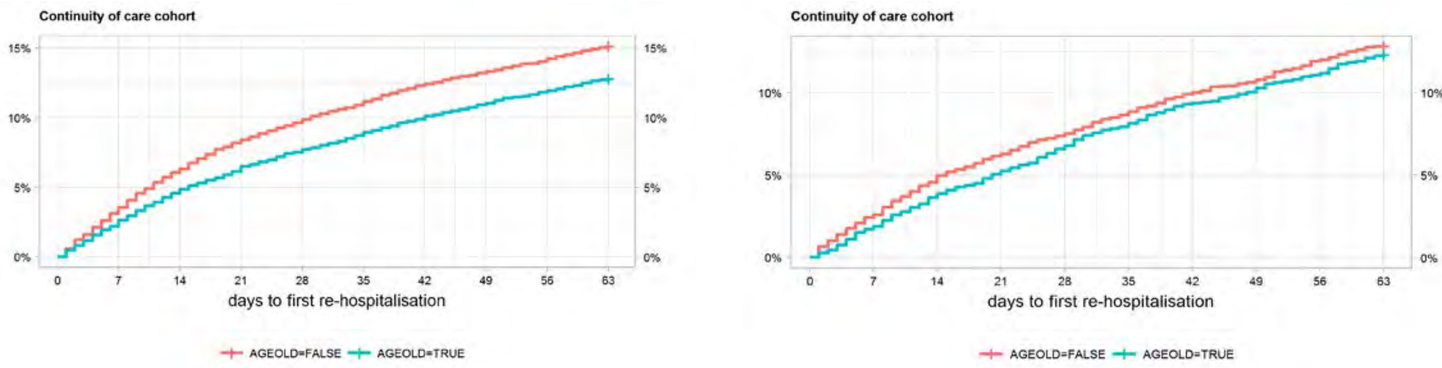


Figure 61: Cumulative rates of first psychiatric re-hospitalisation rates in weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) by psychotic diagnosis: Austria (left), Veneto (right)

Psychotic diagnosis

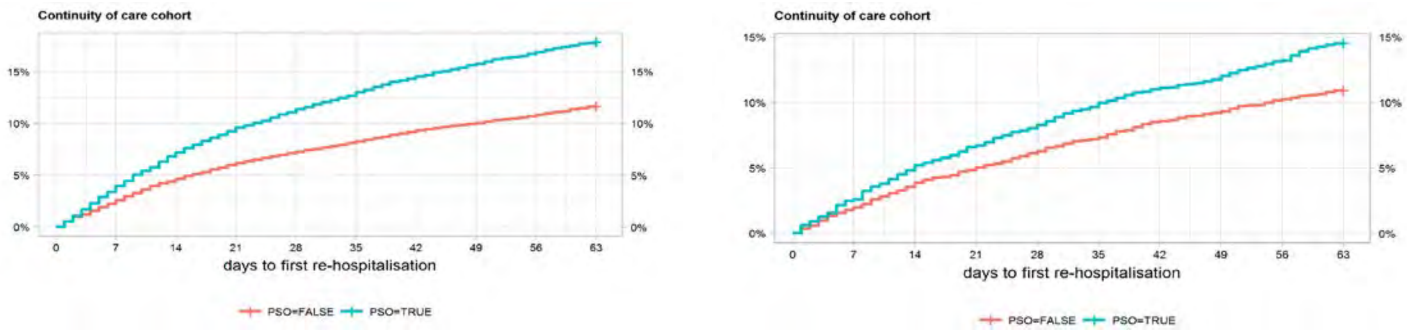


Figure 62: Cumulative rates of first psychiatric re-hospitalisation rates in weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) by physical comorbidity: Austria (left), Veneto (right)

Physical comorbidity

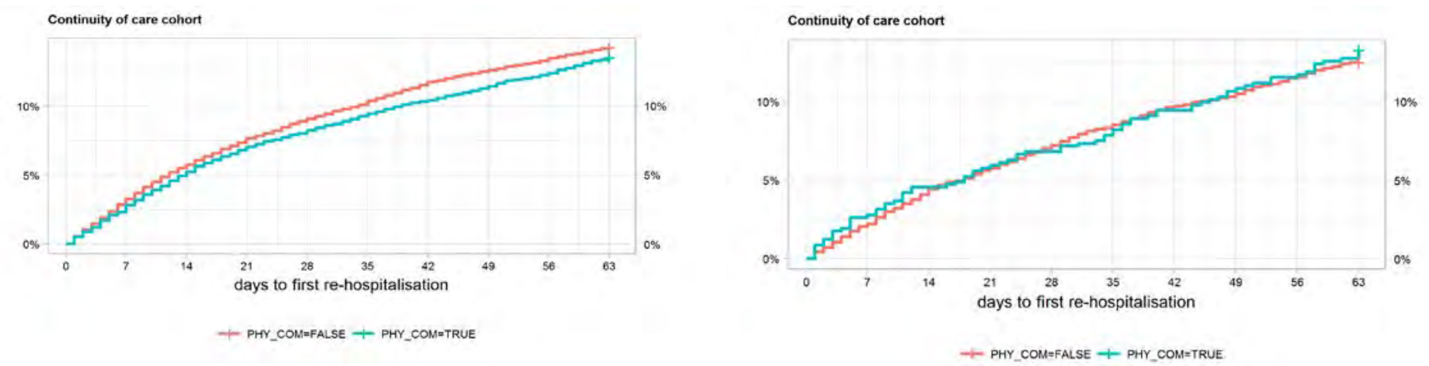


Figure 63: Cumulative rates of first psychiatric re-hospitalisation rates in weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) by length of stay: Austria (left), Veneto (right)

LOS

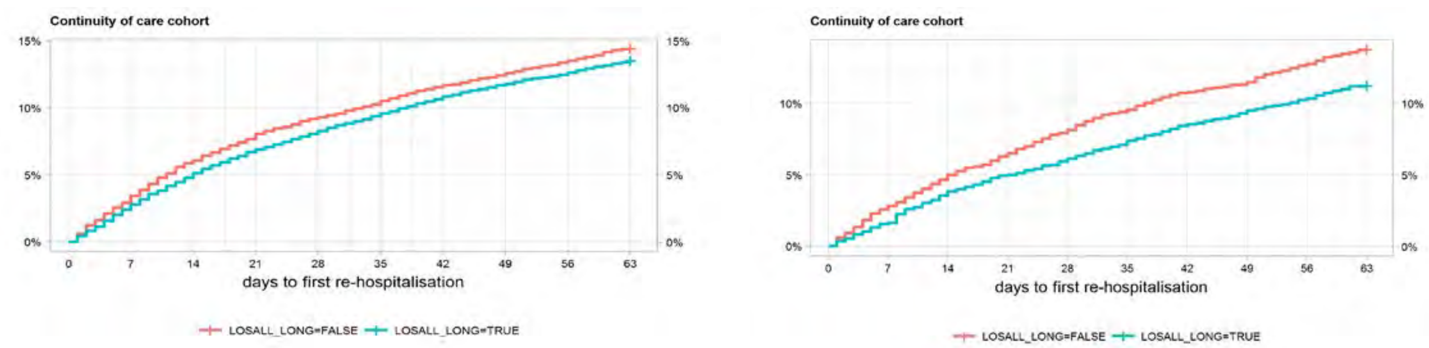
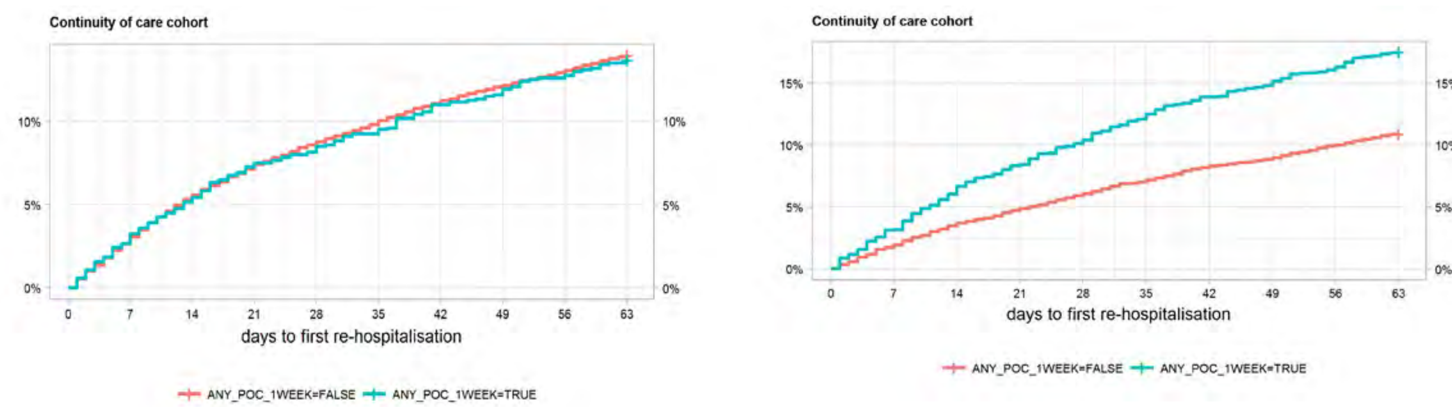


Figure 64: Cumulative rates of first psychiatric re-hospitalisation rates in 9 weekly intervals between day 0 (=day 7 after the index discharge) and day 63 (= day 69 after the index discharge) by ANYPOC in the week before the start of the 9 week follow-up period: Austria (left), Veneto (right)

At least one psychiatric outpatient contact



Concerning the continuity of care variable no difference is found for re-hospitalisation rates in Austria for patients with (N= 1.200, 6.6%) and without (N=17.060, 93,4%) a post-discharge psychiatric outpatient contact in the week befor the start of the follow-up period. In Veneto a much larger proportion of patients (1.787; 25,3%) had had at least one psychiatric outpatient contact, while 5.272 (74,7%) had had no such contacts. For Veneto the surprising findings of much higher psychiatric re-hospitalisation rates in the group with psychiatric outpatient contacts emerges.

The results of the logistic regressions are shown below, for Veneto also separately for public and private hospitals.

Table 36: Results of logistic regression for outcome psychiatric re-hospitalisation (PSY-REHOS) for 7-69 days follow-up. Reported are odds ratios and the respective 95%-confidence intervals (in brackets)

Variable	**Austria N=18.260**	**Veneto N=7.059**
FEM	1,00 (0,92-1,09)	1,21* (1,05-1,40)
AGEOLD	0,83*** (0,76-0,90)	0,99 (0,86-1,15)
PSO	1,68*** (1,54-1,83)	1,29*** (1,12-1,49)
LOSALL_LONG	0,88** (0,81-0,96)	0,80** (0,70-0,93)
PHY_COM	1,04 (0,95-1,14)	1,09 (0,84-1,39)
ANY_POC	0,94 (0,79-1,11)	1,62*** (1,39-1,89)

***p ≤ 0,001 **p ≤ 0,01 *p ≤ 0,05

Psychiatric outpatient contacts in the week before the start of the follow-up period has no effect in Austria, but strongly increases the re-hospitalisation risk in Veneto. This finding seems counterintuitive but could be explained by patients who experience already a worsening of their state at the time of contacting outpatient care which however cannot prevent a re-hospitalisation anymore at this stage. Thus, at the end a mixed picture emerges for the continuity of care issue when comparing Austria and Veneto.

4 Summary and Conclusions

Once interoperable files for altogether 225.600 patients in six countries characterised by quite a few predictor variables and outcome measures were available, a nearly unlimited number of different types of retrospective cohort studies could have been carried out. Only a limited array of such analyses were actually performed in order to show for selected questions thought to be relevant for health care planning how reduction of methodological noise could help to compare findings in different countries. Main results of these analyses are reported and commented here. It has to be stressed that it is impossible to provide definitive interpretations of the findings of a cohort study, since in addition to the variables used unobserved factors might also have influenced the results. For instance, no adequate proxy for the severity of the disorder was present in the datasets. However, some "educated guesses" may not be amiss.

Study cohorts differ in size and case mix

(1) Study cohort sizes differed to a large degree, in fact more than 20-fold, between countries, ranging from 4.536 in Slovenia to 101.834 in Romania, a fact, which has certainly influenced inference on significance in the regression analyses.

(2) The rates per 1.000 population aged 18+ years varied in different ways, with Italy having the lowest rate (1,28‰) and Norway (4,40‰) and Romania (6,26‰) the highest.

(3) In addition to the size, also the case mix of the study cohorts varied. Only differences in the diagnostic compositions are reported here. Depression was the most frequent single diagnosis in Austria, Romania and Norway, while schizophrenia dominated the diagnostic spectrum in Finland, Italy, and Slovenia. These differences were to some extent accounted for by introducing the variable psychotic diagnosis as a predictor for the regression analysis. A remarkable detail is that in Italy in addition to the public system a rather large private (but publicly funded) sector exists which has a different diagnostic spectrum, with depression and personality disorder dominating, in contrast to the public sector with a large preponderance of schizophrenia. It can be suspected that specific provider payment mechanisms play a role here. Physical comorbidity, which is becoming more and more important in mental health care planning, is very differently present as an additional diagnosis, with 3,9% in Norway and 5,4% in Slovenia to 37,6% in Austria and 43,1% in Romania. Whether these differences reflect facts or are an artefact of different motivations of hospital staff to document secondary diagnoses cannot be decided.

Re-hospitalisation rates differ to a substantial degree

(1) Between one third (Italy, Slovenia) and nearly half (Norway) of all patients are readmitted to a psychiatric inpatient service over the 12 months after discharge. These figures are quite high. Differences for these countries are also present in the 30 days re-hospitalisation rates (15% in Norway, 10% in Italy). The differences are difficult to interpret. For instance, while both Italy (mental health centres, CSM=Centri Di Salute Mentale) and Norway (district psychiatric centres, DPS= Distriktspsykiatrisk Senter) have well developed community mental health services, the one year re-hospitalisation rates are very different.

(2) A noteworthy finding is that, when analysing re-hospitalisation rates to any hospital, i.e. including in addition to psychiatric also somatic hospitals, the patterns discussed above are similar but the rates are understandably higher, but to a different extent in different countries. Austria, whose cohort has a high percentage of patients with physical comorbidity, has the largest difference to mere psychiatric re-hospitalisation (plus 20% at 365 days).

(3) A special phenomenon was observed in Romania. There re-hospitalisation rates start to climb in the last few months of the one-year follow-up period. One explanation put forward by local experts could be that patients who are on an invalidity pension, have to prove for the prolongation of their invalidity pension that they needed a hospitalisation once a year.

A major proportion of first re-hospitalisations occur within a few weeks

When comparing 30 and 365 day rates it is evident that roughly one third of the 365 day re-hospitalisations occurs already in the first 30 days, i.e. the highest risk for re-hospitalisation is in the early days after discharge and it is there where preventive measures would be placed best by ensuring the availability of a seamless transition from inpatient to community care.

Person-level predictors: Psychosis is related to higher, older age to lower re-hospitalisation rates

(1) In the regression analyses two patient-level predictors proved to be working consistently in the single level (“standard”) multiple logistic regression analyses with rather large effects in all countries: a *psychotic diagnosis increases psychiatric RHRs (except for Slovenia 30 days)*, *age at or above the median decreases RHRs*, more so for 365 than for 30 days. Gender had no specific effect on psychiatric RHRs in any of the countries. Long length of stay had inconsistent effects across the six countries, small effects in three countries, but a very strong positive effect in Romania, and a negative association in Finland and Norway, (note that in the latter two countries length of stay was differently defined than in other countries). If having an effect at all, physical comorbidity slightly decreases psychiatric RHRs. Cox regression analyses for 365 days produced hazard ratios which were virtually identical to the odds ratios in both direction and size***.***

Contextual predictors: No consistent effect of urbanicity and GDP on re-hospitalisation rates

Including contextual predictors on the NUTS 3 level of the patients’ residence in multilevel logistic regression analyses did not change the effect of the person-level predictors found in the standard regression analysis without context variables. Some country specific effects of the degree of urbanicity and of the regional GDP could be observed, but no consistent pattern emerged across all countries. The reason for the lack of a persistent effect may reside in the fact that NUTS 3 regions are too large – these variables were not available on a lower geographical level for all countries.

Continuity of care variable shows mixed effects on re-hospitalisation

The influence of continuity of care (measured as early psychiatric outpatient contact after the index discharge) on psychiatric rehospitalisation rates was studied only in Austria and the Veneto region in Italy. Two approaches were applied, a “correlational” one and a “pre-post” one. In the “correlational” approach cumulative rates of the first psychiatric outpatient contacts in the first few weeks after the index discharge were compared with the corresponding cumulative curves of the first psychiatric rehospitalisation rates. The main result was that in Veneto a large proportion of patients have early psychiatric outpatient contacts, while re-hopitalisation rates are low; in Austria the opposite is found: few early psychiatric outpatient contacts and substantially higher psychiatric rehospitalisation rates. For the “pre-post” approach a special design with a smaller patient cohort was used (as described in detail in the methods chapter above). In the logistic regression in Austria no effect on psychiatric re-hospitalisation rates was observed, however a clear effect in terms of psychiatric outpatient contacts increasing psychiatric re-hospitalisation rates can be seen in Veneto. The interpretation of the Veneto finding is difficult. For one, as the severity of an individual case is not captured by the data of the present study, such unobserved confounders most likely distort the findings. It is possible that the psychiatric outpatient contacts occurred because the patient’s state was deteriorating, which then led to the outpatient contact and then to the re-hospitalisation. Lack of data (e.g. in Austria no data on contacts with single-handed psychiatrists without social health insurance contract, and no data on contacts with tax funded psycho-social services is available) may have a potentially distorting effect when comparing Austria with Veneto, where all types of psychiatric outpatient contacts were in the data base.

Conclusion

Rendering large national electronic health care databases interoperable and thus comparable across countries is essential for comparing patterns of pathways of health service utilisation in different countries. If this interoperability can be achieved, methodological noise can be reduced in studies on quality of care and cost-effectiveness in different health care systems, and differences can be seen as reflecting "real differences" and not as possibly resulting from methodological discrepancies, i.e. as the consequences of "artefacts". The CEPHOS-LINK project has demonstrated with the example of re-hospitalisation of psychiatric patients that such noise reducing approaches are possible. It has also produced tools which can be used for increasing interoperability in the present situation of diversity in national databases. While applying these tools to national databases the contact with the institutions running them could increase awareness for the necessity for harmonising terminology and concepts on a European level and thus facilitate future cross-country health care studies with common protocols and even pooled data sets. This rise of awareness could already be observed in the present CEPHOS-LINK project.

CEPHOS-LINK

4

Final Scientific Report

PART 4

Pooling of Data

Prepared by

IMEHPS.research and the CEPHOS-LINK team

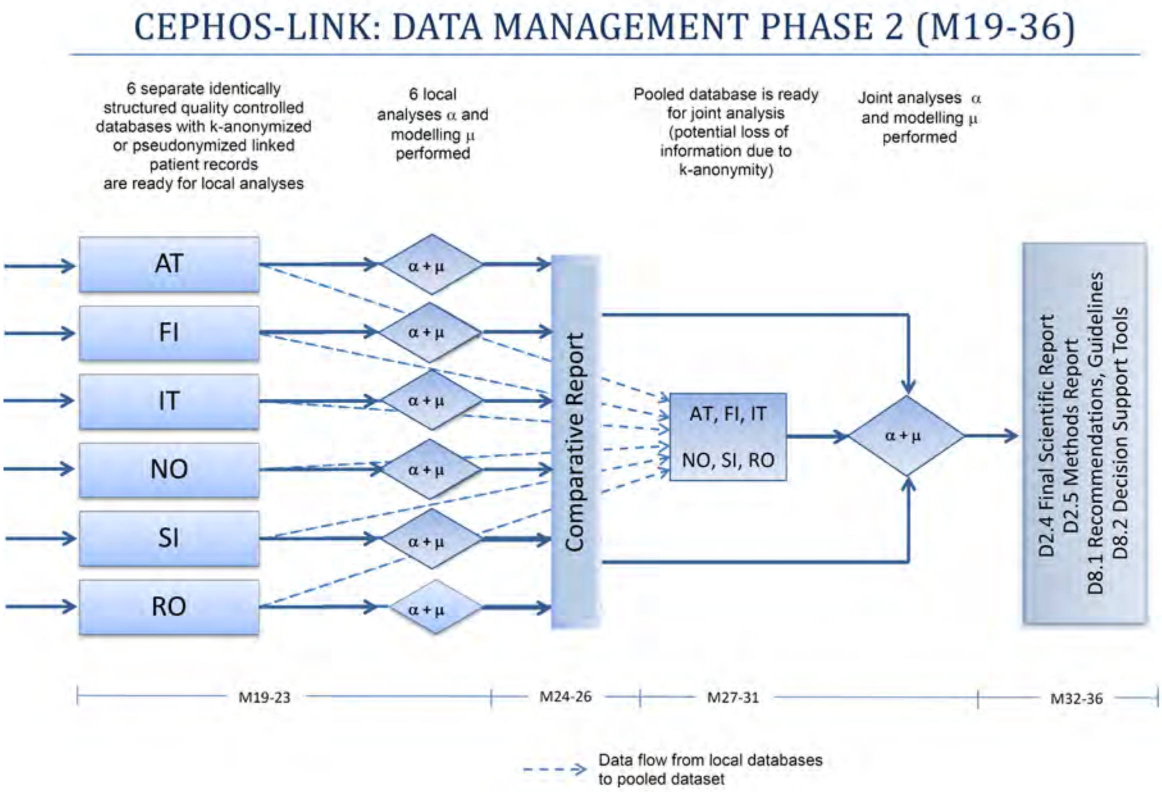
March 2017

This project has received funding from the European Union's Seventh Framework Programme for research technological development and demonstration under grant agreement no 603264

Contents

1 Introduction

In addition to ascertaining interoperability of the national data bases and performing local regression analyses on psychiatric re-hospitalisation according to a common study protocol in each country, it was foreseen to pool the data of all single country study cohorts. In the figure below the process of pooling as outlined in the submission is shown. It involved the secure transfer, quality check, integration and analysis of defined datasets from each participating country. The anticipated added value includes additional and independent quality checks, reproducing local analysis, laying out the foundation for simulation models and the application of more sophisticated statistical analysis on a larger and more diverse dataset. The entire pooling procedure was split into several steps. First, legal and organisational prerequisites had to be prepared. This involved obtaining acceptance from local ethical committees of all countries, approval from data owners, the exchange of data protection and non-disclosure agreements and all technical preparations of the utilised infrastructure. Second, a comprehensive pooling protocol describing the entire process in detail was designed, coordinated and executed iteratively. Various data quality checks were performed during loading the delivered datasets into an integrated database. Finally, by way of example, data analyses were performed with the total pooled data set of 225.600 patients, to show which types of analyses are principally possible. More sophisticated methods will be necessary for weighting the different cohort sizes contributed by different countries, which could not be considered here.



2 Preparatory activities

In this chapter, technical and organisational preparations for the pooling procedures are described. They are building upon and depending on provisions accomplished by the activities on ascertaining interoperability of national databases (PART 2 of the Final Scientific Report), including

- Preliminary study protocol
- Ethics committee approval
- Permission from data owners.

International pooling of sensitive claims data from healthcare systems is a complex procedure. It involves the coordination of diverse and potentially changing legal requirements, building secure and adaptable infrastructure on a tight budget as well as the definition of a clear and flexible approach which, on the one hand, describes the anticipated proceeding thoroughly and conclusively and, on the other hand, is generally replicable and comprehensible. Because there is a low margin of error, e.g. concerning cryptography, and very time consuming prerequisites, e.g. collection of signed privacy statements, these preparatory activities are the critical foundation of the entire conception. During the preparation of the pooling procedure, all participating countries agreed that patient level information without k-anonymisation can be provided. The following preparatory activities are functionally independent and were prepared concurrently.

2.1 Data privacy statement

In this section, the preparation and collection of data privacy statements and non-disclosure agreements is summarised. National legal requirements and common knowledge require some kind of formal agreement, covering the anticipated international transfer of sensitive information and basic conditions for utilising foreign data.

It turned out, that there are clear and commonly applied procedures in most countries and, in contrast, hardly determinably requirements in others. Also, language barriers concerning legislative text are challenging. As a consequence, we developed a composed privacy statement as reference in case no (appropriate) national form is available and to be used as common denominator. A blueprint of this minimal basic privacy statement is contained in a separate document and available on request. The most important basic information are:

- Intention of the agreement
- Name of natural person and employer (legal entity)
- Data and information covered by the agreement
- Time period for which the data is scheduled to be utilised and stored
- Termination of the agreement
- Reference to national laws

Additionally, the following content is included by some participating data holders:

- Purpose, project description and outline of the study protocol
- Data processor's obligations
- Use of a subcontractor
- Security and details of the data processing infrastructure
- Right for security audits, reporting, site visits of the data controller

All partners required manually signed data privacy agreements. Therefore, the physical copies had to be exchanged during one of the biannual meetings or sent via (classic) mail. This time-consuming practice did not allow many iterations, amendments or the integration of new project members on short notice.

2.2 Preparation of safety procedures

Essential preparatory work concerned the consideration of security aspects of the data transfer and storage. The design and configuration of necessary safety procedures depicts the major part of the preparatory activities for data pooling. It can be partitioned into two principal sections:

1. Secure encryption and data transfer
2. Secure storage and processing infrastructure

The first part is especially sensitive because team members from varying countries and with differing expertise, experience and software environments have to cooperate. An error during data transfer exposes the highest risk of data leakage or loss of information. Hence it has to be designed as platform independent procedure, involving state of the art encryption but still has to be straightforward to handle.

In general, any encrypted and decrypted pooled data is only allowed to be processed and stored on the same infrastructure where the Austrian data is handled for several years, located in Vienna. Several possibilities to encrypt and transfer local excerpts of data are prepared and documented. They include (more complex) asymmetric public key cryptography and symmetric encryption. The "Advanced Encryption Standard – 256" AES-256 is required in both cases. "GNU Privacy Guard" (GPG), a free and widely trusted implementation of the OpenPGP standard and other trusted tools are suggested to be applied in this standardised process. While public keys for asymmetric encryption can be exchanged without much additional precautions, individual printouts of several randomly generated passwords have been exchanged during a personal meeting for symmetric encryption. In any case, open, state-of-the-art encryption is utilised and renders loss of sensitive information during transfer over potentially unsecure channels virtually impossible.

Private keys and passphrases were handled most cautiously. The pair of keys for the asymmetric encryption is generated inside the secure environment and only the public part left this server at all. Also, all shared secrets for the symmetric encryption procedure were assembled in the same environment.

The second part encompasses infrastructure for data transmission, data storage, data profiling, data quality assessment and data analysis. These functions are allocated at three distinct facilities with different strengths and purposes. One “transmission” server is exclusively prepared for receiving encrypted files and transferring them to the second, more secure server which is not exposed to the internet (or any other, non-private network). The second “storage” server, also hosting the Austrian core database, holds all keys necessary for decrypting the transferred files. It is used as central storage and processing facility of the pooled dataset including profiling, data quality assessment and data analysis. A third environment is part of the DEXHELPP Research Server (DRS), where an exclusive database and remote computing environment is prepared to collaboratively analyse the pooled dataset with researchers from the Austrian CEPHOS-LINK partners IMEHPS.research and dwh GmbH.

Different options for transferring securely encrypted files are prepared. In case the compressed and enciphered files are reasonably small (i.e. a few megabytes or less), the consortium agreed that e-mail is a fitting and convenient solution. As potentially more secure medium, a VPN infrastructure hosted directly on the “transmission” server is prepared as foundation for alternative data transmission technologies. Furthermore, a dedicated ownCloud instance is provided, including state-of-the-art TLS transfer encryption and granular rights management. Summarising, various means for secure transfer of the encrypted files are available.

Still encrypted, the files are then transported to the secure “storage” server where they can be deciphered and processed. Due to high security standards, a direct transfer to this server from outside is not possible and desirable. Even after decrypting the data, authorised researchers have exclusive access to it. All data handling is performed inside this secure environment, solely for the agreed purposes and project. Secure removal of the data and all derived subsets can be performed as soon as it is certain that no further utilisation can be expected reasonably or at latest a year after the project has ended.

Loading and integration of the pooled datasets as well as data profiling, data quality analysis and detailed documentation are performed in this second “storage” environment. Specific subsets of all received information are extracted and securely transferred to the third computing environment, where data analysis and simulation modelling are performed.

Summarising, highly secure infrastructure is prepared for data transfer and data analysis. Besides security, general usability are main objectives of this task. It turned out, that some procedures are only required in single, very specific situations during the actual realisation of international data pooling. Nevertheless, covering most foreseeable situations and having the possibility to quickly react correctly in complex circumstances was a major cornerstone for the success of the entire project.

2.3 Pooling protocol

A detailed protocol is prepared and provided to all partners. It is designed for end-users, and describes, on the one hand, the anticipated proceeding thoroughly and conclusively and, on the other hand, is meant to be generally replicable and comprehensible. The protocol is contained in a separate document (available on request) and consists of several sections:

- File structure and format based on international standards
- Variable definition based on local study protocols and system variable descriptions
- Documentation of current status
- Definition of file name
- Possibilities to compress the data including software suggestions and screenshots
- Possibilities to encrypt a (compressed) file including software suggestions and screenshots
- Two ways to transfer the data: ownCloud (with or without VPN) or e-mail

It is designed to handle iterative deliveries, error corrections, amendments, partial deliveries and changes of nearly every aspect like, e.g., the amount and definition of variables. The protocol lays out the foundation for rigorous and comprehensible documentation by introducing various levels of detailed versioning of the protocol itself and the delivered datasets.

Name	**Format**	**Content**
PID	Number, positive integer	**Pooling-ID / Person-ID**: is a unique, random number specifying persons. It is independent from other identifying variables, especially personal identifiers or project dependent identifiers used locally. If possible, also the order of the dataset is randomised. A translation between this Pooling-ID and the local personal or dataset identifier is required to be preserved for reproducibility and eventual additions to the pooled dataset.
CC	Character	Country Code, 2 uppercase letters (ISO 3166-1 alpha-2)
		Re-hospitalisation
ANYHOS	Dichotomous	First readmission to ANY hospital bed
PSYHOS	Dichotomous	First readmission has been to a psychiatric hospital bed
DAYSANYHOS	Number	Time To Readmission in days (min. value: 1, max. value: 365)
PSYHOS_X	Dichotomous	First readmission to any PSY hospital by ignoring SOM
DAYS_PSYHOS_X	Number	Time to readmission in days (min. value: 1, max. value: 365)
		Patient-level predictors
FEM	Dichotomous	Female sex = TRUE, Male = FALSE
AGEOLD	Dichotomous	Age ≥ median of the local cohort
PSO	Dichotomous	At least one psychotic diagnosis (ICD10 F2 or F30 or F31) during the same/index hospital episode.
LOSALL_LONG	Dichotomous	Total LoS for the index discharge ≥ median LoS of all specialties.
PHY_COM	Dichotomous	Physical comorbidity
		Contextual predictors
NUTS3	Text	NUTS3 identifier of patient's region of residence, according to System Level Variable (SLV) I2, e.g.: AT130, FI1B1, ITD31, NO061, RO321, SI041
		Continuity of care predictors
ANY_POC_1DAYS	Number	Days since discharge to first ANY_POC
PUBLIC_PRIVATE	Text	Only for Veneto and Italy; exclusive values: priv, pub

Besides technical details, the listing and definition of variables is the most important part of the pooling protocol. The table above holds an excerpt of the variables defined by the protocol. The final list in the protocol comprises some additional variables and is ordered by the history of their inclusion rather than logical criteria. Variable names are not consistent due to their stepwise development during local studies and the definition provided by the system variable report. A variable's definition comprises the name, data type ("Format") and required content, including basic information concerning expected values and detailed formatting.

Every observation, i.e. patient, is described by a unique random identifier. It is independent from other identifying variables, especially personal IDs or project dependent identifiers used locally. If possible, also the order of the dataset is randomised. A translation between this Pooling-ID and the local personal or dataset identifier is required to be preserved for reproducibility and eventual additions to the pooled dataset.

Summarising, the pooling protocol is the third cornerstone of the pooling procedure. Detailed, clear but realisable specifications, no compromise concerning privacy and security accompanied by a focus on flexibility and usability led to a successful implementation.

3 Data transfer

Building upon the preparatory activities, all partners are asked to transfer the according variables by executing the pooling protocol. In general, a stepwise approach with several planned iterations was anticipated.

The first iteration only included a simplified set of mainly dichotomous variables which were necessary to fulfil the most basic requirements of the project. This test run had the advantage of a significantly decreased risk of a data breach in case anything went wrong with encryption. Furthermore, smaller size of files had to be transferred, which sped up the entire process. Subsequently, the definition of additional variables has been discussed and added to the pooling protocol.

Designing the entire procedure as a stepwise process turned out to be a necessity due to several misunderstandings, errors and partial deliveries. Although everyone involved paid attention to every detail, lesser inaccuracies in the protocol and its execution added up. As a result, several iterations were necessary in most cases to get comparable and integrated pooled datasets.

As soon as a new encrypted file arrives by e-mail or shared in ownCloud, a procedure similar to the commonly used ETL (Extract, Transform, Load) process started. First, the encrypted archive is roughly checked for consistency (e.g. file name in line with the protocol) and superficial errors as an improbable file size (e.g. only a few Bytes in some cases), leading to a first feedback to the sender. Next, still encrypted, the file is transferred to the secure environment through a VPN tunnel. It is consequently decrypted and briefly inspected. At this point, about one third of the most common problems as, e.g., a wrong password or missing variables, are already detected before even examining the content itself. Next, the new file is loaded into a new table holding the raw data, which is named according to the filename of the delivery in a specific schema of the database. A more detailed data profiling (described in the following chapter) is applied on this raw data, which is checked thoroughly to prevent dissipation of effort as most errors could by identified in this phase. The newly acquired variables are transformed and integrated manually in a stepwise manner into the pooled data of the specific country, called the "staging" area. This transformation is implemented as logical view (i.e. a stored query) in the database, resulting in a consistent, well defined and reproducible status while preserving all preceding results. The ETL procedure is finalised by unifying the pooled datasets from the staging area into a single table (also implemented as database view). As a result, the current version of the pooled dataset has been well defined at any point in time. At the same time each specific source, e.g. what variable originates from which data delivery, and all transformations can be comprehended directly in the database.

The results from the ETL procedure were provided as database object inside the secure environment. Additionally, an export was available as dedicated database in another secure computing environment "DEXHELPP Research Server", allowing the cooperative accessibility of all eligible Austrian researchers from IMEHPS.research and dwh as well as granular rights management and sufficient computing power.

Summarising, the ETL procedure involved the following steps:

- Several steps from delivered raw data to final pooling dataset: extended ETL
  - Check face validity of delivered files
  - Transfer to secure environment
  - Decompress, decrypt
  - Load to the statistical computing environment "R", data profiling and first feedback
  - Load to database and detailed manual checking of raw data
  - Staging area implemented as database view
    - Transform structure, content and data types to consistent layout
    - Merge different deliveries by unique random identifier
  - Merge pooling dataset of single countries to combined dataset
- Transfer results to second secure infrastructure for collaboration, load to database

In summary, the entire process turned out to be well fitting and allowed to cope with nearly all expected and unexpected problems. Many iterations were necessary and several errors and misunderstandings had to be resolved. It resulted in a more or less individual procedure for each participating country although planned and defined thoroughly, because reoccurring deviations from the protocol were accepted and compensated during the ETL procedure.

4 Quality control – added value

Monitoring and assessment of data quality is a major topic in the entire project. International pooling of defined datasets required rigorous quality control and also enabled additional validation of data and results from local studies.

Besides remote data quality assessment performed by each partner, the following major approaches are implemented during the pooling efforts.

4.1 Profiling

Data profiling in CEPHOS-LINK encompasses the automatic gathering of univariate statistics of a database depending on the pre-defined content and data type. A simple data profiling tool has been developed for the pooling procedure to get a quick and standardised overview over new deliveries, to document files and information received and to give nearly immediate feedback to the data sources.

The tool itself is designed as simple script based on the statistical computing environment R. Originally, a more potent tool was designed and developed, which integrated not only data profiling but also provided a graphical user interface, deployment mechanisms, more advanced statistics, interactive exploration of the data and even generated standardised reports according to defined study protocols. The version of the data profiling tool which has been finally applied in production only allowed the generation of standardised reports.

A data profile holds a short, univariate description of each variable in a table. The amount of records (n), missing and unique values are listed. Additional information as, e.g., most frequent values and their distribution, means, quantiles and histograms are integrated, depending on the data type.

The following screenshots show an exemplary data profile for Austria. It can be observed, that the date of data delivery and date of the profile are listed in the first three lines. The rationale behind this is the unmistakable association of a data profile with a distinct file, a unique table in the database and also a variable in the final pooling dataset. This allows to follow up any information from the source to the final pooling data and vice versa.

