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Using national electronic health care registries for comparing the risk of psychiatric re-hospitalisation in six European countries: Opportunities and limitations☆

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ABSTRACT

Psychiatric re-hospitalisation rates have been of longstanding interest as health care quality metric for planners and policy makers, but are criticized for not being comparable across hospitals and countries due to measurement unclarities. The objectives of the present study were to explore the interoperability of national electronic routine health care registries of six European countries (Austria, Finland, Italy, Norway, Romania, Slovenia) and, by using variables found to be comparable, to calculate and compare re-hospitalisation rates and the associated risk factors. A "Methods Toolkit" was developed for exploring the interoperability of registry data and protocol led pilot studies were carried out. Problems encountered in this process are described. Using restricted but comparable data sets, up to twofold differences in psychiatric re-hospitalisation rates were found between countries for both a 30- and 365-day follow-up period. Cumulative incidence curves revealed noteworthy additional differences. Health system characteristics are discussed as potential causes for the differences. Multi-level logistic regression analyses showed that younger age and a diagnosis of schizophrenia/mania/bipolar disorder consistently increased the probability of psychiatric re-hospitalisation across countries. It is concluded that the advantage of having large unselected study populations of national electronic health care registries needs to be balanced against the considerable efforts to examine the interoperability of databases in cross-country comparisons.

1. Introduction

Hospital inpatient stays are the most expensive component of health care, and efforts to increase the effectiveness and efficiency of health services are increasingly directed at reducing hospital admissions [1]. Re-hospitalisation rates have become of particular interest in this context as a quality metric both for cost containment and quality improvement [2,3]. This increased interest is documented by the large number of studies included in a recent systematic literature review [4]. While re-hospitalisation rates are a seemingly straightforward indicator and somewhat easy to obtain, the review casts considerable doubt on their reliability and validity and suggests that a vast array of methodological problems need to be solved before this indicator could be meaningfully employed.

Psychiatry has a longstanding concern with increased re-hospitalisation rates, dubbed the "revolving door" phenomenon [5]. However, controversy about the meaning of psychiatric re-hospitalisation rates is equally old [6–8], and the issue is still not settled today [9–11]. Recent systematic reviews on determinants of psychiatric re-hospitalisation document the unrelenting interest

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in studying the topic, but have come up with only a few definite conclusions, one of the main reasons being methodological, with the study designs and re-hospitalisation metrics employed varying substantially between studies [12–16]. Until 2013 the OECD had published over several years country-specific 30-day re-hospitalisation rates for schizophrenia and bipolar disorder [17] and recommended to use them as an indicator in the framework of its Health Care Quality Indicator Project [18,19]. However, after an expert committee had evaluated the whole set of indicators regarding validity, reliability, relevance, actionability, as well as international feasibility and comparability [20], the publication of psychiatric re-hospitalisation rates was discontinued.

Thus, while re-hospitalisation rates are appealing and potentially useful for health care planners and politicians, uncertainties about their comparability across individual studies, hospitals and countries limit their inclusion in international benchmarking initiatives and in comparative research projects. The purpose of the present study was to explore the possibilities of increasing the international comparability of psychiatric re-hospitalisation rates by employing a concerted approach to measurement comparison and analyses by using data from national electronic routine health care registries in six European countries. The first objective was to assess the six national hospital patient databases for their interoperability in order to identify the variables which could be justifiably used for comparing psychiatric re-hospitalisation rates. The second objective consisted in actually calculating re-hospitalisation rates and testing, in a retrospective cohort study design, whether the previously identified variables constitute risk factors for re-hospitalisation. Lessons learned from both objectives could contribute to increasing the international comparability of studies with health care registry data in all health care fields.

