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LINKING HEALTH INSURANCE DATABASES WITH DATA FROM HEALTH STATUS ASSESSMENTS AND POPULATION CENSUSES TO IDENTIFY FACTORS INFLUENCING THE EFFICIENCY OF HEALTH CARE

Thesis of Doctoral (PhD) dissertation

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INTRODUCTION

To achieve the goals of health policy and public health, it is essential to develop monitoring systems that are able to provide valid and timely data on the health status of the population, the operation and performance of the health care system, and the factors influencing them. Most of these monitoring systems are based on routinely collected data, which are available as a result of administrative data collection for the whole population or surveys conducted at regular intervals. Health insurance databases (HIDs) are used worldwide to monitor health status and the effectiveness of care. Because these databases generally have national coverage and contain more reliable information and the data are continuously available, the analyses are more cost effective even for long-term follow-up studies. The usability of analyses based on HIDs is limited by data collection related to funding, which can lead to bias in the registration of diagnoses and treatments and limit the scope of data collected (databases include only a small amount of information about the patients and risk factors). Furthermore, the use of HIDs for monitoring purposes is restricted in many countries by existing data protection rules.

In Hungary, the continuous collection and management of data related to health care is the statutory task of the National Institute of Health Insurance Fund Management (NIHIFM). In addition to the basic data of health care providers (location, areas of care, number of patients, etc.), the NIHIFM also collects nationwide data on interventions and their results at the level of primary and outpatient care, the quantity of prescribed and purchased drugs and the costs of health care; these data are available at the individual level. Therefore, NIHIFM's databases can be used to conduct analyses that evaluate the prevalence of diseases, the use of health services, the efficiency of care and their changes over time. However, the socioeconomic characteristics, lifestyles or attitudes of the patients, which have an impact on health status and use of care, cannot be taken into account in this type of analysis because due to the lack of funding implications, these data are not included in the HIDs. As a result, the prevalence and etiological or prognostic factors of diseases and determinants of the effectiveness of care can only be described with limited efficacy based on analyses of NIHIFM's data. At present, such analyses can only be carried out in the framework of targeted projects in Hungary, although databases are available that contain the required sociodemographic and lifestyle data, even at the national level.

In the surveys representing the Hungarian population operated by the Hungarian Central Statistical Office (HCSO) and the health status assessment of several targeted projects also collect data that are applicable for supplementing analyses based on NIHIFM's databases, thus

enabling complex identification and assessment of factors influencing health status and the efficiency of care.

Linking the different data sources certainly improves the quality of existing data, contributes to the use of routinely collected data in a more intensive manner and better satisfies practical needs. Data linkage can also be used to analyze data from a larger sample or from hard-to-reach populations, and thus, it can be used in studies to determine the prevalence and etiological or prognostic factors of diseases. Based on linkage studies, indicators that are applicable for monitoring the quality and performance of health care, as well as the use of care and related costs, can be prepared and can contribute to the evaluation of patient pathways. Although the use of data linkage is increasing and research results confirm that linking different data sources leads to advantages, the routine linking of databases cannot be considered solved either technically or legally in Hungary at present. This results in methodological limitations that hinder the practical use of national databases.

OBJECTIVES

In the practice of current Hungarian monitoring, there are untapped opportunities in the utilization of the available datasets, one of the possible solutions of which is the linking of different data sources. Our purpose was to develop methods based on the available data without separate data collection, which allow the analysis of routinely collected NIHIFM data to better satisfy practical needs and provide data in sufficient detail for interventions. To demonstrate this, two linkage studies were conducted.

In the first study, the outpatient service use and medicine consumption databases of the NIHIFM were linked to data from a project's health status assessment. The aims of the linkage were to determine the prevalence of depression among patients with hypertension (HT) and/or diabetes mellitus (DM), to identify factors influencing the use of outpatient care, to analyze the relationship of depression with episode number and related expenses of secondary health care, and to estimate the workload of regular depression screening in primary care.