Pooling Austria

delivery: 2016-11-08
generated: 2016-11-09 12-02

17 Variables 21839 Observations

CC

n	missing	unique	value
21839	0	1	AT

ANYHOS

n	missing	unique
21839	0	2

FALSE (9121, 42%), TRUE (12718, 58%)

PSYHOS

n	missing	unique
21839	0	2

FALSE (14618, 67%), TRUE (7221, 33%)

FEM

n	missing	unique
21839	0	2

FALSE (8786, 40%), TRUE (13053, 60%)

AGEOLD

n	missing	unique
21839	0	2

FALSE (11099, 51%), TRUE (10740, 49%)

PSO

n	missing	unique
21839	0	2

FALSE (13929, 64%), TRUE (7910, 36%)

LOSALL_LONG

n	missing	unique
21839	0	2

FALSE (11023, 50%), TRUE (10816, 50%)

PHY_COM

n	missing	unique
21839	0	2

FALSE (13623, 62%), TRUE (8216, 38%)

AGE_EXACT

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
21839	0	81	1	45.64	21	24	34	44	56	69	77

lowest : 18 19 20 21 22, highest: 94 95 96 97 98

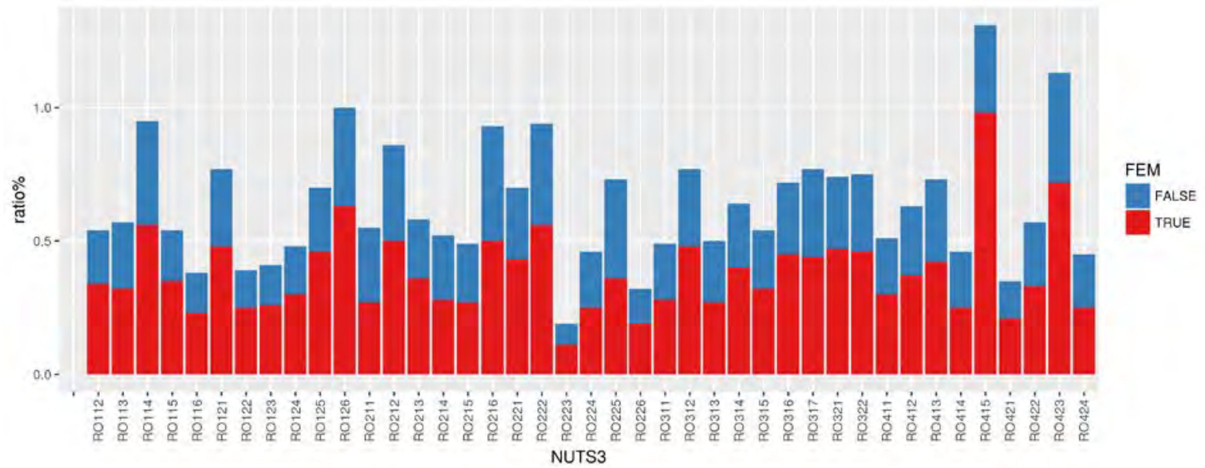
```
DAYSANYHOS
     n  missing   unique   Info   Mean   .05   .10   .25   .50   .75   .90   .95
 12718     9121      365      1   94.2     1     2     8    52   159   265   311

lowest :   1   2   3   4   5, highest: 361 362 363 364 365

LOSALL_EXACT
     n  missing   unique   Info   Mean   .05   .10   .25   .50   .75   .90   .95
 21839        0      215      1  21.77     1     3     8    15    28    46    61

lowest :   1   2   3   4   5, highest: 287 295 337 430 593

ANY_POC_1DAYS
     n  missing   unique   Info   Mean   .05   .10   .25   .50   .75   .90   .95
  6534    15305      365      1  73.39     1     3    10    32    98   231   294

lowest :   0   1   2   3   4, highest: 361 362 363 364 365

NUTS3
     n  missing   unique
 20604     1235       35

lowest : AT111 AT112 AT113 AT121 AT122
highest: AT333 AT334 AT335 AT341 AT342

NUTS3_POP18

      n missing  unique    Info    Mean     .05     .10     .25     .50     .75
  20604    1235      35    0.99  421368   85360  123139  186088  230317  450869
    .90     .95
1418526 1418526
lowest :   16550   25753   31657   39478   65472
highest:  262517  282312  337594  450869 1418526

NUTS3_REGIONAL
     n  missing   unique
 20604     1235        3

IN (7361, 36%), PR (7324, 36%), PU (5919, 29%)

NUTS3_GDP
     n  missing   unique   Info   Mean     .05     .10     .25     .50     .75     .90     .95
 20604     1235       31   0.99  31423   19600   20000   23100   32400   39800   40600   40600

lowest : 15400 16900 17500 17900 19600
highest: 36700 37300 38400 39800 40600

exact_amb_date
     n  missing   unique
 21839        0        2

FALSE (1744, 8%), TRUE (20095, 92%)
```

Although only univariate information is included and, e.g., the number of females in group PSO cannot be determined from the profile, many relevant facts are included. Furthermore, the recognition of sever errors, outliers, missing values and especially false coding, e.g. additional NUTS3_REGIONAL classifications, special codes for missing information, is drastically facilitated and sped up by these simplistic profiles.

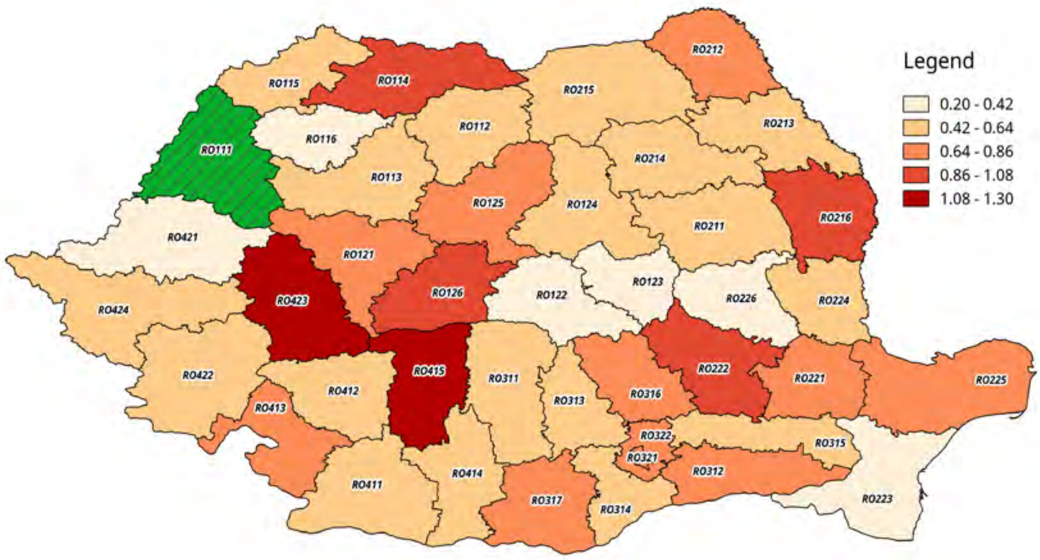
4.2 Data Quality Assessment

Despite their proven usefulness, automatic data profiles do not incorporate specific questions about the data and are not fitting tools for more complex exploration and insights. Ad hoc Data Quality Assessment (DQA) allowed to apply more advanced analytical approaches, quality measures and visualisations to selected indicators and dimensions of data quality. As a result, new structures, research questions and even severe quality problems which were not appearing in previous data analysis could be identified.

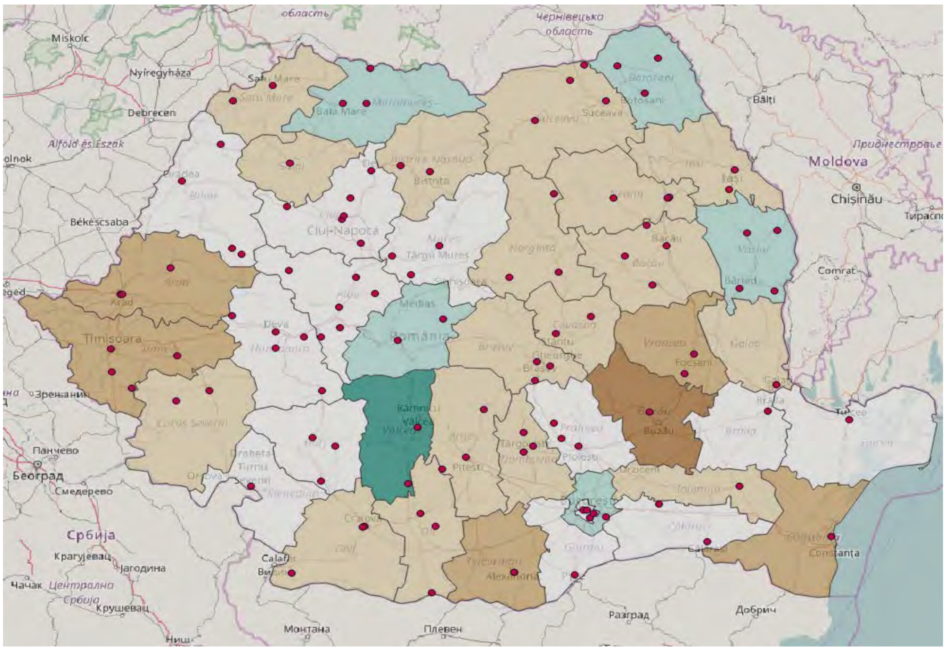
DQA allows multivariate combination of several variables in a meaningful manner. For example, the rate of male and females who are listed in the study population per 1.000 inhabitants in each NUTS 3 region is depicted in the following figure for Romania. Altogether, four variables (i.e. four dimensions) can be directly compared. The graph shows, that there is a huge variability and that there appear to be outliers in both directions.



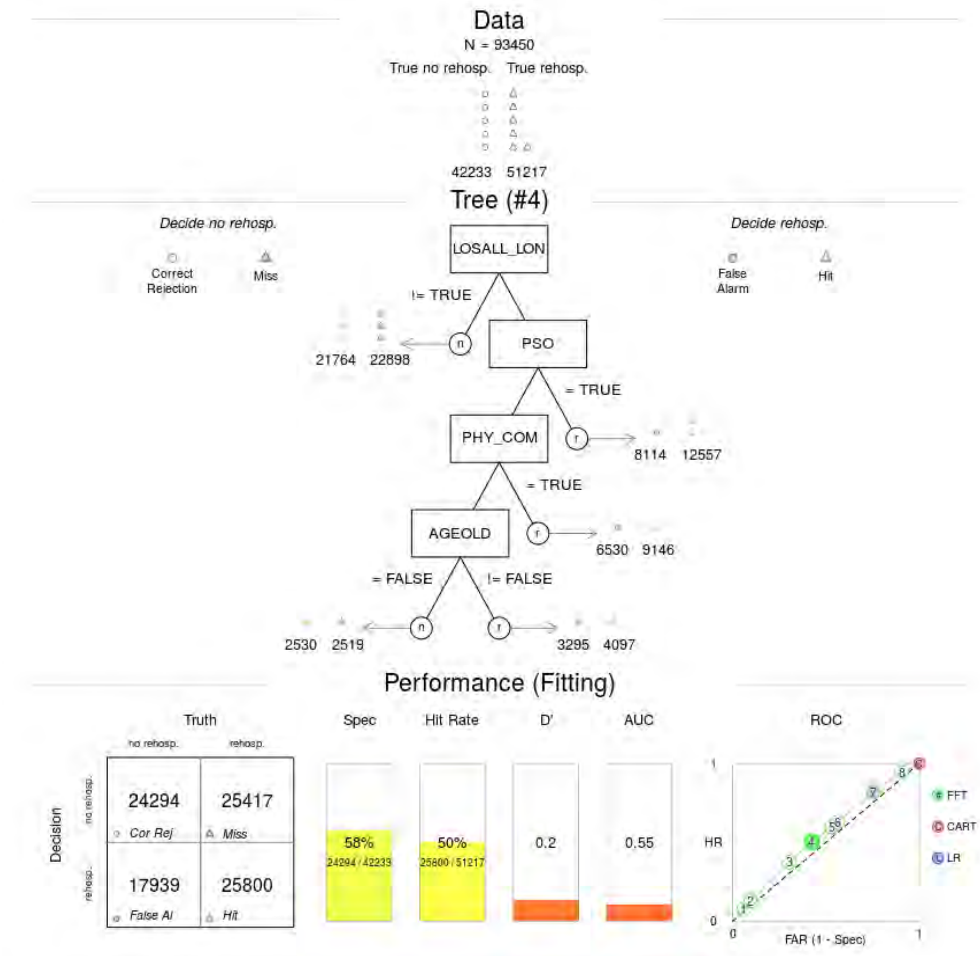
The same information can be combined with geographical data, resulting in the following figure. It can be observed, that despite the huge regional variations, which might not be randomly distributed, an entire NUTS3 region is missing. Such findings would be possible without pooling the data in Austria but, nevertheless, were just discovered after applying detailed DQA on the pooled data. In conclusion, dual control is highly advisable when dealing with complex data.



Joining this information derived from the pooled dataset with the location of hospitals acquired during the mapping project of CEPHOS-LINK, leads to the following figure. At least four different data sources are linked in this visualisation: patients from the CEPHOS-LINK cohort, population density from statistical metadata, location of psychiatric hospitals which were collected by the project itself and maps from OpenStreetMap in the background. It provides the foundation to gather information on the data quality as well as additional insights and emphasises the blurred line between data quality assessment and (exploratory) data analysis.



More sophisticated quality checks are performed as preparation for subsequent data analysis. The following examples shows a Fast and Frugal Tree (FFT), including results of its classification performance and a comparison to alternative methods. Although this approach has also been utilised for quality control, it also holds valuable results.



In conclusion monitoring of new pooling datasets and feedback to the sender are important parts of quality control. The applied approach and the presented methods allowed a clear communication and also generated new insights.

4.3 Repetition of local regression analyses

In addition to data profiling and quality assessment, local record-linkage studies performed in each participating country with different statistical programs were repeated with the statistical computing environment R.

The motivation behind this are the confirmation, that the pooled data is complete and correct and that there are no misunderstandings or even human errors during the execution of the study protocols. Another aspect are the differing software solutions applied in each country, which might report slightly different results by default and do not all include all tools required for the local studies.

Altogether, there are four different software solutions[1], potentially run with varying licensing models and version numbers. As most statistical software packages do not integrate sophisticated reporting capabilities, most researchers had to manually execute each study protocol and integrate the results by hand. This procedure is error prone by design and does not allow (automatic) reproducibility, does not include historisation and each modification requires lots of manual work. Furthermore, results from different countries are formatted differently and are therefore hard to use.

A program generating reports from the pooled dataset according to the study protocols has been developed in Austria. The application is based on R and is capable to produce consistently formatted PDF files (first version) and Microsoft Word documents (second version). It is designed modular and extendable, which allows a high degree of reusability. For example, the module calculating logistic regression models including formatted tables and analytical figures has been utilised in every report of every study protocol. As a result, reports are not only well formatted but are also highly consistent, reproducible and do not require manual interaction. It is also very unlikely, that there are severe errors left (despite the routines for individual data preparation) because the very same program is applied for a huge number of iterations and statistical models without any saliences. The output format (Microsoft Word file) allowed a convenient utilisation and integration of results. Detailed configuration can be defined for each report, allowing, e.g., to alter the number of decimal places in output tables. Summarising, the application facilitated rapid iterations, many experiences without investing much resources while being highly consistent and reliable.

All local studies were redone by applying the described program to the pooled dataset from each country. Furthermore, variations and experiments were carried out which would not be viable with the manual approach. Some differences between the standardised reports and the local results were identified, but most results were identical to three decimal places or at least very similar in a very narrow margin of error, which was most likely caused by the varying software implementations. Hence, results from the pooled data analysis was utilised for further application in most cases due to their consistent structure and usability out of convenience.

Summarising, repeating local studies with an automatic reporting tool improved the quality, utilisation and understanding of most results significantly. Due to the high reproducibility and lack of most human errors, the well formatted reports facilitated country comparison and also revealed errors in statistical procedures and local analyses. It can be concluded, that repeating local studies

[1] Italy, Norway: STATA, Romania, Slovenia: SPSS, Finland: SAS, Austria: R

with a different technological approach has an overwhelming additional value and backs our confidence in the collected data and our results.

5 Examples for pooled data analyses

The benefits of pooling data from different databases for improving interoperability by the complex and iterative process of pooling have been described above, and the pooling process as such is already justified by this improvement of interoperability and data quality.

Here a few examples are provided how the pooled data set of 225.600 patients in six European countries can be analysed in terms of the CEPHOS-LINK re-hospitalisation study protocols. We focus here on the analyses of four patient-level predictors used in the local studies, female gender (yes vs. no), old age (at or above the median, vs. below the median; national values used), psychotic diagnosis (yes vs. no) and physical comorbidity (yes vs. no) and do not consider length of stay, which could not be defined in a comparable way in all countries. The outcome studied was the first psychiatric re-hospitalisation within 30 days after discharge.

It is evident that the results of analyses with pooled data from different countries will be influenced by the different cohort sizes in these countries - and the sizes of the CEPHOS-LINK study cohorts differ widely, between 4.536 patients in Slovenia and 101.834 in Romania. Peculiarities in a country with a large cohort might override smaller countries. We do not consider these problems at present, but simply repeat the local study protocol for the total pooled data set of 225.600 patients, for whom regression analyses were performed.

Below the results of the regression analyses are presented for the 30-day psychiatric re-hospitalisation rates for all 225.600 patients.

Table 1: Logistic regression analysis for all 6 countries (Austria, Finland, Italy, Norway, Romania, Slovenia) - N=225.600 , 30-day follow-up for psychiatric re-hospitalisation

Variable	2.5%	97.5%	OR	Pr	Signif
population (n) = 225.600					
FEM [TRUE]	0,915	0,967	0,940	< 0,001	***
AGEOLD [TRUE]	0,736	0,779	0,757	< 0,001	***
PSO [TRUE]	1,417	1,499	1,457	< 0,001	***
PHY_COM [TRUE]	0,759	0,812	0,785	< 0,001	***

It is not astonishing that with an N of 225.600 all odds ratios are significant. However, as found for the individual country regression analyses the odds ratio for gender only slightly deviates from one, but older age again reduced the psychiatric re-hospitalisation rate clearly, while a psychotic diagnosis increases it strongly. Physical comorbidity reduces the psychiatric re-hospitalisation rate.

Countries can be grouped by certain criteria. By way of example countries were roughly classified into predominantly social health insurance and predominantly tax funded countries. Altogether 128.209 patients were from social health insurance countries (Austria, Slovenia, Romania) and 97.391 from tax countries (Finland, Italy, Norway).

Table 2: Logistic regression analysis for Social Health Insurance countries (Austria, Romania, Slovenia) - N=128.209
30-day follow-up for psychiatric re-hospitalisation

Variable	2.5%	97.5%	OR	Pr	Signif
population (n) = 128.209					
FEM [TRUE]	0,825	0,889	0,857	< 0,001	***
AGEOLD [TRUE]	0,800	0,865	0,832	< 0,001	***
PSO [TRUE]	1,850	1,999	1,923	< 0,001	***
PHY_COM [TRUE]	0,753	0,816	0,784	< 0,001	***

Table 3: Logistic regression analysis for TAX countries (Finland, Italy, Norway) - N= 97.391
30-day follow-up for psychiatric rehospitalisation

Variable	2.5%	97.5%	OR	Pr	Signif
population (n) = 97.391					
FEM [TRUE]	0,996	1,082	1,038	0,073	.
AGEOLD [TRUE]	0,699	0,759	0,729	< 0,001	***
PSO [TRUE]	1,025	1,113	1,068	0,002	**
PHY_COM [TRUE]	0,824	0,942	0,881	< 0,001	***

A comparison of the odds ratios found only one clear difference between these two groups of countries: A psychotic diagnosis has nearly no effect in the group of tax funded countries, but a very strong effect of increasing psychiatric re-hospitalisation rates over 30 days after discharge in the group of social health insurance countries. It has to be remembered that length of stay was not included here, so that a direct comparison with the results of the local studies is not possible.

CEPHOS-LINK

5

Final Scientific Report

PART 5

Simulation Modelling of Psychiatric Hospitalisation and Re-hospitalisation

Prepared by
dwh GmbH and the CEPHOS-LINK team
March 2017

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Contents

1 Introduction

Preliminary results of the first data analysis defined in work package 2 as well as literature reviews show the impact of certain patient characteristics on both first psychiatric hospitalisations, furthermore called index hospitalisations and re-hospitalisations. The most important one is age. For a prognosis of future psychiatric patients based on current knowledge it is mandatory to include the changing population structure. The most important task of the simulation model is therefore the correct representation and change of the age structure. As the time horizon of curing a psychiatric disease, including relapses, requires a long time it is also necessary that single patients can be followed over the course of time. These requirements restrict the used methods severely. Also, the model must be flexible enough to assess the impact of structural changes. Due to these requirements agent based modelling (see the methods section for an in-depths explanation) was applied. As for this method not only data about psychiatric patients but also population and population prognosis data is required, the simulation model was parameterised for the participating partner countries/regions Austria, Slovenia and Veneto. Agents with age, sex and their home region are created for the whole population of the modelled regions. These agents can develop psychiatric diseases. For this model, only diagnoses defined for the final CEPHOS-LINK analyses are considered. Hospitalisation and re-hospitalisation rated are parameterised using the acquired data stratified by age and sex for both psychotic and non-psychotic illnesses. With the distributions for index hospitalisations as well as well as times to re-hospitalisation, regional differences and for another module prognosis data on diabetes development three different tasks were in a proof of concept example evaluated.

2 Methods

2.1 Modelling Concept

The simulation model “CEPHOS-LINK” has been developed as a dynamic agent-based model. The model itself is based on an agent-based population model (GEPOC) that has been developed in cooperation with Comet K-project dexhelpp.

2.1.1 Population Model as a Base for Disease Models

As the patient always poses the centre of interest, valid prognostic modelling for decision support in the health care system is only possible if the underlying population is predicted validly as well. Doubtlessly long-term epidemiological or health-technology-assessment models (for example (Miksch et al. 2009; Urach et al. 2012)) can never be valid if the underlying population growth or decay is not considered. This becomes clear thinking about an average chance of about one percent that an Austrian inhabitant leaves the country or dies during one year. Hence, on the average, every 100^{th} person is “replaced” by an immigrant or newborn child every year leading to a highly fluctuating population.

Moreover a valid population model is not only a necessary part of any model in health-care science; it is also a reusable basis model for different applications.

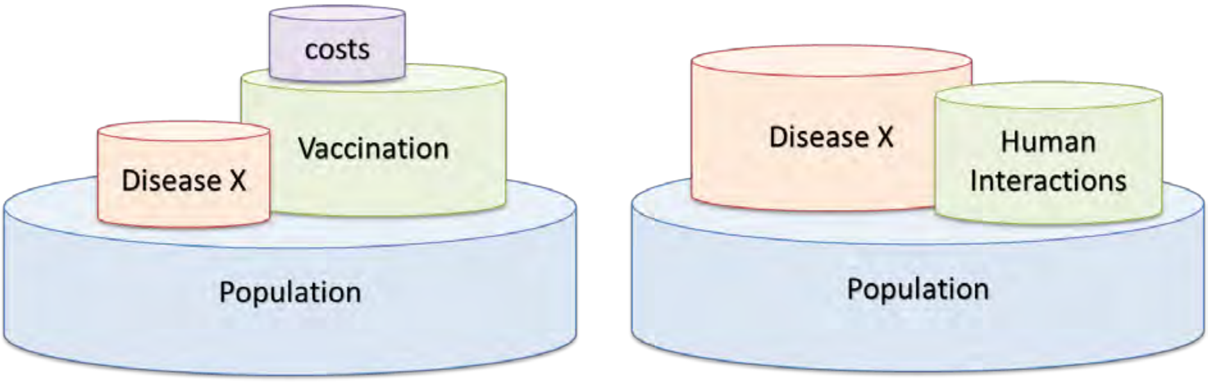


Figure 1: Left: Cost-Effectiveness model for disease X based on a population model. Right: Epidemics model for infectious disease X based on a population model.

Thus the Generic-Population-Concept (GEPOC) model was developed. It poses for a reusable agent-based simulation model that is not only able to depict the current and past population of an arbitrary country via agents, but is able to validly predict the future population of the specific country. Before going into details about this model we give a very short introduction to agent-based modelling.

2.1.2 Introduction to Agent Based Modelling

The term "agent" derives from the Latin word "agere", meaning "to act". So, defined by the root of the word itself, the main function of an agent is to act individually. Hence, we can give a first characterisation: Agent-based simulation is microscopic simulation method based on individually (inter)acting sub-models. One aspect of this sentence is especially noteworthy: It does not state that agents necessarily have to pose for persons. Rather, a sub-model can represent everything ranging from a car in a traffic jam to a charged molecule in a liquid or even an abstract concept that can be represented as an agent. Regardless of what is being represented by an agent, there are still some additional requirements that need to be fulfilled, in order to completely define this modelling method. We thus come to a formal description that covers these.

Unfortunately, it is not easy to fix a unique formal definition for the term "agent-based modelling", in order to be able to make a clean decision if a given theoretical model should an agent-based or not. This is due to the "problem" that agent-based modelling (as well as many other modelling approaches) is a scientific method that used in a multitude of disciplines; as a correct formal definition of a method is always linked to the corresponding scientific termini of a field of application, problems occur if the same method is used within disparate academical areas. To illustrate this point further, a definition of a method developed by mathematicians, given in a mathematical language, would not satisfy the needs of computer scientists or social scientists (and vice versa). In the specific case of agent-based modelling, scientists from different fields have developed their own formal descriptions, using their own scientific termini. It is obvious that this has caused a lot of communication problems, especially at interdisciplinary conferences. In order to solve these problems, very rough definitions were developed, sometimes even directly within the context of those conferences by interdisciplinary discourse. One of these definitions, which, by our estimations, seems the most applicable, developed at the Winter Simulation Conference 2005/2006 (Macal and North 2006) states that:

An agent-based model is a microscopic simulation model consisting of a great number of individual parts, so called agents, and a, possible abstract, environment.

An Agent has to

- be uniquely identifiable,
- act autonomously and independently and
- cohabitate an environment with other agents, wherein it has to be able to communicate with other agents

and may

- be able to act targeted,
- be able to change its behaviour.

Agent-based modelling is known to require a very low level of abstraction compared with other modelling techniques. In terms of agent-based models for population almost all parameters of real persons can directly be modelled as parameters of agents. This feature especially motivates the use of agent-based population models.

2.2 GEPOC - Population Model

Although the Generic-Population-Concept (GEPOC) originally does not pose for a model, but for a generic modelling concept summarised in a broad handbook, the main result of the GEPOC project was achieved by a versatile agent-based model to simulate population of Austria until 2050 (starting in 2006). Hence we will moreover identify this model by the name of the project.

2.2.1 Formal Model Definition

Agents

As the Austria's population consists of individuals, they are represented by agents (or individual-agents) in the model. As it might not be possible to simulate millions of agents at once, finally one model agent stands for a hole aggregate of people (e.g. 10,100,1000 henceforth denoted as $\boldsymbol{K}$) which all behave alike.
As model borders do not take into account to simulate immigrants before they immigrated, a second type of agent needs to be introduced: the government-agent. This type of agent is responsible for the creation of newly immigrated individual-agents.

Time and Dynamics

The model is simulated in equidistant time-steps with length δ from t_{start} to t_{end}. In case

$$t_{end} \neq t_{start} + k\delta,$$

for some natural number k, a new $\delta' < \delta$ is introduced so that

$$t_{end} = t_{start} + k\delta + \delta'$$

Hence the last time-step needs to be done with a different step-size. This is, unfortunately, the general case.

In a more general version the model even uses time-steps with arbitrary length. This generalisation was done to finally receive the simulation results for specific points in time (e.g. the first of every new month).

During each time-step each agent, individual or government, is addressed once and the agent may perform its behaviour. After that each agent is addressed once more to update its state (for details about the behaviour see below).

Individual-Agent States and Behaviour

In the standard GEPOC model (only) sex and age are key parameters of the model. Hence each agent has a certain *birth-date* and a *sex*, both of which are fixed until the agent's death. They are assigned either at the start of the simulation or at the agent's day of birth.

Furthermore each agent has the following behaviour. Hereby δ denotes the current length of the time-step, t denotes the current time, s denotes the agent's sex and a denotes the agent's age.

- Given the time each agent can find out its own age via its birth-date. This might sound trivial, but can yet be counted to the behaviour of agents. Moreover it sounds but it is **not** a simple computation for a computer to correctly find out how old a person is (leapyears).
- Each agent has a behaviour to die - respectively in the language of computer scientists, to destroy itself. The agent does this every time-step t with a certain probability
  $$Dp(t, \delta, a, s).$$
- Each agent has a behaviour to emigrate. In case the agent survived, each agent may decide to leave the country with a certain probability
  $$Ep(t, \delta, a, s).$$
  As emigration implies that the agent leaves the model-borders, this is equivalent to its destruction as well.
- Each female agent has a behaviour to give birth to another agent. This may be done, in case the agent survived and remained in the country, every time-step t with a certain probability
  $$Bp(t, \delta, a).$$
  As a model simplification the birth-process is applied instantaneously (no pregnancy), without partner and ignoring possible chances for multiple births in this basic-model. Note that the latter simplification does not lead to less overall births, but is compensated by more single-births.

Government-Agent States and Behaviour

The government-agent does not have any state. Its only behaviour is

- The government-agent creates a number of immigrated individual-agents. Hereby number, sex and age of the immigrants are sampled according to some probability space depending on $t, K$and δ.

Initialisation

Initially the government agent and a number of initial agents is created. The initial number is fixed according to the scaling factor K and the population of the country at t_{start}. The initial age and sex of each agent are sampled with respect to some probability model depending on t_{start}.

2.2.2 Parametrisation and Data

Used Data

Parametrisation of the model is done according to specific formulas described in the parametrisation section. Therefore the following data was used gained from Statistics Austrias "Stat Cube" concept:

- Population of Austria 2003 by sex and age
- Average yearly number of children per 1000 women from 2000-2013 by age
- Average yearly deaths of 100000 individuals from 2000-2014 by age and sex
- Total number of yearly immigrants from 2002-2014 by age and sex
- Total number of yearly emigrants from 2002-2014 by age and sex
- Prognosis on the average yearly deaths of 100000 individuals from 2014-2070 by age and sex
- Prognosis on the total number of yearly immigrants from 2014-2076
- Prognosis on the total number of yearly emigrants from 2014-2076
- Prognosis on the mean-fertility age and the total-fertility rate from 2014-2050

Additionally the static number

- Probability of a (statistically representative) new-born to be male/female

was gained from (Gray 1991). Prognosis data for the average yearly number of children per 1000 women and the age/sex-dependencies of migration data were developed ourselves according to extrapolation algorithms. Note that it is not useful to use classic linear regression here they do not conserve the integral and cannot consider additional information. The latter becomes clear thinking about prognosis for immigrants: While data is available for all age and sex cohorts prognosis are only available as total numbers. In order to extrapolate the trend of the available data, but still conserving the total-number prognosis, more sophisticated algorithms need to be used.

Parametrisation

While the available data is given on the aggregate level it is main task of the parametrisation process to calculate parameter-values for the individual level – i.e. probabilities that hold for **one representative** person = agent for one model time-step.

While total numbers for a specific point in time (like total number of Austrian inhabitants at 2003.01.01) can be processed quite easily, classically by simple divisions – e.g.

$$P(\text{agent}'\text{sex} = \text{female}) = \frac{|\text{number of female persons in Austria}|}{|\text{number of total persons in Austria}|},$$

it is a little bit more difficult to process "differential-numbers", i.e. numbers that are valid for a specific time-span (like total number of immigrants, emigrants,… during a year), to probabilities that are valid for one specific time-step as the length of the time-step is arbitrary.

Representative for all other "differential" parameters we show the parameter calculation process on the example of the death-probability. Given the number

$X :=$ "average yearly deaths of 100000 Austrians during year$= y$ for age=a and sex=s"

The corresponding parameter value $Pd(t, \delta, a, s)$ (days as unit for δ) can be approximated by

$$Pd(t, \delta, a, s) = 1 - \left(1 - \frac{X}{10000}\right)^{\frac{\delta}{365}},$$

which is valid for all $t \in [y, y+1)$. This formula can be attributed to the geometric distribution.

2.2.3 Model Implementation

Implementation

The model was implemented in Python 3 and (usually) executed with CPython 3.3. Attempts to execute the model with the faster Python like Pypy 3.3 unfortunately failed due to incompatibilities with the python numerics package NumPy.

The source-code is structured into four different classes: The simulation-class is responsible for the initialisation and the dynamics of the model. It creates and addresses instances of the agent-class and additionally takes on the role of the government-agent. It furthermore creates and controls an instance of the protocol-class and the sampler-class. Each instance of the agent-class poses for one individual-agent and hence represents K persons in reality. The protocol-class is responsible to save all necessary data of the simulation run. The sampler-class is responsible for the parametrisation of the data-driven background of the model. We do not want to go into detail about the specific classes.

Parallelisation

As the model is quite likely run with up to 9.5 Million agents not only the heap space but also the speed of the model is a large issue especially because CPython is known to be comparably slow. Note that the calculation time of some algorithms in the model like sorting and indexing do not grow linearly when increasing the number of agents, but faster. Hence the whole simulation was parallelised manually by splitting the whole agent-population into an arbitrary number of parts. From the computer engineering point of view this is probably the most interesting part of the whole implementation. Questions like

- How to correctly split the population into parts avoiding errors?
- How to use the correct parameter-sheets for the correct simulation part?
- How to correctly merge all simulation results? Which results need to be aggregated, which need to be merged differently?

needed to be dealt with.

2.2.4 Model Validation

Validation of a model denotes the process wherein the model respectively the model results are finally compared to reality. This is necessary in order to finally state the claim: The model is *valid* and can be used to predict reliable prognosis, or the model is *invalid* and needs to be re-conceptualised. In reality the result of this process is usually neither black or white, but much more a set of nuances on a grey-scale stating which parts of the model produce rather valid results and which parts need to be treated carefully as errors might be involved. It is a general fact, that, as we cannot look into the future, no predictive model can be said to be perfectly valid.

In terms of a population model the general chances of validating a model are not too bad as a big amount of data exists freely. Statistics Austria is probably the most commonly used source for data concerning topics related to Austria's population. From this source almost any information about life-expectancy, family state, births, deaths and social status can be accessed freely and can be resolved in terms of age-classes and locality. In case information is not directly accessible, an extended so called “Stat-Cube” enables even more detailed data for research purposes. As well as collected data from surveys over the last decades also several prognosis are available.

Target of the modelling process was the derivation of a model to simulate the Austrian population. Hereby the timespan

$$\mathbf{01.01.2003 \rightarrow 31.12.2050}$$

was chosen to mark the borders of validity of the model. Hence, in order to empirically-validate the population model there are two different sources for data available from Statistics Austria:

Collected Data concerning the Austrian Population between 01.01.2003 and 01.01.2015.

Prognostic Data concerning the Austrian population between 01.01.2015 and 31.12.2050.

The collected data can be used to directly validate the model for the last 12 years. Hereby we expect that for 2003 the model results and the real data directly match, as the population-data was used to initialise the model. The prognostic data accessible at Statistics Austria was derived using a statistical regression-model. Hence if we compare the agent-based model (ABM) and the System Dynamics (SD) results with the prognostic data, we compare a stochastic, mathematical model with a statistical regression-model. This can be seen as a kind of cross-model validation.

As the data required to parametrise the model was also gained from Statistics Austria, this process directly compares the modelling method with the statistical regression-method. The connection of the claimed Statistics Austria data to both models is visualised in Figure 2.

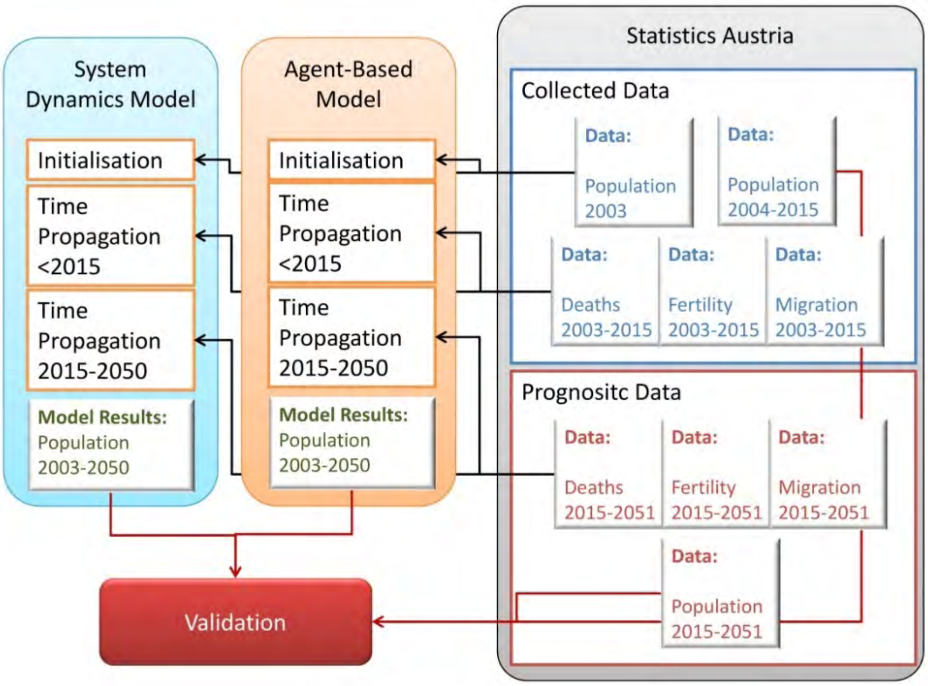


Figure 2: Summary of the connection between Statistics Austria and the two GEPOC models, the agent-based model and the system-dynamics model. Black arrows indicate the usage of data for parametrisation. Red arrows indicate usage and comparison of data during the validation process.

The validation process was very successful. We compared the agent-based model (mainly) with $\delta = 365\ days$ and $\delta = 30\ days$ with data collected from Statistics Austria planning to show that the model delivers valid results for different step-sizes. Some chosen results of this process can be seen in Figures 3-5.

unit: [persons]	StatAustria (Data/ Prognosis)	ABM 365d	ABM 30d
Female Population, 01.01.2015	4378538	4369296	4398287
Error Female Population, 01.01.2015	0	9242.00	19748.67
Female Population, 31.12.2050	4866808	4857100	4983140
Error Female Population, 31.12.2050	0	9708.00	116332.00
Male Population, 01.01.2015	4187808	4202186	4191633
Error Male Population, 01.01.2015	0	14378.00	3825.33
Male Population, 31.12.2050	4674467	4640958	4667487
Error Male Population, 31.12.2050	0	33509.00	6980.33

unit: [persons]	StatAustria (Data/ Progno-sis)	ABM 365d	ABM 30d
Number of Immigrants between 01.01.2014 and 31.12.2014	170115	169887.83	169909.49
Error of Immigrants between 01.01.2014 and 31.12.2014	0	227.17	205.51
Number of Emigrants between 01.01.2014 and 31.12.2014	97791	95786.99	98274.74
Error of Emigrants between 01.01.2014 and 31.12.2014	0	2004.00	483.74
Number of Births between 01.01.2014 and 31.12.2014	81722	77473.62	83168.59
Error of Births between 01.01.2014 and 31.12.2014	0	4248.38	1446.59
Number of Deaths between 01.01.2014 and 31.12.2014	78252	81005.63	78911.92
Error of Deaths between 01.01.2014 and 31.12.2014	0	2753.63	659.92
Net Growth between 01.01.2014 and 31.12.2014	75794	70568.82	75891.41
Net Growth error between 01.01.2014 and 31.12.2014	0	5225.18	97.41
Number of Immigrants between 01.01.2050 and 31.12.2051	147000	146798.45	146632.31
Error of Immigrants between 01.01.2050 and 31.12.2051	0	201.55	367.69
Number of Emigrants between 01.01.2050 and 31.12.2051	120571	115190.53	121588.21
Error of Emigrants between 01.01.2050 and 31.12.2051	0	5380.47	1017.21
Number of Births between 01.01.2050 and 31.12.2051	84385	81091.68	87369.87
Error of Births between 01.01.2050 and 31.12.2051	0	3293.33	2984.87
Number of Deaths between 01.01.2050 and 31.12.2051	102472	106164.19	105840.00
Error of Deaths between 01.01.2050 and 31.12.2051	0	3692.19	3368.00
Net Growth between 01.01.2050 and 31.12.2051	8342	6535.41	6573.97
Net Growth error between 01.01.2050 and 31.12.2051	0	1806.59	1768.03

Figure 3: Quantitative comparison of model results vs. Statistics Austria data/prognosis. Top right for total population numbers at specific dates, bottom right and left for total immigration, births, deaths and emigration numbers per year. Errors are calculated with respect to Statistics Austria.