2. Methods

2.1. Countries and databases

The health care systems of the six participating countries represent different types of predominantly tax-funded (Italy, Norway, Finland) and social health insurance funded systems (Austria, Romania, Slovenia) with different health care data reporting routines. The mental health care systems are quite different in these countries, with Italy and Norway, in contrast to the other countries, having an extensive net of territorial community mental health services. As far as hospital inpatient care is concerned arrangements are also different, with, at the one end of the spectrum, Slovenia relying nearly exclusively on specialised stand-alone psychiatric hospitals, and, at the other end, Italy and Norway with a country-wide system of small psychiatric departments in general hospitals and district psychiatric centres respectively, with the other countries having a mix of these types. Each partner was able to obtain an agreed upon data set with linked pseudonymised records extracted for a full two-year period from national electronic health care registries, covering the total population and practically all acute care hospitals of the participating countries. All publicly funded hospitals were included. Hospitals exclusively used for chronic patients and military, prison and forensic hospitals were excluded, mainly due to non-inclusion in the health databases. In Norway where forensic psychiatry is integrated in the psychiatric services the aimed at exclusion of forensic units was not fully possible. Because of the usually very low turnover of these patient groups potential errors should be very small. The two-year restriction was imposed by Austria and Slovenia where linked data sets were available only for 24 months at the time of the study, and not for the aimed at period 2012/2013, but for 2006/2007 in Austria and for 2013/2014 in Slovenia. While it cannot be excluded that these different time periods may matter for the comparisons, it has to be noted that the mental health care and data reporting systems have not changed over time in these two countries. The names of the databases are provided in Table 1.

2.2. Interoperability of databases

In a first step, the national databases, the relevant variables, their definitions and their granularity were identified and described in detail. A “Methods Toolkit” was developed for this purpose. Two examples for the tools, a questionnaire on the relevant administrative databases and another one on the main variables considered for the study are included as Appendix 1 in Supplementary material. Pilot studies were carried out in each country to better identify the problems arising from using data from different national electronic health care registries, and several partner meetings, conference calls and on-site visits to hospitals and database owners were required to achieve this aim. Adaptations had to be made, for instance, by reducing the number of variables and their granularity or accounting for unclear meanings of codes. The problems identified (see the Discussion section below) led to a pragmatic evaluation of the possibilities and limitations of using national health care registry data for inter-country comparisons, and to a final agreed upon protocol based on comparable data sets.

2.3. Study design and data analysis

Patient cohorts to be followed up and analysed for re-hospitalisation consisted of adults (aged 18+ years) who were discharged from a hospital inpatient stay, whereby the first discharge in the one-year recruiting period (the “baseline” year) was selected, after having spent at least one night on a psychiatric hospital bed. Only patients with a so-called “functional mental disorder”, covering schizophrenia, affective, anxiety and personality disorders (main ICD-10 diagnosis of F2, F3, F4, F5 or F6) were included. The study cohorts were characterised by using descriptive statistics. Cumulative crude and European standard population adjusted [21] rates for the first psychiatric re-hospitalisation (with an overnight stay) within 30 and 365 days after discharge were calculated for each country. In addition, the continuous outcome variable “time to first psychiatric re-hospitalisation” (measured by the number of days) was used to generate cumulative incidence curves. In a retrospective cohort study design, multi-level logistic regression analyses were carried out separately for each country in order to identify risk factors for the first re-hospitalisation to a psychiatric hospital bed both for the 30- and 365-day follow-up periods. Due to problems of interoperability of the databases, only five dichotomous patient-level variables were finally chosen as potential risk factors for re-hospitalisation: female sex, older age (country median or higher), longer length of stay (country median or longer), a main diagnosis of a “severe mental disorder” (schizophrenia or mania or bipolar disorder; ICD-10 F2, F30 or F31), and physical comorbidity defined as at least one secondary physical ICD-10 diagnosis at the time of inclusion in the study cohort (for details see Appendix 2 in Supplementary material). In addition, two geographical indicators on the NUTS 3 level for the patient’s place of residence were retrieved from EUROSTAT databases: first, degree of urbanicity as a potential proxy for the distance to a hospital [22], second, per capita Gross Domestic Product (GDP) measured in Purchasing Power Standards (PPS) [23] (divided by 1000 for the regression analyses in order to have larger unit changes of potential effects on the probability of re-hospitalisation). Reasons for not considering specific variables will be explained in the Discussion section below. The statistical software R was used, and a multilevel multiple logistic regression model with random intercept for the NUTS 3 level was employed (function “glmer” in the package lme4 [24]). To keep the model parsimonious for this overview paper,

Table 1
Patient cohorts by country.

