

SHORT THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (PHD)

Determinants of variability in performance of general medical
practices in Hungary

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INTRODUCTION

Health care providers are often assessed by their observed variability in performance, therefore there is a need for reliable indicators which are able to measure the personal contribution of the general practitioner (GP). GP-independent factors could have an impact on primary care performance. In addition to the characteristics of patients and general medical practices (GMPs), the age and gender of GP can also determine the effectiveness of care. However, the existing performance assessment system ignores the sociodemographic characteristics of patients and the structural composition of GMPs. The changing composition of health care professionals can have consequences for the planning of the supply of health care human resources. The share of female physicians has consistently increased, and family medicine is highly affected by feminization. Hungary is among the countries with the highest share of female physicians in general medicine, thus the country is ideal to investigate the details of gender effect at the level of primary care.

Use of P4P for improving quality in primary care

There is an increasing trend of applying results-based funding or incentives in PHC systems to exploit additional potential opportunities for PHC. Countries with diverse healthcare systems, such as the UK, USA, Canada, Australia, New Zealand, and Germany, adopted pay-for-performance (P4P) programs to stimulate quality improvement in primary and specialised care. Strengthening remuneration arrangements for reaching a level or degree of a performance indicator has reached is a key policy tool to improve the quality of care.

Despite widespread use, the evidence for the impact of performance monitoring on quality is unclear. The negative experiences of financial incentives might arise from the use of indicators which reflects rather the effect of factors out of the control of physicians, instead of the personal performance of the provider. However, characteristics of good quality indicators are controllability by the people, the possibility to detect changes in the quality of care, validity, and relevance. Evidence-based objective measures are indicators, which are used to measure the performance and improve the quality of care. Although the indicators do not provide definitive answers, they indicate possible problems, the appropriate quality of care, and the need for development opportunities. The indicators used in the performance assessment of providers measure the quality of care and services. In Hungarian practice, the indicators used in the performance assessment of GPs consider only the process of care among the dimensions of quality of care according to Donabedian; the system does not contain indicators in terms of structure and outcome. Healthcare providers are often evaluated

on the basis of the variability observed in their performance, so reliable indicators should measure the personal performance of the GP team.

Monitoring based on indicators that accurately measure the performance of providers could lead to improvements in the quality and efficiency of both the health care system and services.

Influencing factors of performance by patients and general medical practices

The variation observed in the quality of healthcare services and health outcomes among GMPs is partly due to the physicians advocating that a more comprehensive understanding of the factors contributing to performance is necessary. Health behavior, psychosocial factors and social conditions of patients, severity of illness, socioeconomic factors, health care organizations, rural and urban location of GMP, practice size, as well as sociodemographic composition of patients, and other GP-independent factors also have an impact on that. The performance assessment system is expected to measure the personal performance of GP's as accurate as possible, which, in turn, cannot be guaranteed by ignoring factors beyond the physician's control.

Changing demographic composition of healthcare sector

The growing shortage of health professionals is a serious problem in almost all developed countries. The proportion of practicing doctors aged 55 and over increased from 21% to 35% between 2000 and 2018 in OECD countries, while in Hungary, a much higher proportion of 44.1% was observed in 2018. Primary care is particularly affected, as the aging of GPs and the lack of supply leads to a steady increase in the number of vacant GP practices. The resulting workforce crisis raises concerns in terms of access to care and the quality of care. The number of vacant GP practices has multiplied in the last decades in Hungary, according to the National Institute of Health Insurance Fund Management (NIHIFM). The total number of vacant GMPs was 639 (9.8% of all practices) in Hungary in May 2021 (306 mixed, 180 adult, and 153 pediatric practices), and 66% of GPs were aged 55 years or older, with a mean age of 58.8 years.

The change in the gender composition of physicians was experienced in OECD countries over the last decades. The share of practicing female physicians has increased from 38% to 48% (from 2000 to 2018), and this tendency is expected to increase further. The increasing share of female physicians is not consistent in medicine; some medical specialties are more affected by feminization, like family medicine. According to the data from NIHIFM, the proportion of

women GPs in Hungary with a territorial supply obligation was 51.4% in December 2004, which increased to 57.4% by December 2020.

The importance of physician's gender in healthcare

The physician's gender can influence the effectiveness of care in primary health care, which effect is manifested mainly in primary and secondary prevention activities. Female primary care physicians are prone to provide more preventive services, and they rather adhere to chronic disease guidelines compared with their male counterpart. Moreover, they achieve better intermediate treatment outcomes for HbA1c and cholesterol levels, as well as blood pressure.