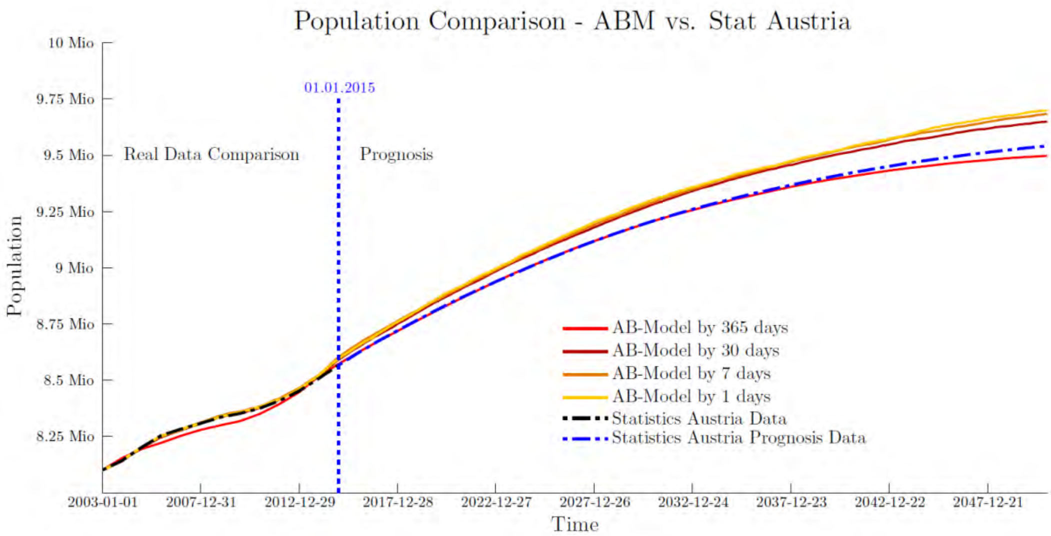


Figure 4: Temporal development of the total population. Results of simulation with different model time-steps compared with Statistics Austria data/prognosis.

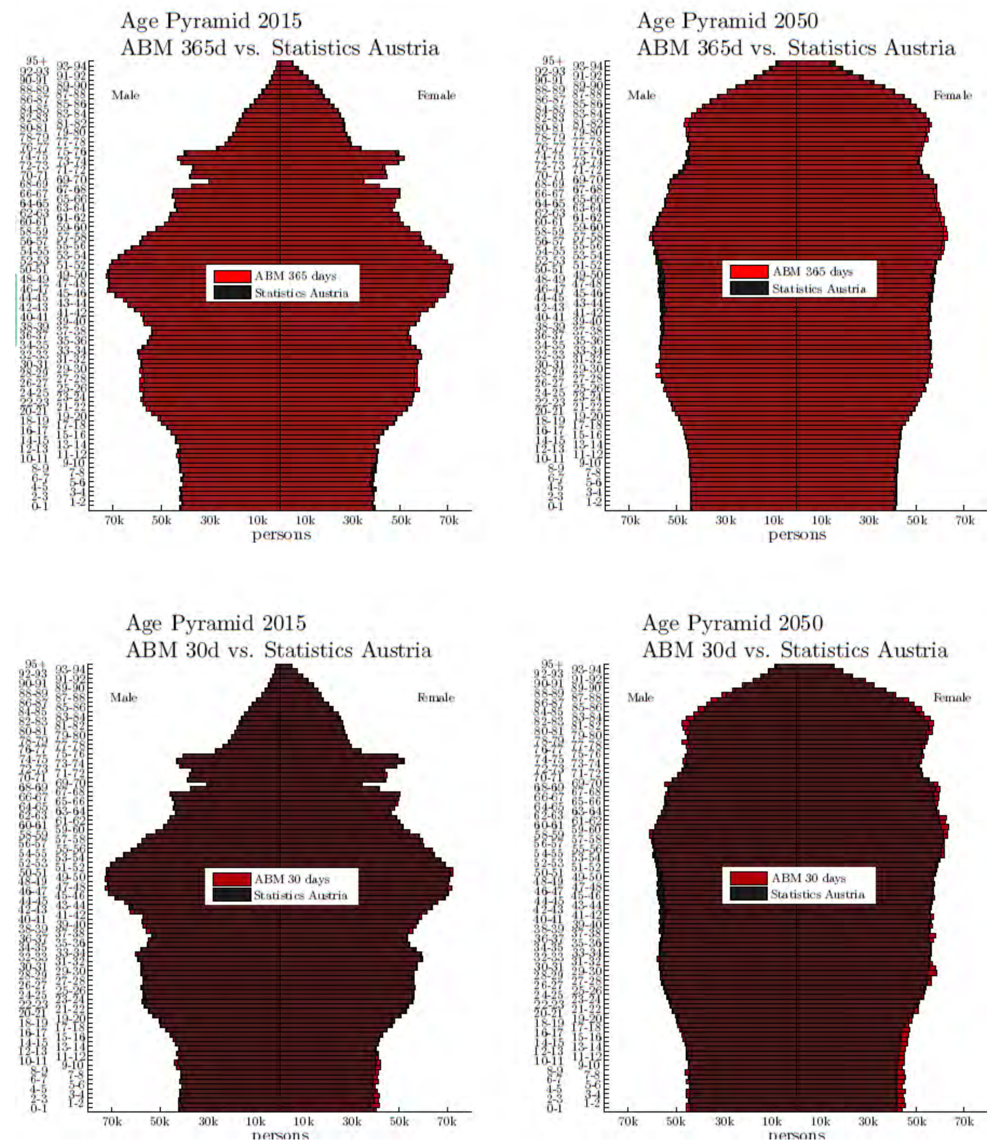


Figure 5: Age pyramid resulting from the model vs. age-pyramid resulting from Statistics Austria data/prognosis. Only for the 365 day execution slight differences can be seen for 0-5 year old women.

2.3 CEPHOS-LINK Model

Clearly GEPOC is a suitable base for analysis of clinic hospitalisations in mental hospitals as mentioned in the first chapter. In order to comparably analyse the situation in Veneto and Slovenia first of all GEPOC had to be re-parametrised for these countries in addition to Austria.

Reparametrisation of GEPOC for Slovenia and Veneto

In the contrast to Austria the acquisition of data for both regions was considerably more difficult. The main statistical institutions of both countries, the Italian National Institute of Statistics (Istat) and the Statistical Office of Slovenia (SI-Stat) hardly offer fine resolved data and, especially, hardly any prognoses. Hence a lot of parameters had to be calculated with known method using the EUROPOP 2013 study (Eurostat Population Projections 2013 in (Kotzeva and Statistical Office of the European Communities 2013)). This data source freely offers population projection data for all 28 EU countries until 2080. Although these projections are doubted by several institutions, the data was at least sufficient to use described methods to calculate the required model parameters. Regards the mentioned doubts, we ourselves are convinced that *any* population prognosis (not only EUROPOP2013) that exceeds a period of more than 5-10 years into the future needs to be doubted and should be interpreted qualitatively but not quantitatively. This does not mean that we should ignore the prognosis results – they are the best we can get so far – but we need to be careful where and how we use and interpret them.

In order to be able to fulfil Task B, each agent not only inhabits a country, but more specifically needs to inhabit a NUTS 3 region. In order to include this functionality data from national statistical offices (Austria, Slovenia and Veneto) and EUROPOP2013 prognoses were used to calculate probabilities

$$Pnuts3(t) = \frac{|persons\ in\ NUTS\ 3\ region\ at\ time\ t|}{|total\ person\ in\ country\ at\ time\ t|}$$

that a representative agent inhabits a specific NUTS 3 region at a given time.

2.3.1 Model Assumptions and data for the CEPHOS-LINK Tasks

General requirements

- Countries/regions: Austria, Veneto (province of Italy), Slovenia.
- Simulation time: The model is simulated until 2039. The simulation start depends on the baseline year from the respective countries/regions (which is 2006 for Austria and 2013 for Slovenia and Veneto).
- Model type: agent-based model of the respective populations with integrated modules for Tasks A, B and C which were defined in the CEPHOS-LINK project.

Task A – Cases in a population

The task is modeling the index stays (the hospital stay corresponding to the index discharge) and re-hospitalisations (second stay following an index discharge) in a changing population. The simulation will be performed for the three countries (or region in the case of Veneto) and covers several years beginning with the baseline year up to 2039.

Distributions and Data

- Probability that a person has an index stay (by age, sex, and diagnosis-group PSO vs NON-PSO)
- Probability of a re-hospitalisation after an index stay (by age, sex, and diagnosis-group)
- Distribution of the duration of index stays and re-hospitalisations (by age, sex, and diagnosis-group)
- Distribution of the time between discharge and re-hospitalisation (by age, sex, and diagnosis-group)
- Optional: The probabilities/distributions are not given by age, sex, and disease. Instead, base probabilities/distributions are given, and multipliers to compute the probability/distribution for an age, sex, and disease.
- Population data as required by the model is partly obtained by the modeling team and partly provided by the CEPHOS team.

Assumptions

- A person is eligible for an index stay
  (A) when he never had an index stay or
  (B) more than 365 days after the discharge date of an index stay without re-hospitalisation or
  (C) after discharge from a re-hospitalisation, but not within the same year of the discharge date.
- Only two diagnosis-groups are simulated, psychotic or non-psychotic diagnosis

Result-tables

- The resulting population (by age, sex) for each year
- A list of all patients with at least one index stay containing age, sex, and diagnosis group of the patient, and date and length of each hospital stays (index stays and re-hospitalisations).

Task B – Influence of changing distances to service in NUTS 3 regions

This task is testing the influence of changing distances to service on the level of NUTS 3 regions on re-hospitalisation. Countries are split into NUTS 3 regions. In this task, the model from Task A is extended with required features.

General requirements

- Each person gets assigned to a NUTS 3 region representing where he/she lives. We assume that the distance to the next hospital is the same for all persons of a NUTS 3 region. Hence, in our case, the NUTS3 region represents the distance of a person to the next hospital.
- Depending on the distance, which is given for each NUTS 3 region, a multiplier is given that affects the probability of a re-hospitalisation.
- For validity, parameters are adjusted accordingly that the total number of re-hospitalisations is the same as in task A.
- Scenarios: testing the outcome if multipliers are varied in defined NUTS 3 regions in defined years

Distributions and Data

- Distribution of the NUTS 3 regions (population of each region)
- A multiplier for each NUTS 3 region that is applied on the re-hospitalisation probabilities

Assumptions

- Age/sex distribution is the same in all NUTS 3 regions
- The relative size of the NUTS 3 regions does not change when population changes (i.e., when the total population grows, all NUTS 3 regions grow accordingly)
- The NUTS 3 regions do not have an effect on the index stay or the diagnosis group

Result tables

- Same as in Task A, including the population of each NUTS 3 region and the NUTS 3 region of each listed patient

Task C – Influence of changing distances to service in NUTS 3 regions

2.3.2 Model Definition as an Extension of GEPOC

In order to fulfil the three tasks described in GEPOC has to be extended by a couple of new functionalities/modules:

- Each agent (statistical representative for a real person) has a possibility to have a hospital stay. Herein it receives a diagnosis which influences how long the patient stays in the hospital and whether the agent might return to a hospital after some time, i.e. has a re-hospitalisation.
- Each NUTS 3 region has a specific mean-driving time to a hospital which influences the re-hospitalisation probability for all inhabitants.
- Each person may additionally suffer from Diabetes Mellitus which itself increases the re-hospitalisation probability.

Moreover GEPOC used as a part of CEPHOS-LINK is always executed with the total population of about 8 -9Mio. Agents (i.e. $K = 1$) to avoid rounding errors and, more importantly, confusions which might lead to a lack of credibility. Moreover yearly steps are used as all input data is given at a yearly basis. Note that yearly steps does not imply that every step is 365 days long (leap-years).

Hospitalisations and Re-hospitalisations in Hospitals

In addition to the defined agent behaviour in the GEPOC section each agent (standing for one representative real person) has a probability to have a called <u>index-stay</u> during each time-step. By this term we refer to the first hospital-stay of a person (agent) in a year which is not a re-hospitalisation. I.e. any agent that did not already have a re-hospitalisation in the observed year has a certain probability

$$Pi(a, s),$$

wherein a, s stand for age and sex of the agent, to visit a fictional hospital at some point during the observed year. Note that this probability, in the contrast to almost all standard GEPOC parameters, does not depend on time. In case the person is (randomly) selected to do so, first of all the agent receives one of two diagnosis: *psychotic* or *nonpsychotic*:

$$P(Diagnosis\ =\ psychotic) =: Pdp(a, s), \qquad P(Diagnosis = nonpsychotic) =: Pdn(a, s),$$
$$Pdn(a, s) + Pdp(a, s) = 1.$$

We will refer to this diagnosis as d henceforth. Dependent on this diagnosis the length of the stay is sampled. This is either done using a gamma-variate random variable or sampling a number of days by a discrete distribution. In any case this duration must exceed one day (one night) by definition:

$$Length\ of\ stay(a, s, d) \sim \Gamma(\alpha, \beta)\ or\ discrete.$$

Moreover each agent might have a chance to be readmitted at a later point in time. Although this might basically sound acausal, the question whether or not an agent is readmitted is answered immediately at the point of the index stay due to data reasons. Therefore we have a probability

$$Pr(a, s, d)$$

deciding about if an agent is readmitted. In case an agent is chosen to do so two time-spans are sampled, once more either by gamma-variate random numbers or by discrete distributions:

$$Time\ until\ readmission(a, s, d) \sim \Gamma(\alpha, \beta)\ or\ discrete.$$

$$Length\ of\ readmission \sim \Gamma(\alpha, \beta)\ or\ discrete.$$

All of these time-spans must not be shorter than one day (night). The time until re-hospitalisation must not exceed 365 days.

Mean Driving Time Influences Re-hospitalisation Probability

In order to have the re-hospitalisation probability depend on the mean driving time to a hospital in a specific NTUS3 region, the NUTS 3 extended GEPOC version (described before) is used. Moreover let r define the region an agent inhabit and $F(r)$ a specific factor that indicates how much higher the probability for a re-hospitalisation for a specific NUTS 3 region r is. In most cases two NUTS 3 regions were identified, that have a significantly higher re-hospitalisation rate than the rest. Hence $F(r) > 1$ for two regions and 1 for all others. We receive:

$$Pr(a,s,d,r) = F(r) \cdot Pr(a,s,d) \cdot K,$$

for a constant compensation factor K (slightly smaller than 1) which had to be calibrated, so that the new simulation results do not differ from the old ones in total (total Austria). More about that in section Stochastic Model Calibration.

All other parts of the model remained untouched.

Diabetes Mellitus

Given only the total prevalence of diabetes in Austria, Veneto and Slovenia the model, but not the incidence numbers the model had to be parametrised differently than the hospitalisations – it is not possible to correctly calculate a probability for a diabetes case by knowing only the absolute numbers per year. Therefore the Government Agent (described in the GEPOC Section) takes care about the number of diabetes diseases in the model. It observes the number of diabetes cases (per sex and age cohort) at the beginning of each time-step and randomly "distributes" new diabetes cases randomly among the population to fit the diabetes-prevalence numbers of the actual year. This yet very macabre way of modelling a disease is the only way to use prevalence data to directly parametrise disease models. Otherwise a very demanding calibration process had to be done.

Say an agent's diabetes status D is either $true$ or $false$ and $F_2(D)$ ($= 1$ for $false$, > 1 for $true$) denotes the influence of diabetes on being readmitted to a hospital the probability for a re-hospitalisation is given by the following probability:

$$Pr(a,s,d,r,D) := F_2(D) \cdot Pr(a,s,d,r) \cdot K_2 = F_2(D) \cdot F(r) \cdot Pr(a,s,d) \cdot K \cdot K_2.$$

Once again, a compensating factor $K_2 < 1$ had to be calibrated.

2.3.3 Parametrisation

Hospitalisation Specific Parameters

Without going into detail about data acquisition at this specific stage (it is briefly explained in <somewhere else>) we will only explain which and how data was used to parameterise the model.

First of all probabilities

$$Pi(a,s), Pr(a,s)$$

Could be determined using known methods (dividing number of known index-stays or re-hospitalisations by total population or total number of index-stays respectively). We chose numbers for 2006 (Austria) and 2013 (Slovenia, Veneto) as reference for these calculations. Age classes 65+ had to be dealt as a whole. This was a matter of the sample size as for certain age classes >65 not even one index-stay was recorded in 2006/2013 which would have perturbed the model parametrisation by (definitely wrong) $Pi(a,s) = 0$.

In order to sample a length of a stay or the time between two hospital-stays was initially tried to be fitted by a gamma distribution dependent on age and sex (and diagnosis). Hence two age, sex (and diagnosis) parameters α and β were determined using a standard maximum-likelihood method. In case the gamma-distribution turned out to be a bad match for the given data, a discrete distribution was fitted – i.e. the numbers

$$P(time\ interval = x\ days\ |s, a, (d)), x \in \{1, \dots, 365\}$$

were determined by a histogram. Which method was used for which parameter can be seen in Table 0.

	Austria	Slovenia	Veneto
Length of index-stay	gamma-distribution	gamma-distribution	gamma-distribution
Time until re-hospitalisation	discrete	discrete	discrete
Length or re-hospitalisation-stay	gamma-distribution	discrete	discrete

Table 0: Which distribution was used to sample which time-span for all three considered regions

Diabetes Specific Parameters

Diabetes Mellitus (DM) prevalence data was available for two specific points in time:

- Total number of DM cases for 2010 and Austria, Slovenia and Italy with following subcategories
  No. of Female Cases, No. of Male Cases, No. of cases [20-39], No. of cases [40-59], No. of cases [60,79]
- Total number of DM cases (estimation) for 2030 and Austria, Slovenia and Italy with following subcategories
  No. of Female Cases, No. of Male Cases, No. of cases [20-39], No. of cases [40-59], No. of cases [60,79]

In order to use the data for parameterisation of the model, the following pre-processing was performed. As the model requires a finder resolution than the given data some assumptions had to be made as well.

- Assumption: Age and sex are (approximately) independent parameters
  - Calculated total number of diabetes cases per age cohort and sex based on marginal distributions
- Assumption: Total case numbers behave approximately linearly with time
  - Total numbers for cases linearly inter/extrapolated based on data for 2010 and 2030.
- Assumption: Diabetes cases are homogenously spread among italy (i.e. veneto cases can be scaled using the veneto/italy fraction)
  - Divided Population-numbers for Veneto by Italy (per year and sex gained from EUROPOP2013 study). Used this fraction to get case numbers for Veneto

- Diabetes cases per person (or per 10000) is a number that behaves linearly with age.
  - Gain diabetes cases per person for age cohorts [0,20) and [80+] by linear extrapolation from the other three available age classes [20,40),[40,60),[60,80) . Finally gained total number of diabetes cases by re-multiplying these numbers with the population.

2.3.4 Stochastic Model-Calibration

As mentioned during the model definition two compensation parameters had to be calibrated in the stage of the model parametrisation – the two compensation parameters K and K_2.

Calibration of a parameter describes the process of determining a specific parameter's value, in this case treated as the input of the model, so that the model's output matches a given reference value. In that sense the problem can be seen as a optimisation problem. Let p denote the parameter which needs to be calibrated, R the reference solution we try to obtain with the model and $M(p)$ a function that maps the parameter-value onto the correspondent model result (i.e. the simulation itself), then we aim for

$$p = argmin(|M(p) - R|).$$

As the model itself is stochastic this problem is not well defined as each simulation result might differ a little. We need to reformulate a stochastic optimisation problem via

$$p = argmin(|E(M(p)) - R|).$$

with E denoting the expected value of the simulation. As standard calibration algorithms (Genetic-Algorithm, Particle-Swarm-Optimisation, Simulated Annealing, etc.) are, first, developed for deterministic problems and, second, require a lot of function evaluations (=model simulations) we needed to setup different methods for this task. Note that one execution of the agent-based model takes a lot of time.

We describe our developed method for the calibration in Task B for Austria (compensation-factor for the NUTS 3 influence factor K) in the following subchapters. Note that a slightly new variable notation will be introduced in the following subchapter which will remain valid (only) for the remainder of this Calibration chapter.

Task A - The Underlying Probability Model

In order to understand the calibration task we first of all analyse the agent-based model defined in Sections "GEPOC" and "Model Definition as an Extension of GEPOC" for its underlying probability model with respect to re-hospitalisations. We start with the analysis of the Task A-stage model.

Define a random variable $R_i \in \{0,1\}$ indicating whether (1) or not (0) an agent (representing one real person) gets readmitted to a psychiatric clinic. The index i indicates a unique identifier of this agent. We investigate the probability for the event $R_i = 1$. This probability does basically not depend on the agent's id but by a vector of properties $\vec{x}_i$ such as age, sex and diagnosis (psychotic/nonpsychotic). I.e. there is an index independent random variable R so that

$$P(R_i = 1) = P(R = 1|\vec{X} = \vec{x}_i).$$

Moreover the probability for a re-hospitalisation strongly depends on whether the person has had an index-stay before. Let I_i be either 1, in case the person has had an index-stay before, or 0 otherwise. In case $I_i = 0$ no re-hospitalisation is possible. Thus

$$P(R_i = 1) = P(R_i = 1|I_i = 1)P(I_1 = 1) = P(R = 1|I = 1, \vec{X} = \vec{x}_i)P(I = 1|\vec{X} = \vec{x}_i)$$

In the course of CEPHOS-LINK Task A we determined all numbers $p_{\vec{x}}$ which correspond to the probabilities

$$p_{\vec{x}} \coloneqq P(R = 1|I = 1, \vec{X} = \vec{x})$$

for all possible age, sex and diagnosis combinations $\vec{x}$. We moreover used them in a microscopic simulation model. As a result of the model with $N \approx 8$ Mio individual agents $i \in \{1, \dots, N\}$ an average total number of 12400.6 re-hospitalisations could be evaluated for the year 2006. I.e.

$$E(T) \coloneqq E\left(\sum_{i=1}^{N} 1_{\{1\}}(R_i)\right) = E\left(\sum_{i=1}^{N} R_i\right) = \sum_{i=1}^{N} E(R_i) = \sum_{i=1}^{N} P(R_i = 1) = \sum_{i=1}^{N} p_{\vec{x}_i} P(I = 1|\vec{X} = \vec{x}_i)$$
$$\approx 12400.6.$$

This number was gained by the repeating the stochastic simulation $M = 100$ times using the sample mean $E(T) \approx \overline{T} \coloneqq \frac{1}{M}\sum_{i=1}^{N} T_i$.

Task A - Error estimation for the sample-mean

We moreover observed

$$V(T) \approx s^2 = 110.3^2 \Rightarrow \sigma(T) \approx 110.3$$

also based on 100 simulation runs using the (corrected) sample variance . As stochastic sums are known to scatter according to the Law of Iterated Logarithm (Law of Hartman-Windtner) we deduce that $\overline{T}$ fulfils

$$limsup_{M\to\infty} \frac{|\overline{T} - \mathrm{E(T)}|}{|\sigma|\sqrt{\frac{2\ln(\ln(M))}{M}}} = 1.$$

Hence $|\sigma|\sqrt{\frac{2\ln(\ln(M))}{M}}$ is a realistic bound for the fluctuation for the sample mean. In our case $M = 100$ samples lead to a bound of about 19.3 (of course replacing the original, unknown standard deviation by the sampled one), which basically implies that $\overline{T}$ is not further away from the real mean $E(T)$ than this rather insignificant number of individuals:

$$E(T) \in [12400.6 \pm 19.3].$$

Task B – The Underlying Probability model

In the course of Task B we aimed to introduce an additional condition n_i to the probability indicating the NUTS 3 region of agent i and assumed that this condition influences the overall probability for re-hospitalisation:

$$P(R = 1\big|I = 1, \vec{X} = \vec{x}_i) \neq P(R = 1\big|I = 1, N = n_i, \vec{X} = \vec{x}_i).$$

In order to correctly parametrise the model we moreover required the numbers

$$p_{\vec{x},n} \coloneqq P(R = 1\big|I = 1, N = n, \vec{X} = \vec{x}),$$

which, by assumption, are not equal to the numbers $p_{\vec{x}}$. Nevertheless a relationship was assumed: There are known numbers $f_n \in \mathbb{R}^+$, dependent on the NUTS 3 region, so that

$$p_{\vec{x},n} \propto p_{\vec{x}} \cdot f_n.$$

Hence there is an unknown constant C so that

$$p_{\vec{x},n} = p_{\vec{x}} \cdot f_n \cdot K.$$

As a matter of the working hypothesis f_n were fitted to suit to the mean driving distance of each NUTS 3 region. In most cases $f_n = 1$ indicating that the driving distance did not influence the probability. In a few (two) cases $f_n > 1$ indicating that there is an observed relationship.

Task B – Calibration Task

In order to find a value for parameter K a hypothesis was defined: In Task B the average number of total re-hospitalisations (henceforth denoted as T_K to show the dependence on parameter K) gained from Task A has to be maintained. I.e.

$$E\left(\sum_{i=1}^{N} 1_{\{1\}}(R_i)\right) = \sum_{i=1}^{N} P(R_i = 1) = \sum_{i=1}^{N} P\big(R = 1\big|I = 1, N = n_i, \vec{X} = \vec{x}_i\big)\, P\big(I = 1\big|N = n_i, \vec{X} = \vec{x}_i\big)$$

$$= \sum_{i=1}^{N} p_{\vec{x}_i,n_i}\, P\big(I = 1\big|N = n_i, \vec{X} = \vec{x}_i\big) = \sum_{i=1}^{N} p_{\vec{x_i}} \cdot f_{n_i} \cdot K \cdot P\big(I = 1\big|N = n_i, \vec{X} = \vec{x}_i\big)$$

$$= K \cdot \sum_{i=1}^{N} p_{\vec{x_i}} \cdot f_{n_i} \cdot P\big(I = 1\big|N = n_i, \vec{X} = \vec{x}_i\big) = 12400.6.$$

Task B – Calibration Strategies

Based on the choice of f_n we deduced that the optimal K needs to lie somewhere between 0.99 and 1 as only two NUTS 3 regions are scaled. A parameter sweep or a bisection search algorithm seemed to be the optimal solution on the first glance. Note that we only have a one dimensional optimisation problem. Yet problems arose due to the fluctuation of the model. A parameter sweep (K_i) would have required hundred(s) of simulation runs to get a robust estimate for the mean-value $E(T_{K_i})$ of just one parameter. Similar problems arose for the bisection algorithm. Hence we chose to use a different strategy.

As seen in the last formula parameter K has a linear influence on the expected value. We get

$$E(T_K) = K \cdot E(T_1).$$

Task B – Calibration Strategy1: "K=1"

The first, straight forward, idea is finding an approximation for $E_1(T)$. Hereby again $M = 100$ simulation runs were used resulting in a sample-mean approximation of

$$E(T_1) \approx \bar{T}_1 = 12464.2$$

As a consequence

$$K_{opt} = \frac{E(T)}{E(T_1)} \approx \frac{12400.6}{12464.2} \approx 0.994899$$

could be determined. Based on a fluctuation estimate of 16.4 for $E(T_1)$ analogous to the fluctuation estimate of $E(T)$ in the first section (Iterated Logarithm) we deduce that the real value of K_{opt} will spread on the interval

$$K_{opt} \in \left[\frac{12400.6 - 19.3}{12464.2 + 16.4}, \frac{12400.6 + 19.3}{12464.2 - 16.4}\right] \approx [0.99205, 0.99776]$$

Task B – Calibration Strategy 2: "Stochastic Sweep"

In order to apply strategy 1 we are necessarily required to know the effects of the parameter on the random number precisely (which is the case here). In case this effect is only known qualitatively or nothing at all this second strategy could be applied.

This strategy for calibrating the unknown parameter K reconsiders the idea of a parameter sweep. We perform a parameter sweep from 0.99 to 1 with bandwidth of h leading to $\frac{0.01}{h} =: M$ parameter values $K_i, i = 1 \dots M$ to try out. This time we do not consider calculating a sample mean for each of them, but perform only one simulation run per parameter. Applying a linear polynomial fit on the resulting data $\left(K_i, T_{K_i}\right)_{i=1 \dots M}$ leads to a function that approximates the mean-values.

After fitting we get a polynomial with two coefficients p_1 and p_2 and a estimator

$$E(K) \approx p_1 + K \cdot p_2.$$

Hence, given a desired expected value $E(K)$ we calculate the unknown parameter K via $K = \frac{E(K)-p_1}{p_2}$. We gained

$$p_1 \approx -6030.7, \qquad p_2 \approx 18500.4$$

and

$$K \approx \frac{12400.6 + 6030.7}{18500.4} \approx 0.99626$$

Although this idea seems to be a lot more inefficient that the first one, it makes a more explorative approach possible. In case the linear behaviour (reason for choosing the linear fit in our case) is not known precisely, one could look for different trends in the output data and try if e.g. exponential functions or higher order polynomials fit more properly. Hence this approach is a more general one and can be applied for other stochastic models.

Unfortunately, no error bound can be given here.

Task B – Calibration Strategy refinement

As seen in the first strategy the fluctuation span of the correct parameter is quite broad. Thus we aimed to use additional knowledge of every simulation run to refine the process.

As a second observable of the simulation, the total number of patients that have had an index-stay before, independent of whether they are readmitted or not, is known perfectly. This number

$$T' := \sum_{i=1}^{N} 1_{\{1\}}(I_i)$$

does not depend on the NUTS 3 region and hence not on parameter K. Moreover it is positively correlated with T_K and T - i.e. the more individuals have an index-stay, the more resubmissions are possible. As a consequence we observed the random variable T_K/T' and its expected value which clearly fulfils

$$E\left(\frac{T_K}{T'}\right) = K \cdot E\left(\frac{T_1}{T'}\right)$$

as well. Hence both calibration strategies are possible again.

Based on our 100 reference simulation runs we observed

$$\overline{\left(\frac{T}{T'}\right)} \approx 0.58333, \qquad s^2 \approx 0.0038^2 \Rightarrow s \approx 0.0038$$

as our reference value. This leads to an uncertainty of about

$$E\left(\frac{T}{T'}\right) \in [0.58333 \pm 0.00066]$$

For 100 runs based on the stated Hartman-Windtner law.

Task B – Calibration Strategy 1: "K=1" - refined

Based on our 100 simulation runs with parameter 1 we observed

$$\overline{\left(\frac{T_1}{T'}\right)} \approx 0.58634, \qquad s^2 \approx 0.0031^2 \Rightarrow s \approx 0.0031$$

and

$$E\left(\frac{T_1}{T'}\right) \in [0.58634 \pm 0.00054].$$

Thus

$$K_{opt} = \frac{E\left(\frac{T}{T'}\right)}{E\left(\frac{T_1}{T'}\right)} \approx \frac{0.58333}{0.58634} \approx 0.994867$$

and

$$K_{opt} \in \left[\frac{0.58333 - 0.00066}{0.58634 + 0.00054}, \frac{0.58333 + 0.00066}{0.58634 - 0.00054}\right] \approx [0.99280, 0.99691].$$

These bounds are a little bit sharper than for the unrefined version which affirms the use of T/T'.

3 Analysis for the Parameterisation of the simulation model

3.1 General Model assumptions

- Countries/regions: Austria, Veneto (province of Italy), Slovenia.
- Simulation time: The model is simulated until 2039. The simulation start depends on the baseline year from the respective countries/regions (which is 2006 for Austria and 2013 for Slovenia and Veneto).
- Model type: agent-based model of the respective populations with integrated modules for Tasks A, B and C which were defined in the CEPHOS-LINK project.

3.1.1 Task A – Cases in a population

The task is modeling the index stays (the hospital stay corresponding to the index discharge) and re-hospitalisations (second stay following an index discharge) in a changing population. The simulation will be performed for the three countries (or region in the case of Veneto) and covers several years beginning with the baseline year up to 2039.

Distributions and Data

- Probability that a person has an index stay (by age, sex, and diagnosis-group PSO vs NON-PSO)
- Probability of a re-hospitalisation after an index stay (by age, sex, and diagnosis-group)
- Distribution of the duration of index stays and re-hospitalisations (by age, sex, and diagnosis-group)
- Distribution of the time between discharge and re-hospitalisation (by age, sex, and diagnosis-group)
- Optional: The probabilities/distributions are not given by age, sex, and disease. Instead, base probabilities/distributions are given, and multipliers to compute the probability/distribution for an age, sex, and disease.
- Population data as required by the model is partly obtained by the modeling team and partly provided by the CEPHOS team.

Assumptions

- A person is eligible for an index stay
  (A) when he never had an index stay or
  (B) more than 365 days after the discharge date of an index stay without re-hospitalisation or
  (C) after discharge from a re-hospitalisation, but not within the same year of the discharge date.
- Only two diagnosis-groups are simulated, psychotic or non-psychotic diagnosis

Result-tables

- The resulting population (by age, sex) for each year
- A list of all patients with at least one index stay containing age, sex, and diagnosis group of the patient, and date and length of each hospital stays (index stays and re-hospitalisations).

3.1.2 Task B – Influence of changing distances to service in NUTS 3 regions

This task is testing the influence of changing distances to service on the level of NUTS 3 regions on re-hospitalisation. Countries are split into NUTS 3 regions. In this task, the model from Task A is extended with required features.

General requirements

- Each person gets assigned to a NUTS 3 region representing where he/she lives. We assume that the distance to the next hospital is the same for all persons of a NUTS 3 region. Hence, in our case, the NUTS 3 region represents the distance of a person to the next hospital.
- Depending on the distance, which is given for each NUTS 3 region, a multiplier is given that affects the probability of a re-hospitalisation.
- For validity, parameters are adjusted accordingly that the total number of re-hospitalisations is the same as in task A.
- Scenarios: testing the outcome if multipliers are varied in defined NUTS 3 regions in defined years

Distributions and Data

- Distribution of the NUTS 3 regions (population of each region)
- A multiplier for each NUTS 3 region that is applied on the re-hospitalisation probabilities

Assumptions

- Age/sex distribution is the same in all NUTS 3 regions
- The relative size of the NUTS 3 regions does not change when population changes (i.e., when the total population grows, all NUTS 3 regions grow accordingly)
- The NUTS 3 regions do not have an effect on the index stay or the diagnosis group

Result tables

- Same as in Task A, including the population of each NUTS 3 region and the NUTS 3 region of each listed patient

3.1.3 Task C – Influence of Diabetes

The task is testing the influence of diabetes as one of the most important chronic diseases in the European population on hospitalisations. In this task, the model from Task B is extended with required features.

General requirements

- Each person gets assigned an attribute that states whether he/she has diabetes, or not. This attribute can change (i.e., persons without diabetes can develop diabetes). The number of persons having/developing diabetes depends on the data.
- Simulating the system where persons with and without diabetes have different probabilities of index stay, given as multipliers for the base probability
- For validity, parameters are adjusted accordingly that the total number of re-hospitalisations is the same as in task B.
- Scenarios: testing the outcome if diabetes numbers are changing

Data

- Prevalence or incidence rates of diabetes each year (by age, sex). This is the fraction of the population that has or develops diabetes each year.
- A multiplier for diabetes/non-diabetes that is applied on the probabilities of index stay

Assumptions

- Diabetes numbers and the influence of diabetes are independent from NUTS 3 regions

Result tables

- Same as in Task B, including the population with/without diabetes, and the diabetes status of each listed patient

3.2 Restrictions and remarks

Throughout the whole analysis it is of interest to first answer the following questions: Which age groups are relevant and which age groups are neglectable? What is the absolute number of females or males that had an index hospitalisation?

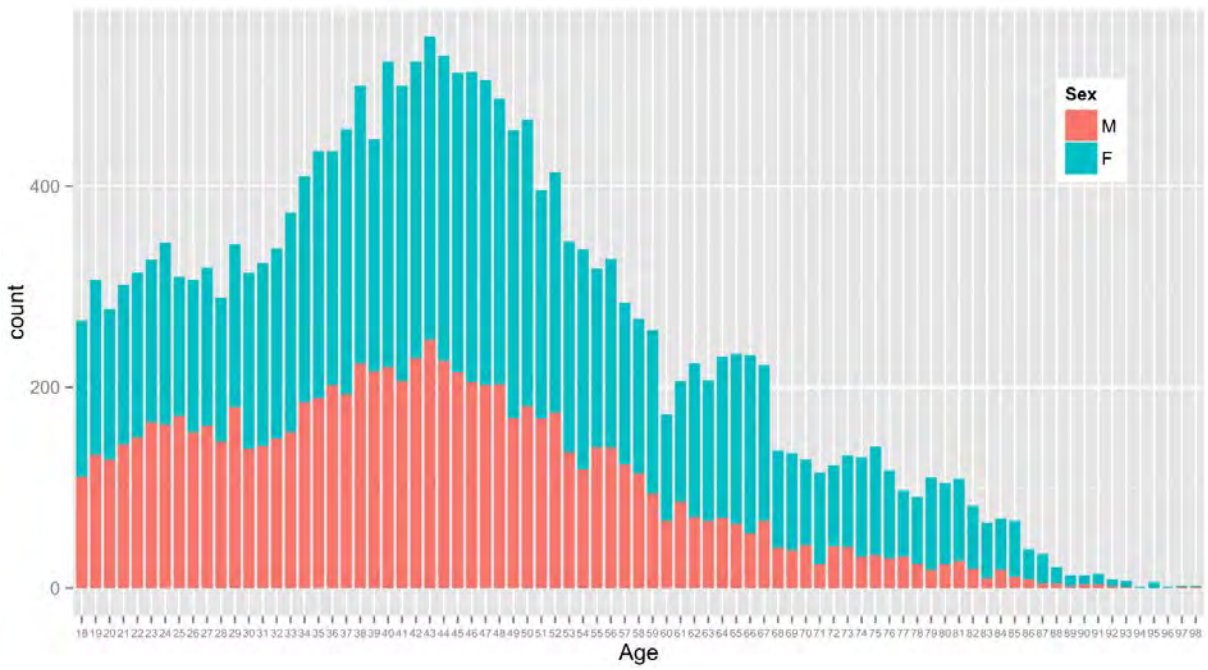


Figure 6: Distribution of females and males that had an index hospitalisation (AUSTRIA)

The focus has to lie upon the females and males of age 18-60. There are less people above that age and especially the number of males and females above 85 that had an index hospitalisation is decreasingly small. Since the numbers in the diagram are absolute this can have various other reasons, including the in general decreasing number of people older than 65 years.