The goal of the second study was to develop and supplement the data processing methodology of the indicator-based performance evaluation system (PES) of the NIHIFM. As part of this, we linked the basic indicator data with the characteristics of general practitioners (GPs) and data from the 2011 census. The aim of this study was to demonstrate that it is possible to produce indicators that are applicable for the evaluation of primary care activity independent of the general medical practice's (GMP's) characteristics and that reveal the dysfunctional

elements of the current evaluation system. An additional goal was to model how the evaluation of the performance and indicator-based funding of GPs providing care to adult patients would change if monitoring were based on the statistical evaluation of the adjusted performance indicators.

METHODS

Prevalence of depression and its impact on the use of outpatient care

The data in our first study were derived from the Health Status Assessment (HSA) conducted within the framework of the Primary Care Model Programme. In our pilot study, we linked the HSA records with the secondary outpatient service use and drug consumption databases of the NIHIFM in the period from 1 October 2013 to 30 September 2014. We examined the relationship between depression and outpatient care use among patients with HT and/or DM who appeared in secondary outpatient care at least once in the past year.

The presence of depressive symptoms was evaluated by the Hungarian abbreviated (9-item) version of the Beck Depression Inventory (BDI) as part of the HSA. Furthermore, we examined antidepressant drug (AD) purchases within the 12 months prior to the HSA based on the NIHIFM database. The following 8 groups were defined based on these factors: 1) BDI-normal, AD-; (reference group); 2) BDI-normal, AD+; 3) BDI-mild, AD-; 4) BDI-mild, AD+; 5) BDI-moderate, AD-; 6) BDI-moderate, AD+; 7) BDI-severe, AD-; and 8) BDI-severe, AD+.

From the HSA data, sociodemographic data (age, sex, ethnicity, education), lifestyle characteristics (alcohol consumption, smoking, obesity), and medical history data (kidney disease, musculoskeletal disease, osteoporosis, visual and hearing impairment) were used in the analysis. Based on the drug consumption databases of NIHIFM, we examined the regularity of drug purchases for HT and/or DM to evaluate the compliance of patients.

The use of outpatient care was determined on the basis of the number of episodes and related reimbursement included in the NIHIFM databases. After calculating the median values, the patients were classified into groups above and under the median.

Analysis

The association between depression and secondary health care utilization was evaluated by multiple logistic regression. The results are presented as odds ratios (ORs) with the corresponding 95% confidence intervals (95% CIs).

Based on the data from the study, the HCSO 2011 census and Health Interview Survey 2014, we estimated the number of hypertensive and/or diabetic patients with depression in Hungary. To evaluate the GPs' workload due to systematic screening for depressive symptoms, we calculated the number of HT and/or DM cases per GMP using data from the General Practitioners' Morbidity Sentinel Stations Program and then determined the number of screenings per month per GMP.

Methodological development of the NIHIFM's performance evaluation system (PES)

In the second linkage study, we used data from the indicator-based PES by the NIHIFM, which monitors the activities of GPs providing adult care. We analyzed data of the 12 NIHIFM indicators for 4850 GMPs with territorial care obligations from June 2016. To improve the methodology, we produced indicators adjusted according to the GPs' characteristics (age and sex of adults, level of education, county, and settlement type).

Analysis

To determine the number of expected care-related events per GP, we used the national-level reference frequencies calculated on the basis of the given GP's characteristics and the number of those belonging to the target group of the care service described by the given indicator. By comparing the number of care-related events actually observed for a GP with the number expected care-related events, we calculated a standardized ratio for each indicator. To separate the significant deviation of the performance from the reference level, we used the mid-p test, based on which we categorized GPs, in the case of each indicator, as having above average, below average or average performance.

We examined the effectiveness of the current monitoring by comparing the classification based on the NIHIFM target value with the categories formed on the basis of the evaluation of standardized indicators.

To evaluate the appropriateness of funding, we calculated the proportion of the additional funding provided to GPs who – on the basis of the standardized indicator adjusted according to the given GP's characteristics – perform significantly better than average in relation to the total amount paid in the case of the given indicator. We examined the ratio of the lack of funding among GPs who performed significantly better than average according to the standardized indicator but did not receive funding in the current assessment.