Country	All countries	Austria	Finland	Italy	Norway	Romania	Slovenia
Acronym of Database[a]		GAP-DRG	Terveys HILMO	SDO	NPR	DRG	e-SBO
Year of recruitment		2006	2012	2012	2012	2012	2013
Number of patients	225,600	21,839	16,814	63,419	17,158	101,834	4536
Number of episodes	404,735	52,045	24,764	130,970	36,027	154,968	5961
Episodes per patient	1.79	2.38	1.47	2.07	2.10	1.52	1.31
Population 18+	82,253,204	6,667,764	4,333,723	49,396,435	3,898,012	16,254,443	1,702,827
Patients per 1000 population 18+	2.74	3.28	3.88	1.28	4.40	6.26	2.66
Person-level predictor variables							
Female Sex %	57.2	59.8	55.4	51.4	58.8	60.3	54.5
Age in years (median)	49	44	43	46	42	52	47
Length of stay in days (median)	12	15	18	11	14	12	32
Severe mental disorder (ICD-10 F2/F30/F31) %	45.5	36.2	56.4	60.6	39.3	37.2	51.8
Physical comorbidity %	28.3	37.6	8.8	14.7	3.9	43.1	5.4
Contextual level (NUTS 3) predictor variables characterising patients' residence (Ns are slightly reduced in some countries because not all patients could be allocated to a NUTS 3 region)							
	All countries	Austria N = 20,604	Finland N = 16,680	Italy N = 63,418	Norway N = 17,147	Romania N = 101,834	Slovenia N = 4,497
Number of NUTS 3 regions	237	35	19	110	19	42	12
Predominantly urban %	23	28.7	29.2	35.0	18.8	13.9	25.4
Intermediate urban/rural %	40.1	35.7	29.5	42.9	50.4	39.5	33.8
Predominantly rural %	36.9	35.6	41.3	22.0	30.7	46.7	40.8
Per capita Gross Domestic Product (GDP) as Median of Purchasing Power Standards (PPS)	21,100	32,400	28,000	28,100	34,800	11,200	19,500

[a] Full names of databases: Austria: GAP-DRG - Datenbank für Grundlagenforschung für ambulante patientenbezogene Diagnosis Related Groups; Finland: Terveys HILMO - Hoitoilmoitusjärjestelmä; Italy: SDO - Scheda Dimissione Ospedaliera; Norway: NPR - Norsk pasient register; Romania: DRG - Diagnostic Related Groups2F; Slovenia: e-SBO - Spremljanje bolnišničnih obravnav.

interaction effects between variables were not considered. The individual country data extracts were pooled at a secure research server in Austria for performing the analyses. All local ethical committees approved the study protocol.

3. Results

For the identification of the study cohorts and for calculating the re-hospitalisation rates the interoperability between the data extracts received from the six partner country databases was found to be satisfactory, although some intended analyses could not be performed because variables were not available in all countries (death during follow-up; planned vs. unplanned re-hospitalisation). Concerning the identification of risk factors for re-hospitalisation, some doubts concerning the comparability of the length of stay measure and of physical comorbidity arose, but they were nevertheless included in the logistic regression, because of their potential importance for health care planning and policy. In order to avoid repetition, the detailed findings on the problems of interoperability of the databases and variables will be presented in a separate subsection of the Discussion section below. Here we focus on the quantitative findings.

Following the protocol, a total of 225,600 patients were included from the six countries, which together have a general population of altogether 82,253,204 adults aged 18 years and older (Table 1). Since the countries vary substantially in their 18+ population (from 1.7 million in Slovenia to nearly 50 million in Italy), a broad array of cohort sizes resulted, ranging from 4536 patients in Slovenia to 101,834 in Romania. The rates of study cohort patients per 1000 population 18+ vary by a factor of nearly one to five between the lowest (Italy: 1.28) and the highest value (Romania: 6.26).

In Table 2 the 30- and 365-day crude and European standard population-adjusted [21] re-hospitalisation rates are shown. The adjusted rates differ only slightly from the crude rates and will not be further considered. The crude 30-day psychiatric re-hospitalisation rate is 10.3% for all 225,600 patients. Individual country rates deviate substantially from the overall value. They vary from well below 10% (Romania: 8.5%) to nearly twice the value in Austria (16.5%). After 365 days, the psychiatric re-hospitalisation rate ranges between one third (Slovenia 33.6%) to nearly every second patient in Norway (47.9%). The respective 95% confidence intervals do not overlap in most instances (Fig. 1 and Appendix 3 in Supplementary material).

Table 2
Crude and European standard population adjusted re-hospitalisation rates to a psychiatric hospital bed (for 95% confidence intervals of crude rates see Fig. 1 and Appendix 3 in Supplementary material).