3.2.1 Usage in the model

The model is based on the data of the year 2006/ 2013 (from the pooled data-set from 2016-11-21). So the analysis done is just valid for that year and it is assumed that over the next year the index hospitalisations and re-hospitalisations do not significantly change. Furthermore the calculated parameters (whether directly calculated or by using a fitted function) are stored in csv files, which are used in the simulation model.

One of the main problems using this approach is the small number of patients in smaller countries, such as Austria, for specific age groups. This leads to spikes and to another problem, namely that it is not possible to fit a distribution function, e.g. for the length of stay, over such a small amount of data.

That is the main motivation for the analysis done in this report. By using fitted functions we are able to sort out the relevant information from spikes and bad or non-existing distribution fits. The results become more accurate, especially for older age groups.

Throughout the whole analysis all people older than 65 are treated together, i.e. as one group.

3.2.2 Hospitalisations

By the probabilities of a hospitalisation depending on age, sex and the diagnosis (psychotic or non-psychotic) (calculated from the data of the year 2006) it is determined whether a person is hospitalised. If a person is hospitalised, the length of the stay is calculated for the specific patient based on given parameters of a gamma distribution (also fitted on the data of 2006).

3.2.3 Re-hospitalisations

If a person was hospitalised there is the possibility that the person is rehospitalised. That is determined using the probabilities of a re-hospitalisation. In the case of a re-hospitalisation the time between the discharge of the hospitalisation and the re-hospitalisation and the length of the re-hospitalisation stay are calculated by the distributions based on 2006 data.

3.2.4 Parameter-Files for the model (if not stated otherwise the same file names and types apply to all countries/regions):

- indexhospitalisation.csv

Probabilities depending on age, sex and diagnosis that a person has an index hospitalisation

- re-hospitalisation.csv

Probabilities depending on age, sex and diagnosis that someone, who already had an index hospitalisation is rehospitalised in the same year (after maximum 365 days).

- indexduration.csv

Basically this file deals with the distribution of the duration of an index stay depending on age, sex and diagnosis. Since the distribution is not the same for Austria, Veneto and Slovenia, it is handled differently in the three countries/regions.

  - Austria: In this case the underlying distribution is close to a gamma distribution and therefore in the file the parameters for the gamma distribution are given.
  - Veneto: In the case of Veneto the underlying distribution can also be assumed to be a gamma distribution. However, the number of patients in the year 2013 is not sufficiently big enough to make a good statistical fit and therefore all patients younger than 44 years are treated together (as are the persons older than 65 as mentioned above).
  - Slovenia: For Slovenia the sample size is too small to fit a gamma distribution. Therefore the other solution was to calculate the probabilities for each of the possible length of stays (a number between 0 and 365) and weight the random numbers used to calculate the length of stay for a specific patient accordingly. Those values are given for each age, sex and diagnosis group, which results in four different csv files containing the corresponding values for each combination of sex and diagnosis.

- time_until_re-hospitalisation.csv

In this case we faced a similar problem as the one described for the index duration data of Slovenia. For the time between the index hospitalisation and the re-hospitalisation it does not only affect the

Slovenia data, but also Veneto and Austria. Therefore in all three cases the data are handled in the same way as above resulting in four files for each of the countries.

3.3 Probability that a person has an index hospitalisation (by age, sex and diagnosis group, i.e. Psychotic or Non-Psychotic)

The task is to calculate probabilities depending on the parameters age, sex and diagnosis (PSYCHOTIC or NON-PSYCHOTIC) that a person has an index hospitalisation out of the total population of the specific country. The population data is the same as the one used in the simulation model.

3.3.1 AUSTRIA

The probabilities are calculated for the different settings, i. e. for the various combinations of ages and age groups (18-44, 45-64 and 65+), the sex (f/m) and the diagnosis.

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	**Percentage female**	**Percentage male**	**Percentage female**	**Percentage male**
18-44	0,1160661	0,1326656	0,25093032	0,16725818
45-64	0,17630958	0,11430725	0,27733075	0,18967466
65+	0,04054226	0,01466762	0,10061852	0,04230226

Table 1: Percentage of people with an index hospitalisation (by age, sex and diagnosis)

Table 1 just gives an overview over the magnitude of the values. In the model itself the probabilities of a hospitalisation depending on the exact age, sex and diagnosis are used. Due to the small sample size people older than 65 years are treated as a group, however.

3.3.2 VENETO

In this case the underlying data are from the year 2013.

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	**Percentage female**	**Percentage male**	**Percentage female**	**Percentage male**
18-44	0,057079123	0,07470623	0,09258956	0,07470623
45-64	0,134647	0,1064411	0,18125610	0,106441068
65+	0,04615567	0,03370267	0,1052078	0,05624859

Table 2: Percentage of people with an index hospitalisation (by age, sex and diagnosis)

Again, in the model itself the probabilities of a hospitalisation depending on the exact age, sex and diagnosis are used. Due to the small sample size people older than 65 years are treated as a group, however.

3.3.3 SLOVENIA

Also in this case the underlying data are from the year 2013.

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	Percentage female	Percentage male	Percentage female	Percentage male
18-44	0,029819	0,0560693	0,04149718	0,05606933
45-64	0,076818	0,05795287	0,0860247228	0,05795287
65+	0,02765943	0,039198	0,039198	0,01719999

Table 3: Percentage of people with an index hospitalisation (by age, sex and diagnosis)

3.4 Probability of a re-hospitalisation after an index hospitalisation (by age, sex and diagnosis group)

How probable is it that a person gets rehospitalised after an index hospitalisation? Again, the probabilities are calculated by age, sex and diagnosis group.

3.4.1 AUSTRIA

The percentage of patients that were rehospitalised after an index hospitalisation is again given for each age group for each of the countries.

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	Percentage female	Percentage male	Percentage female	Percentage male
18-44	62,3867874	59,9725526	54,9285362	49,1654572
45-64	61,8015964	60,2564103	57,3758608	60,0441501
65+	61,0606061	68,115942	63,7973138	62,6465662

Table 4: Percentage of patients that were rehospitalised after an index hospitalisation (by age, sex and diagnosis)

3.4.2 VENETO

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	Percentage female	Percentage male	Percentage female	Percentage male
18-44	40,88831	38,33747	35,07363	27,37361
45-64	45,961	50,76923	42,75862	33,55263
65+	21,42857	63,63636	44,18604	38,0952

Table 5: Percentage of patients that were rehospitalised after an index hospitalisation (by age, sex and diagnosis)

3.4.3 SLOVENIA

	PSYCHOTIC		NON-PSYCHOTIC	
Age groups	**Percentage female**	**Percentage male**	**Percentage female**	**Percentage male**
18-44	44,11765	42,85714	43,87352	40,95745
45-64	43,4457	48,49246	35,95318	39,84576
65+	48,7395	50	43,29004	48,14815

Table 6: Percentage of patients that were rehospitalised after an index hospitalisation (by age, sex and diagnosis)

3.5 Distribution of the duration of index stay and re-hospitalisation (by age, sex and diagnosis group)

3.5.1 AUSTRIA

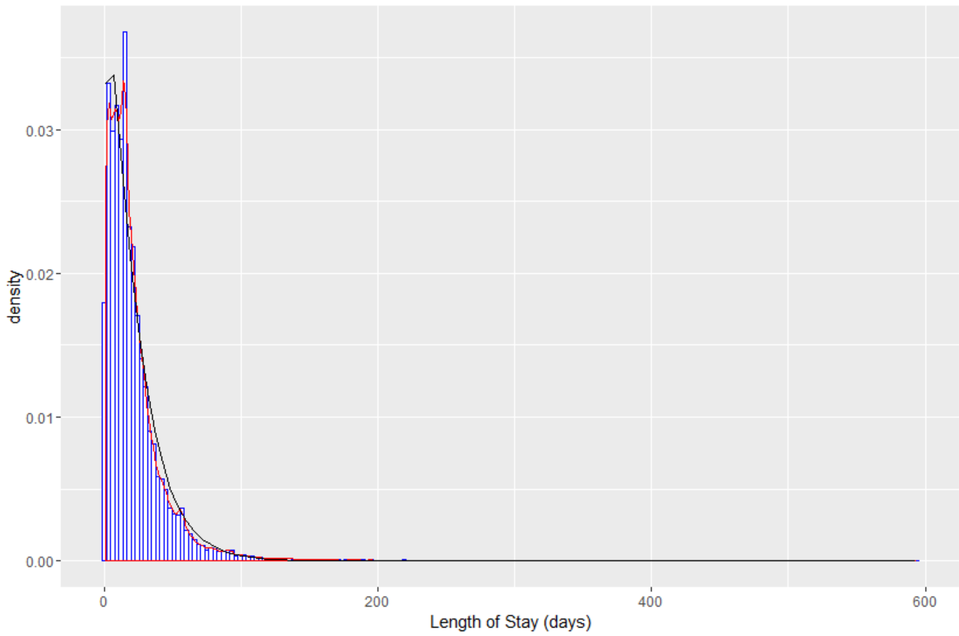


Figure 7: Length of stays according density function (red) overlayed with a gamma density function (black)

Figure 7 implies that the length of stays could be following a gamma distribution.

The parameters for the gamma distribution are estimated with a Maximum Likelihood estimator. For psychotic diseases we first concentrate on the psychotic females in different age groups.

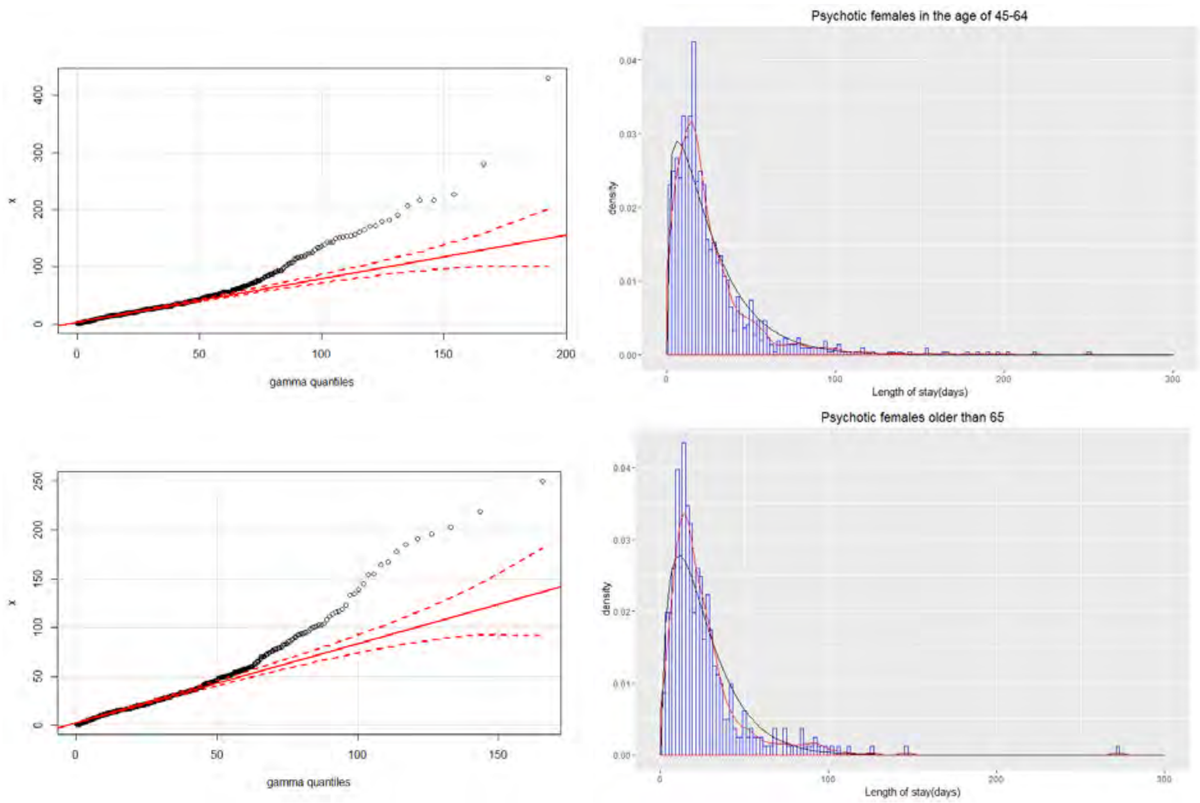


Figure 8: Distributions and according densities (red) overlayed with a gamma density (black) and the according QQ-plots

In the model the fits are not applied to age groups but to all ages separately. Even in that case the fit is sufficiently good enough.

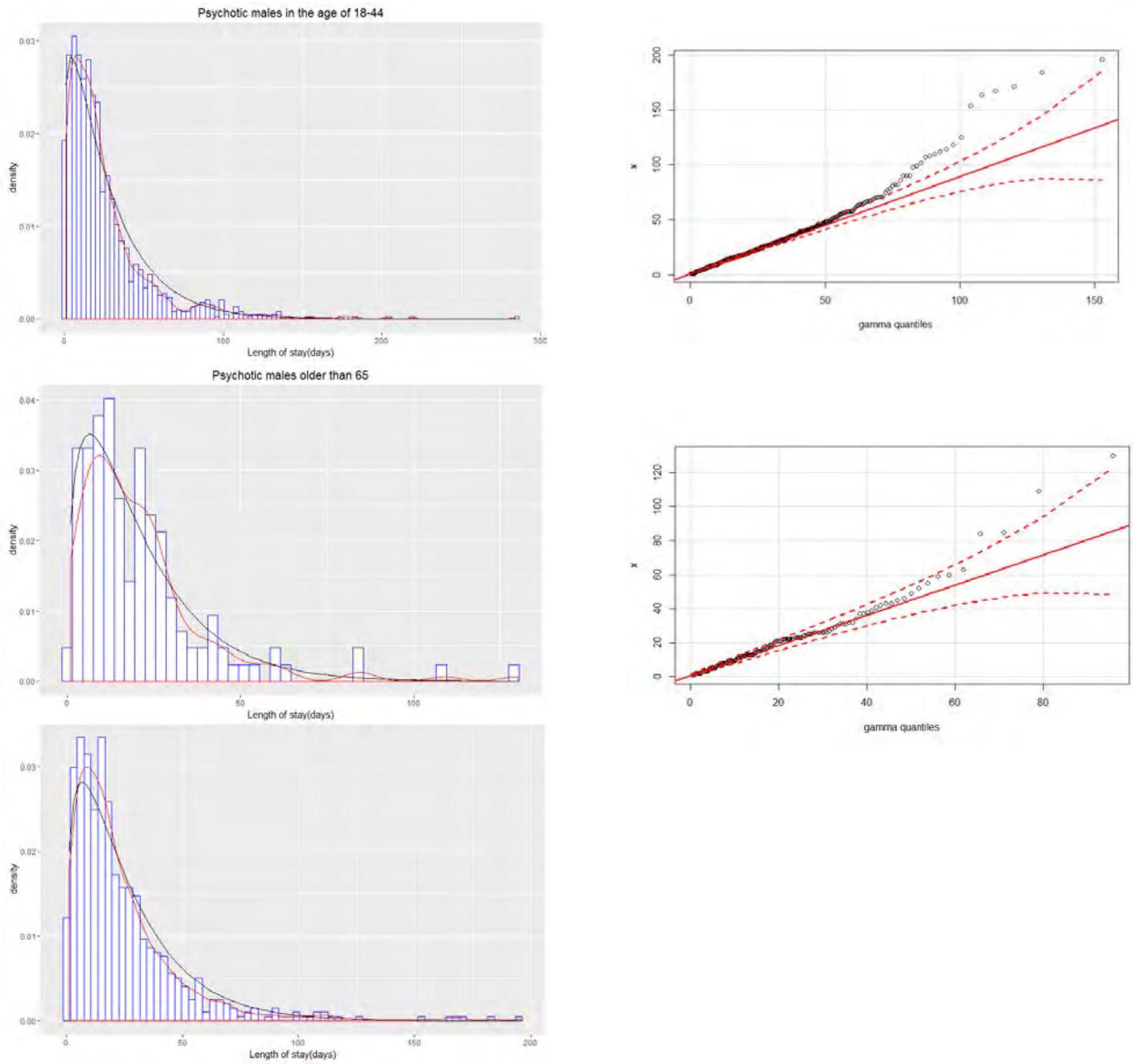


Figure 9: Distributions and according densities (red) overlayed with a gamma density (black) and the according QQ-plots

In this case it is as well plausible to use the gamma function with the MLE for the shape and scale as an approximation for the distributions of the duration of index stay for psychotic diseases for all age groups.

Non-psychotic diseases

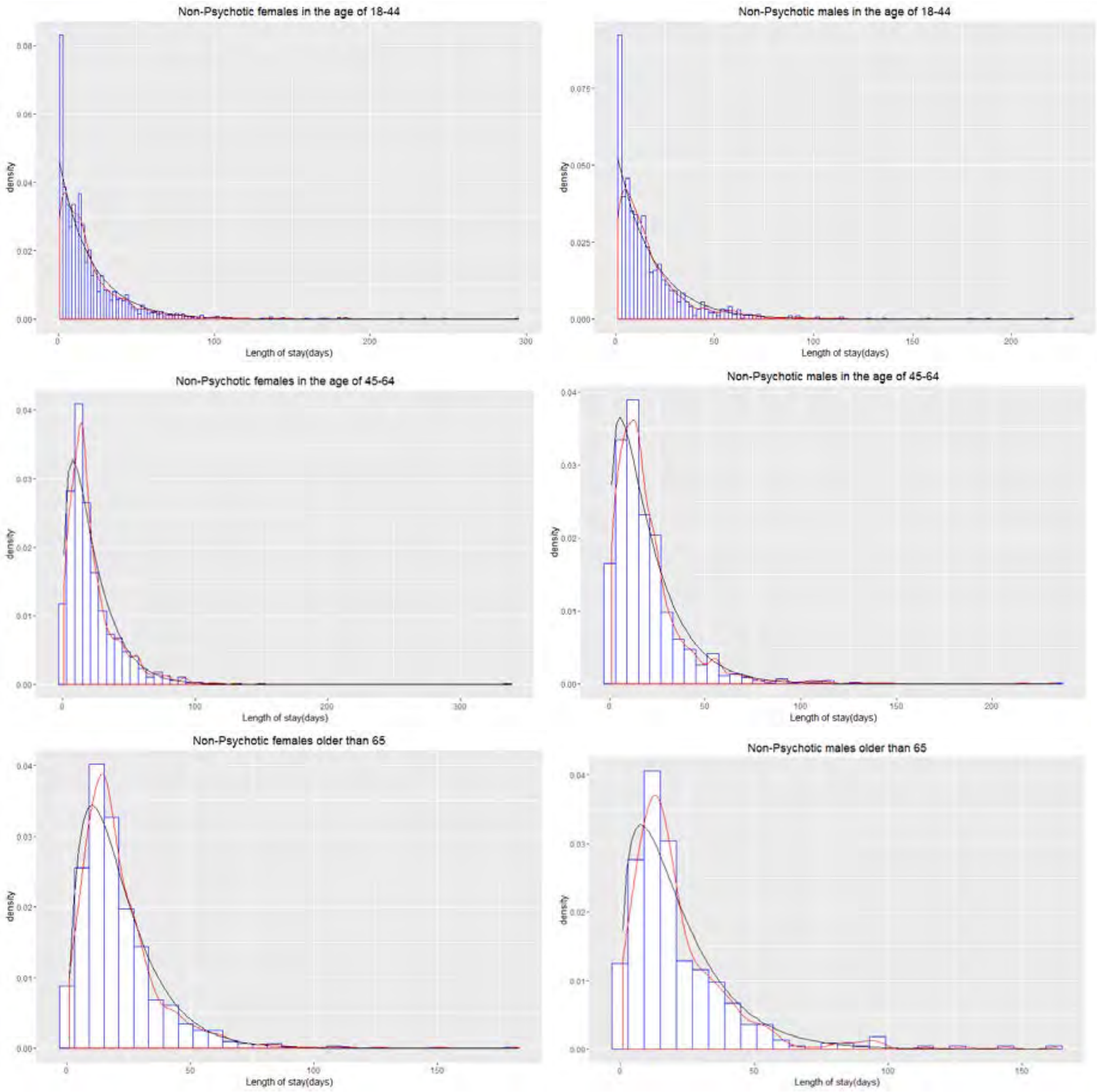


Figure 10: Distributions and according densities (red) overlaid with a gamma density (black) for non-psychotic females and males

Here, the female and male patients of the same age classes can be described by the same underlying distribution.

3.5.2 VENETO

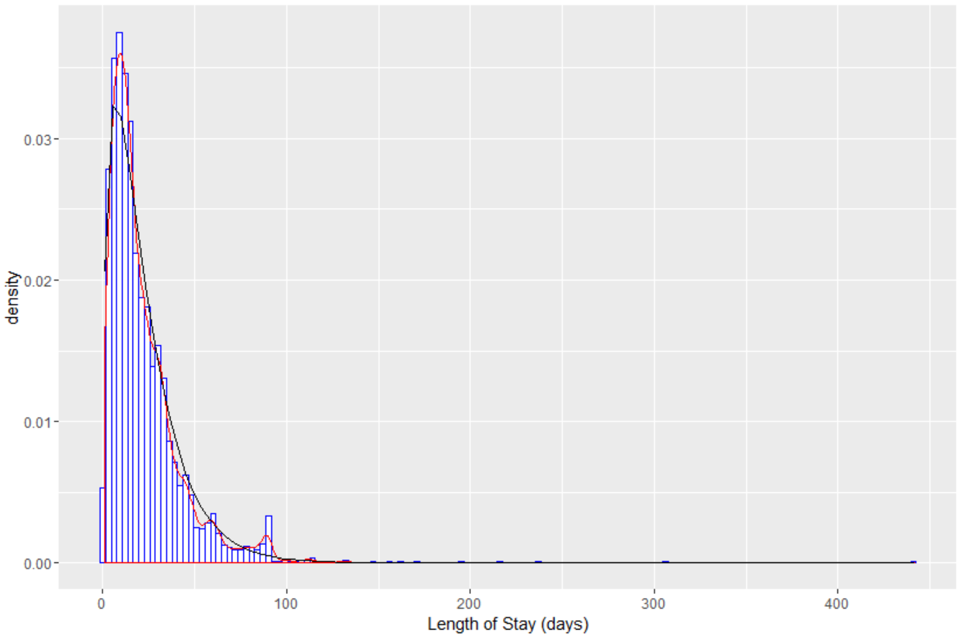


Figure 11: Length of stays according density function (red) overlayed with a gamma density function (black)

In the both cases (Veneto and Slovenia) it is also possible to assume that the gamma distribution is a good fit.

3.5.3 SLOVENIA

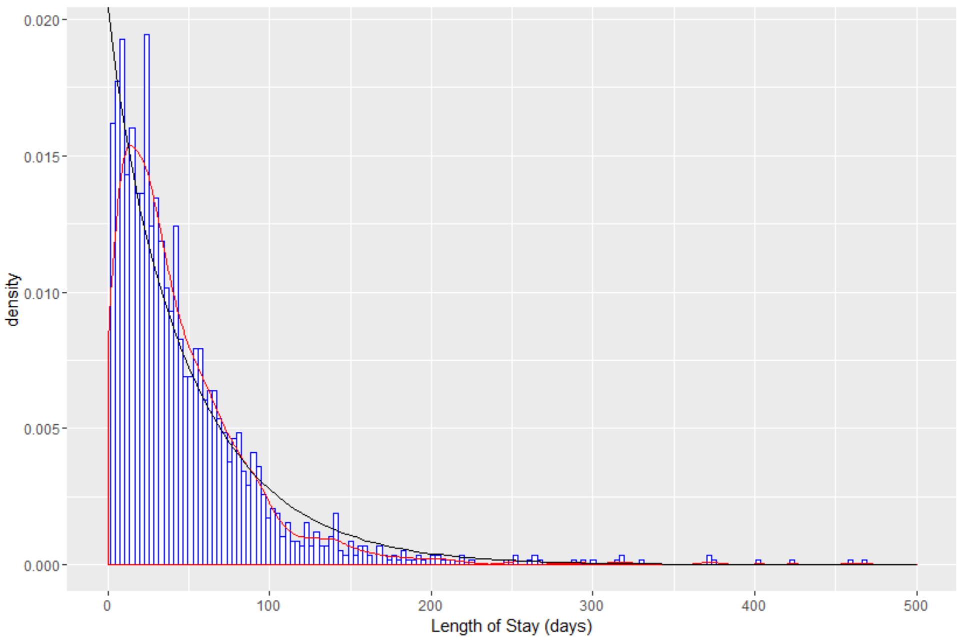


Figure 12: Length of stays according density function (red) overlayed with a gamma density function (black)

3.6 Distribution of the time between discharge and re-hospitalisation (by age, sex and diagnosis group)

3.6.1 AUSTRIA

First, to get an overall idea, the distribution of the time between discharge and re-hospitalisation for all the patients is plotted.

The density of the distribution of all patients can be fitted with the

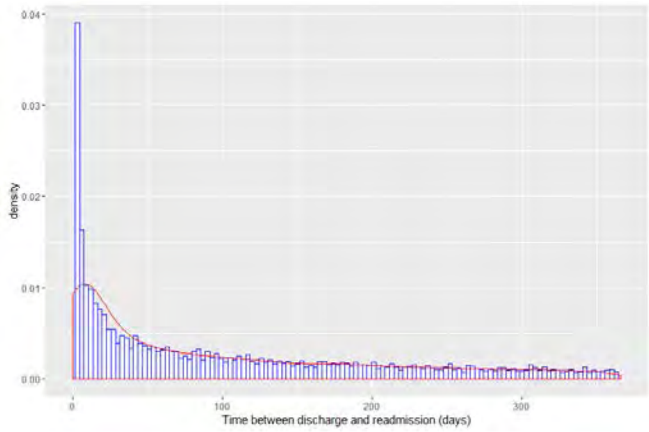


Figure 13: Distribution of the time between discharge and re-hospitalisation in days and according density

function $f(x) = \frac{0.15}{x} + 0.001$.

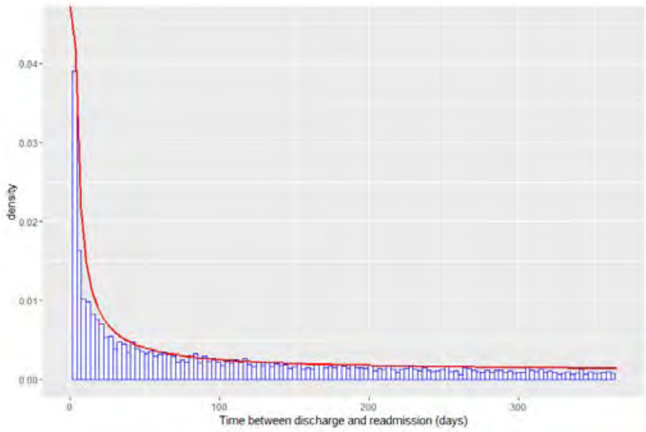


Figure 14: Distribution density of the time between discharge and re-hospitalisation in days fitted with the function f

Now there are two possibilities: The first one is to use the inverse transform sampling, i.e. use the density to calculate the distribution function and use the distribution function to determine the number of days between discharge and re-hospitalisation. However, the second approach is easier and almost to the same degree as computational expensive as the first one and therefore the solution used in the model.

The second approach is the following: The probabilities for each of the possible number of days between the discharge and re-hospitalisation, which must be a number between 1 and 365, can be calculated separately for each age depending on the sex and diagnosis group. Those are used as weights for the determination of the length of stay at the index hospitalisation. Due to higher computational load as well as possible outliers for groups with small sample size in this approach the first approach is implemented.

3.6.2 VENETO

Again, the gamma distribution does not seem to be a good fit.

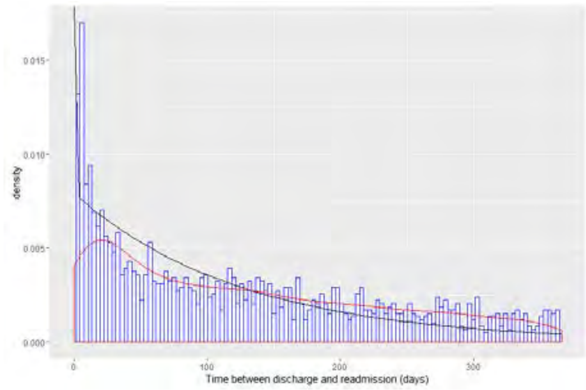


Figure 15: Distribution of the time between discharge and re-hospitalisation in days and according density FITTED WITH A GAMMA DISTRIBUTION

The same is true for the data of Slovenia. Therefore we proceed in both cases in the same way as for that data and calculate the probabilities for each of the possible number of days separately depending on the sex and diagnosis group.

3.6.3 SLOVENIA

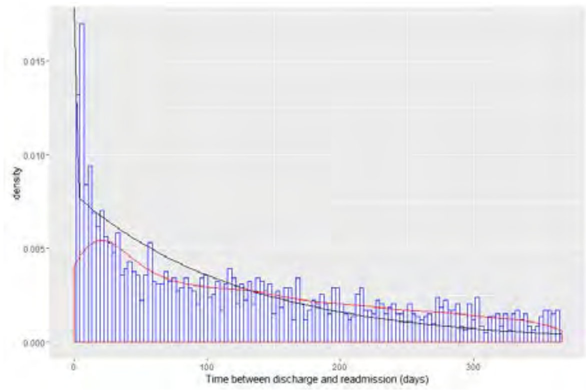


Figure 16: Distribution of the time between discharge and re-hospitalisation in days and according density FITTED WITH A GAMMA DISTRIBUTION

3.7 Distribution of the length of the re-hospitalisation stay (by age, sex and diagnosis group)

3.7.1 AUSTRIA

Directly used as table whereas people younger than 65 years were treated for each age separately whereas people 65+ use the same parameters.

3.7.2 VENETO

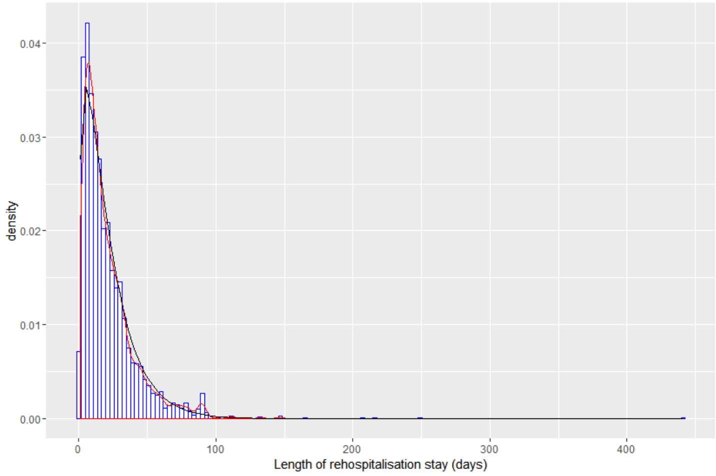


Figure 17: Distribution of the Re-hospitalisation stay in days and according density FITTED WITH A GAMMA DISTRIBUTION

In this case we can assume that the underlying distribution is a gamma distribution.

3.7.3 SLOVENIA

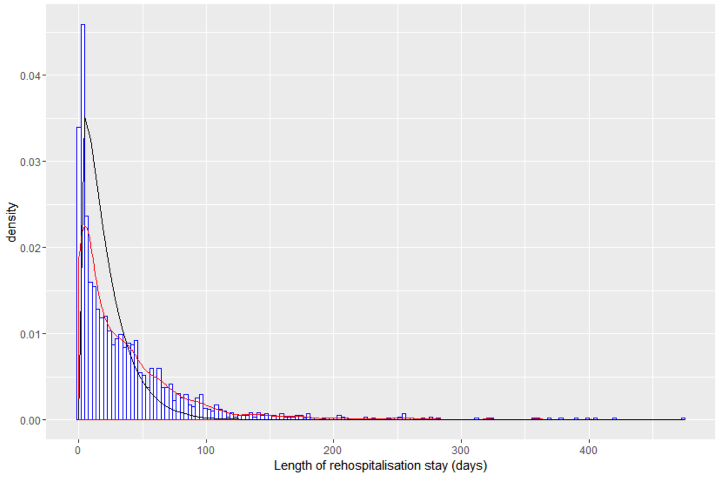


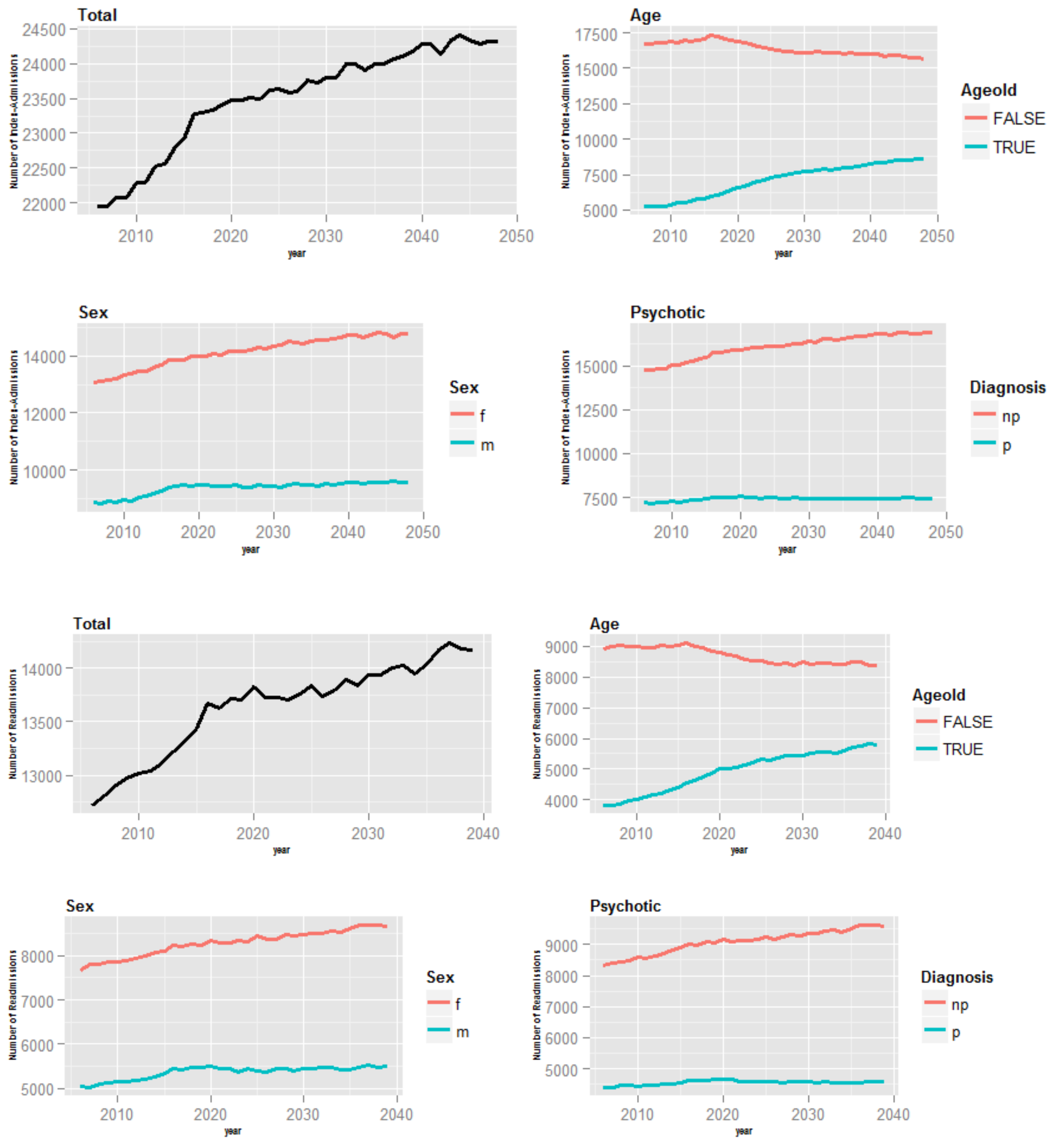
Figure 18: Distribution of the Re-hospitalisation stay in days and according density FITTED WITH A GAMMA DISTRIBUTION

The previous assumption does not apply for Slovenia, so again for the model the probabilities for the possible length of re-hospitalisation stays are calculated based on age, sex and diagnosis.