We modeled the effects of funding based on standardized indicators by reallocating the available financial envelope.

RESULTS

Prevalence of depression and its impact on the use of outpatient care

Characteristics of the study sample

The analyzed database contained data from 2027 adults with HT and/or DM. The average (±SD) age of the patients was 60.43 years (±12.96). The sample was dominated by women (63.99%), the proportion of Roma adults was 6.46%, and 45.05% of the patients had a primary level education. Based on BDI score and one-year AD purchase history, 63.20% of the patients were free of depressive symptoms, and the proportion of AD-treated adults was 7.30%. Untreated moderate or severe depression was observed in 14.16% of patients.

The impact of depression on the use of outpatient care

AD-treated patients used secondary services more frequently than non-AD-treated patients with normal BDI scores, regardless of the severity of depression ($OR_{normal,\ AD+}$: 2.39, 95% CI: 1.36-4.19, $OR_{mild,\ AD+}$: 3.53, 95% CI: 1.45-8.58, $OR_{moderate,\ AD+}$: 2.72, 95% CI: 1.14-6.50, and $OR_{severe,\ AD+}$: 6.80, 95% CI: 2.85-16.21). A similar relationship was also observed for reimbursement, and we found that the more severe the depression was, the higher the expenses were for secondary health care services ($OR_{normal,\ AD+}$: 2.37, 95% CI: 1.35-4.19, $OR_{mild,\ AD+}$: 4.78, 95% CI: 1.67-13.71, $OR_{moderate,\ AD+}$: 8.76, 95% CI: 1.62-47.47, and $OR_{severe,\ AD+}$: 9.62, 95% CI: 3.55-26.08).

Among patients with a negative AD history and severe depression, the number of episodes was higher than the reference values (OR: 1.60, 95% CI: 1.11-2.31). In terms of expenses, the results were significant for patients with moderate untreated disease (OR: 1.52, 95% CI: 1.04-2.23) or severe depressive symptoms (OR: 2.20, 95% CI: 1.50-3.22).

The national prevalence of depression and the workload of regular screening

According to our estimates, 2.55 million of the 2.75 million hypertensive and/or diabetic patients in Hungary have not purchased ADs in the last 12 months (they are the target group for depression screening in primary care). The estimated numbers of patients with mild, moderate, and severe depressive symptoms among the non-AD-treated patients were 0.36 million, 0.17 million, and 0.17 million, respectively.

Based on our estimates, the average number of untreated patients with at least moderate depressive symptoms (requiring psychiatric care) among hypertensive and/or diabetic patients was 67 per Hungarian GMP. The extra workload associated with regular depression screenings for a typical GMP would be 2.16 screenings per month among patients with newly

diagnosed HT and/or DM and 39.83 screenings per month among formerly diagnosed patients. With systematic screening, the GP could recognize patients with untreated depression and could organize necessary specialist care for them.

Methodological development of the NIHIFM's performance evaluation system (PES)

Effectiveness of monitoring

The proportion of GPs excluded from the evaluation due to the target group limit was the most frequent in the case of the indicators related to care provided for ischemic heart disease (IHD) and to care provided to patients with chronic obstructive pulmonary disease (COPD) (21.56% and 16.50% of GPs, respectively).

The ratio of GPs who performed above average based on the adjusted evaluation among those GPs received funding (i.e., well-performing on the basis of the target value) showed significant variability for each indicator. The lowest level of efficiency was observed in the case of care provided to COPD patients (0.20%), while the highest level of efficiency was observed in the case of influenza vaccination (99.86%). In the case of 4 indicators (HbA1c examination for diabetic patients, patients aged 55-69 years receiving care for HT, serum creatinine examination for patients with HT and care provided to COPD patients), our assessment showed that the performance of more than 20% of GPs receiving additional funding was not any different from the average, if evaluated on the basis of the standardized indicator. There was no indicator identified for which a GP performing below average based on the standardized indicator would have received any additional funding.