Several arguments could explain the observed differences among genders. Accordingly, female physicians more frequently apply patient-centred care approach. They are more likely to discuss psychosocial issues during a consultation and effectively facilitate the participation of patients in the medical exchange. Moreover, female physicians tend to spend more time with their patients. Others emphasize the importance of patient-centered communication style as well as empathy, which is a well-known feature of women. An enhanced level of empathy is associated with enhanced patient compliance and more favorable healthcare outcomes. In addition, it can also influence career choices, individuals who have a higher level of empathy seem to prefer the family medicine specialty.

The association between the physician's gender and the effectiveness of the services is well described in many settings, however, there is insufficient information on the size of the effect and how gender actually influences the care practice.

Hungary is ideal to investigate the details of gender effects at the primary care level. The country has a high share of female physicians of general medicine and paediatrics (55.9% in 2015). The primary care is particularly affected, 56.2% of GPs were women in 2017. According to experiences from other countries, the gender of the GP can be considered as a possible factor influencing the performance of GMPs in Hungary, however, there is no available data about the details of gender effect in Hungarian primary care.

Primary care in Hungary

The primary care is expected to use the resources in a cost-effective way and achieve public health goals. The Hungarian healthcare system is based on compulsory health insurance with universal coverage. GPs working in primary care receive capitation payments, so the financing is based on the number of insured persons registered in the GMP. According to the

Primary Health Care Activity Monitor for Europe (PHAMEU) and other studies which were concentrating on the quality of primary care, the performance of the Hungarian PHC system is poor, which confirms that the use of financial incentives in national practice is reasonable.

Primary care services are delivered by GPs who are working in solo practices, that is one GMP is operated by one GP with continuous availability. By contrast, the services are provided by temporary GPs in vacant practices. Patients can choose and change their primary care provider without any restriction.

Indicator-based performance assessment of primary health care providers

A nationwide integrated system of primary healthcare indicators was founded in 2009. The National Institute of Health Insurance Fund Management was aimed to improve the efficiency of healthcare, providing financial incentives for those GPs who are able to reach the predefined target values. The IT network and financial background for performance monitoring were established, and the regular assessment of performance with financial consequences was accepted by GPs. The target values are determined by the NIHIFM, taking into account the regional location (counties and Budapest) and the settlement type (rural or urban) of GMPs. The fee per score budget is the ratio of appropriations to the nationwide level of aggregated scores of GPs entitled to remuneration. In 2010, about 1.7% of the total healthcare funding was intended for this issue, and this was increased continuously to 4.5% in 2016. Although the determined target values reflect the goals of health policy, just the most effective 25% of all practices is able to meet the required levels. The monitoring is exclusively based on process indicators to evaluate the quality of care.

OBJECTIVES

A nationally integrated PHC indicators system was developed by NIHIFM in 2009, in order to improve the primary health care in Hungary. Although monitoring systems require continuous upgrading because of the needs of patients, providers, and funders, the indicator system has not yet been evaluated and adjusted. Moreover, the identification of confounding variables, which need to be incorporated in indicator development, has also not been carried out yet. The current assessment ignores the socio-demographic and structural characteristics of the GMPs (only the county and the type of settlement are taken into account in defining the target value).

The increased female participation in health care can have consequences for the organization of health care, regarding the differences in performance in the care practices of the two gender. However, we do not have information on how the gender of the GP in Hungarian practice affects the quality of care. The objectives of our studies were:

1. to analyze the performance of primary care practices across PHC indicators,
2. to examine the variability in performance across GMPs with respect to various patient characteristics (age, gender, relative education) and practices (type of settlement, size of GMP, region of GMP, and vacancy),
3. to describe the characteristics of patients and practices by gender of GP,
4. to analyze the performance of primary care practices across certain PHC indicators by the gender of the GP,
5. to examine the relationship between GP gender and the quality of primary care,
6. to estimate the population-level impact of the gender effect.

METHODS

Study design

A nationwide cross-sectional study was performed to assess the effect of patient and GMP characteristics on PHC indicators in Hungary. NIHIFM provided the data for the analysis for the investigated years. This study included all general medical practices providing primary care for adults. The study population was adults registered in all GMP by gender and 5-years age groups. The study protocol was reviewed and permitted by and performed in concordance with the Internal Data Safety and Patient Rights Board of the NIHIFM. (E01/317-1/2014.)