Country	Study cohort	Re-hospitalisation rates to a psychiatric bed (%)			
		30 days		365 days	
		crude	adjusted	crude	adjusted
Austria	21,839	16.46	15.61	40.13	38.67
Finland	16,814	10.35	10.07	39.92	39.30
Italy	63,419	9.83	9.31	35.60	33.62
Norway	17,158	15.22	14.63	47.87	46.48
Romania	101,834	8.47	9.49	45.68	41.72
Slovenia	4,536	8.62	8.87	33.64	32.86
All countries	225,600	10.28	10.49	41.80	39.49

The cumulative incidence curves for the first psychiatric re-hospitalisation over the total 365-day follow-up period are shown in Fig. 1. It can be seen that the order of countries in a "league table" would change if different time snapshots were chosen. For instance, in Austria, nearly one in six patients is already re-hospitalised within 30 days after discharge, but the leading role of Austria in the first few weeks is handed over to Norway around day forty. Italy, Finland, Romania and Slovenia have nearly identical and very low rates within the first 30 days after discharge, but they start to drift apart over the subsequent weeks. Romania starts out with a low rate and overtakes nearly all other countries at the end of the follow-up period, showing a surprising steep rise in the final two months.

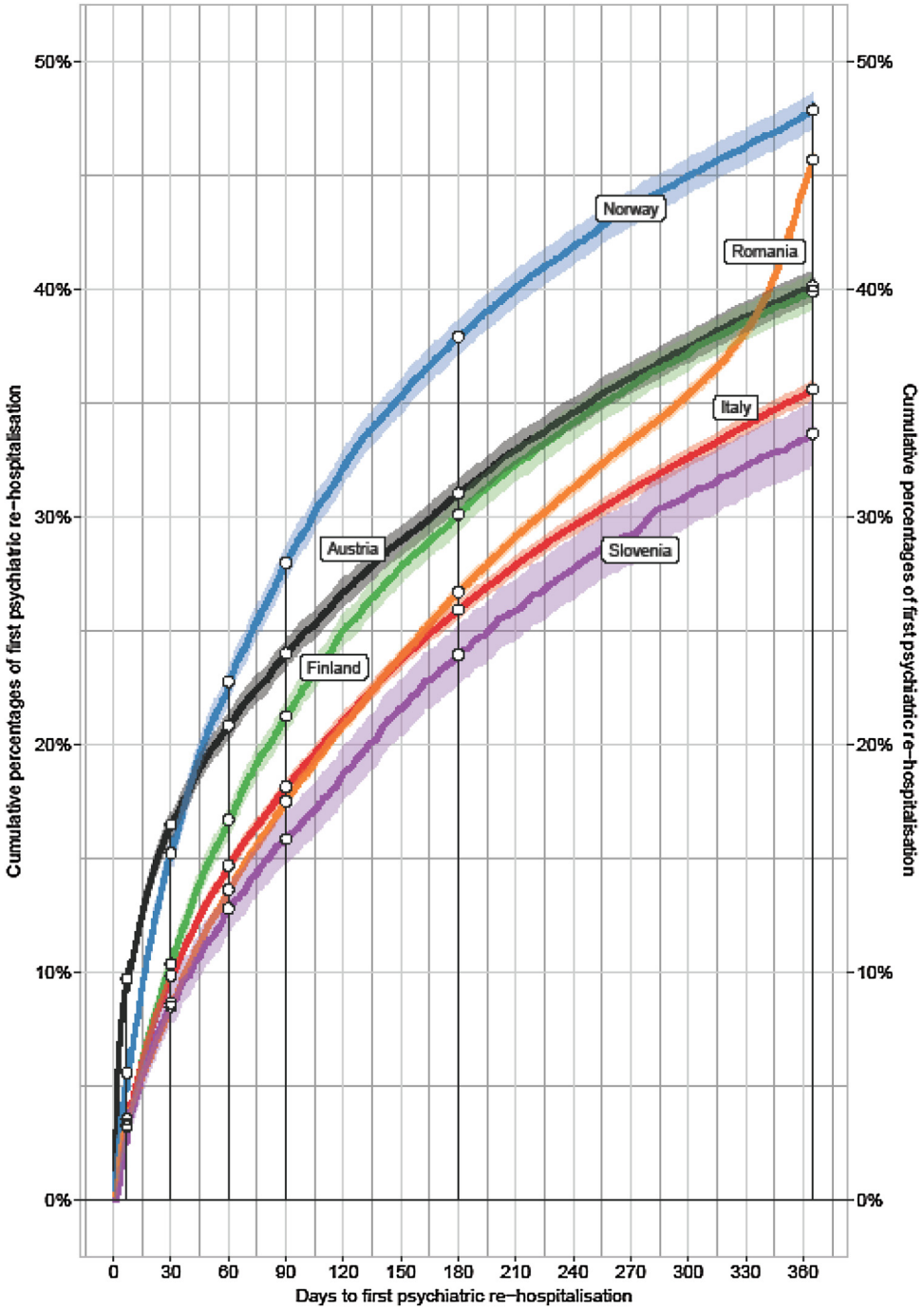

Fig. 1. Cumulative rates (with 95% CI) of first psychiatric re-hospitalisation for 365 days (for numerical values for 7, 30, 60, 90, 180 and 365 days including 95% CI see Appendix 3 in Supplementary material).