Although the performance was above average according to the standardized indicator-based evaluation in the indicator related to influenza vaccination, 786 GPs (16.21% of GPs) did not receive any additional funding because they did not manage to reach the target value.

Appropriateness of resource allocation

In June 2016, when the amount of funding paid per indicator point was HUF 14,670, based on the 12 indicators, a total of HUF 224.17 million was distributed among the GPs, rewarded on the basis of the target value. 34.46% of the total amount paid in the indicator scheme (HUF 77.25 million) was allocated to GPs performing above average also on the basis of the standardized indicator, and 65.65% of the amount of financing (HUF 146.92 million) was allocated to GPs for which performance, according to the standardized indicators, did not deviate significantly from the average. Overall, based on 12 indicators, an amount equal to 8.83% of the current financial envelope (HUF 19.80 million) was not allocated to better-

performing GPs who did not manage to reach the target value or were not included in the evaluation due to exclusion criteria (HUF 19.72 million and HUF 0,09 million, respectively).

The impact of standardized indicator-based monitoring on funding

According to the standardized indicator-based evaluation, a total of 6616 GPs performed above average in terms of the 12 indicators. If the total amount of additional funding paid in June 2016 (HUF 224.17 million) had been distributed only among those GPs who performed better than average irrespective of the GPs' characteristics, the amount of funding allocated to one indicator would have increased from HUF 14,670 to HUF 33,884.

The GPs not evaluated in the current system would have been eligible for a total funding amount of HUF 0.20 million on the basis of the standardized indicator-based monitoring. Those GPs who were to be rewarded according to the current and the standardized monitoring scheme as well would have received HUF 178.43 million instead of the current HUF 77.25 million. The GPs not receiving funding according to the current evaluation, although they performed above average, would have been eligible for HUF 45.54 million on the basis of the assessment by standardized indicators.

DISCUSSION

Prevalence of depression and its impact on the use of outpatient care

According to our results, one-third of the patients with HT and/or DM were depressed, based on their BDI score and AD purchase. This proportion was similar to that in the published data. Regardless of the examined patient characteristics (sociodemographic status, lifestyle, compliance, and comorbidities), we found a significant association between untreated depression and increased use of outpatient services (the relationship between depression symptom severity and health care utilization was more pronounced in patients with more severe depressive symptoms). Our findings are in agreement with the reported data of other studies among patients with IHD and DM.

Considering that depression is quite frequent among hypertensive and diabetic patients and that the long-term care for this group of patients is mainly managed by GPs, regular depression screening at the level of primary care seems to be justified, which may contribute to the identification of untreated cases and the initiation of specialist treatment. Our results show that the number of screenings would be 42 per month in a typical GMP, which requires approximately 210 minutes of extra work.

Strengths and limitations of the study

The treatment of depression without AD therapy is rare in Hungary; therefore, the classification based on AD purchases did not lead to significant bias in the analysis of the relationship between depression and outpatient care service use. In our study, we did not examine the type and details of outpatient care; therefore, the increased health care utilization might only reflect psychiatric care. However, because secondary care use was higher in non-AD-treated patients with severe depressive symptoms, this possibility is improbable. The risk factors that lead to extra use of outpatient care were controlled for in the analyses. Nevertheless, we cannot exclude that a certain proportion of increased health care utilization can be attributed to diseases not associated with the examined factors, and these states may have contributed to the development of depression.

Methodological development of the NIHIFM's performance evaluation system (PES)

A comparison of the current PES and the GPs' characteristic-adjusted evaluation revealed errors in the present resource allocation. According to our results, one-third of the additional funding related to current PES support only improves the efficiency of primary care. 65.54% of the financial envelope is allocated to GPs with average performance who can achieve the NIHIFM's target value due to favorable social-demographic conditions and/or a favorable location. The current PES is unable to identify all GPs who reach a much higher efficiency level than the performance expected on the basis of their characteristics, and as a result, the NIHIFM does not provide 8.83% of the additional funding to GPs.