4 Results

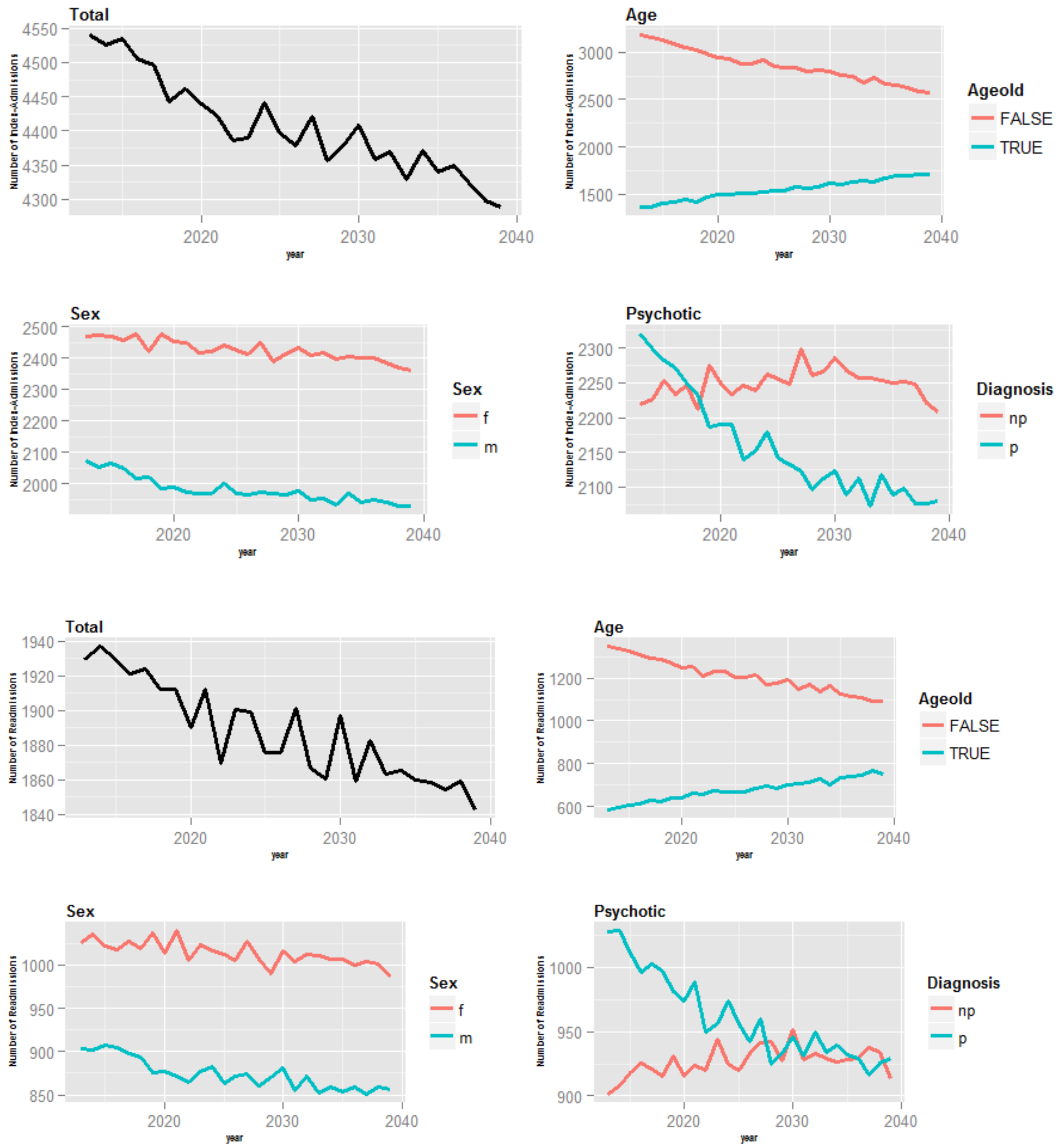
4.1 Task A

4.1.1 Austria



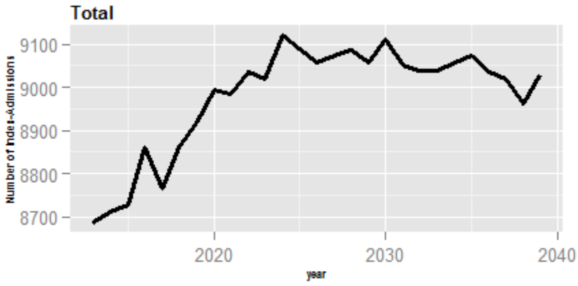
The expected index hospitalisations as well as re-hospitalisations rise over the course of the next years, especially in the female population. Also, non-psychotic illnesses increase much more than psychotic illnesses.

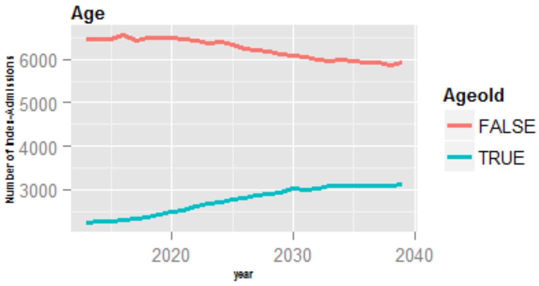
4.1.2 Slovenia

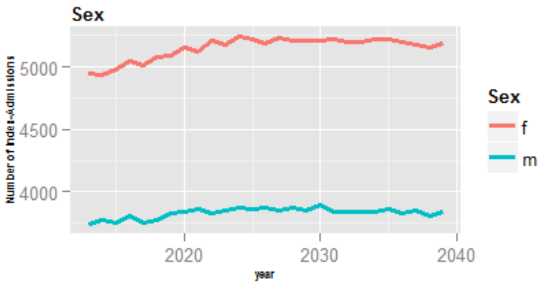


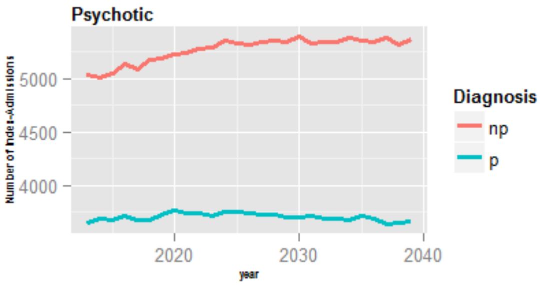
In Slovenia the number of index hospitalisations and re-hospitalisations for psychotic diseases is prognosed to sink when non-psychotic illnesses remain on a stable level.

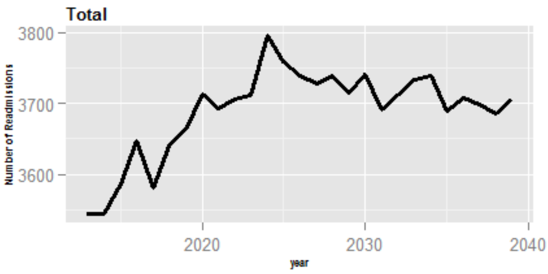
4.1.3 Veneto

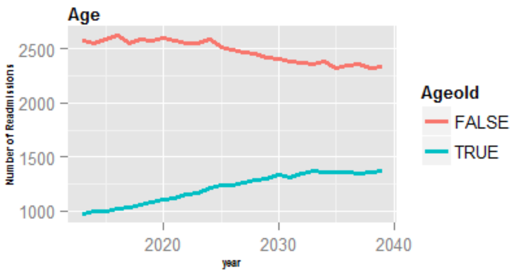


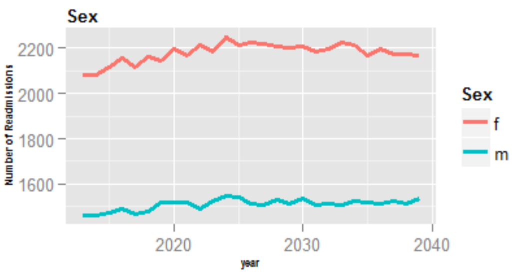


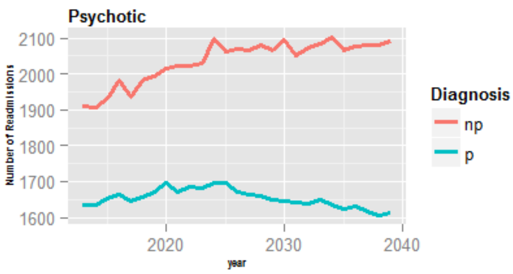








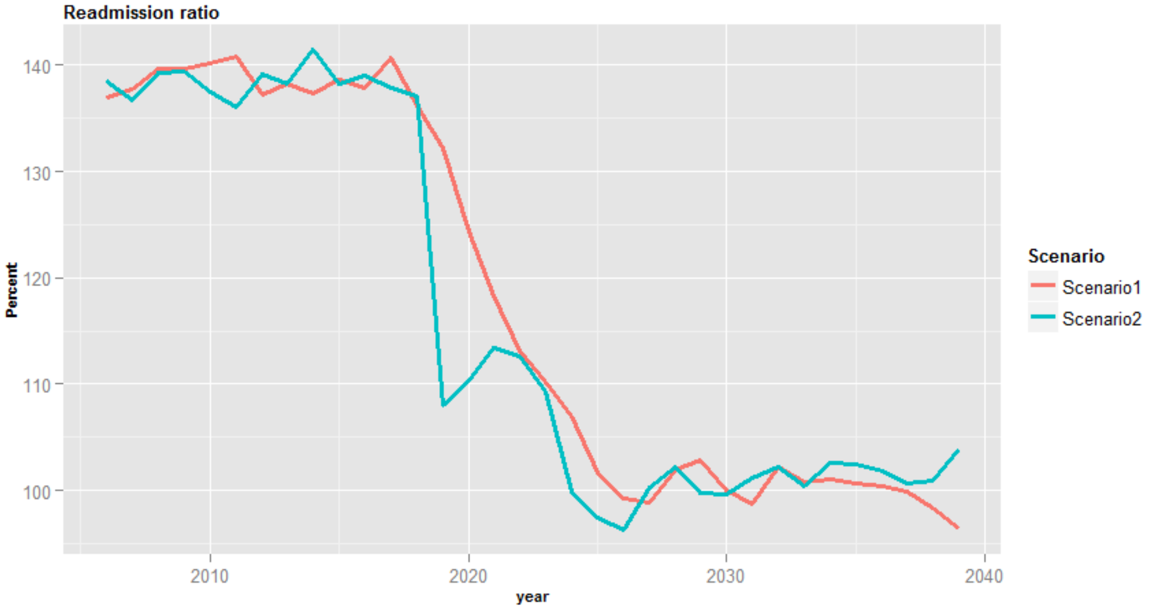




Over the course of the next 10 years the number of index hospitalisations will increase about 5% and if the population prognoses are correct will remain about the same for the years afterwards.

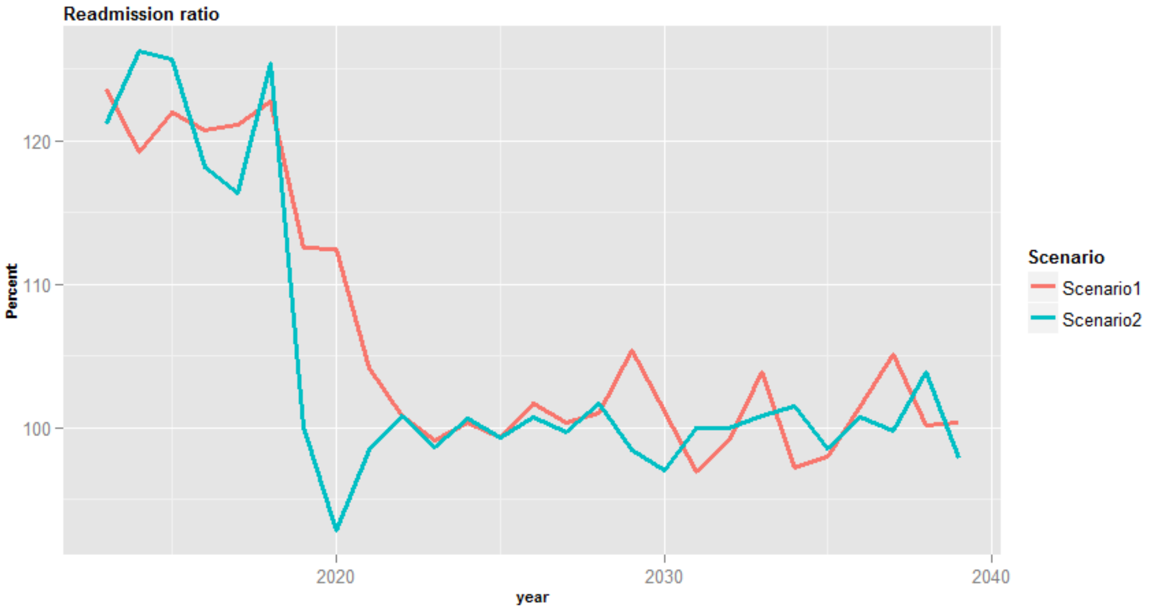
4.2 Task B

4.2.1 Austria



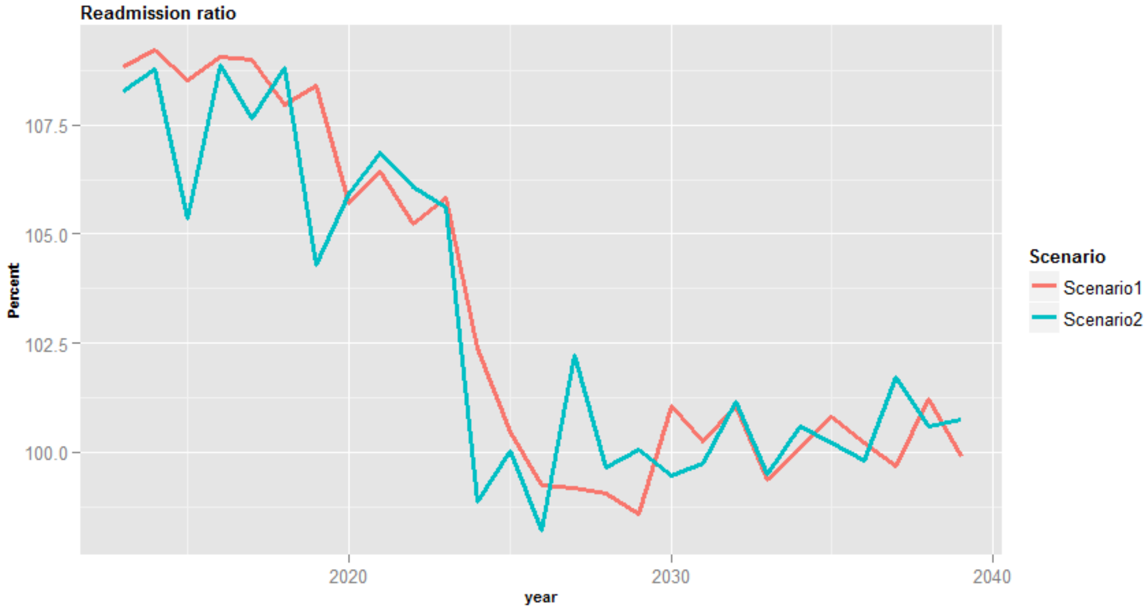
The two scenarios show how re-hospitalisation rates for the NUTS 3 regions with bad access and high re-hospitalisation rates and therefore currently a 40 percent higher percentage than the national average could be levelled.

4.2.2 Slovenia



In Slovenia there are not as drastic outlier regions as in Austria. Still the two Scenarios show how the re-hospitalisation rates could be lowered to the national average over 5 years.

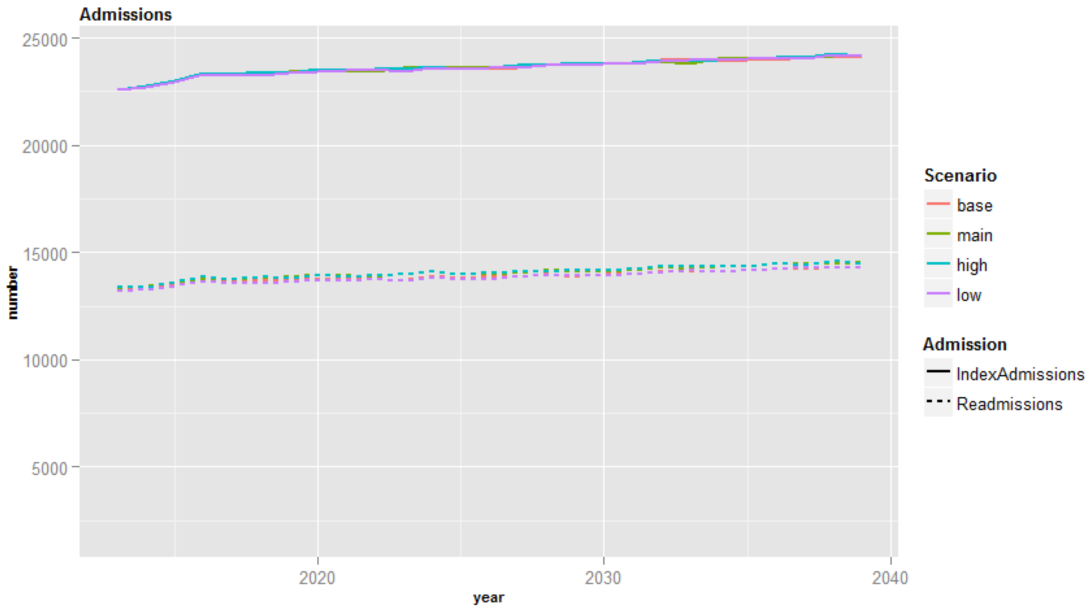
4.2.3 Veneto



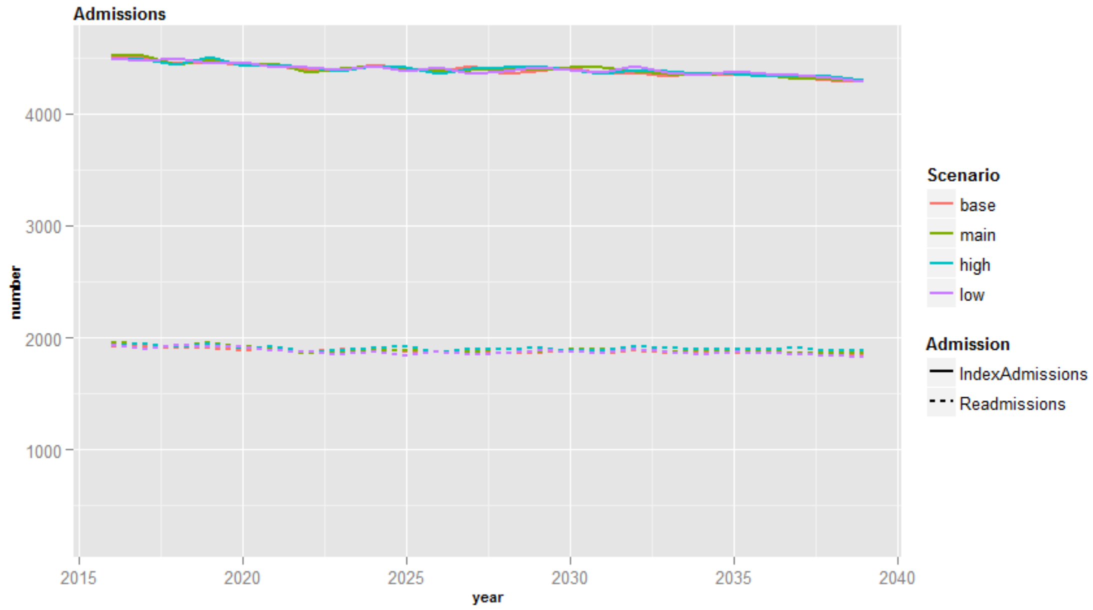
In Veneto the differences of improved infrastructure are the least noticeable as currently (corresponding to the used data set) there are not much differences within the NUTS 3 regions.

4.3 Task C

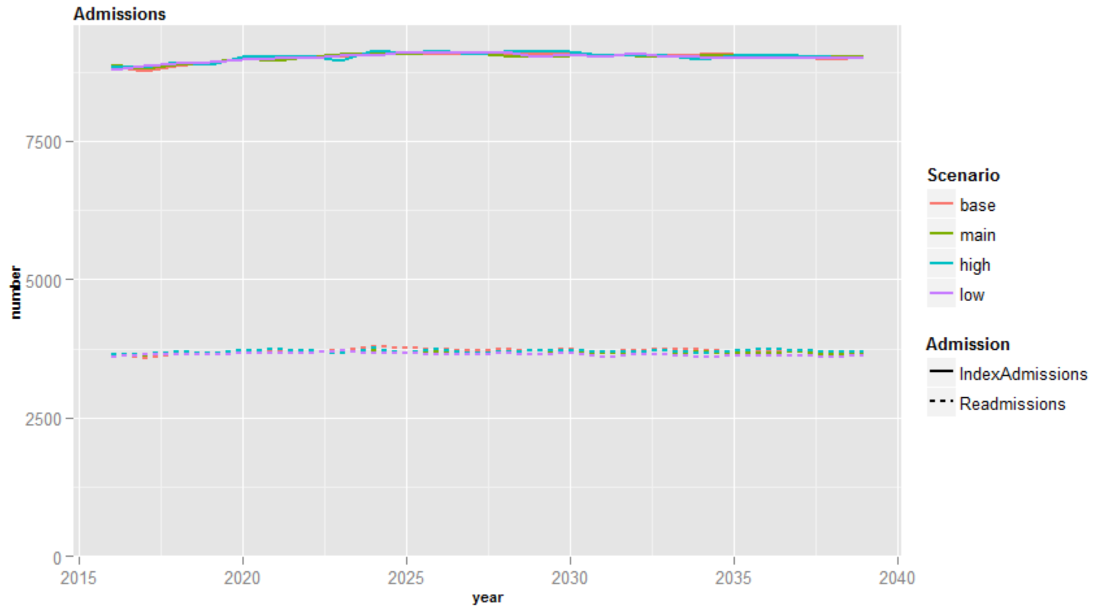
4.3.1 Austria



4.3.2 Slovenia



4.3.3 Veneto



The re-hospitalisation rates are a bit higher due to rising diabetes prevalence. In Austria this effect can be observed the best although it is still quite small.

4.4 Economic analysis

Based on the calculated cases and the forecast of the re-hospitalisations in the three modelling regions Austria, Veneto and Slovenia cost analyses are performed.

To get comparable results the **purchasing power parity** (**PPP**) cost data sets are used in the analysis. This follows the strategy implemented in the Decision Support System developed in the CEPHOS-LINK project. The cost data used for the reference year 2016 are therefore:

Country	Costs in Euro (€)
Austria	5 350
Italy/Veneto	8 713
Slovenia	4 936

To depict the current cost and cost trend effects in the regions of interest, the actual inflation is taken (year 2016) and the trend of costs for re-hospitalisations is calculated taking into account the demographic change and the forecast of the national inflation. Additionally the data from European monetary Union (EMU) are taken and the forecast of overall-costs are realised. Due to the fact that age and gender of the patients is modelled in detail the analysis can be done on different levels.

For the inflation data the following values are taken for the modelled regions:

Country	Inflation in the year 2016
Austria	1,44% [1]
Italy/Veneto	0,49%[2]
Slovenia	0,51%[3]
EMU	1,8%[4]

The calculations are done for comparison of the costs in the three modelling areas. Exemplarily the following graph (Figure 19) show modelling results of the relative change of the overall costs for re-hospitalisations for the age group of the 50 to 59 years old patients in the three regions in

[1] Source of inflation rate for Austria in the year 2016
http://de.inflation.eu/inflationsraten/osterreich/historische-inflation/vpi-inflation-osterreich-2016.aspx

[2] Source of inflation rate for Italy in the year 2016
http://de.inflation.eu/inflationsraten/italien/historische-inflation/vpi-inflation-italien-2016.aspx

[3] Source of inflation rate for Slovenia in the year 2016
http://de.inflation.eu/inflationsraten/slowenien/aktuelle-vpi-inflation-slowenien.aspx

[4] Source of inflation rate for EMA in the year 2016
https://de.statista.com/statistik/daten/studie/217052/umfrage/inflationsraten-in-den-laendern-der-eu-monatswerte/

comparison. In each country the costs are inflation affected with the inflation of each country based on the year 2016.

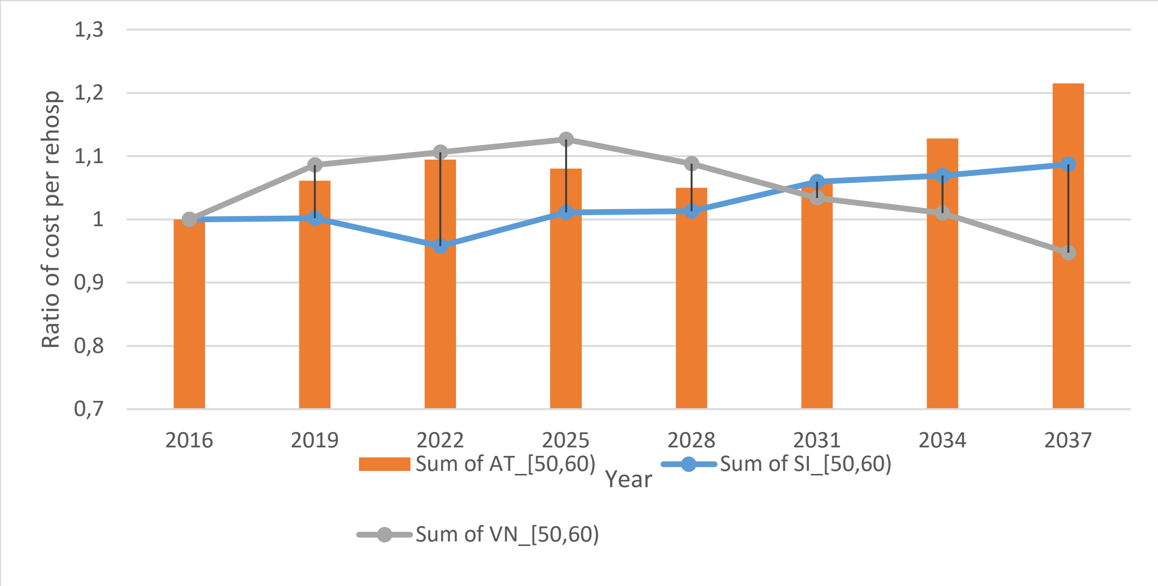


Figure 19: Relative change of the overall costs for re-hospitalisations for the age group of the 50 to 59 years old patients in the three regions in comparison. In each country the costs are inflation affected with the inflation of each country based on the year 2016.

To compare the influence of different inflation on the health care costs, Slovenia as one of the two regions with highest difference in the 2016 national inflation and the EMU value is taken for comparison. In case of the EMU inflation for calculation of the future costs Figure 20 depicts the cost development in a three years time step for the 10-years age groups between 20 and 90 years old patients for index stays.

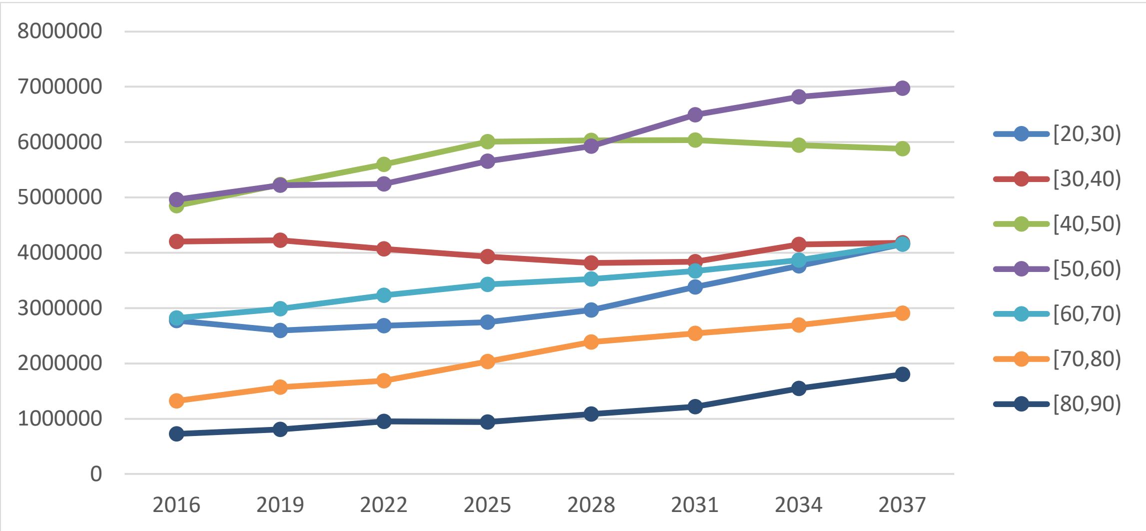


Figure 20 Cost development in a three years time step for the 10-years age groups between 20 and 90 years old patients for the Slovenian setting for index stays

In Table 7 the results depicted in the figure above are represented in detail. As can be seen the influence in the overall costs of the older population is growing in Slovenia as expected in most of the European countries. Comparing this results for Austria (as depicted in Figure 20 and detailed results in Table 8) a bigger change in the older population can be identified.

Table 7 Cost development for Slovenian cost forecast for index stays for the scenario when EMU inflation of costs is taken into account

Year/Age group	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	Grand Total
2016	2.774.032	4.200.536	4.852.088	4.960.680	2.818.456	1.322.848	725.592	21.654.232
2019	2.593.271	4.223.178	5.233.407	5.222.993	2.989.031	1.572.626	807.142	22.641.647
2022	2.680.906	4.070.802	5.598.040	5.240.952	3.230.272	1.686.554	950.403	23.457.930
2025	2.747.157	3.929.478	6.004.335	5.656.594	3.425.253	2.034.287	938.902	24.736.005
2028	2.965.447	3.815.339	6.028.724	5.924.780	3.527.965	2.384.587	1.082.235	25.729.078
2031	3.380.050	3.838.034	6.037.646	6.495.630	3.670.321	2.541.488	1.219.140	27.182.309
2034	3.763.226	4.151.117	5.940.861	6.818.720	3.865.303	2.694.824	1.544.760	28.778.811
2037	4.156.780	4.178.318	5.879.798	6.971.042	4.156.780	2.907.592	1.801.989	30.052.300

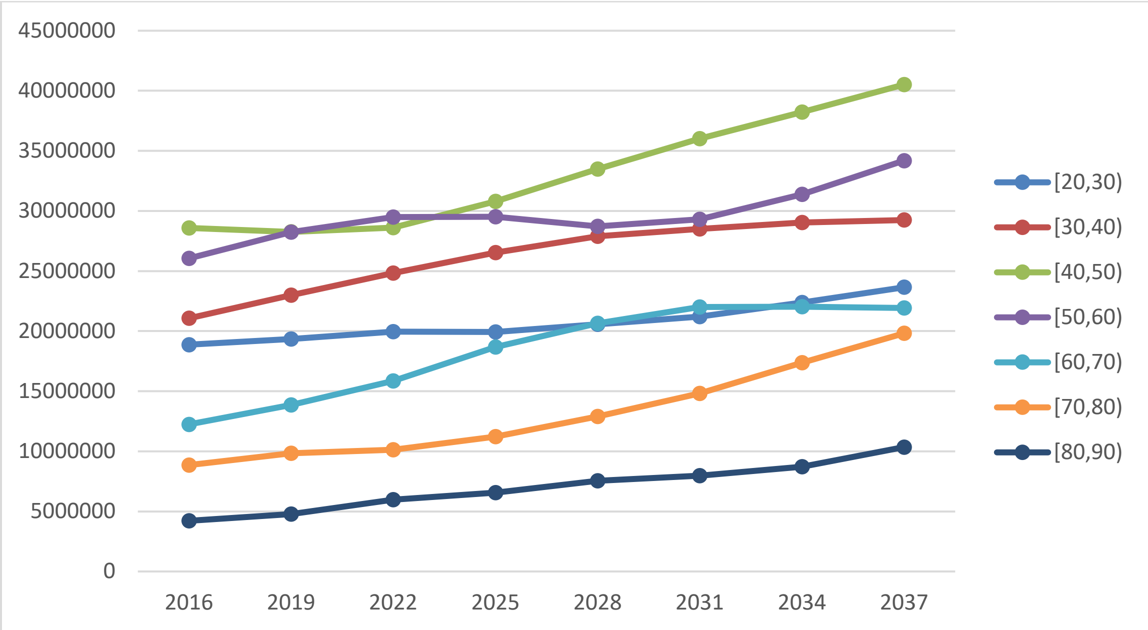


Figure 21 Cost development in a three years time step for the 10-years age groups between 20 and 90 years old patients for the Austrian setting for index stays

Table 8 Cost development for Austrian cost forecast for index stays for the scenario when EMU inflation of costs is taken into account

Years/age group	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	Grand Total
2016	18.874.800	21.068.300	28.590.400	26.054.500	12.240.800	8.854.250	4.215.800	119.898.850
2019	19.331.150	23.005.480	28.254.522	28.243.234	13.845.054	9.837.721	4.763.647	127.280.807
2022	19.947.352	24.824.033	28.617.007	29.486.355	15.850.702	10.128.491	5.972.297	134.826.238
2025	19.938.418	26.534.304	30.799.643	29.511.875	18.675.778	11.213.005	6.564.476	143.237.498
2028	20.577.316	27.900.322	33.480.386	28.728.716	20.636.960	12.909.698	7.554.957	151.788.355
2031	21.205.224	28.518.334	36.013.224	29.294.391	22.016.238	14.808.000	7.963.320	159.818.732
2034	22.393.169	29.038.836	38.214.429	31.376.989	22.031.751	17.384.947	8.725.665	169.165.786
2037	23.647.641	29.242.459	40.517.692	34.191.423	21.927.954	19.819.197	10.349.247	179.695.613

Beside the costs for index stays special focus is on the development of the costs for re-hospitalisation in the CEPHOS – LINK setting. As these costs are the one of major interest to be reduced. Keeping the actual setting the following behavior for re-hospitalisation costs for selected age groups can be identified in the Austrian setting. The influence of the prognosticated demographic change by Statistics Austria is reflected in the form of the curve. The presented time span reflects the overall behavior in the whole simulation time on a yearly time resolution. The graph is depicted in Figure 22.

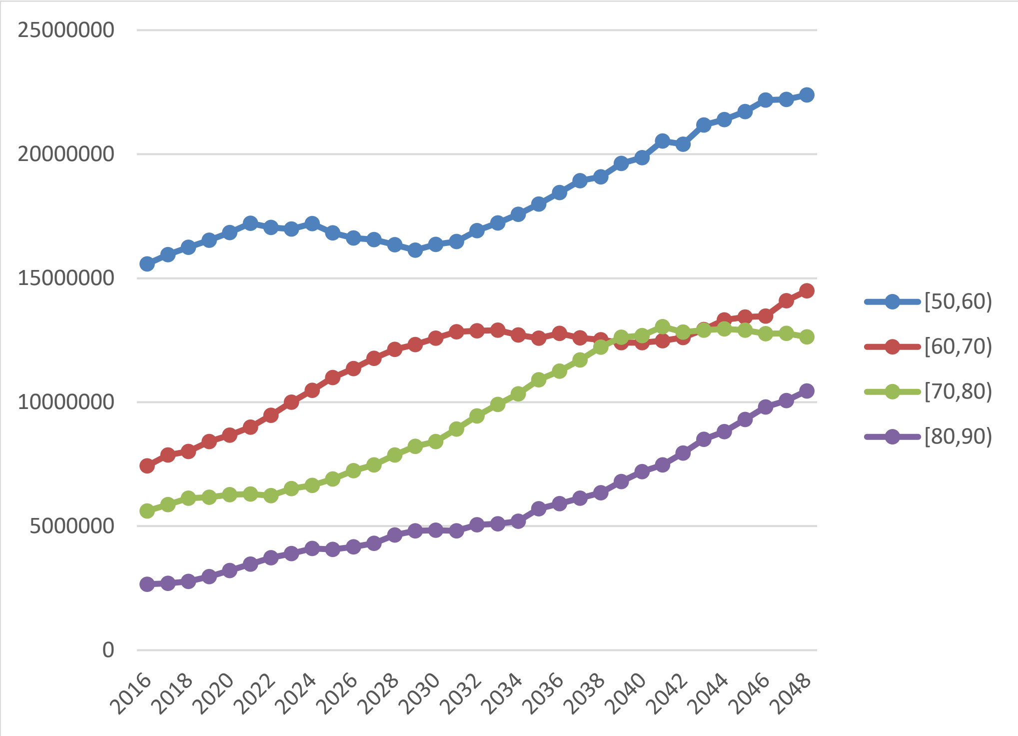


Figure 22 The graph represents the change over the whole simulation time for the Austrian data setting of the overall re-hospitalisation costs for the four 10 years age groups between 50 and 90 years based on the Austrian inflation assumption.

5 Summary and Discussion

Psychiatric hospitalisations and especially rehospitalisations need throughout analysis to identify the most important risk factors get knowledge on possibly preventable cases and get predictions for planning purposes. In the reviewed literature mostly standard methods, like logistic or Cox regression were used. For the assessment of future development of both psychiatric hospitalisations and re-hospitalisation the shift in population structure is an essential part. For both understanding the influence of risk factors and population dynamics more sophisticated methods are needed. Due to the requirements of such a model we identified the necessity use an agent-based approach. We developed a modular agent-based simulation model which incorporates analysis results from statistical standard models together with data from other sources like studies on the influence of diabetes on psychiatric re-hospitalisation and detailed population forecasts. To integrate and merge the information provided by the various sources methods for parameterisation and calibration were developed. The presented model shows that this simulation model serves both as a tool for prognosis of development of hospitalisation cases based on current knowledge and to answer so-called "what-if" questions.

These results based on several simulation runs show what impact interventions of policy makers like structural changes can have on the utilisation of psychiatric hospitals or services. These questions can also be about the influence of comorbidities, like in this proof-of-concept diabetes on the future burden of psychiatric diseases. This method is flexible enough for implementation of a base structure which can be parameterised for Task A and extended with modules for Tasks B and C. The integration and communication of the modules for the different tasks work very well and whereas the population module in Task A is mandatory the other modules can either be active or inactive. The same way further modules can be implemented to address additional risk factors.

Altogether, we conclude that the model works well for the defined questions, but to improve prognosis quality further data and especially assumptions on causal relations are desirable. The implementation of the agent-based approach in the modular design for the CEPHOS-LINK model is flexible enough to suffice these further requirements and with improved data quality as well as more actual data provide can provide more insight on the development of both index- and re-hospitalisation rates. The parameterisation of the model shows that the countries share similar properties from a qualitative point of view which is in itself an interesting result. It shows that although there are quantitative differences the countries probably share the same causal relations in the background which lead to hospitalisation and re-hospitalisation rates. The quantitative results use a defined list of assumptions and therefore must not be seen as true numbers, but as scenarios which may become true under certain conditions. Creating further assumptions and possible changes like a change in comorbidities or structural changes are essential in gaining more information in what may happen. The current model predicts a rise in re-hospitalisations and costs especially in Austria but also in Veneto and a decrease of psychotic patients in Slovenia. An interesting part for future model based evaluations is therefore integration of even more interdisciplinary knowledge also from social sciences, experts on plans of changing treatment infrastructure and different guidelines. Utilising such a simulation model correctly then may prevent unexpected treatment bottlenecks and help decision makers to optimise allocation of their resources for better treatment of psychiatric patients.

6

Final Scientific Report

PART 6

Focus Groups with Service Users

Prepared by
SINTEF and the CEPHOS-LINK team
March 2017

This project has received funding from the European Union's Seventh Framework Programme for research technological development and demonstration under grant agreement no 603264

Contents

1 Background and aim

Repeated hospitalisations to a mental hospital is characterized as a new form of institutionalization, often referred to as “revolving door psychiatry”. Reducing the number of re-hospitalisations is a high priority in services striving for efficiency and improving patient outcomes (Duhig et al., 2015). It is accepted that re-hospitalisation constitute profound interruptions to a patient’s life and are not conducive to the needs of mental health patients in terms of optimal quality of life in the community. Repeated hospitalisation is costly and disruptive to individuals, and can lead both providers and patients to feeling demoralized or a sense of failure (Davies et al., 2001). In addition, psychiatric wards are not always considered safe therapeutic places, and hospitalisation can perpetuate the feeling of social isolation (Mind, 2004). Independent of the circumstances of hospitalisation and despite the drawbacks, being admitted to a hospital provides refuge and an opportunity to regroup and build resources; that is, hospitalisation provides sanctuary (Duhig et al., 2015).