The results of the multi-level multiple logistic regression analyses are shown in Table 3, where odds ratios, 95% confidence intervals and significance levels are presented for the 30- and 365-day follow-up periods for each of the participating countries. The baseline values of the seven risk factors used for the regression analyses show some variation between countries (Table 1), with a noteworthy outlier for length of stay in Slovenia (32 days) and a remarkably large spread for physical comorbidity (Norway 3.9%, Romania 43.1%). The regression results are rather consistent across countries for "older age", which strongly decreases the probability of re-hospitalisation, and for a "severe mental disorder", which increases this risk. Length of stay has inconsistent effects across countries, with a reduction of psychiatric re-hospitalisation rates with longer length of stay in Finland and Norway, and an increase in Romania. For gender and physical comorbidity no consistent patterns across countries were found. The same is true for the two contextual variables urbanicity and GDP.

4. Discussion

4.1. Interoperability of databases and corresponding limitations

By assessing the available databases with the "Methods Toolkit" and by carrying out pilot studies with data extracts obtained from the national registries insights were obtained into which variables could be used for the purpose of the study and which not.

Table 3
Re-hospitalisation to a psychiatric hospital bed within 30 and 365 days after the index discharge: Individual country results of multi-level multiple logistic regression analyses with five patient level and two contextual variables. Reported are odds ratios with p-values (***p < 0.001 ** p < 0.01 *p < 0.05) and 95% confidence intervals.

Variable	Follow-up period	Austria N = 20.604	Finland N = 16.680	Italy N = 63.418	Norway N = 17.147	Romania N = 101.834	Slovenia N = 4.497
FEMALE female sex yes vs. no	30 days	1.02 (0.94–1.10)	1.07 (0.96–1.18)	0.97 (0.92–1.02)	1.21*** (1.10–1.31)	0.82*** (0.78–0.86)	0.90 (0.72–1.11)
	365 days	1.03 (0.97–1.09)	1.06 (0.99–1.13)	1.00 (0.96–1.03)	1.17*** (1.10–1.25)	0.96*** (0.93–0.98)	0.89 (0.78–1.01)
AGE_OLD age = country median or higher yes vs. no	30 days	0.77*** (0.71–0.83)	0.84*** (0.76–0.93)	0.68*** (0.64–0.72)	0.79*** (0.72–0.86)	0.88*** (0.84–0.92)	0.54*** (0.44–0.68)
	365 days	0.85*** (0.80–0.91)	0.97 (0.91–1.03)	0.85*** (0.83–0.88)	0.86*** (0.81–0.92)	1.04** (1.01–1.07)	0.80*** (0.71–0.91)
LOS_LONG length of stay = country median or higher yes vs. no	30 days	1.05 (0.97–1.13)	0.68*** (0.61–0.75)	0.94* (0.89–0.99)	0.62*** (0.57–0.68)	2.35*** (2.23–2.47)	0.98 (0.79–1.22)
	365 days	1.11*** (1.05–1.18)	0.82*** (0.76–0.87)	1.05** (1.01–1.08)	0.77*** (0.73–0.82)	1.50*** (1.47–1.54)	1.17* (1.02–1.33)
Severe mental disorder (ICD-10 F2/F30/F31) yes vs. no	30 days	1.39*** (1.29–1.51)	1.15* (1.03–1.27)	1.11*** (1.05–1.17)	1.45*** (1.33–1.58)	2.24*** (2.13–2.36)	0.91 (0.73–1.13)
	365 days	1.86*** (1.75–1.98)	1.50*** (1.40–1.60)	1.25*** (1.21–1.30)	1.75*** (1.64–1.86)	1.51*** (1.46–1.55)	1.49*** (1.30–1.69)
PHY_COM physical comorbidity yes vs. no	30 days	0.82*** (0.75–0.89)	1.12 (0.93–1.33)	0.95 (0.88–1.03)	1.08 (0.86–1.34)	0.80*** (0.76–0.84)	0.95 (0.56–1.61)
	365 days	0.97 (0.91–1.03)	1.14* (1.02–1.27)	0.95* (0.91–1.00)	0.93 (0.79–1.09)	1.06*** (1.03–1.09)	1.11 (0.82-1.50)
URBAN NUTS 3 vs. intermediate/rural yes vs. no	30 days	0.93 (0.54–1.60)	1.00 (0.54–1.85)	1.10 (0.99–1.23)	0.90 (0.65–1.25)	2.06 (0.94–4.52)	1.00 (0.39–2.57)
	365 days	1.01 (0.73–1.39)	0.85 (0.50–1.44)	1.07 (0.98–1.17)	0.87 (0.66–1.14)	1.69* (1.02–2.81)	1.08 (0.65–1.79)
GDP NUTS 3 measured as PPS divided by 1.000	30 days	1.17 (0.94–1.45)	1.06 (0.84–1.34)	1.00 (1.00–1.01)	0.99 (0.87–1.12)	0.82 (0.62–1.08)	1.02 (0.69–1.52)
	365 days	1.14* (1.01–1.30)	1.11 (0.92–1.34)	1.00 (0.99–1.00)	0.99 (0.89–1.09)	0.80* (0.67–0.96)	1.02 (0.82–1.27)