According to our analyses, the amount available on the basis of one indicator point could be more than twice the current amount (HUF 33,884 instead of HUF 14,670) if only those GPs able to provide above average performance irrespective of their characteristics were rewarded. As a result, nearly 10% of total practice revenue would come from the maximum theoretical amount of indicators, which would probably increase the efforts taken to provide more efficient care services based on international experience.

Strengths and limitations of the study

The indicators adjusted according to the GPs' characteristics are able to assess the performance of GPs by eliminating the influence of factors that affect care but are independent of the GPs. In addition to the elements we examined, other factors may also affect the efficiency of care that cannot be influenced directly by GPs (severity of illnesses, the patient's lifestyle and compliance), and adjusting for these factors would further improve

the efficiency of monitoring. As a limitation, it should be mentioned that the relative education used in the analyses refers to the area provided by GPs (because these data are not available at NIHIFM), and the use of individual patient data would further increase the effectiveness of the correction. The evaluation based on standardized indicators differs from the current system of the NIHIFM only in the methodology used. Therefore, any bias in the adequacy of the indicators and the quality of the reported data does not influence the validity of our methodological findings.

According to our results, the development of the current PES is justified, the dysfunctional elements of which can be eliminated by an evaluation based on GPs' characteristic-adjusted indicators. This methodology, which does not require separate data collection and uses existing data more intensively, could improve the allocation of resources related to PES and the efficiency of primary care.

Linkage study - justification of the application in Hungarian research

To assess the efficiency of care, we need to have data on patient characteristics, existing diseases, treatments and their outcomes. Such data are rarely available from the same data source. Therefore, it is recommended to use methods that produce reliable data in a cost-effective manner to inform health policy decisions and interventions. One such option is the routine use of data linking, which compensates for the limitations of different data sources and combines their benefits.

Our first study demonstrated that by providing ethical and legal conditions, data from population-based surveys can be linked to NIHIFM's health insurance databases to determine the prevalence of diseases and etiological and prognostic factors of illnesses and to identify factors influencing the use of care. The second linkage study verified the benefits of linking health insurance data to administrative databases.

Our research confirms that by applying the appropriate methods and without separate data collection, it is possible to analyze routinely collected data to better satisfy practical needs and provide data in sufficient detail for interventions. Data linking can be used to examine the factors that are essential for evaluating health status and the performance of the care system but are not available in HIDs due to the lack of funding implications. However, the supplementation of the analyses based on Hungarian HIDs can only be carried out in the framework of targeted projects similar to our studies.

NEW RESULTS OF THE RESEARCH

Prevalence of depression and its impact on the use of outpatient care

1. The proportion of antidepressant purchases in the last 12 months was 7.30% among hypertensive and/or diabetic patients.
2. The frequency of untreated depression was 27.08% among patients with hypertension and/or diabetes (the proportion of moderate or severe depression was 14.16%).
3. Comorbid depression in hypertensive and/or diabetic patients was frequent among women, less educated patients, Roma individuals, regular smokers, and patients with sensory disorders and chronic musculoskeletal disorders.
4. Among hypertensive and/or diabetic patients who purchased antidepressants, the episode number and related expenses of outpatient care were higher than the median.
5. Untreated depression was significantly related to increased outpatient care utilization in a severity-dependent manner (the associations between depression severity and extra use of care were more pronounced in patients with more severe symptoms).
6. Based on our estimates, the number of patients with hypertension and/or diabetes is 2.75 million in Hungary, of whom 0.20 million have antidepressant-treated depression and 0.70 million have untreated depression (0.34 million have moderate or severe depression).
7. By systematic depression screening at the level of primary care, 67 hypertensive and/or diabetic patients with untreated moderate or severe depressive symptoms can be identified and referred to specialist care in a typical Hungarian general medical practice.
8. The workload of typical general medical practices would increase by 42 screenings per month with regular depression screening among patients with hypertension and/or diabetes (2 screenings among newly diagnosed cases and 40 screenings among formerly diagnosed cases).

Methodological development of the NIHIFM's performance evaluation system (PES)

1. The statistically evaluated and GP characteristic (age, sex, level of education, county, and type of settlement)-adjusted version of the current NIHIFM indicators are able to evaluate the performance of the GPs.