In this chapter, we explore mental health service users’ own positive and negative experiences of hospitalisation and re- hospitalisation and their suggestions about how one can avoid re-hospitalisations. In a review of the literature on psychiatric re- hospitalisation, Machado et al (2012) conclude that the perspective of the patient regarding their re- hospitalisation, is largely unexplored. This report is based on user experiences in all six countries participating in the CEPHOS project: Romania, Slovenia, Finland, Italy, Austria and Norway.

2 Methods

A focus group methodology was used to elicit participants’ attitudes towards and experiences of repeated hospitalisation. A focus group study is described as “a carefully planned series of discussions designed to obtain perceptions on a defined area of interest in a permissive, nonthreatening environment” (Krueger & Casey, 2014, p.2). An important aspect is that a group process can help people to explore and clarify their views in ways that would be less easily accessible in a one-to-one interview (Kitzinger, 2005). Focus groups are a suitable method for obtaining knowledge about patients’ experiences of a treatment or health service (Malterud, 2012).

A total of eight focus groups were administered, one or two groups in each of the six participating countries (Table 1). A total of 55 service users participated, and there were six to nine participants in each focus group.

2.1 Recruitment and sample

To select the users, we invited people who had received mental health services for at least 1 year and had experienced more than one hospitalization. The participants were recruited through user organizations and activity centres. All participants provided written informed consent.

Table 1: Recruitment and sample in each country

Country	Number of focus groups	Number of participants
Romania	1	8
Austria	2	12
Slovenia	2	14
Finland	1	6
Italy	1	9
Norway	1	6
Total	8	55

The participants in the focus groups completed a simple survey form to provide information about their background (sex, age, education and housing), use of health services and diagnoses. The purpose was to provide a detailed description of the sample; the data are summarized in Table 2.

2.2 Procedure and analysis

Focus groups were run between September 2016 and March 2017. Groups were led by a moderator (a researcher from the project group) and often included an assistant moderator (either another researcher or a professional from the user organization). The moderator's task was to lead, to maintain the focus of the interview and to encourage discussion between participants.

After introductions, the facilitator opened the discussion with a general question about the participants' experiences of hospitalization in general and how it feels to be hospitalized within mental health care. The interviews were semi-structured. An interview guide was used for all interviews, but the focus group leader was given flexibility to adjust questions according to the participants' responses within the various main topics discussed.

Moderators/facilitators allowed between 60 and 90 minutes for each group. The focus group interviews were digitally recorded and transcribed verbatim. The focus group discussions were held and transcribed in the original language and later translated into English.

Transcripts of the focus groups were imported into HyperRESEARCH 3.7.3 qualitative software. Line-by-line coding was performed to generate initial codes for developing the coding framework. Codes were defined into the following four main categories: i) positive experiences of hospitalization, ii) negative experiences of hospitalization, iii) experiences related to re-hospitalisation, and iv) avoiding rehospitalisation.

3 Results

In the following section, we will first present information about the sample, followed by the results from the focus group study with mental health service users' experiences of hospitalisation and re-hospitalisation and measures for preventing re-hospitalisation to a psychiatric hospital based on the interviewees' own experience-based suggestions.

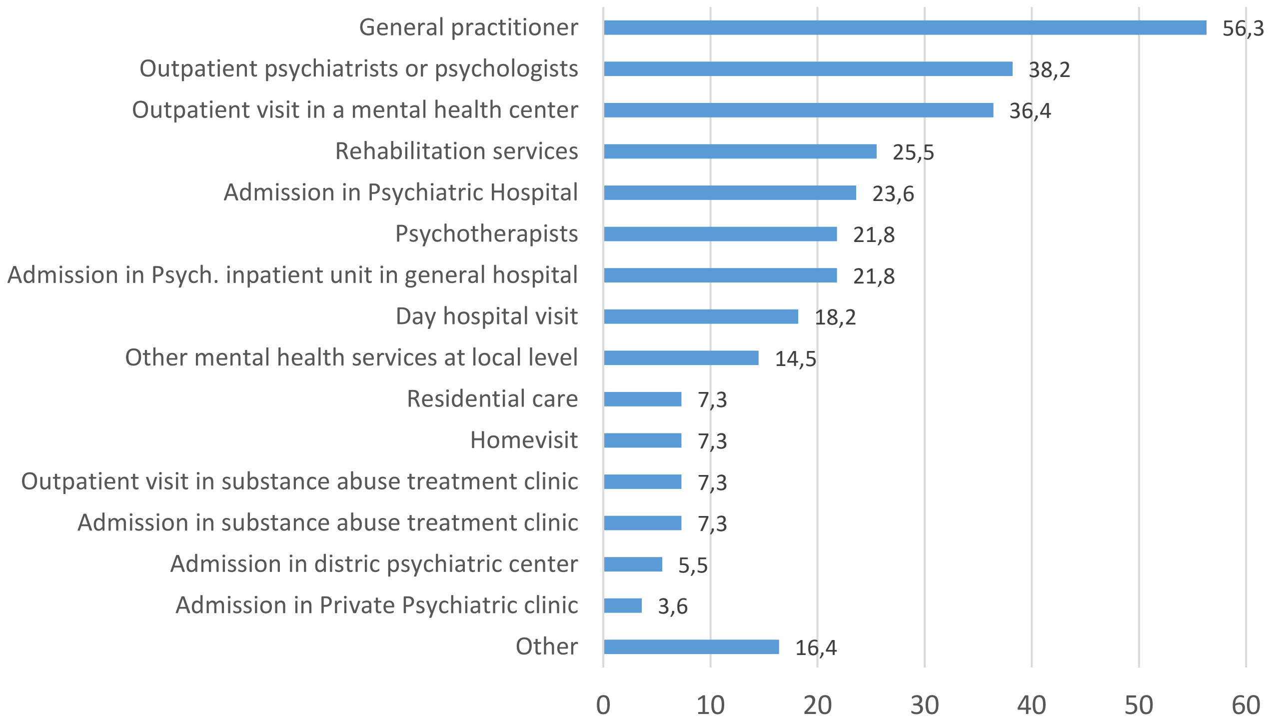
3.1 Participants profile

A total of 55 mental health service users (60 per cent women) participated in the focus groups (Table 2). The participants were aged 26–65 years, and half were older than 45 years. More than one of four had completed a lower or higher degree at university or college, and 10,9 per cent had completed university or college examinations but did not have a degree. 38,2 per cent had completed secondary/high school as their highest education, and 25,5 per cent had completed only primary school. Nearly half (45,5 per cent) lived alone, 15,5 per cent lived with a spouse or cohabitant, and 7,3 per cent alone with their child(ren). 18,3 per cent lived either with their parents (12,7 per cent), sister or brother (3,6 per cent) or other relatives (2,0 per cent). 3,6 per cent lived with other co-habitants, and 10,9 per cent lived with other co-habitants in residential care. The most frequent diagnoses among the participants were psychosis and bipolar disorder: 31,1 per cent were diagnosed with psychosis, 28,4 per cent with bipolar disorder, 16,2 per cent with a depressive disorder and 9,5 per cent with anxiety disorder.

Table 2: Description of the patient population

Category	Variable	Per cent	N
Sex	Male	40,0	22
	Female	60,0	33
Age, years	26–35	22,2	12
	36–45	24,1	13
	46–55	29,6	16
	56–65	24,1	13
Highest education	Completed primary school	25,5	14
	Completed secondary/high school	38,2	21
	Exams from College/University (without degree)	10,9	6
	Completed lower degree at University/College	9,1	5
	Completed higher degree at University/College	16,4	9
Living situation	Living with parents	12,7	7
	Living with husband/wife, partner	14,5	8
	Living with sister or brother	3,6	2
	Living alone with own child(ren)	7,3	4
	Living with relatives	1,8	1
	Living with other co-habitants	3,6	2
	Living with other co-habitants in residential care	10,9	6
	Living alone	45,5	25
Psychiatric diagnoses (multiple occurencies possible)	Psychotic disorder	41,8	23
	Depressive disorder	21,8	12
	Bipolar disorder	38,2	21
	Anxiety disorder	12,7	7
	Other	20,0	11

Figure 1: Contact with mental health services last 12 months (at least one contact) (n=55). Per cent



During the last twelve months 52,7 per cent of the participants in the focus group had been admitted to an inpatient stay. 56,3 per cent had had contact with the general practitioner. Most of the participants had regular outpatient visits. Some had visits at day hospital, others visited mental health services at local level and a few had residential care and/or home visits.

The service-users' reflections on how they experienced hospitalisation and re- hospitalisation to inpatient mental health care can be divided into the following main themes: a) first-time hospitalisation is viewed as "a trauma", particularly when admission is involuntarily; b) re-hospitalisation makes the individual feel like an experienced patient, c) re- hospitalisation is sometimes necessary, d) patients' experiences can be used to formulate suggestions for avoiding re-hospitalisation.

3.2 First-time hospitalisation is viewed as a trauma

Most participants described their first hospitalisation as something terrible and intolerable, as a shock and a trauma. These feelings were induced by both the illness and the experiences related to the process of hospitalisation. Most described a situation in which they were in a very bad mental shape: having visual and auditory hallucinations, being afraid of everything and having panic attacks. Some experienced years of torment without any treatment. Others could not remember clearly because they had been pharmacologically sedated and some because of feelings such as being "out of my mind". Several used the words "trauma" and "traumatizing" to describe the experience.

> "(..) the first time in psychiatry was just traumatizing for me, and so many things happened that were absolutely not okay (..) (A2/2)
>
> "For me, my first admission...It was...(..) It was a trauma, a very big one. (I/7)
>
> "For me, it was terribly traumatic, a really horrible experience, the worst I have ever been through in my life. Really terrible." (F/2)

Several participants experienced particular stressful situations while being moved or hospitalized involuntarily; some were moved by ambulance, sometimes with the involvement of police. Some mentions situations in which their family members became desperate because they could no longer care for them or were afraid of their behaviour and the risk of suicide. Other tragic aspects of the family situation mentioned were a history of violence with participants as both victims and perpetrators. A few participants mentioned instances when their children were taken from them or did not want to live with them.

The results confirm the highly negative effects of involuntary admissions both immediate and in years to come, as described by the following participant:

> “I know others have other experiences but, for me, it was terribly, terribly traumatizing, simply the worst trauma in my whole life. What I experienced within psychiatric care—to be involuntarily admitted, injected, isolated—and it caused trauma that took me several years to process. I had to go to private therapy and pay thousands of euros to recover from what the psychiatric hospital care had done to me ….”(F/2)

Another response to being involuntarily admitted may be trying to hide how ill the person is, as described by the following participant:

> “Well, when I was in psychiatry the first time, it was after a suicide attempt and I was there involuntarily, and that was by far the worst thing that has ever happened to me. I mean, deprivation of freedom, and I want that to never, never, never again happen to me in my whole life. That is why I [now] try to work around my suicidal thoughts somehow.” (A1/2)

The participants also described their first hospitalization in positive terms, although to a much lesser extent. These were different experiences. Some described the relief of being hospitalized. Others postponed hospitalisation by trying to cope and hoping that it would not be necessary. Others described not being able to obtain a referral even though they felt strongly that it was needed. Others mentioned good experiences as accessing a form structure of things and called hospitalization a “lifeline” or “rebirth”, something that released the responsibility.

In describing their experience with their first hospitalization, several of the participants (goes with the following hospitalizations also) mentioned the paradox of going through a difficult time while, at the same time, feeling good. One participant commented as follows:

> “It was very hard to be hospitalized… despite the fact that I felt good because I was hospitalized… I was feeling good… (..) I was making scenes [and] it was very hard, but it brought results.” (R/7)

A woman with the diagnosis of schizophrenia who had always been admitted involuntarily described this as a violation, but, at the same time, she reflected on the alternative:

> “It could have gone seriously wrong if they did not, somehow (...). I'm so into my own world that I do not understand that I’m sick. (..) They did what they had to do. I stopped taking my medicine, so they made me take it again, and it went well.” (N/2).

3.3 Re-hospitalisation makes the individual feel like an experienced patient

The interviewees described diverse feelings associated with re- hospitalisation. Several interviewees emphasized the advantages of being an “experienced patient” and the necessity of hospitalisation. By contrast, some were critical of repeated hospitalisation, which they called “useless” and “a default” without any benefit for the patient.

Most of the interviewees described being hospitalized for the first time as a dramatic experience in many ways, whereas being readmitted gave them the feeling of being more in control of their circumstances, which enabled them to cope better. This was described by the following participants:

> “(..) and the next stay, then I knew how it all works and actually felt in good hands, and they actually helped me a lot.” (A2/3)

> “The second time, I simply already knew what would happen, and that was okay then.” (A2/4)

Some simply needed to have a rest, like the following participant who describes second hospitalization with the following words:

> " I thought it was positive. It all started with manic depression to me, you know. I thought it was good to come in and rest." (N/2)

Participants noted another positive experience of being readmitted: that hospital staff and patients remembered each other from previous stays. This lead to a greater sense of safety when being admitted. An example is given below. Interestingly, the interviewee does not assign any particular dramatic meaning to the re- hospitalisation:

> “The only thing that I can say in this regard, there is a difference if you have seen the personnel and the doctors already. You know them and are known; well, that makes a bit of a difference. (...) [If you] at a readmission get into a setting that you already know—okay; with him or her you have to behave like this and the people also know, with him/her you have to behave a bit like that, that can sometimes also make it a bit more pleasant.” (A/6)

On the other hand, participants also viewed knowing the system and providers and being recognised by providers as a negative factor. Several interviewees talked about how difficult it was to return to a place where providers already had a specific opinion about the returning patient, which the participants felt may have been wrong. Other negative experiences related to a previous poor relationship with the care providers and disappointments over previously “not being taken seriously” and not being admitted when one had felt the need for a hospital stay (A1/2). A participant from Romania compared later hospitalisation s with the first one and explained that, when he was admitted the first time, no one knew him:

> “...following the hospitalisation when I was locked up [the first], I had already argued with the nurses. They were stealing my good cigarettes and the nurses were giving me treatments on an empty stomach, which caused stomach problems, and…ohhh… (...) when I returned to the same place, of course, they gave me a more unpleasant treatment, so to say.” (R/6)

However, this participant continued to describe that he was voluntarily admitted at a later time in the same hospital and treated much better than the previous time. This participant believed that he had received better treatment during the later stay because the staff saw that he was much more balanced.

Some participants emphasised that rea- hospitalisation felt embarrassing and made them feel like a failure. Interestingly, such feelings could be triggered by the staff's seemingly well-intentioned statements at the time of discharge. One of the interviewees explained that, when staff said that they hoped they would never see the person again, it exerts a pressure or at least an expectation that one should not be readmitted:

> "The second time I heard it—and it was rather well meant—but it actually expresses an attitude. It also says that when I get there again… For me, I am sorry to admit, if I were readmitted to the same hospital, I would be embarrassed. (..) That's a failure then, a slipping further, according to them, and that is embarrassing." (A2/3)

Experiences like this suggest that staff should be careful about how they talk to these patients at the time of discharge. Even when meant positively, such statements can strengthen the feeling of failure if re- hospitalisation is necessary.

3.4 Re-hospitalisation is sometimes necessary

Re- hospitalisation was considered by most participants to be sometimes necessary if a crisis develops or as a relief. However, several participants expressed disappointment and critical attitudes towards the hospital's ability to actually heal them, as shown in the following quotations from Austria, Finland and Romania, respectively:

> "Spontaneously, it occurs to me that psychiatry does not heal you. You don't go to hospital and are discharged healthy. This is simply not the case. Psychiatry—I see a picture of the fire brigade. There is a fire, and the task of psychiatry is, somehow, to extinguish the fire—I think that is also how they see themselves. Once that is done, they have done their work and leave, so to speak, a ruin… and what happens to that ruin does not concern them any longer. That's about how I see that." (A1/1)

One patient's strong criticism suggested that the mental health system itself maintains mental health problems:

> "If one would allocate the resources correctly, then people would just go through their shit once, and then regain their health. Then, oh my God, how much money would be saved.... now it's like people come [to hospital] again and again, and why do people come in again and again and again? Well, people come in again and again and again because psychiatry "chronicises" instead of helping people regain their health." (F/2)

Consistent with this view, another participant described how his/her re- hospitalisation was caused by the previous stays:

> " … and then I got hospitalised a fourth time just to recover as I felt so exhausted after the first three time—they made me exhausted." (R/6)

Another critique directed at the hospital and the doctors assessing patients was that of re-hospitalisations as something that happened "by default":

> "I mean, they do not evaluate you, whether you were… hospitalised five times in Hospital X; they do not care anymore about the… current state. The present state is simply put described by default.." (R/1)

These examples reveal highly critical attitudes towards re-hospitalisations and a system that does not offer any progress or recovery for the patient. However, the participants also gave examples of a pragmatic way of looking at this, as shown by their comparing re-hospitalisation to a mental health unit with re- hospitalisation caused by somatic illness:

> "In my opinion, you have to think that it [readmission] is a part of life. Admission to hospital is natural; it is not a big deal. If you have to go to the hospital to have your appendix removed, not many people question that, right? But, if you have [a chronic illness], it is partly a defeat, but partly you should also think that it is natural." (N/1)

These participants conceptualised their mental illness not only as chronic, but also as part of life and something that should be normalised in society. However, normalisation is an ideal, and different cultures attach different degrees of stigma to mental illness. The participants found it difficult to believe in normalisation if it was not confirmed by their surroundings. Normalisation may be easier to believe in in countries such as Norway, which has relatively well-organised and comfortable wards. On the other hand, this perspective may also be a sleeping pillow for development and new solutions within the mental health services.

Based on the results, the concept of re-hospitalisation and its negative valour can be discussed. As one interviewee said, "I don't understand the difference between admission and readmission. You never get into the same situation again; it's always different. I mean, the situation is simply always new." (A/1). A woman from Norway described some of the same – in her case being admitted based on different illnesses/diagnoses that she had. If the situation is often different, this has consequences for the discussion of re-hospitalisation as a problem. Many of the participants had received several diagnoses and each of these illnesses could reoccur at different points in time.

3.5 Patients' experiences used to formulate suggestions for avoiding re-hospitalisation

Most of the participants were receiving outpatient treatment at the time of the focus group interview. Several referred to their psychiatrist or psychologist as necessary for treating their symptoms and controlling their medication. However, this was not emphasised when the participants discussed ways to avoid the need for a new hospitalisation. Several referred to problems such as not seeing their psychiatrist often enough or the need for a type of service to monitor mental state. They felt that something or someone more is needed—someone who can identify changes and take care of the patient when he/she cannot do so.

The interviews addressed two main ways to reduce the need for re-hospitalisation. Central to avoiding re-hospitalisation was the availability of different kinds of day centres or activity centres with various activities, workshops and seminars, and assisted living or housing. For example participants in Slovenia, referred to Altra[1], and paricipants in Romania (Bucharest) referred to Estuar[2]. In Norway some of the

[1] According to their home page, Altra Association is a Slovenian non-governmental, non-profit and humanitarian organization that provides services and programmes in the field of mental health in the community. They operate in the field of social and health care programmes of a preventive nature, activities of residential groups, day care centres and drop-in centres, counselling centres, clubs and other forms of care and protection of persons with mental health problems. They organize self-help groups and provide services in the fields of consulting, planning, implementation and coordination of support, crisis intervention, and employment and training programmes. (http://www.altra.si) (page visited 8 March 2017)

[2] According to their home page, Estuary Foundation's mission is to provide social options and alternatives for adults with mental health problems to enable their reintegration into the Romanian community. They present their organization as the first in Romania to offer sheltered housing for adults with mental health problems and a viable alternative to hospitalization in hospitals for chronic diseases. (http://www.estuar.org/) (page visited 8 March 2017)

participants referred to the meeting places run by the municipality/local government[3]. Another suggested solution often mentioned was to strengthen the services available in the local community, which would allow patients to live in their own home. Most of the suggestions were based on the idea that people want to live at home, but that many need substantial support to manage.

We begin the next section by summarising the findings related to avoiding re-hospitalisation with the opinion that it is an advantage to start planning for life after discharge while still in the hospital. We then discuss the situation after discharge. Finally, we look at the importance of peer support as important to the patient learning to cope on him/her own.

3.5.1 Planning for discharge

Participants believed that it is important to plan and prepare for life after discharge. They felt that a lack of planning increases the chance of going into a crisis or having problems, which could lead to re-hospitalisation. The interviewees talked about the importance of obtaining information and learning about the various services that are available. Ideally, this would occur as part of thorough planning for discharge. They mentioned that it can be difficult to obtain this kind of information from friends, family or their social network because these people may have little knowledge about the topic. Stigma about mental illness also seems to affect the situation because people find it difficult to talk about mental illness, even when someone in one's network has had personal experiences with mental health care services. This indicates that it is important for health care professionals to inform patients about the different options as part of preparation for discharge from hospital. The following quote illustrates this point:

> "I think it would make sense, if we already think about it somehow during the hospital stay (...). What are the options, for example, in the local community? What are the therapy offerings or recreational offerings? It depends [because] each person is different. Maybe there are a couple of people caring for you, and so there are nurses and social workers. Maybe a couple of people have a couple of ideas, and you can then create a list and then somehow… consider these together—that is a good idea and you might simply have a pool or alternative. That you somehow have a network, that you are rescued, that would be great, that would certainly have helped me." (A2/2)

As noted by another interviewee from Austria, to prevent the feeling of loneliness and lack of structure and meaning in life, it would also be useful to have a detailed plan for the first days after discharge:

> "What would help me in hospital as a preparation for discharge, I think, if I can already have talks in hospital: what the next 1 or 2 weeks will look like, not only that I know I have a social worker at the psychosocial service, but also that I can make an appointment while being in hospital. So, not only knowing what is already working, but that I really can make appointments, that I write down that, [for example,] on Tuesday I will go for a walk for an hour, even if I don't do it then, but that it is written in my diary; yes that. Because I always get home and the diary is empty, and it all this can happen again. At the same time, I can call

[3] This example is a municipal-run day care centres for adults with mental illness. According to their home page, this day centre aims to contribute to "fellowship and growth for people with mental health problems through a safe and inclusive environment in great venues. We are a welded-together group that has room for more people. This is a place to be—a social community, in addition to a weekly schedule of regular activities. You do not need a referral or decisions to come."

> these people, so that my psychosocial quasi-network is starting again. That is really hard for me after a hospital stay, that may be too much again immediately [after discharge].” (A2/6)

Another interviewee (A/4) discussed how he/she was assisted by a social worker after two hospital stays. The social worker arranged for the interviewee to work in a sheltered workshop. A simple solution like this can be helpful for the newly discharged person.

3.5.2 Follow-up after discharge

The participants agreed on the need for some type of close follow-up after discharge. Most of the participants expressed the desire to live on their own in their home and to receive some kind of help and follow-up, to be part of a social community and to have meaningful activities. Assisted living was relevant for a few.

An assisted living arrangement is probably the closest professional follow-up that one can have in terms of having access to a professional while maintaining privacy. Six of the participants lived in residential care, four of whom were from Slovenia. On the question of what prevented re-hospitalisation, one of them, a man, said: “For me it was a housing solution, so I didn’t have to go [to hospital] for 12 years.” (S2/12) This was also an important solution for a male participant from Norway: "I moved into X service center, where I have lived for fifteen years and it works great" (N/2).

One woman commented on why she would not consider assisted living:

> “I would prefer, basically, to live alone, not in an [assisted] living community. I would find that [living alone] to more agreeable personally and being cared for there for a certain amount of time and to have self-responsibility. That I can say how long I need help and that I can give feedback that is heard. [I would like] somebody who comes to me, thinking of [living alone] as a real hospital substitute. If you think about that, then I would [prefer] somebody who comes [to my home]. And maybe also varying it—for some time, somebody comes, and then I say, now I am feeling better, it depends; so, quite flexible.” (A2/3)

Living in an assisted-living arrangement means assuming less responsibility for oneself and, for some situations, having less influence over one’s own situation. Several interviewees commented on the importance of having a place to live that feels safe. Some had been homeless while others had lived with friends at various times. It is obvious that providing safe housing for those in need is beneficial to the mental health situation. However, assisted living may be perceived as too much assistance for many in this target group, particularly during periods of stable mental health.

3.5.3 Individual coping-measures

Many participants talked about the importance of what they could do themselves in order to avoid re-hospitalisation, such as taking good care of oneself, both physically and mentally, having an emergency plan and using medications correctly. As one participant from Austria commented:

> “I’ve come to know through effort over the years, is that it is my own responsibility to work on what helps me, when it starts to sway just a little again at home.” (A1/5)

One woman from Slovenia explained her approach for staying out of hospital:

> “Never say never. But I don’t ever want to go to hospital again. Not this one, not someplace else. But I have to say, I do it a lot (...): working out, eating well, contacts with my family, contacts with those from before, contacts with new people, conversations, conversations with myself. I walk outside with my dog. I talk a lot to myself, and I go out to that field [where the hospital is] a lot, because I still have, not fear, but a bad feeling, when I see that building

> [the hospital?], so I go there every day. To get over this fear. So that this would give me the feeling that I am strong and that nothing bad would happen because of it." (S2/10)

Other interviewees in the Slovenian group also emphasised how they took individual responsibility for themselves and their health, using wording such as "a lot of movement" (S2/11) and "a walk, a bath, holy mass" (S2/12). They also mentioned doing creative things and stressing as little as possible (S2/8).

Other interviewees talked about how they had developed coping strategies either by themselves or with the help of professionals. Some also had emergency plans. In the following example, a woman from Austria explains how she has been trained to recognise signals of deteriorating mental health and what to do if this happens:

> "In my case, what I've learned through the training skills is to make plans for various situations, such as tense, depressive or social situations. I write lists and plans and consider what I would want if such a situation occurred again (...) [I learned] this in the long-term department, where I was admitted for 7 continuous months, and then I learned other training skills that are now offered at the day hospital in Hollabrunn, so I am really adept with regard to skills training" (A1/5).

This quote shows how the hospital can teach patients about their mental health reactions and how they can cope. This approach can be seen as way to empower mental health patients. Another example from Norway reflects the approach described above:

> "We do have a plan, where you write down your warning signals and when these become critical so that you can make a move yourself and ask, 'What are you going to do first?' Yes, you can call for example the [activity centre/day centre] where they have an emergency bed. And you can go there and have a chat or just be there for a while, or stay for a night or two. If the situation is more critical, you can call a DPS [district psychiatric center], and you can stay there up to a week. That is a very good safety net." (N/5)

In the Romanian group, an interviewee also stressed the importance of coping strategies in the form of being able to self-monitor and call for help if needed:

> "Establishing with a psychologist or a psychiatrist at the moments before the crisis, I mean, the ways that you react before a crisis, so you can monitor yourself … the feelings that you experience before the crisis, that you can monitor yourself continuously and you can warn the family and you can intervene before the crisis." (R/1)

The interviewees also noted several examples of really simple measures from the services that could help maintain coping. One Norwegian interviewee talked about his contact with a municipal service who phoned him every morning to make sure that he got up, thereby helping him to maintain a structure for the day. One Romanian interviewee noted that it would be useful for social workers or NGOs to visit people at home and to act as a mediator between the patient and parents or other people in difficult domestic situations. One of the Austrian interviewees suggested that simply having a telephone number to phone in a crisis would be helpful:

> "It may also be something in between, where you say, 'okay, now I feel it doesn't work anymore, I know that I can call there', and that simply gives one an enormous [feeling of] safety. That really could be a good safety net, I think, you know." (A2/3)

Their experiences of other situations in which people may need help from a professional indicate that people with mental health problems feel safer simply by having a telephone number to call, even if they never use it.

One method, which was mentioned mainly by the Slovenian group, was the use of medications, both taking medications as prescribed and being aware of the need for adjustments. One interviewee answered the question about what has kept her/him out of hospital, “For me, these medications, for how many years I have taken them.” (S2/7). Another interviewee agreed with his doctor that he would use medication at the moment he felt the need for it and then contact his doctor. (S1/2)

The Romanian group also mentioned the use of medications. However, they mentioned this in the context of being too heavily drugged when trying to live a normal life outside the hospital:

> “They [doctors] give you doses so high that you leave there like a vegetable. Basically, you cannot even walk on the street. And, in this state, I had to be taken by my aunt to work, do you understand? I sat on a chair, like a sack of potatoes, for a few hours until the work day finished. The same happened on other days and, after a week, I started to work.” (R/15)

This example supports the above mentioned beliefs that using the medications and dosages correctly is important for a stable health situation, which in turn can prevent re-hospitalisation.

3.5.4 Activity and meaning

The participants emphasised the need for plans, activities and something meaningful to do after discharge as critical to not requiring re-hospitalisation. Professionals play a major role in facilitating such services and activities through private organisations and public services.

In Norway, the primary care services within the municipality are responsible for a patient after discharge. A Norwegian participant explained that she had been readmitted a couple of times, and that this could have been prevented by a closer collaboration between the district psychiatric centre and the municipality. After some time, she started to visit a municipal day centre that offered several activities, and this became very important for her for collecting her medicines, talking with people and participating in sport. This service gave her “meaning, more structure, regular appointments, etc.” Another participant from Norway, a man, explained the importance of meeting places as follows:

> "I go to the meeting place run by the municipality, and I think that it is absolutely invaluable. Opportunity to go there and relax, meet other people, to paint etc. If they close down this place..I mean, it is more expensive to treat people than to rehabilitate people. So, that way you would think that places like this should be maintained." (N/1)

This need for “something to do” after being discharged was talked about in all focus group interviews. Interviewees from the different groups/countries used slightly different words for such (semi)professional arrangements: day centre, workshops and activity centre. However, common to all of them is that they more or less fulfilled the need for structure, activity and meaning in daily life for people with mental problems. We do not have detailed descriptions of all of these arrangements from the interviews, and these offerings probably vary between countries. It seems, though, that a combination of work/activity and socialising is a main component of all such programmes. Some also provide training or courses of various types. Some provide daytime activities only, whereas others allow for overnight stays. Participating in these workshops makes the person with mental health problems feel “useful”, as one interviewee from Romania said (R/7). Below are some quotes from the interviews about their experiences at day centres and workshops. The first example from Romania notes the diversity of activities provided:

> “This is what Club House was doing: it taught you how to cook, how to manage yourself, how to have fun in a team, how to wander around, how to go on trips, how to sing…” (R/4)

> “To teach you how you can help, to be… not to get pissed off when your baby is screaming, or… how to say [things], to mobilise yourself, depending on the situation, possibly to accept a new member in the family.” (R/1)

Other arrangements consider work to be a central feature. Several interviewees in the Slovenian group had experiences with the same type of follow-up arrangement, and spoke warmly about it:

> “I have to admit that it’s helping me a lot, really. Without this, I do not know, I think I wouldn’t be okay. Maybe I would pull through, I don’t know. I think I would fall into depression or something else or mania. So for me, it really helps.” (S1/3)

> “I can only say good things about it. You are also more socially included then, you go to work, you work for 8 hours, it’s a rhythm. You get used to this order, and over a month or two and you have work, you get paid, you are socialised again and you start living in a totally different way. (S1/2)

One of the Austrian groups expressed that there was greater need for these arrangements, which they called a kind of “intermediate service.” The interviewees argued that, when a person is unable to cope completely by him/herself, this type of service would allow the person to make contact and get the needed help, which would prevent re-hospitalisations:

> “Where you already notice things don’t work out so well anymore—I am having a hard time doing this and the warning bells start ringing in my head a bit. I think [this type of arrangement] is missing, where you can go and say ‘hi’, I need support with structure and my daily rhythm, I need work, I can’t get along with housekeeping anymore; that kind of help exactly, when I need it.” (A1/2)

It was clear that there are such services available in Austria, but also that the waiting times are very long. According to the interviewees, the result is that more people have to seek acute hospitalisation to hospital.

The services outlined above may be understood as comprehensive in-between types of services that are situated between strictly psychiatric help (e.g., via an outpatient clinic) and more socially focused, loosely organised services. Interviewees shared their impressions of both types of services. If we first look at the predominantly psychiatric services, one Austrian interviewee talked about his/her experience of intensive treatment, which made a hospitalisation avoidable:

> “Yes, well, what can help apart from a hospital stay? I once definitely agreed to an intensive treatment at the right time during a manic episode, when I was in hospital for a short time, but it then turned out that that was not adequate. So, my need turned out not to be so acute even though I needed intensive treatment. There was the opportunity for time-consuming treatment with the psychosocial service, which I did two or three times a week, and this helped me avoid needing a longer hospital stay.” (A1/6)

The Norwegian interviewees noted the need for more opportunities to attend the outpatient clinic. This was also noted by the Romanian interviewees, who talked about the lack of professionals and services. Both public and private mental health services are relevant to providing appropriate mental healthcare. Regardless of who provides the service, the interviews show that people with mental health problems want more frequent (medical) follow-up.

3.5.5 Peer support and networks

Another topic addressed in the interviews was the use of peer support and user-based initiatives to support people with mental health problems and thus to prevent re-hospitalisations. Several of the interviewees had experiences of this kind of initiative. They called it different names, but the idea of peer support was a motivation for all of them. In the Austrian interviews, the Windhorse[4] and Ex-In[5] projects were mentioned frequently. In one of the focus group interviews in Slovenia, several interviewees had participated in a club for people with bipolar disorder. Their response to what they regarded as helpful or positive about peer support groups can be summarised briefly as the sharing of experiences important.

It is interesting that the interviewees noted that peer support groups may feel safer than professional support because participation in a support group cannot lead to hospitalisation. The interviewees talked about the need for combining peer support with professional help. These are not mutually exclusive services, but rather, should be seen as complementary. When asked about how they cope with daily life after being discharged and how professionals can help, one participant answered as follows:

> "I think you need something else. Having a network that lasts. If you go to a psychiatrist or some professional, you have 45 minutes to talk about what is on your mind, and then it is over. And you are sort of back in everyday life. I don't think that makes people healthy. Building a network that can support you and can last [is important]. This works well at activity centre X [a municipal centre]. We support each other, and we participate in activities together." (N/1)

The interviewees mentioned programmes in which they acted as support for other ill people, such as "experts by experience". They offered several ideas about how to use peer support, especially the focus group in Finland. They emphasised that peer support/peer contact could start even during the hospital stay. We see from the quotes that the idea of early peer support/peer support starting during the hospitalisation was regarded positively. However, this is difficult to implement.

Some participants also mentioned the topic of religion and spirituality, and that it can be important to have the opportunity to discuss these matters with someone:

> "It has just occurred to me, that the spiritual aspect is also important. For all I know, what is the meaning of life and are there acts of God or higher powers… talking about this may be good, even if your counterpart says, I do not know these things either (...) So, I had conversations with pastors [within the hospital], they were almost best of all [available personnel], you know? So this aspect should also be taken into account." (A1/1)

The Romanian group expressed most strongly of all the groups that the family's support is important. The Slovenian group noted that having a "relationship with your close ones helps" (S2/12). An

[4] The Windhorse treatment and care concept is described on their home-page as characterized by eight characteristics: Health and resource orientation; Establishment of a therapeutic household / environment / setting; Intensive client participation; Inclusion and clarification of the interests of the family members with regard to the client-specific objectives (network perspective); High integration of a multiprofessional team; Close collaboration with inpatient psychiatry, psychiatrists and psychotherapists; Training of employees in both psychosocial and contemplative skills; and Personal contemplative practice of Windhorse employees. http://www.windhorse.at (viewed 8 March 2017)

[5] The term Ex-In (which represents "Experienced Involvement") describes a person who was a patient in psychiatric treatment but now treats psychiatric patients. https://de.wikipedia.org/wiki/Ex-In (viewed 8 March 2017)

Austrian interviewee said that what he simply needed was somebody to discuss together about "what can be done?" and, after a decision is made, "who supports me implementing it?" (A1/1).

3.6 Summary of the results

In this part, we have explored mental health service users' own positive and negative experiences of hospitalisation and re-hospitalisation and their suggestions about how one can avoid re-hospitalisations. Data was based on eight focus groups with service users in all six countries (Romania, Slovenia, Finland, Italy, Austria and Norway). A total of 55 service users, aged 26-65 years, participated. The most frequent diagnoses were psychosis (41,8 per cent) and bipolar disorder (38.2 per cent). Many of the participants had been in and out of mental health hospitals for several years. Half of them had been hospitalised during the last twelve months.

Overall, the participants in the focus group interviews expressed strongly negative experiences related to their hospitalisation. Many described highly dramatic and traumatic experiences, particularly in connection to their first admittance and involuntary admissions. It was described as something terrible and intolerable, as a shock and a trauma. These feelings were induced by both the illness and the experiences related to the process of hospitalisation. Others described their first hospitalisation in positive terms, although to a much lesser extent. They then pointed at the relief of being hospitalised, accessing a form structure of things and called hospitalisation a "lifeline" or "rebirth", something that released the responsibility.

Many considered re-hospitalisation to be difficult and upsetting in many ways, although subsequent hospitalisations were experienced by many as less frightening. This was mainly because they had been through the situation before and felt more in control of the situation in terms of knowing what to expect and being conscious and capable of developing coping strategies for themselves. Re-hospitalisation was not talked about in the same dramatic terms as when they described their first hospitalisation. Re-hospitalisation was often considered a relief and a means for them to obtain the necessary help. A common view among the interviewees across countries is that one must accept the need for re-hospitalisation even though it may be associated with both good and bad experiences. The interviewees perceived their illness as a chronic condition and that they would sometimes need to be readmitted to ease the crisis. However, some participants described their re-hospitalisation as something happening "by default" and without any healing effect.

Most of the participants were receiving outpatient treatment, and saw their psychiatrist or psychologist as necessary for treating symptoms and controlling medication. Several referred to problems such as not seeing their psychiatrist often enough or the need for a type of service to monitor mental state. They felt that something or someone more is needed—someone who can identify changes and take care of the patient when he/she cannot do so. The actions participants considered helpful for preventing re-hospitalisation varied between participants and over time. The most important was the availability of different kinds of meeting places, day centres or activity centres with various activities, workshops and seminars.