Concerning the selection of the study cohorts it was somewhat unexpected that the identification of a hospital discharge as such was a challenging task. First, the codes used for the termination of a hospital inpatient episode were found to vary between countries to a large extent, both in numbers and in meanings. They ranged from the simple and clear-cut codes "death", "transfer to another hospital" and "discharge" to lengthy lists of up to 16 codes, which in some instances could not be clearly mapped to these three main categories. Second, in the pilot study a proportion of "transferred" patients could not be identified as being admitted on the same day to another hospital, so the question arose whether these patients were actually "discharged" and the "transfer code" was erroneously used. To be on the safe side the solution adopted for all countries was to include only those patients for whom a termination date of a hospital episode was found but who had not died and were not re-admitted on the same day to a hospital. By this approach a small proportion of patients who had a "real" same-day re-hospitalisation were excluded, but this was regarded as the smaller problem, since some countries had rather high proportions of transfer codes. A clarification of this issue is certainly "a must do" [25] in international health services research. It is not helpful in this respect that the OECD uses the term "hospital discharge" with two different meanings (*"A hospital discharge is the formal release of a patient from hospital" which includes "discharges from all hospitals . . ., deaths in hospital, transfers to other hospitals, . . ."* [26]). While in other contexts such lack of differentiation may not matter, for a re-hospitalisation study it does (the term "hospital separation" might be a suitable alternative for the general meaning of ending a hospital episode as such [27]). No significant problems were encountered in assessing age at discharge. Except for Italy all countries were using ICD-10 – in Italy ICD-9CM was utilised but codes were converted into ICD-10 for the present project by using a comparison table [28].

Identifying the date of the first psychiatric re-hospitalisation after discharge posed no problems. However, two potentially relevant variables could not be considered. Censoring for death was not applied, because the data sets available in the two largest countries (Italy and Romania) did not cover death outside a hospital during follow-up. While this is certainly a shortcoming, it is a less serious problem here than it is for studies on physical diseases with a high mortality [4]. A more relevant limitation is that the distinction between planned and unplanned re-hospitalisations was not considered, because the variable did not exist in two countries and where it existed, the information was mostly regarded as unreliable. Considering the many possible constellations of emergencies, referrals and self-referrals, as well as the waiting time before admission, classifying re-hospitalisations as planned or unplanned is not an easy task anyhow. For instance, in some places in Norway patients in continuous community care have the right to admit themselves in times of crisis [29]. Many general re-hospitalisation studies also do not use a variable for unplanned admissions [4]. This issue certainly requires further definitional effort on an international level.