2. Methodological development and supplementation revealed dysfunctional elements of the current PES:
   - GPs that perform well in terms of quality of care are not rewarded;
   - the effect of influencing factors independent of the GP is not corrected for;
   - in the absence of a statistical evaluation, accidental effect and truly good performance are not separated; and
   - lower-performing GPs are not identified.
3. In the current PES, exclusion from the evaluation was most frequent in the case of the indicators related to care provided to IHD and COPD patients.
4. The NIHIFM currently identifies the highest proportion of truly good performance in the case of influenza vaccination (99.86% overlap between the adjusted assessment and the evaluation based on the achievement of the target value) and the lowest proportion in the indicator related to COPD care (0.20%).
5. The present allocation of resources supports the conservation of performance because average-performing GPs receive two-thirds of the additional funding related to evaluation (HUF 146.92 million in June 2016).
6. An amount equal to 8.83% of the monthly financial envelope (HUF 19.80 million in June 2016) was not paid due to the lack of identification of significantly better performance.
7. According to the modeling of funding on the basis of the indicators adjusted for GP characteristics compared to the present evaluation system:
   - the amount available on the basis of one indicator point could be more than twice as large (according to the data of June 2016, HUF 33,884 instead of HUF 14,670);
   - the good performance of currently unevaluated GPs would be recognized;
   - unjustified rewarding of GPs with average performance would be avoided;
   - the revenue from GPs who perform better than average would be increased markedly; and
   - GPs with above average performance who were not rewarded would be recognized.

Options for performing linkage studies

1. A technical and legal method has been developed to link targeted health status assessment to the NIHIFM's routinely collected data related to outpatient care. The developed methodology is applicable for answering epidemiological research questions.

2. The efficiency of the current GP performance evaluation system by the NIHIFM can be improved through more intensive utilization of existing data and the linking of administrative databases and indicator data. The necessary technical conditions have been established, and the statistical methodology of the analyses and the conditions for routine application have been developed.
3. Our research demonstrates that the linking of existing Hungarian databases can be well applied in both individual-level and ecological research.
4. There are no legal or ethical obstacles in Hungary that exclude the possibility of data linkage.
5. Our results support that the linking of different data sources can significantly improve the efficiency of current monitoring.

SUGGESTIONS AND RECOMMENDATIONS

1. The more intensive use of existing data in Hungary would be justified in order to improve the efficiency of the monitoring system, one of the possible methods of which is the linking of different data sources.
2. To improve the usability of data and the validity of evaluations in a cost-effective manner, it should be possible to routinely link databases of the whole population.
3. Targeted health assessment surveys carried out in the framework of projects should be designed and conducted (ensuring the necessary ethical and legal conditions) so that they could be linked to health insurance databases.
4. Among hypertensive and/or diabetic patients, it is recommended to introduce systematic depression screening at the level of primary care, which could contribute to the early detection of untreated cases and their referral to appropriate specialist care.
5. The development of the current indicator-based performance evaluation system by the NIHIFM would be justified because this can eliminate dysfunctional elements of the system and improve the efficiency of monitoring.
6. The use of statistically evaluated indicators adjusted according to the GPs' characteristics in the current monitoring practice would increase the efficiency of funding allocation.

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PUBLICATION LIST

List of publications related to the dissertation

1. Pálinkás A, Sándor J, Papp M, Kőrösi L, Falusi Z, Pál L, Bélteczki Z, Rihmer Z, Döme P.: Associations between untreated depression and secondary health care utilization in patients with hypertension and/or diabetes. Soc Psychiatry Psychiatr Epidemiol. 2019 Feb;54(2):255-276.
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1. Sándor J, Nagy A, Földvári A, Szabó E, Csenteri O, Vincze F, Sipos V, Kovács N, Pálinkás A, Papp M, Fürjes G, Ádány R.: Delivery of cardio-metabolic preventive services to Hungarian Roma of different socio-economic strata. Fam Pract. 2017 Feb;34(1):83-89.
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