4 Implication

The results indicate the importance of focusing more on the first hospitalisation (in addition to the problem of re-hospitalisation), as well as the importance to patients that hospitalisation is voluntary. The results also indicate that, for avoiding re-hospitalisation, follow-up are needed to cover the patient's social and activity needs. Ideally, this should be facilitated as a close collaboration between the hospital, municipality/primary care and mental health service user.

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7

Final Scientific Report

PART 7

The CEPHOS-LINK Methods Toolkit

Prepared by
IMEHPS.research and the CEPHOS-LINK team
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Content

Introduction

Part 7 contains a set of tools developed for Objective 3 which stipulates to develop a methods toolkit for conducting record linkage studies in the mental health care field in and across European countries, in order to improve the evaluation of mental health care systems in Europe. The tools were developed during the preparatory activities phase of CEPHOS-LINK project (Part 2 of the final scientific report) and the pooling of data phase (Part 4 of the final scientific report) with the intent of improving the quality of data and for ascertaining interoperability of national databases for performing the CEPHOS-LINK re-hospitalisation studies. The main characteristic of the CEPHOS-LINK project was that a retrospective cohort study design was used with routine data available in large electronic national databases. As foreseen already at the time of the submission of the CEPHOS-LINK project, a substantial amount of time and resources had to be invested into ascertaining this interoperability. The tools included here document these activities. They are thought to serve as models for similar projects and to support capacity building in comparative effectiveness research using large electronic national databases.

Tool 1 - Questionnaire on Administrative Databases

CEPHOS-LINK

CEPHOS-LINK (CX) - QUESTIONNAIRE ON ADMINISTRATIVE DATABASES

Please fill in partner country:

The purpose of this short questionnaire is to explore how the process functions in each country

from administrative data bases >>> to the analyses we require for CX.

The questionnaire may not apply to all partners in the same way, but, based on previous experiences, as a start 4 stages are preliminarily distinguished in this process: After identifying relevant databases please identify and describe the organization(s) which

1. Own(s) the relevant data base(s)/the data (database and data may have different legal owners)
2. Carries out pseudonymisation in case UPIs are available
3. Carries out record linkage by probabilistic/deterministic methods
4. Carries out the data analyses

In a specific country not all of the above may relate to separate organisations. In fact, only one single organisation could be involved in all stages. The information asked for here is especially relevant for ethical and data protection considerations and may imply complex legal relationships which have to be explored, since they may not be evident at first sight. Data analysis itself should preferably be carried out by the CEPHOS partners themselves, in order not to be too much dependent on other institutions – the use of business intelligence methods may be helpful to achieve this aim, while at the same time data protection is guaranteed (e.g. the use of pivot tables in conjunction with k-anonymity)

You may write as much text into a box as is needed and may also add lines if required and add comments as you wish.

Existing databases with potential relevance for CX, please consider at this stage of the project also non-health databases (e.g. prison, social housing, schooling), these might not be available in all countries but may be useful for comparing a subset of CX countries

Acronym	Long name	Covering what? Health? IP? OP? Death? Other? Social?	UPI?	Geographical area covered	Start date still active? if historical > end date?	Primary purpose of data collection	Owner of databse	Owner of data

Comments:

1. **For each database identified above: Is there an institution/organization which is responsible for and carries out pseudonymisation of UPIs in administrative databases? This may be just one institution for several, or even all databases**

Acroym of databases	Name of institution/organization, unit within the organization?	Legal status, Ownership of this institution	Legal framework covering the duty/right for pseudonymizing administrative data	How is privacy protected? Who has access to the table linking the pseudonyms to the real names of a person?

Comments:

2. Which institution/organization carries out record linkage

2.1 deterministic linkage of pseudonymised records within and across databases in order to produce linked records/data sets for planning and research purposes

Name of institution/organization	Legal status, Ownership	Legal frame work	How is privacy protected? K-anonymity?	How are / can be data provided to researchers? Business Intelligence tools? Pivot?

2.2 probabilistic linkage for databases without UPI, in order to produce linked records/data sets for research purposes – and establish links with 3.1 databases

Name of institution/organization	Legal status, Ownership	Legal frame work	How is privacy protected? K-anonymity?	How are / can be data provided to researchers? BI? Pivot?

Comments:

3. From the present perspective: Who would carry out the data analyses for CX?

Name of institution/organization The CX partner himself?	Legal status, Ownership	Legal framework	How is privacy protected? K-anonymity?	How are data provided to researchers? Pivot?

Comments:

Tool 2 - Questionnaire on Master LEEARs

CEPHOS-LINK (CX) - Questionnaire on Master LEEARs

CX requires that two rehospitalisation studies be performed with data contained in Large Existing Electronic Administrative Registries (LEEARs; see objectives 1 and 2 on pages 4, 8 and 9 of the CX Description of Work). While we must eventually check all LEEARs within each country, which contain variables potentially explaining the rehospitalisation outcomes, we must first find out in which LEEARs the variables are contained which are absolutely necessary for performing the two study designs in a comparable way in each of the partner countries. These variables are called “Master variables” and the LEEARs in which they are contained “Master LEEARs”. The information collected with this questionnaire refers to these Master LEEARs.

For two CX studies data on service utilisation of hospitals and specialist psychiatric outpatient contacts are needed, as follows.

		CX Objective (study) 1: rehospitalisation after discharge from a psychiatric/ non-psychiatric bed	CX Objective (study) 2: rehospitalisation after discharge from a psychiatric bed & modifying influence of psychiatric outpatient contacts
Master variables	Inpatient service utilisation of psychiatric and non-psychiatric beds Admission & separation*) dates Primary and secondary ICD-10 diagnoses at hospital separations	X	X
	Psychiatric outpatient contacts Date of contact		X

*) Separation includes all types of discontinuation of hospital episodes, such as death, discharge, escapes, transfers to other hospitals (but not within a hospital).

These Master variables may be contained in one single Master LEEAR in a specific country, but might also be contained in more than one LEEAR – especially if different types of psychiatric outpatient services are considered.

A crucial point for discussion in this description is what type(s) of hospital beds are included and how to deal with beds in “non-hospital” structures which may fulfil a similar function as hospital beds. Also the types of psychiatric outpatient care need to be discussed.

It might well be that the Master LEEAR(s) contain also other than hospital and psychiatric outpatient health service utilisation variables, and these should also be documented here (although we will come back to these variables later).

Name of Master LEEAR

A. General information

When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward = person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	
Is the owner/custodian/steward of the database accustomed to having **personal records linked** a) within the data base and/or b) with other databases (e.g. "KELA" see below)? If so, where does linkage occur?	
Other useful information	

B. Description of variables - Please note: Not all questions need to apply – in this case fill in NA

1. Individual patient data	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	

Date of birth (yes/no; which format?)	
Age (Number of years completed at which date? For inpatient care: At date of admission/date of discharge? For outpatient care: Date of contact?) Any special arrangements (e.g. five year groups – which five year groups, 0-4, 5-9,…. or 0-5, 6-10,…)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

2. Type of service	
"Functional code" of type of service/level of care covered by this LEEAR: – Ambulatory care? – Inpatient care? – Day patient care? – Primary care (general practitioner)? – Other?	
"Functional code" of medical specialty (psychiatry, gynaecology, surgery,…) – list all and note to which of the above types of service these codes apply – ambulatory care, inpatient care, day patient care? All of those?	

3. Diagnosis	
Please detail in each answer-box to which type of service your answer(s) relate: to inpatient, ambulatory care, day care, primary care.	
Diagnosis recorded in a format which can be analysed? If yes, ICD-9 or ICD-10?	
Main diagnosis: How many characters can be used (e.g. ICD-10: F0 = two characters)?	
Additional/secondary diagnosis: How many additional diagnoses can be documented? Which format (see 9b).	
Please try to find out how many additional diagnoses are on average documented in the LEEAR: Frequencies of a) no additional diagnosis b) one additional diagnosis c) two or more additional diagnoses	

4. Inpatient care	
Date of admission in case of inpatient care (Precise date? If not: month, year of contact? Planned or unplanned admissions, other?)	
Type of admission (Referral from other inpatient hospital care? If yes: from where? Other?)	

Date of separation/ discontinuation in case of inpatient care (precise date? If not: month, year of contact? Other?)	
Type of “separation/ discontinuation (Death? Transfer to a different department in the same hospital? Transfer to a different hospital? Home? Other?)	
5. Ambulatory care	
Date of contact with service in case of ambulatory service use (Precise date? If not: month, year of contact? Other?)	
6. Day care	
How are the contact dates with day care documented? Each day of a visit to day care? Beginning and end of a day care period?	

C. Additional questions on the services covered by the MASTER LEEAR

INPATIENT CARE

Psychiatric inpatient care (patient stays overnight)

What types of beds are covered (most categories are taken from FINCENTO p.141ff, http://www.refinementproject.eu/)? Please mark relevant categories with an x. For the final decision, which beds to include in the CEPHOS-LINK empirical studies, reports about the available Master LEEARs from all 6 partner countries will have to be compared and discussed.	
	Geographically stand-alone psychiatric hospital – acute care
	Geographically stand-alone psychiatric hospital – long-term care
	Geographically stand-alone psychiatric hospital – long-term and acute care
	Part of a psychiatric centre / community mental health centre
	Psychiatric departments in general hospitals (non-university)
	Psychiatric departments in general hospitals (university)
	Psychiatric beds in long stay residential care homes (non-organic conditions)
	Psychiatric beds in long stay residential care homes (organic conditions) Other psychiatric beds, please describe (forensic, military, psychosomatic, prison hospitals,…)

Comments: Please note whether and in which types of the above psychiatric beds involuntary admissions are possible:

Non-Psychiatric inpatient care (patient stays overnight)

	Non-psychiatric inpatient care services (general hospitals, etc.)

PSYCHIATRIC AMBULATORY CARE: If none are covered by this Master LEEAR, mark the box to the right with an x		

What types of services are covered? Please mark relevant categories with an x	
Psychiatric ambulatory care services (patient comes to service)	
	Self-employed psychiatrist, single handed
	Self-employed psychologist/ psychotherapist, single-handed

	Self-employed psychiatrists/ psychologists/ psychotherapist, in group practice or similar
	Geographically stand-alone outpatient service where doctors are employed
	Outpatient service of a hospital where doctors are employed
	Outpatient service of a mental health/psychiatric centre" (with several other types of care provided), community mental health centre, community team
	Other, please describe:
Psychiatric day care services (patient comes to service)	
	Integrated with inpatient section in a hospital
	Separate organisational structure of a hospital and located in hospital
	Separate organisational structure of a hospital but not located in a hospital
	Part of a psychiatric centre / community mental health centre
	Other, please describe
Psychiatric mobile services (service goes to patient)	
	Organisationally part of a specialist psychiatric unit
	Organisationally part of a community mental health team/service
	Organisationally part of a stand-alone community mobile mental health team/service
	Organisationally part of local/regional government social care services
	Other, please describe

D. Other health service utilisation variables covered by the MASTER LEEAR

What types of services are covered? Please mark relevant categories with an x	
Primary health care services, physician led	
	Self-employed primary health care physician, single handed
	Private company or partnership owned by the practising physicians (group practice)
	Physician-led public primary care organisations where physicians are employees
	Other, please describe
Non-psychiatric ambulatory health care services (patient comes to service)	
	Self-employed specialists, single handed
	Self-employed specialists, in group practice or similar
	Geographically stand-alone outpatient service where doctors are employed
	Outpatient service of a hospital where doctors are employed
	Other, please describe:
Non psychiatric day health care service (patient comes to service)	
	Non psychiatric day care service

PHARMACY

Pharmacy: Date of filling of prescription – how detailed? Exact date? Month? Others? ATC code? Please differentiate between medication given in hospitals and prescription/drugs filled in pharmacies.	

Other comments:

(1) Please describe here, whether there are sectors in your country where data on publicly funded service utilizations related to our Master Variables a) hospital admissions/discharges b) psychiatric outpatient care (ambulatory, day, mobile care) are not contained in the above LEEARs and can probably not be retrieved from other registries.

(2) Please also describe situations where you are not clear whether to include or not to include specific types of services

Example for (1) In Finland patient records of visits to ambulatory psychiatric services may not be available in any accessible LEEAR, if such service utilizations are reimbursed by the occupational health insurance system.

Example for (2) In Norway it is unclear whether to include admissions to municipality beds for mental patients (crises beds), which are not registered in the National Patient Registry.

Please also provide an estimate how large the volume of each of these service utilisation records is in relation to the total amount of service utilisation records for the whole country.

Attention: **We don't mean private providers who are privately paid - there is no way to get those data.**

Tool 3 - Questionnaire on additional information for the continuity of care study

CEPHOS-LINK

Questionnaire on variables for the continuity of care study

Country:

In order to clarify the relevant variables and codes needed for analysing CX objective 2 (comparing patients with post-discharge psychiatric outpatient contacts vs no such contact) we kindly ask you to provide the following information in part A and B. Please note: We are only interested in information that is *actually available* for our CX analyses. In case you work with linked MASTER LEEARs please report on the variables included in the linked dataset. In case of comments, additional details or clarifications please use the comments section at the end of this questionnaire.

A) Please fill in the missing information and check and correct the already filled in information. Please refer to each of the three types of outpatient services: ambulatory care, day care and mobile care in the respective column

	Ambulatory care	Day care	Mobile care
Identifying service utilisation in ambulatory, day and mobile care			
Name of variable identifying service utilisation in ambulatory, day and mobile care			
• in your language			
• English translation			
• Variable name or abbreviation used in the database			
Codes and meaning of codes of variable identifying service utilisation in ambulatory, day and mobile care in your language (e.g. in Finland telephone contacts, …)			
• in your language			
• English translation			
Any additional variables and codes to identify service utilisation in ambulatory, day and mobile care? If yes please provide name (in your language, English, name in database) and codes and meaning of codes (in your language, English)			
Identifying the provider and provider details			
Does a variable exist to identify type of provider (e.g. if provider is self-employed, group practice, geographical stand-alone outpatient service where doctors are employed, outpatient service of a hospital…)? If yes, name of variable identifying type of provider			
• in your language			
• English translation			
Codes and meaning of codes of variable identifying type of provider:			
• in your language			
• English translation			
Is any geographical information on provider available? (Address – in which details?, district, etc.)			
• Yes/no			

	Ambulatory care	Day care	Mobile care
• If yes, what type of information? Please provide details			
Identifying medical specialty of provider (psychiatry, internal medicine, …) - please see also question B below			
Name of variable to identify medical specialty of provider			
• in your language			
• English translation			
Documentation of date of contact or contact details			
Date of contact with service In case of day care provide details on how are the day care visits are documented (each day of visit or beginning and end of care)			

B) (a) Please provide a list of the codes identifying the medical speciality of the outpatient service (in case there are separate variables and codes for ambulatory, day and mobile care, please provide for each type separately).
(b) Highlight those specialties that you would suggest to include as psychiatric ambulatory care, day care and mobile care in our CX-analyses (please use different colours for ambulatory, day and mobile care).

Any comments:

Tool 4 - Questionnaire on Other Health and Non-Health LEEARs

CEPHOS-LINK (CX)

Questionnaires on Other Health and Non-Health LEEARs

Name of country:

Other Health and Non-Health LEEARs

In the framework of CEPHOS-LINK the so called Master LEEARs contain variables on psychiatric and non-psychiatric inpatient care service utilisation, as well as on specialised psychiatric outpatient care service utilisation. They are described in the previous questionnaire on Master LEEAR(s).

While the variables identified in the Master LEEARs are so to say the “skeleton” variables for answering the basic study objectives 1 and 2 of CEPHOS-LINK (cf. pages 8 and 9 in the DOW in our proposal), we also want to identify modifying service utilisation variables both in the health services and the non-health services sector. The dividing line between the health sector and the non-health sector may be different in different countries and we shall have to discuss this categorisation at the end of this preparatory phase of CEPHOS-LINK. For the purpose of getting an overview on existing relevant Other Health LEEARs please consider the types below:

1 Service LEEARs
   - Primary care services, physician led
   - Primary care services, not physician led
   - Non-psychiatric specialist ambulatory care (“outpatient”) services
   - Non-psychiatric day care services
2 Pharmacy/prescription LEEARs
3 Specific disease LEEARs (e.g. cancer registry)
4 Mortality LEEARs
5 Other health related LEEARs

For each of the above five types we have developed specific questionnaires which are attached as separate word documents which we ask you to copy and fill in for each identified LEEAR. PLEASE NOTE: It is possible that some of the above types of health care services are covered by the Master LEEARs in your country that were already described in the Master LEEAR questionnaire. In this case a note should be made referring the reader to the Master LEEAR questionnaire and the relevant part in the separate questionnaire need not to be filled in. When in doubt, please fill in the information also here and we will clarify at a later stage the appropriate categorisation.

As a first step before answering sections 1, 2, 3, 4 and 5 please fill in the table below to provide an overview on Other Health Care Service LEEARs.

Primary health care services, physician led	
	PLEASE FILL IN: **Name of LEEAR which includes personal service utilisation records (SUR), etc.**
Self-employed PHC physician, single handed	
Private company or partnership owned by the practising physicians (group practice)	
Physician-led public primary care organisations where physicians are employees	
Other, please describe	

Primary health care services, not physician led	
	PLEASE FILL IN: **Name of LEEAR which includes personal service utilisation records (SUR), etc.**
Primary health care services, not physician led	

Non-psychiatric ambulatory care services (patient comes to service)	
	PLEASE FILL IN: **Name of LEEAR which includes personal service utilisation records (SUR), etc.**
Self-employed specialists, single handed	
Self-employed specialists, in group practice or similar	
Standalone outpatient service where doctors are employed	
Outpatient service of a hospital where doctors are employed	
Other, please describe:	

Non-psychiatric day care services (patient comes to the service)	
	PLEASE FILL IN: **Name of LEEAR which includes personal service utilisation records (SUR), etc.**
Non psychiatric day care service	

1. Services

Acronym of specific LEEAR: **Full Name of specific LEEAR:**

E. General information

When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward =person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	

Is the owner/custodian/steward of the database accustomed to having **personal records linked** a) within the data base and/or b) with other databases. If so, where does linkage occur?	
Other useful information	

F. Description of variables - Please note: Not all questions need to apply to the specific LEEAR described here – in this case fill in NA

1. Individual patient data	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	
Date of birth (yes/no; which format?)	
Age (Number of years completed at which date? For inpatient care: At date of admission/date of discharge? For outpatient care: Date of contact?) Any special arrangements (e.g. five year groups – which five year groups, 0-4, 5-9,…. or 0-5, 6-10,…)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

2. Type of service covered by this specific LEEAR	
Please tick as many as apply	☐ Primary care services, physician led ☐ Primary care services, not physician led ☐ Non-psychiatric specialist ambulatory care ("outpatient") service ☐ Non-psychiatric day care services ☐ Others, please specify:
If "Non-psychiatric specialist ambulatory care ("outpatient") service" applies, please provide list of "functional codes" for medical specialty.	

3. Diagnosis	
Please detail in each answer-box to which type of the above service type (Primary care services, physician led, Primary care services, not physician led, Non-psychiatric specialist ambulatory care ("outpatient") service, Non-psychiatric day care services, Others) your answer(s) relate	
Diagnosis recorded in a format which can be analysed? If yes, ICD-9 or ICD-10? If yes, other?	
Main diagnosis: How many characters can be used (e.g. ICD-10: F0 = two characters)?	
Additional/secondary diagnosis: How many additional diagnoses can be documented? Which format?	
Please try to find out how many additional diagnoses are on average documented in the LEEAR: Approximate frequencies of d) no additional diagnosis e) one additional diagnosis f) two or more additional diagnoses	

4. Dates (of contact/treatment periods)	
4.a Ambulatory care date of contact: Precise date? If not: month, year of contact? Other?	
Primary care services, physician led	
Primary care services, ot physician led	
Non-psychiatric specialist ambulatory care "outpatient") services	
4.b Day care treatment periods: How are the contact dates with day care documented? Each day of a visit to day care? Beginning and end of a day care period? Precise date? If not: month, year of contact? Other?	
Non-psychiatric day care services	
4.c Other services: Dates of contact: Precise date? If not: month, year of contact? Other?	
Please specify	

Other information and comments:

2. Pharmacy/prescription LEEARs

Acronym of specific LEEAR: **Full Name of specific LEEAR:**

A. General information

Usually such LEEARs are kept for medication sold in pharmacies; occasionally there might be LEEARs either including also medication distributed in hospitals or only for medication distributed in hospitals. Please check to which of these options the specific LEEAR applies. If there are two separate LEEARs please fill in two separate forms.	☐Medication sold in pharmacies ☐Medication distributed in hospitals
When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward =person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	
Is the owner/custodian/steward of the database accustomed to having **personal records linked** a)	

within the data base and/or b) with other databases. If so, where does linkage occur?	
Other useful information	

B. Description of variables - Please note: Not all questions need to apply to the specific LEEAR described here – in this case fill in NA

Individual patient data	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	
Date of birth (yes/no; which format?)	
Age (Number of years completed at which date? For inpatient care: At date of admission/date of discharge? For outpatient care: Date of contact?) Any special arrangements (e.g. five year groups – which five year groups, 0-4, 5-9,…. or 0-5, 6-10,…)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

G. Specific pharmacy / prescription data

Date of filling of prescription How detailed? Exact date? Month? Others?	
ATC code, how detailed?	
Other relevant information contained in this LEEAR:	

Other information and comments:

3. Specific disease LEEARs (e.g. cancer, epilepsy)

Acronym of specific LEEAR: **Full Name of specific LEEAR:**

A. General information

When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward =person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	
Is the owner/custodian/steward of the database accustomed to having **personal records linked** a) within the data base and/or b) with other databases. If so, where does linkage occur?	
Other useful information	

B. Description of variables - Please note: Not all questions need to apply to the specific LEEAR described here – in this case fill in NA

Individual patient data	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	
Date of birth (yes/no; which format?)	
Age (Number of years completed at which date? For inpatient care: At date of admission/date of discharge? For outpatient care: Date of contact?) Any special arrangements (e.g. five year groups – which five year groups, 0-4, 5-9,…. or 0-5, 6-10,…)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

C. Specific Disease data

Focus on one disease or group of diseases? Which diseases? ICD -10? ICD-9?	
Please attach list of variables used in this LEEAR!!!!	

Other information and comments:

4. Mortality LEEARs

Acronym of specific LEEAR: Full Name of specific LEEAR:

A. General information

When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward =person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	
Is the owner/custodian/steward of the database accustomed to having **personal records linked** a) within the data base and/or b) with other databases. If so, where does linkage occur?	
Other useful information	

B. Description of variables - Please note: Not all questions need to apply to the specific LEEAR described here – in this case fill in NA

Individual patient	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	
Date of birth (yes/no; which format?)	
Date of death (which format?)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

C. Specific Mortality data

Causes of death, which classification is used?	

Other comments and information:

5. Other Health Related LEEARs

(which are not covered in questionnaire 1, 2, 3 and 4)

Acronym of specific LEEAR: **Full Name of specific LEEAR:**

A. General information

When did it start? Which is the latest validated year as of June 2014?	
Primary purpose of data collection	
Owner of database	
Owner of data	
Who is the custodian/ steward of the database? (custodian/ steward =person/group responsible for decisions, whether data can be linked with other databases)	
Is the owner/custodian/steward of the database used to having personal records **encrypted** and if so, where does encryption occur?	
Is the owner/custodian/steward of the database accustomed to having **personal records linked** a) within the data base and/or b) with other databases. If so, where does linkage occur?	
Other useful information	

B. Description of variables - Please note: Not all questions need to apply to the specific LEEAR described here – in this case fill in NA

Individual patient data	
UPI?	
Format of the UPI (How many characters? Which structure?)	
Gender (yes/no)	
Date of birth (yes/no; which format?)	
Age (Number of years completed at which date? For inpatient care: At date of admission/date of discharge? For outpatient care: Date of contact?) Any special arrangements (e.g. five year groups – which five year groups, 0-4, 5-9,…. or 0-5, 6-10,…)	
Place of residence (Which format? How detailed? Postal code? County? Other?)	
Other patient variables? Please specify:	

C. Specific data

Please provide details on specific data in the LEEAR:	

Other comments and information:

Tool 5 - Questionnaire on Flow of Inpatient Service Utilisation Data

Report on Flow of Inpatient Service Utilisation Data

Country:

Baseline year:

(please describe the data flow at the time of the CX baseline year)

(1) Please fill in the steps of the flow of service utilisation data in PART A starting at the inpatient services in your country, arriving at a central LEEAR and at statistical offices and international organisations.

(2) Create a graph on the data flow for your country using the provided example at the end of this document to describe the steps and direction of the data flow in PART B.

Note for PART A and B: If there are differences between different inpatient types (e.g. specialist psychiatric hospitals, psychiatric departments in general hospital, community mental health services, other specialist hospitals) please describe the process for each different type of service separately. Also state if there are differences between psychiatric and somatic care in data reporting.

Also note: Data flow might not be linear and parallel steps are possible (see example of Austrian data flow).

PART A – Description of the data flow

Please explain step by step

- To which organization(s) are patient service utilisation data sent in the subsequent step? Please describe all the steps – including the way to the central LEEAR(s) and up to the international level
- What type of data is sent? Is data anonymized, is a UPI included or not included?
- At what stage is the granularity of data changed? E.g. only aggregates are sent
- Where is quality control performed? Where is data validated?
- What is the interval of data reporting /date of reporting/time period?
- At what level does the reporting take place: service level, provider level, subnational/regional level, national or international level?

Please proceed this way:

For which type of service is the data flow described. Please fill in type of inpatient service:

Step one of data flow

from (1) …
to (2)…
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

Step two of data flow

From (2) …
To (3) …
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

Step three of data flow

From (3) …
To (4) …
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

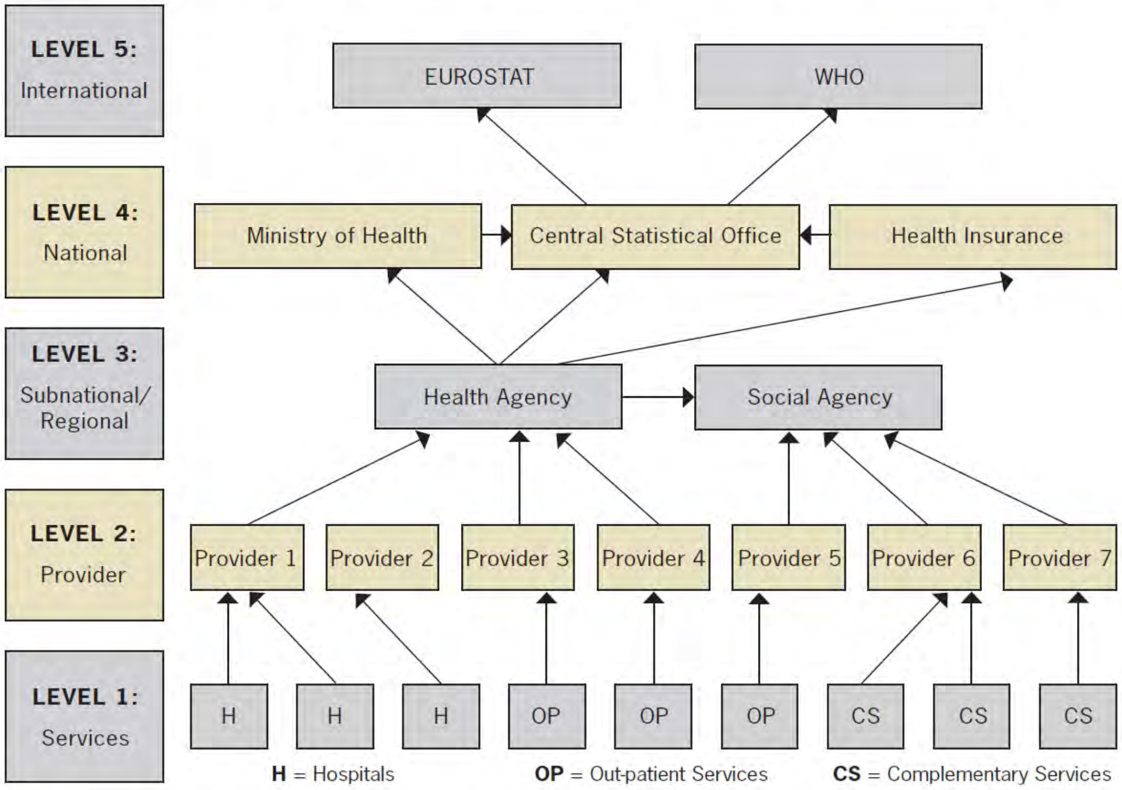
And so on, please complete for further steps. Then do the same for different directions of data flows and in case there are differences between different inpatient services.

Comments and other information

PART B – Graph on data flow

Please fill in the information on the data flow in the graph below. Use the numbers from PART A in the graph, e.g. (1) hospital to (2) provider

Figure 1: A General Model of a Reporting System of Mental Health Service Utilization Data



Tool 6 - Questionnaire on Flow of Psychiatric Outpatient Service Utilisation Data

CEPHOS-LINK

Report on Flow of Psychiatric Outpatient Service Utilisation Data

Please fill in separately for ambulatory care, day care and mobile care

Country:

Baseline year (please describe the data flow at the time of the CX baseline year):

Please fill in the steps of the flow of service utilisation data in PART A starting at the psychiatric outpatient services in your country, arriving at a central LEEAR and at statistical offices and international organisations (not all countries report outpatient service utilisation data to international organisations).

Create a graph on the data flow for your country using the provided example at the end of this document to describe the steps and direction of the data flow in PART B.

Note for PART A and B: If there are differences between different outpatient types (e.g. for ambulatory care: self-employed doctors, geographically stand-alone outpatient service where doctors are employed, outpatient service in a hospital, mental health center, … for day care: day care in hospital, day care in community mental health centre, …. For mobile care: organizationally part of a hospital unit, organizationally part of a community mental health service…) please describe the process for each different type of service separately. Also state if there are differences between psychiatric and somatic care in data reporting.

Also note: Data flow might not be linear and parallel steps are possible.

PART A – Description of the data flow

Please explain step by step

- To which organization(s) are patient service utilisation data sent in the subsequent step? Please describe all the steps – including the way to the central LEEAR(s) and up to the international level
- What type of data is sent? Is data anonymized, is a UPI included or not included?
- At what stage is the granularity of data changed? E.g. only aggregates are sent
- Where is quality control performed? Where is data validated?
- What is the interval of data reporting /date of reporting/time period?
- At what level does the reporting take place: service level, provider level, subnational/regional level, national or international level?

Please proceed this way:

For which type of service is the data flow described. Please fill in type of outpatient service:

Step one of data flow

from (1) …
to (2)…
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

Step two of data flow

From (2) …
To (3) …
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

Step three of data flow

From (3) …
To (4) …
Type of data sent/anonymized/UPI:…
Data editing:….
Quality control/validation/anonymization: …
Interval/time period/date of reporting: …
Level of reporting:…

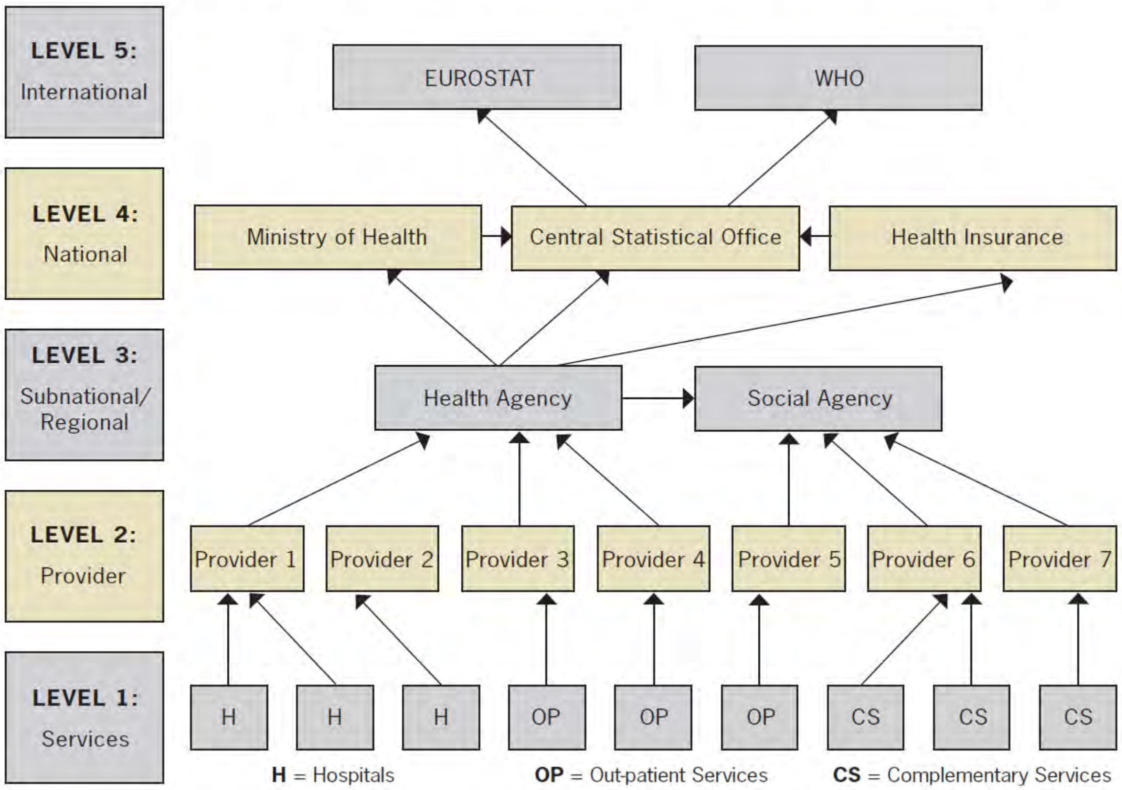
And so on, please complete for further steps. Then do the same for different directions of data flows and in case there are differences between different outpatient services.

Comments and other information

PART B – Graph on data flow

Please fill in the information on the data flow in the graph below. Use the numbers from PART A in the graph, e.g. (1) self-employed to (2) social insurance company

Figure 1: A General Model of a Reporting System of Mental Health Service Utilization Data



Tool 7 - Online Form tool for Mapping of Psychiatric Inpatient Services and Beds

Please use this link for insights into the tool:

http://cephos.endel.at/Screencast_Formtool.mp4

Tool 8 - Instructions to Use the Online Form Tool for Mapping

CEPHOS-LINK

CEPHOS-LINK instructions to use the online form for mapping of hospitals/hospital departments with psychiatric beds for people aged 18+ years

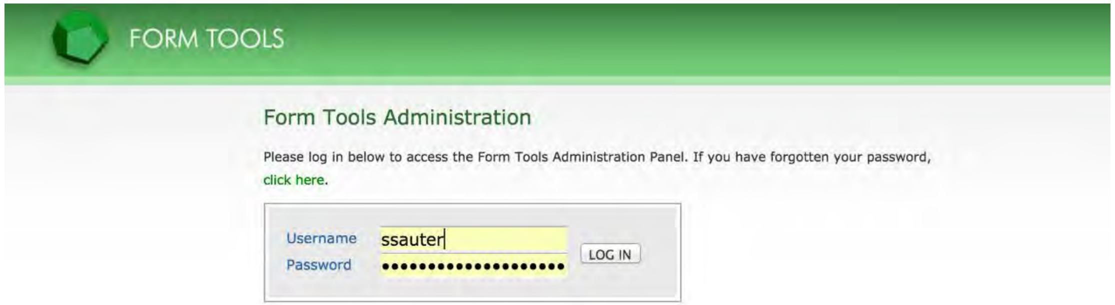
General information:

We have modified the template for the mapping of hospitals/hospital departments with psychiatric beds in regards to its content and to its form. Instead of the previously used excel-sheet we have prepared an online form. The form should be easy to use and each partner gets an individual login which can be used by any team-member in your country. Below you find an instruction on how to use the tool.

For the purpose of CX we will only analyse separations from and admissions to acute/sub-acute psychiatric hospital beds. However, for the mapping exercise we will include all types of inpatient care services ("hospitals") with "psychiatric" beds which existed in the two years we have chosen for our study, i.e. also chronic/long-term services, specialised substance abuse, geronto-psychiatric and psychiatric rehabilitation inpatient services. We will not include here child and adolescent, military, prison and forensic inpatient services. Different from what we have planned previously we are not mapping non-psychiatric service.

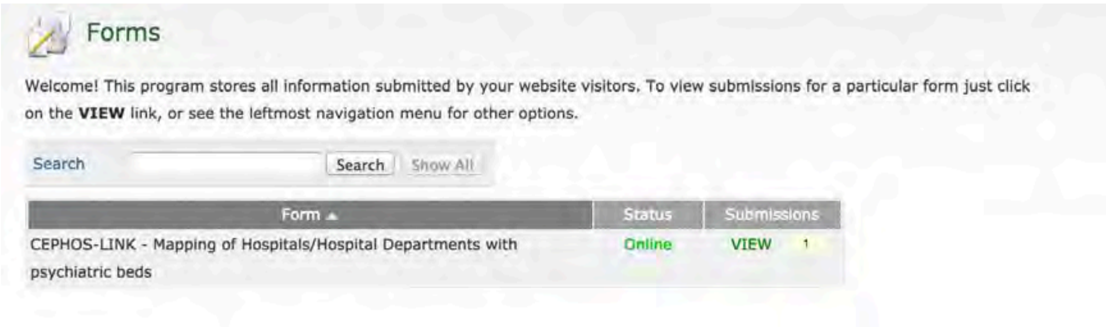
Please include **all inpatient service with psychiatric beds** – **not only those included in the CX Master LEEARs**. The reason is that we want to know whether some types of psychiatric inpatient services exist and are used by part of the population but are not included in the Master LEEARs.

Instructions to use the online form:



1) Login with your user and password.

2) Select form “CEPHOS-LINK – Mapping of Hospitals/Hospital Departments with psychiatric beds”. Press “VIEW” to enter.