Concerning the selection of relevant risk factors for psychiatric re-hospitalisation, several issues need to be discussed. First, to assess length of stay in a comparable way proved to be more difficult than expected and we had to make specific decisions. We decided that in case of a patient being transferred within a hospital between different departments ("*intra*-hospital transfers") the total length of stay in that hospital was considered. In case of "*inter*-hospital transfers", only the last hospital episode before discharge was used for calculating length of stay. A problem arose with these definitions because in some countries "hospitals" are standalone institutions, between which *inter*-hospital transfers can occur, while in other countries standalone hospitals are administratively merged into "one" hospital ("hospital associations" in

Norway and Finland) and "intra-hospital" transfers are coded. The values for the median length of stay are therefore not comparable, though they could still be used for the regression analyses, since for each country its own median value was utilised for defining the variable "length of stay long". A second issue was the more than tenfold difference between the lowest (Norway) and the highest value (Romania) for physical comorbidity. One could speculate that rather than reflecting real differences, coding behaviour which might be related to reimbursement issues may be relevant. In fact, while diagnoses are not relevant for reimbursement in four countries (among them Norway), they are in the Romanian DRG system, where not only the main diagnosis but also additional diagnoses are relevant for hospital reimbursement, so documenting additional diagnoses could be incentivised. But this reasoning would not explain the similarly high rate of physical comorbidity in Austria where in the DRG system only the main diagnosis matters for reimbursement. Concerning the two geographical indicators for the patient's place of residence (urban vs. rural; GDP), the rather large NUTS 3 regions had to be used (up to several hundred thousand residents and more), since for some countries the location of the patient's place of residence was not available on a lower regional level (LAU - Local Administrative Unit). The large size of the NUTS 3 regions could well cloud smaller scale differences. Two potentially relevant risk factors for re-hospitalisation could not be included in the study. Information on involuntary admission was not analysed, since it was not contained in the health care registries of three countries (such information is sensitive and often kept in non-health registries, with which it is difficult to establish record linkage). While evidence for the effect of involuntary admission on the risk of psychiatric hospitalisation was not clear in a recent systematic review, the second missing variable, prior psychiatric hospitalisation, clearly increases this risk [12]. However, no variable on prior hospitalisation is contained in health care registries and no washout time could be considered for the six country comparison, since in Austria and Slovenia the linked databases were only available exactly for the two-year periods described above.

4.2. Cross-country comparisons

With the discussed methodological precautions taken, it is unlikely that between country differences in the study cohorts and the psychiatric re-hospitalisation rates are the result of methodological artefacts. These differences are likely caused by unobserved country characteristics, such as the extent to which community mental health services exist, or how reimbursement of psychiatric hospitals is organised. As these factors are not captured in our data set, it is, however not possible to formally check for a causal relationship. We will attempt below to discuss the potential relationships of a few of these system factors to our results, although we should consider that most differences remain unexplained.

A first observation is that there is a rather strong correlation between the re-hospitalisation rates and the rates of patients in the study cohorts per 1000 of the 18+ aged general population, i.e. the more persons of the general population are included in the study cohort the higher is the re-hospitalisation rate. Given the large differences in the 18+ population of the participating countries it is evident that the absolute cohort sizes would differ accordingly. It was, however, rather unexpected that the rates of the study cohort patients per 1000 of the 18+ general population would vary to a large extent as well (Table 1). Romania (6.26 per 1000) and Norway (4.40 per 1000) have the highest value for the study cohort, and Italy (1.28 per 1000) and Slovenia (2.66) the lowest – and Romania (45.68%) and Norway (47.87%) have the highest, and Italy (35.60%) and Slovenia (33.64%) the lowest re-hospitalisation rates for 365 days (Table 2).

Looking only at Italy and Romania, what first comes to mind are the well-developed territorial community mental health services in Italy which could prevent unnecessary hospitalisations, in contrast to a lack of such services in Romania [30]. Also, the much lower rate of psychiatric beds in Italy (10/100,000 population) than in Romania (74/100,000) could play a role [31]. Since Norway has a very high rate of cohort patients (more than three times as large as that in Italy) and the highest re-hospitalisation rate, one might expect that it corresponds to Romania in terms of the two health system factors addressed. But, while Norway is similar to Romania in terms of having more than ten times as many beds as Italy [31], Norway, like Italy, has well-developed community mental health services, including so-called district psychiatric centres as well as comprehensive mental health services at the municipal level [29,32].

Concerning hospital payment mechanisms Romania and Italy are also different, with DRGs in Romania (which could act as incentive to increase the number of admissions) and a territorial budget in Italy. It is noteworthy though that only two countries (Austria and Romania) were using a DRG system for reimbursing psychiatric as well as somatic inpatient care, whereas the other countries, while using DRGs for physical disorders, have different reimbursement systems for mental disorders (e.g. budget, daily rates), corresponding to the finding that diagnoses in psychiatry explain only a small variance of costs [33]. While Norway, similarly as Italy, has a budget for psychiatric in-patient services, it has, in contrast to Italy, high values concerning the cohort and the re-hospitalisation rates. So, other factors must play a role, such as perhaps the attitudes of professionals and the general population to psychiatric hospitalisation [29].

Some country peculiarities are worthwhile mentioning. For instance, Romania has a very low re-hospitalisation rate in the first month after discharge, but the second highest after 365 days, due to a steeply rising curve at the end of the follow-up period (Fig. 1) - this rise could be related to the legal requirement in Romania that persons receiving a sickness pension have to undergo yearly reassessments. Austria is remarkable because of a very high re-hospitalisation rate in the first few weeks. While Austria has a DRG system, which could account for this finding, the fact that the number of outpatient psychiatrists with a contract with social health insurance institutions (who can be contacted for free) is relatively small, might also be important, since continuity of care is less probable.

Concerning the between country differences in risk factors for psychiatric re-hospitalisation we cannot be as certain as with the re-hospitalisation rates that they do not represent methodological artefacts. It is remarkable though that despite different health care and provider payment systems two variables, a diagnosis of a severe mental disorder and young age, strongly increase both the 30- and 365-day psychiatric re-hospitalisation rates. While definite interpretations are not possible, the consistency of this pattern across countries hints at the need to pay more attention to such patients if the aim is the prevention of re-hospitalisation [1]. Gender has mostly no effect on re-hospitalisation rates, with the exception of Norway (where women have significantly higher rates) and Romania (where men have higher rates). Length of stay was not related to re-hospitalisation in a recent systematic review [12] and also in our study no consistent finding emerged. Longer length of stay strongly decreases the re-hospitalisation rate in Finland and Norway, but increases it in Romania. None of our partner countries has general legal requirements for length of stay (Italy has a 7-day rule for involuntary admission, but such admissions are rare [34] and the detention period can be extended). Finally, the contextual variables urbanicity and Gross Domestic Product had practically no effect on re-hospitalisation rates, presumably

because NUTS 3 regions are rather large with a high degree of inner heterogeneity.

5. Lessons learned and conclusions

For comparing re-hospitalisation rates between countries national health care registry data offer the advantage of including the total, i.e. unselected patient population with the defined criteria and all hospitals of a country (and not just a subset of hospitals or a single hospital [35]), implying that no selection bias is present and patient cohorts are very large. Also, as was the case in our study, agreed upon protocols and the same statistical software can be applied and comparability thereby enhanced - in contrast to systematic reviews where studies with many different designs have to be summarised. However, expectations may be somewhat curtailed by the limitations described above and by the lesson learned from the current study that the effort is huge to arrive at comparable data sets, an experience encountered also in other cross-country studies with registry data [36,37].

Lessons learned concerning problematic interoperability of databases comprise the unclarity encountered in distinguishing clearly between the codes for discharges and transfers to another hospital (solved here by record linkage), the different concepts of "a hospital" (differences between standalone hospitals and hospital associations) with implications for calculating length of stay, and the largely discrepant frequencies of coding of additional diagnoses (in our case for physical comorbidity of mental disorders). A more serious problem for a re-hospitalisation study is that some variables, such as whether a re-hospitalisation was planned or not, were not at all or not consistently available. Also, since we had to get data extracts from the registries, legal and ethical considerations, not the least those related to record linkage, led to restrictions. The "Methods Toolkit" (Appendix 1 in Supplementary material) developed for our study could serve for ensuring interoperability of databases in similar studies in the future.

Based on our experience with six European countries it is relatively safe to assume that the selection of patient cohorts and the calculation of psychiatric re-hospitalisation rates are rather free from methodological bias and that the differences found between countries can be taken as real, although they remain mostly unexplained in terms of correlating them with health system differences. It also became clear that cumulative curves of re-hospitalisation rates over time show different shapes in different countries and it might be advisable in future studies not to look only at fixed follow-up periods. It is not unreasonable to assume that factors influencing early readmissions are different from those responsible for late readmission [38,39].

Concerning risk factors for re-hospitalisation we encountered barriers, especially for length of stay and additional diagnoses - between-country differences should therefore be seen with caution. What is astonishing though is that a diagnosis of a severe mental disorder and younger age consistently increase the risk of re-hospitalisation in all countries despite the different health care systems.

It remains to be seen whether current efforts to harmonise health care information systems in Europe [40] and new developments in the information technology field, relating to the use of electronic health care records [41–43] will improve this situation.

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Declaration of Competing Interest

The authors declare that there is no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.healthpol.2019.07.006.

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