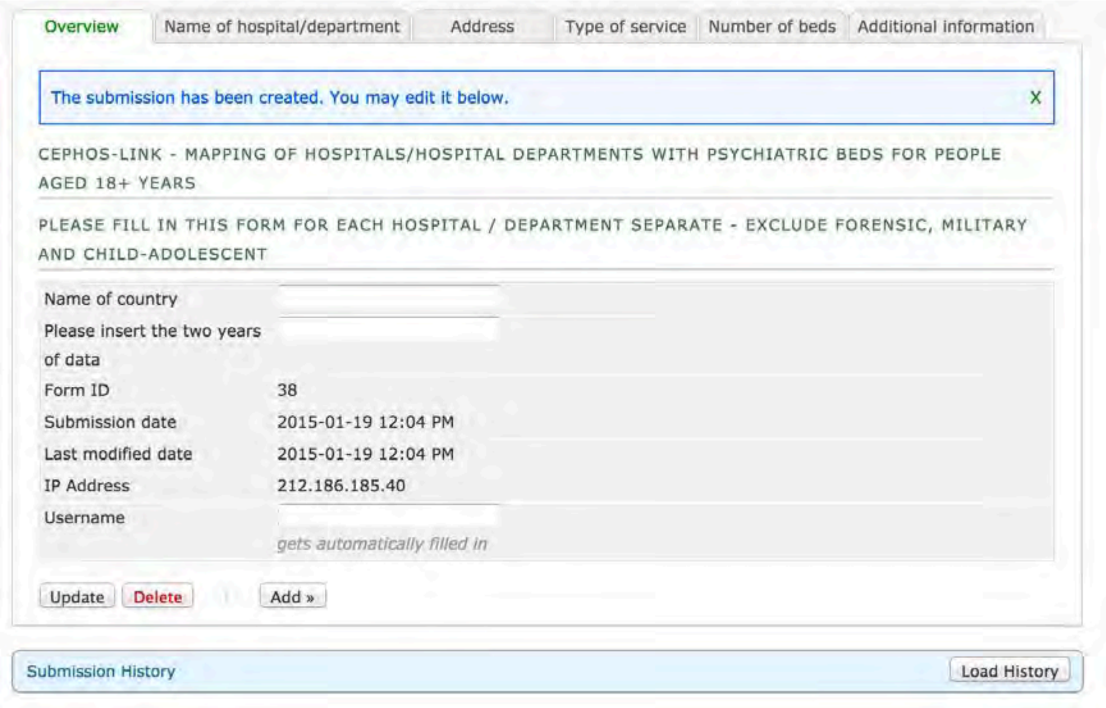


3a) Press “Add” to start a new form or…

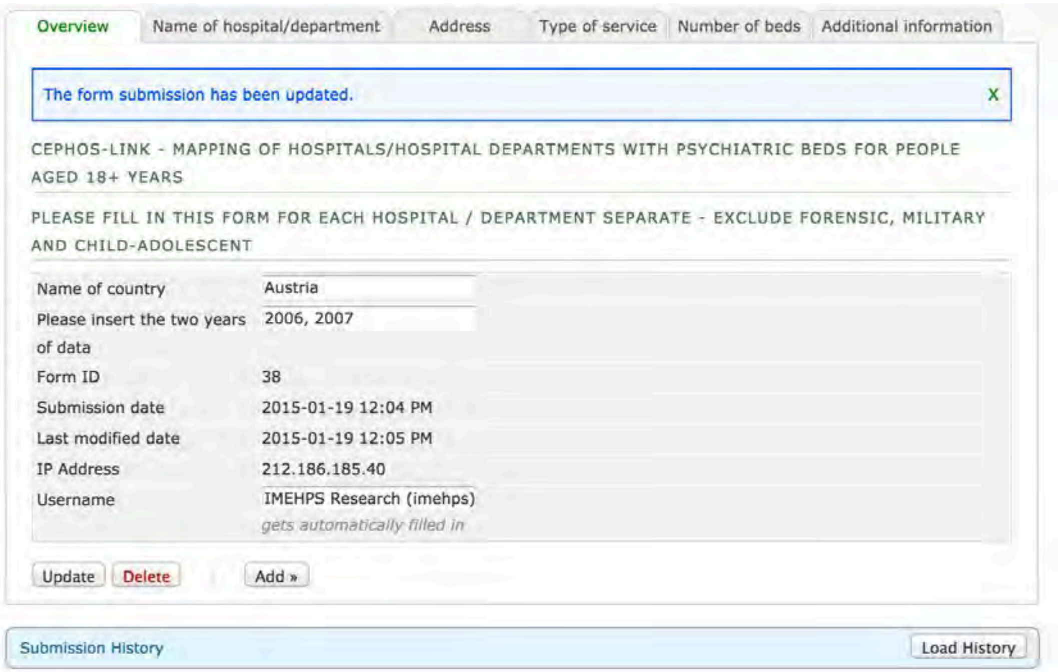
3b) press the “pencil button” on the right side to continue a form.

Beforehand please note that the steps below have to be filled in for each hospital/hospital department separately.

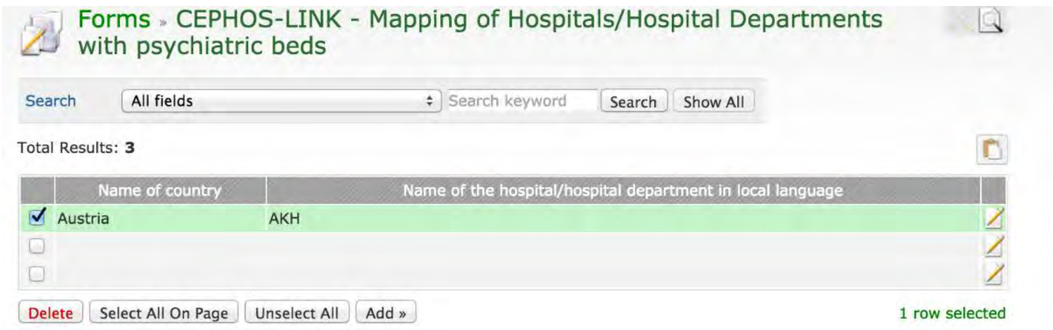
4) Please start filling in the information about one hospital/hospital department.



5) After filling in the information and before you go to the next tab it is important to click on the “update”-button (alternatively you can just press enter). Once you have pressed the “update” button (or enter), on the top of the screen the information message appears “The form submission has been updated” and your information is saved. You don’t have to enter your username, this field will be filled automatically. Overall the form for each hospital includes six tabs which have to be filled in separately for each hospital.



7) In case you have already filled in some information and you re-enter the form, select the hospital you want to continue and press the pencil-button on the right. If you want to enter a new hospital you have to add a new form by pressing the "add"-button.



8) When you are have finished entering your information and saved it ("update" or enter) just close your browser. Thank you ☺

Tool 9 - Definitions of psychiatric inpatient services and beds for the online form tool

CEPHOS-LINK

CEPHOS-LINK - Mapping of psychiatric inpatient services and beds for people aged 18+ years

Definition of psychiatric inpatient services and beds

This is a draft of a glossary on the terms that we use in the "Online form of mapping of psychiatric inpatient services and beds". Please note that

(1) we are do not want to produce a list of formally universal valid terms, but a guideline for how we - in our CX project - use terms for our study. The main aim of this glossary is to support collecting data in a comparable and consistent way.

(2) we want to consider in the glossary different linguistic terminologies for services and beds in the CEPHOS countries which may point out different concepts in service structures, service types and beds. The health care systems have developed historically in different ways in different countries and the terminology has also developed in a specific way and usually also in the specific language in that country. Trying to translate the terms into English can become very tricky and lead to misunderstandings. So we have to start with the terms that are used and the meanings these terms have in the specific countries. So please if in your country specific terminology differs from the terminology used below, add these terms either to the already specified section of terms below in the glossary or create a new section. E.g. if you have specific beds labelled as "secure beds" and these are part of the acute/sub-acute beds then include them in the respective category below – suggestion: In NO there are specially labelled "secure beds" ("sikkerhet") and these are included in the category "acute/sub-acute beds" in the CEPHPOS-LINK mapping.

Psychiatric inpatient services	
Specialist psychiatric hospital	A specialized hospital for the care and treatment of patients affected with acute or chronic mental illness.
Psychiatric department of a general hospital - on the grounds of the general hospital or not on the ground of the general hospital	A general hospital is not specialising in the treatment of only one particular illnesses or any kind of patients (e.g. of a particular sex or age group), but it is set up to deal with different kinds of disease and injury. General hospitals can have psychiatric departments/wards which are specialised in the field of mental health care for people with mental health needs. The information if a psychiatric department of a general hospital is on the grounds of the general hospital or not is relevant for analysing accessibility and remoteness. Psychiatric departments in general hospitals might be easier accessible (these services are usually nearer to where the patients live and this might facilitate admissions/readmissions) than stand-alone psychiatric hospitals and there might be also fewer psychological barriers for psychiatric admission/readmission because the psychiatric patient goes through the same door to the hospital as a somatically ill patient.
Hospital/department belonging to university	A hospital/department belonging to university (affiliated with a university). In CEPHOS-LINK the question arises if such services are obliged to admit all patients of a given catchment area or are allowed to select patients for research purposes and refuse admission to other patients.
Psychiatric centre / community mental health centre with beds for inpatient care with legal hospital status	A community mental health centre is a mental health treatment centre located in a catchment area close to the homes of mental health service users. It features a series of comprehensive services performed by mental health professionals and all aimed at providing a coordinated program of continuing mental health care. Services can be inpatient, outpatient, therapeutic rehabilitation, emergency, day treatment, screening and personal care home services. (Source: Refinement Glossary) Some of these community mental health centres in some CEHPOS-LINK participating countries have inpatient beds and have a legal hospital status, these are the services we are interested in the CEPHOS-LINK mapping.
Specialised hospitals/departments for substance abuse treatment	Hospitals/departments primarily providing diagnostic, medical treatment and monitoring services to people with substance abuse disorders. In the CEPHOS-LINK mapping these types of services are only included when they have inpatient beds (see definition for substance abuse beds below).
Specialised hospitals/departments for geronto-psychiatric treatment	Hospitals/departments primarily providing diagnostic, medical treatment and monitoring services to people mental disorders occurring mainly in old age, e.g. dementia. In the

	CEPHOS-LINK mapping these types of services are only included when they have inpatient beds see definition geronto-psychiatric beds below).
Specialised hospitals/departments for psychiatric rehabilitation	Hospitals/departments primarily providing services to people with mental health needs with the aim of restoration of community functioning and well-being. Psychiatric rehabilitation is usually one step in a chain of treatment steps following an acute or subacute incidence of mental illness, but also persons with chronic mental diseases might be treated in such a service. Usually there is a certain waiting time for being treated in such a service. In the CEPHOS-LINK mapping these types of services are only included when they have inpatient beds see definition for rehabilitation beds below).
Specialised hospitals/departments for psychosomatic treatment	Hospitals/departments primarily providing services to people with psychosomatic disorders. These services can be specialised in certain fields of disorders, e.g. eating disorders, burnout. Usually there is a certain waiting time for being treated in such a service. In the CEPHOS-LINK mapping these types of services are only included when they have inpatient beds (see definition for psychosomatic beds below).
The following specialised psychiatric hospitals/departments/services are excluded in CEPHOS-LINK	
Forensic inpatient services	In such services patients with psychiatric disorders who have committed a crime and are in custody or facing prosecution, or have an existing criminal conviction are treated either in specialised hospitals or in specialised departments of psychiatric or general hospitals. These services might also provide aftercare of patients with psychiatric disorders with past criminal convictions, imprisonment, or on parole might. Becoming a forensic patient involves certain legal procedures.
Military inpatient services	In such services usually patients who are or have been employed with military services are treated. This may also apply to dependents of these persons.
Prison inpatient services	Wards/hospital beds which are located within prisons.
Child and adolescent inpatient services exclusively *for patients under the age of 18*	Hospitals/departments primarily providing services to children and adolescent. These services usually admit children and adolescent until the age of 18, but exceptions exist, e.g. in Finland these services serve adolescent up to the age of 25.

Psychiatric beds Nota bene: not all types of beds mentioned below necessarily exist in each of the CEPHOS-LINK partner countries	
Acute/sub-acute psychiatric care beds	Psychiatric beds for acute/sub-acute care are usually provided for a short period of time to treat an illness episode or a flare-up of an existing condition and may concern all acute psychiatric illnesses. This may involve crisis, intensive or emergency care. Usually there is no waiting time on such beds and admissions are not planned. Sub-acute beds can be defined as treating patients who had been admitted on acute beds and could not be discharged from the hospital/department because they needed some more treatment (e.g. in some countries in order to empty "acute" beds some acute patients are referred within a hospital to a "sub-acute" ward and then discharged) Acute/sub-acute psychiatric beds may exist in non-specialised as well as in specialised (substance abuse, geronto-psychiatric,…) psychiatric hospitals and departments in general hospitals (as an extreme all beds may be acute/sub-acute).
Chronic/long-term psychiatric care beds	In CEPHOS-LINK this is an overall term for non-acute beds. Usually chronically ill patients are accommodated in beds for chronic/long-term care. This type of care may last month or years and probably nowadays takes mostly place in residential care homes and not in hospitals. There are exceptions: e.g. in Romania such long-term care sections may still exist in psychiatric hospitals. Chronic/long-term care psychiatric beds may exist in non-specialised as well as in specialised (substance abuse, geronto-psychiatric,…) psychiatric hospitals and departments in general hospitals. Usually admissions to these beds are planned.
Beds in general psychiatry (=non specialised psychiatric inpatient services)	In CEPHOS-LINK this category includes beds in any psychiatric hospital/department that are not defined as specialised psychiatric services (e.g. as substance abuse beds, geronto-psychiatric beds, etc.).
Substance abuse beds (=specialised)	Here beds for people with substance abuse disorders in specialised hospitals/departments for substance abuse are included.
Psychosomatic beds (=specialised)	Here beds for people with psychosomatic disorders in specialised psychosomatic hospitals/departments are included. "Psychosomatic" is a diffuse concept and we have only put it as a category into the mapping exercise since in some countries beds are labelled as such (sometimes the category F5 of ICD 10 is included here, but sometimes very idiosyncratic definitions exist). If beds are not

	labelled like that in a country than no beds should be reported. Sometimes such beds are labelled as “psychotherapy beds”. Usually admissions to these beds are planned.
Geronto-psychiatric beds (=specialised)	In such beds mental disorders occurring mainly in old age, e.g. dementia are treated. Sometimes patients above 65 years of age are treated. The exact age limit for entering geronto-psychiatric services may vary between countries, and in practice people below the age limit may occasionally be treated in these services (e.g. in case of a dementia diagnosis or very frail people with multimorbidities).
Psychiatric rehabilitation beds (=specialised)	Beds for people who are not in an acute illness state but have progressed into recovery and aim to further their functional recovery using a range of approaches including occupational therapy, various psychotherapeutic and socio-therapeutic approaches. Psychiatric rehabilitation beds may exist in non-specialised as well as in specialised (substance abuse, geronto-psychiatric,…) psychiatric hospitals and departments in general hospitals. If beds are not levelled as rehabilitation in a country than no beds should be reported.

Tool 10 - Questionnaire on Hospital Episodes in the Baseline Year

CEPHOS-LINK

Questionnaire on Hospital episodes in the baseline year

(= first year of the two-year data-set used for CX analyses)

Report for

country:

baseline year:

Purpose of this document

In a first approach to getting an overview of the data situation in the CX partner countries data on the hospital episodes of the baseline year of the CX project should be provided. At this stage no record linkage is required.

1. General population of country in the baseline year

Table 1: Population in the baseline year as available in national statistics (Source: ?)

	All ages		18+	
	N	%	N	%
Men				
Women				
All		100,00%		100,00%

2. Hospital episodes defined by the separation date in the baseline year

Separations are defined as events when a hospital episode ends. There are three main types of separations, which make up the bulk of these events

(1) Discharges
(2) Deaths
(3) Transfers to a different hospital

The actual codes in a given country can be more complex but can usually be collapsed into the categories above – but for filling in the first two tables we ask you to use the codes exactly as stated in your MASTER LEEARs.

PLEASE NOTE: 0-day stays, i.e. hospital stays where a patient is admitted and discharged on the same day should be excluded. In some countries stays in “day hospitals” are included in the published statistics on hospital separations. Such stays in “day hospitals” have to be excluded in the tables to be filled in below. If such day hospital stays cannot be excluded this should be clearly stated below each table.

2.1 Hospital separations in the baseline year in the MASTER LEEAR for objective 1

2.1.1 Hospital separations in the baseline year in the MASTER LEEAR for the total population, all ICD-10 codes

PLEASE NOTE: Please use your own language for describing the codes - the tentative English translation is in brackets

Table 2: Hospital separations in the Master LEEAR for the baseline year (all ages with all ICD-10 diagnoses)

Country specific separation codes in local language (tentative English translation in brackets)	**Male**		**Female**		**Sum**	
	N	%	N	%	N	%
TOTAL		100,00%		100,00%		100,00%

2.1.2 Hospital separations in the MASTER LEEAR for population aged 18+, all ICD-10 codes in the baseline year

Table 3: All hospital separations for population aged 18+ with ICD-10 diagnoses in the Norwegian Master LEEAR for the baseline year 2012

Country specific separation codes in local language (tentative English translation in brackets)	**Male**		**Female**		**Sum**	
	N	%	N	%	N	%
TOTAL		100,00%		100,00%		100,00%

2.1.3 Hospital DISCHARGES only for population 18+ by main ICD-10 diagnoses first digit

(please use the grouping for discharges for your country provided in the CX document "Types of separation from inpatient care in the MASTER LEEARs"- see attached document)

Table 4a: Hospital discharges only (absolute numbers and column percentages) for population 18+ by main ICD-10 diagnoses first digit in the Master LEEAR for the baseline year (male, female; 1st column: ICD-10)

ICD-10 Classification		Male Nr	Female Nr	Male %	Female %	Sum	Sum %
First letter	**Chapter and Title**						
A	I, Certain infectious and parasitic diseases						
B	I, Certain infectious and parasitic diseases						
C	II, Neoplasms						
D	II and III, Neoplasms and Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism						
E	IV, Endocrine, nutritional and metabolic diseases						
F	V, Mental and behavioural disorders						
G	VI, Diseases of the nervous system						
H	VII and VIII, Diseases of the eye and adnexa and Diseases of the ear and mastoid process						
I	IX, Diseases of the circulatory system						
J	X, Diseases of the respiratory system						
K	XI, Diseases of the digestive system						

L	XII, Diseases of the skin and subcutaneous tissue						
M	XIII, Diseases of the musculoskeletal system and connective tissue						
N	XIV, Diseases of the genitourinary system						
O	XV, Pregnancy, childbirth and the puerperium						
P	XVI, Certain conditions originating in the perinatal period						
Q	XVII, Congenital malformations, deformations and chromosomal abnormalities						
R	XVIII, Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified						
S	XIX, Injury, poisoning and certain other consequences of external causes						
T	XIX, Injury, poisoning and certain other consequences of external causes						
Z	XXI, Factors influencing health status and contact with health services						
Total				100%	100%		100%

Table 4b: Hospital discharges only over a 12-month period with an additional F2 or F3 or F4 or F5 or F6 ("functional mental disorders") for patients aged 18+ in all discharges episodes with a main non-psychiatric ICD-10 diagnosis (first digit A-E and G-Z). Results for baseline year

ICD-10 Classification		Main ICD-10 diagnosis (1st digit)		Additional ICD-10 diagnosis F2-F6	
First letter	Chapter and Title	1 Absolute numbers	2 Column percentages	3 Absolute Numbers of column 1	4 percentages of column 3 in column 1
A	I, Certain infectious and parasitic diseases				
B	I, Certain infectious and parasitic diseases				
C	II, Neoplasms				
D	II and III, Neoplasms and Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism				
E	IV, Endocrine, nutritional and metabolic diseases				
G	VI, Diseases of the nervous system				
H	VII and VIII, Diseases of the eye and adnexa and Diseases of the ear and mastoid process				
I	IX, Diseases of the circulatory system				
J	X, Diseases of the respiratory system				
K	XI, Diseases of the digestive system				
L	XII, Diseases of the skin and subcutaneous tissue				
M	XIII, Diseases of the musculoskeletal system and connective tissue				
N	XIV, Diseases of the genitourinary system				

O	XV, Pregnancy, childbirth and the puerperium				
P	XVI, Certain conditions originating in the perinatal period				
Q	XVII, Congenital malformations, deformations and chromosomal abnormalities				
R	XVIII, Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified				
S	XIX, Injury, poisoning and certain other consequences of external causes				
T	XIX, Injury, poisoning and certain other consequences of external causes				
Z	XXI, Factors influencing health status and contact with health services				
Total			100%		

2.1.4 Hospital DISCHARGES (Please use the grouping for discharges for your country provide in the CX document "CEPHOS-LINK rules for identifying hospital discharge"- see attached document) for population 18+by main ICD-10 F diagnosis first and second digit (mental disorders)

Table 5: Hospital discharges (absolute numbers and column percentages) for population 18+ by main ICD-10 F diagnoses first and second digit in the Master LEEAR for the baseline year (F2-F6 highlighted = diagnoses to be selected for CX – see also Table 6)

	Male		**Female**		**Total**	
	N	Row percentages	N	Row percentages	N	Column percentages
F-diagnosis						
F0						
F1						
F2						
F3						
F4						
F5						
F6						
F7						
F8						
F9						
Total						**100,00%**

Focus on F-diagnosis F2-F6

CX selects ICD-10 diagnose F2-F6, since for F0 (“organic mental disorders”) and F1 (“substance abuse disorders”) the situation of treatment in hospitals is very different in different countries and the inclusion of these disorders might confound the results in an untraceable way. For F7 (“mental retardation”) similar considerations apply. F8 and F9 are “child and adolescent psychiatric disorders” most of which we exclude anyhow by setting the age of our study population at 18+ years.

Table 6: Hospital discharges for population 18+by main ICD-10 F2-F6 diagnoses in the Master LEEAR for the baseline year by gender

	Male		**Female**		**Total**	
	N	Row percentages	N	Row percentages	N	Column percentages
F-diagnosis						
F2						
F3						
F4						
F5						
F6						
Total						**100,00%**

2.1.5 ADDITIONAL TABLES ON COMORBIDTY AND CODING OF DIAGNOSES

QUESTION: Was there a restriction on the number of additional diagnoses that can be coded in the CX baseline year?	Yes	No	If yes, please elaborate:
	○	○	

Table 4c: Total number of frequencies of additional diagnoses in hospital discharges in the CX baseline year

Country	N Discharges (population 18+)	0 additional diagnosis (only main diagnosis)		1 additional diagnosis		2 additional diagnoses		3 or more additional diagnoses	
	(from Table 4a)	N	% out of all discharges	N	% out of all discharges	N	% out of all discharges	N	% out of all discharges
Austria									
Finland									
Veneto									
Norway									
Romania									
Slovenia									

Table 4d: Hospital discharges with a main ICD-10 F-diagnosis (F0-F9) for patients aged 18+ by additional somatic ICD-10 diagnoses (first digit A-E and G-Z) in the CX baseline year

Main ICD-10 F-Diagnosis		**Any additional ICD-10 diagnoses A-E, G-Z**	
	1 Absolute numbers	2 Absolute numbers	3 Percentages of column 2 in column 1
F0			
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			
F9			
Total (all F-diagnoses)			

Table 4e: Hospital discharges with a main ICD-10 F-diagnosis (F0-F9) by any additional ICD-10 diagnoses (first digit A-Z, multiple additional diagnoses possible) for patients aged 18+ in the CX baseline year

Main ICD-10 F-Diagnosis	**At least one additional ICD-10 Somatic Diagnosis of each of the following first letters**																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Z	Total
F0																						
F1																						
F2																						
F3																						
F4																						
F5																						
F6																						
F7																						
F8																						
F9																						
Total																						

Table 4f: Hospital discharges with a main ICD-10 F-diagnosis (F0-F9) by additonal ICD-10 F-diagnoses (F0-F9) for patients aged 18+ in the CX baseline year

Main ICD-10 F-Diagnosis		**At least one additional ICD-10 F-Diagnosis (F0-F9)**										
Chapter	Absolute number	F0	F1	F2	F3	F4	F5	F6	F7	F8	F9	Total (all F-diagnoses)
F0												
F1												
F2												
F3												
F4												
F5												
F6												
F7												
F8												
F9												
Total (all F-diagnoses)												

Tool 11 - Data Profiling Tool

Data profiling in CEPHOS-LINK encompasses the automatic gathering of univariate statistics of a database depending on the pre-defined content and data types. A simple data profiling tool has been developed for the pooling procedure to get a quick and standardized overview over new deliveries, to document files and information received and to give nearly immediate feedback to the data sources.

The tool itself is designed as simple script based on the statistical computing environment R. Originally, a more potent tool was designed and developed, which integrated not only data profiling but also provided a graphical user interface, deployment mechanisms, more advanced statistics, interactive exploration of the data and even generated standardized reports according to defined study protocols. The version of the data profiling tool which has been finally applied in production only allowed the generation of standardized data quality reports.

A data profile holds a short, univariate description of each variable in a table. The amount of records (n), missing and unique values are listed. Additional information as, e.g., most frequent values and their distribution, means, quantiles and histograms are integrated, depending on the data type.

The following screenshots show an exemplary data profile for Austria. It can be observed, that the date of data delivery and date of the profile are listed in the first three lines. The rationale behind this is the unmistakable association of a data profile with a distinct file, a unique table in the database and also a variable in the final pooling dataset. This allows to follow up any information from the source to the final pooling data and vice versa.

Although only univariate information is included and, e.g., the amount of females per manifestation of PSO cannot be determined from the profile, many relevant facts are included. Furthermore, the recognition of sever errors, outliers, missing values and especially false coding, e.g. additional NUTS3_REGIONAL classifications or special codes for missing information, is drastically facilitated and sped up by these simplistic profiles.

Pooling Austria

delivery: 2016-11-08
generated: 2016-11-09 12-02

17 Variables 21839 Observations

CC

n	missing	unique	value
21839	0	1	AT

ANYHOS

n	missing	unique
21839	0	2

FALSE (9121, 42%), TRUE (12718, 58%)

PSYHOS

n	missing	unique
21839	0	2

FALSE (14618, 67%), TRUE (7221, 33%)

FEM

n	missing	unique
21839	0	2

FALSE (8786, 40%), TRUE (13053, 60%)

AGEOLD

n	missing	unique
21839	0	2

FALSE (11099, 51%), TRUE (10740, 49%)

PSO

n	missing	unique
21839	0	2

FALSE (13929, 64%), TRUE (7910, 36%)

LOSALL_LONG

n	missing	unique
21839	0	2

FALSE (11023, 50%), TRUE (10816, 50%)

PHY_COM

n	missing	unique
21839	0	2

FALSE (13623, 62%), TRUE (8216, 38%)

AGE_EXACT

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
21839	0	81	1	45.64	21	24	34	44	56	69	77

lowest : 18 19 20 21 22, highest: 94 95 96 97 98

DAYSANYHOS

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
12718	9121	365	1	94.2	1	2	8	52	159	265	311

lowest : 1 2 3 4 5, highest: 361 362 363 364 365

LOSALL_EXACT

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
21839	0	215	1	21.77	1	3	8	15	28	46	61

lowest : 1 2 3 4 5, highest: 287 295 337 430 593

ANY_POC_1DAYS

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
6534	15305	365	1	73.39	1	3	10	32	98	231	294

lowest : 0 1 2 3 4, highest: 361 362 363 364 365

NUTS3

n	missing	unique
20604	1235	35

lowest : AT111 AT112 AT113 AT121 AT122
highest: AT333 AT334 AT335 AT341 AT342

NUTS3_POP18

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75
20604	1235	35	0.99	421368	85360	123139	186088	230317	450869

.90	.95
1418526	1418526

lowest : 16550 25753 31657 39478 65472
highest: 262517 282312 337594 450869 1418526

NUTS3_REGIONAL

n	missing	unique
20604	1235	3

IN (7361, 36%), PR (7324, 36%), PU (5919, 29%)

NUTS3_GDP

n	missing	unique	Info	Mean	.05	.10	.25	.50	.75	.90	.95
20604	1235	31	0.99	31423	19600	20000	23100	32400	39800	40600	40600

lowest : 15400 16900 17500 17900 19600
highest: 36700 37300 38400 39800 40600

---

exact_amb_date

n	missing	unique
21839	0	2

FALSE (1744, 8%), TRUE (20095, 92%)

Tool 12 – Data analysis and reporting

A program generating reports from the pooled dataset according to the study protocols has been developed in Austria. The application is based on R and is capable to produce consistently formatted PDF files (first version) and Microsoft Word documents (second version). It is designed modular and extendable, which allows a high degree of reusability. For example, the module calculating logistic regression models including formatted tables and analytical figures has been utilized in every report of every study protocol. As a result, reports are not only well formatted but are also highly consistent, reproducible and do not require manual interaction. It is also very unlikely, that there are severe errors left (despite the routines for individual data preparation) because the very same program is applied for a huge number of iterations and statistical models without any saliences. The output format (Microsoft Word file) allowed a convenient utilization and integration of results. Detailed configuration can be defined for each report, allowing, e.g., to alter the number of decimal places in output tables. Summarizing, the application facilitated rapid iterations, many experiences without investing much resources while being highly consistent and reliable.

All local studies were redone by applying the described program to the pooled dataset from each country. Furthermore, variations and experiments were carried out which would not be viable with the manual approach. Some differences between the standardized reports and the local results were identified, but most results were identical to three decimal places or at least very similar in a very narrow margin of error. These differences were most likely caused by the varying software implementations, computing platforms or unknown parameterizations of applied routines. Hence, in most cases these results based on the pooled data were utilized for further application due to their consistent structure out of convenience.

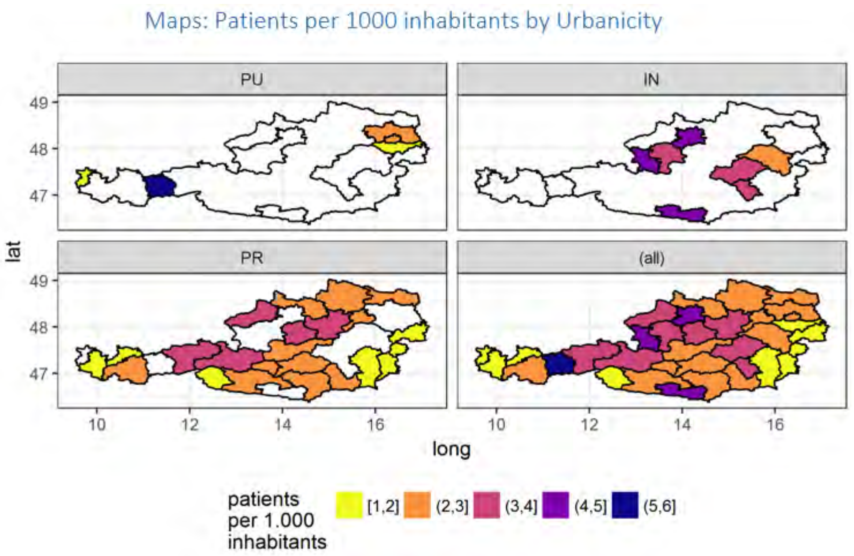
Summarizing, repeating local studies with an automatic reporting tool improved the quality, usability and understanding of most results significantly. Due to the high reproducibility and lack of most human errors, the well formatted reports facilitated country comparison and also revealed errors in our statistical procedures and local analyses. It can be concluded, that repeating local studies with a different technological approach has an overwhelming additional value and backs our confidence in the collected data and our results.

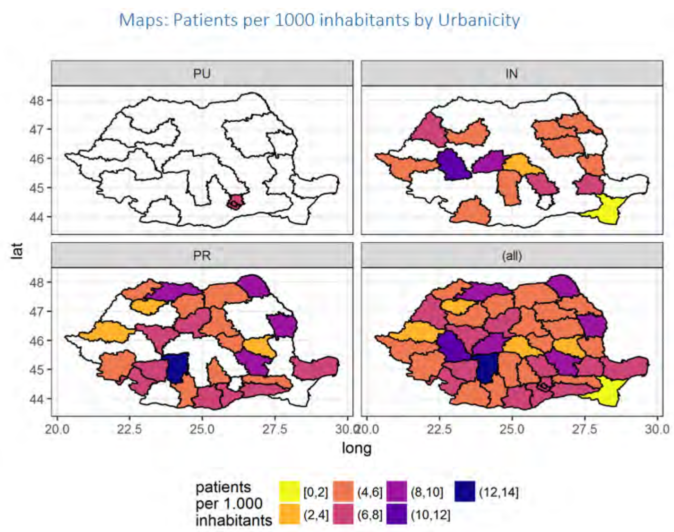
Some selected screenshots from different reports are presented on the following pages.

Every report is identified by a timestamp in the filename and header on each page. A strict structure is provided for straightforward navigation:

- (2) Frequencies/Quality control
  - a) study cohort
  - b) patients per NUTS3
  - c) patients per urbanicity group
  - x) additional exploratory analysis
    - Maps: Patients per 1000 inhabitants by Urbanicity
    - NUTS3 regions per Urbanicity
    - frequencies: entire dataset
    - frequencies: splitted by sex
    - frequencies: splitted by ANYHOS
    - frequencies: splitted by PSYHOS
- (3) regression analysis
  - (a) standard logistic regression: Follow-Up 365 days
    - 1) Urbanicity: PU vs. IN+PR
      - (A) ANYHOS
      - (B) PSYHOS
      - (C) PSYHOS_X
    - 2) Urbanicity: PR vs. IN+PU
  - (a) standard logistic regression: Follow-Up 180 days

Reports included univariate and multivariate exploratory data analysis and visualizations.



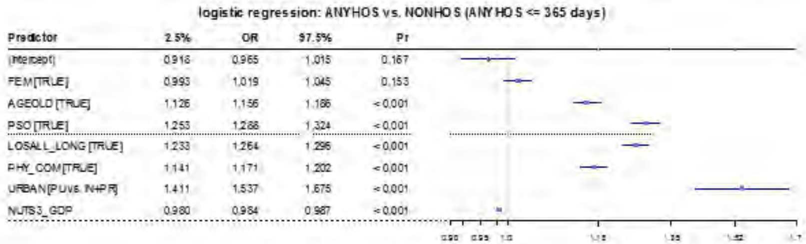


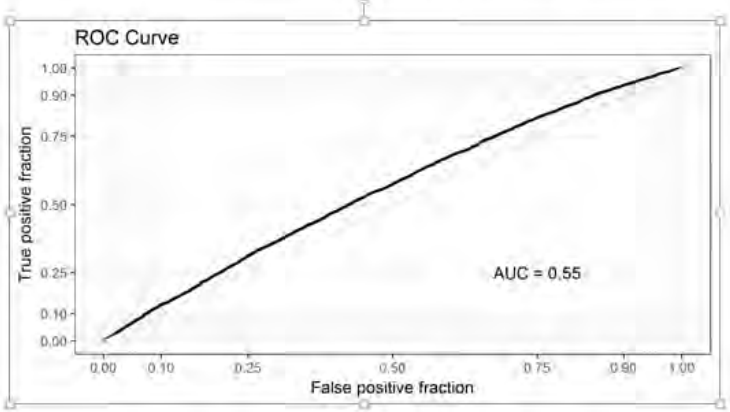
Results from regression models are presented in a very consistent format, including visualizations and basic model performance indicators. Each table is optimized for further utilization with Microsoft Word or Excel.

(A) ANYHOS

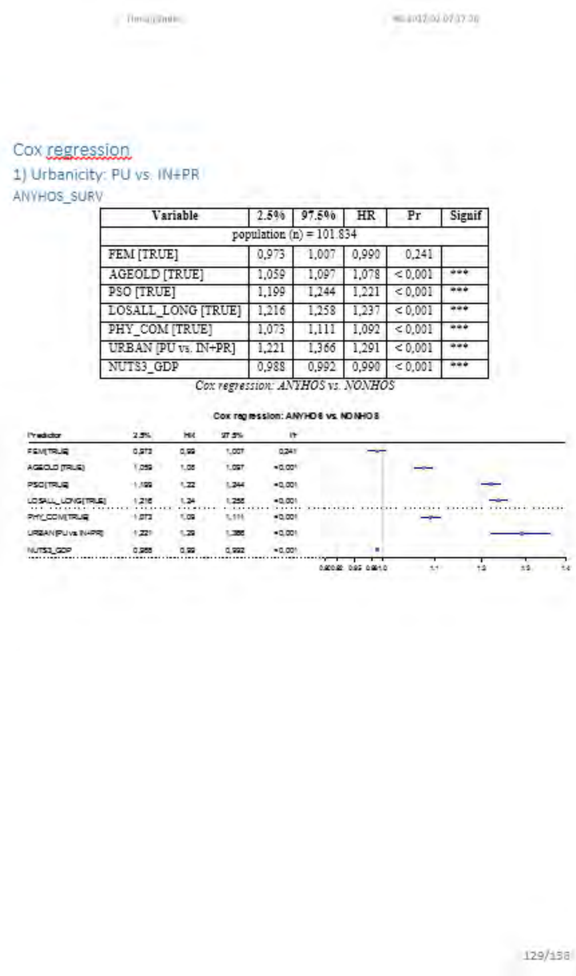
Variable	2.5%	97.5%	OR	Pr	Signif
population (n) = 101.834					
(Intercept)	0,918	1,015	0,965	0,167	
FEM [TRUE]	0,993	1,045	1,019	0,153	
AGEOLD [TRUE]	1,126	1,186	1,156	< 0,001	***
PSO [TRUE]	1,253	1,324	1,288	< 0,001	***
LOSALL_LONG [TRUE]	1,233	1,296	1,264	< 0,001	***
PHY_COM [TRUE]	1,141	1,202	1,171	< 0,001	***
URBAN [PU vs. IN+PR]	1,411	1,675	1,537	< 0,001	***
NUTS3_GDP	0,980	0,987	0,984	< 0,001	***

logistic regression: ANYHOS vs. NONHOS (ANYHOS <= 365 days)





The last screenshot shows two pages of a report about survival analysis, i.e. Kaplan-Meier plots and Cox regression models. The headings indicate, that there are many more variations of this analysis included, which are all formatted in exactly the same way and are generated by exactly the same procedures of the automatic reporting tool. It can be observed, that there are timestamps at the top of the page, allowing to pin down any result to an exact point in time and dataset. In this case, a single report holds over 100 pages and was automatically generated in a few minutes.



Cox regression

1) Urbanicity: PU vs. IN+PR

ANYHOS_SURV

Variable	2.5%	97.5%	HR	Pr	Signif
population (n) = 101.834					
FEM [TRUE]	0,973	1,007	0,990	0,241	
AGEOLD [TRUE]	1,059	1,097	1,078	< 0,001	***
PSO [TRUE]	1,199	1,244	1,221	< 0,001	***
LOSALL_LONG [TRUE]	1,216	1,258	1,237	< 0,001	***
PHY_COM [TRUE]	1,073	1,111	1,092	< 0,001	***
URBAN [PU vs. IN+PR]	1,221	1,366	1,291	< 0,001	***
NUTS3_GDP	0,988	0,992	0,990	< 0,001	***

Cox regression: ANYHOS vs. NONHOS