The second study covered all GMPs providing primary care for adults in 2016 in Hungary. The study population was the same, adults registered in GMPs by gender and 5-years age groups. GMPs without a permanent GP (vacant practices) during the investigated period (5.71%, N=277) were excluded, so demographic data of 7 207 186 clients were analyzed. The analysis aimed to measure the influence of GPs' gender on process indicators in primary care.

Characteristics of patients, GMPs, and physicians

All variables in the analyses were provided by NIHIFM. Adult patients registered in each GMP were used in the models by gender and 5-year age groups.

The relative education (standardized educational ratio) was used to express the educational attainment of patients and thereby to determine the socioeconomic status of patients enrolled in the study. The indicator was calculated using 2011 Hungarian Census data as gender, age groups, and residence specific data, which was provided by the Hungarian Central Statistical Office. The age- and gender-standardized educational index was calculated to reflect the relative education of inhabitants compared to the national reference level, adjusting for the differences due to different demographic structure. This settlement-specific indicator can be used to indicate the educational level of the given practice providing care for one settlement. In GMPs provided care for patients from more settlement, a weighted settlement-specific variable was used to express the relative education.

GMPs were categorized through the practice size (number of people registered in each GMP), and types of settlement, county of GMP, and actual occupancy of GMPs. The age of the physician was used as a continuous variable in the analysis, and the male gender of GP was used as the reference in the models.

Primary healthcare indicators

Twelve indicators were used to assess adult PHC. Primary care indicators assess the performance of GP practice for one year (24 months for mammography, 6 months for referral practice) retrospectively. The following indicators were evaluated: influenza immunization; screening mammography; proportion of patients with hypertension aged 40 to 54 years; proportion of patients with hypertension aged 55 to 69 years; serum creatinine measurement; lipid measurement; beta-blocker application among IHD patients; HbA1c measurement; ophthalmological examination; management of chronic obstructive pulmonary disease (COPD); referral rate to secondary care; and use of antibiotics.

Among the above-mentioned indicators, we investigated the indicators for the professional guideline-based care could be clearly determined (e.g. it was possible to estimate the number of missed care events). Thus, our analysis for 2016 did include neither indicators related to the prevalence of hypertension nor indicators of referral care and antibiotic use.

A composite indicator was calculated to indicate the proportion of patients who received guideline recommended care by summarizing the number of care events and the number of people in target groups by indicator.

The investigated process indicators always reflected the proportion of patients who received the care in the given period.

Statistical analysis

Pearson Chi-Square test was used for categorical and two-sample t-test for continuous variables in descriptive analysis of data.

The hierarchical structure of data required to use of multilevel regression models. Multilevel logistic regression models were used to evaluate the association between the age, gender, and relative education of patients, practice size, the status of vacancy, types of settlement, geographical location, and the performance of GPs. In order to assess the effect of the GP's gender on performance, the models were controlled for age, gender and relative education of patients, age of the GP, and characteristics of GMPs (size of practice, types of settlement, county of GMP).

Odds ratios (OR) with the corresponding 95% confidence intervals (CI) and intra-class correlation coefficient (ICC) were calculated. The goodness of fit of the regression models was tested by Hosmer-Lemeshow test.

To examine the consistency of the relationship between the practice characteristics and the performance achieved in each practice, we also performed the analyses of the available databases for the period 2012-2014.

Missed care events were calculated to estimate the impact of GPs gender at the population level. The number of expected care events was calculated for practices performed by male GPs using the demographic composition of patients. Based on the difference between the observed and expected numbers in the practices performed by male GPs, we determined the relative excess/deficit in the number of care events and the relative proportion of missed events compared to the care practices of female GPs.

The result of the statistical analysis was considered significant at $p < 0.05$. The statistical analyzes was performed using STATA IC version 13.0 software 0 (GLLAMM, Generalized Linear Latent And Mixed Models).

RESULTS

Characteristics of the study population in 2015

The number of all GMPs provided primary care for adults was 4845 in 2015. The total number of insured adults was 7 491 888, and the share of male and female adults registered in GMPs was 46.66% (N = 3 495 760) and 53.34% (N = 3 996 128).

Two-thirds of GMPs operated in urban areas (66.36%, N = 3215). The medium-sized GMPs were most common; 31.7% (N = 1538) of practices provided services for 1201–1600 patients and 29.8% (N = 1444) of GMPs for 1601–2000 patients. Almost 20% of all GMPs provided healthcare for more than 2000 clients, while the registered number of clients was less than 1200 patients in 19% of GMPs (<800: 3,9%; or 801–1200: 14,82%). Approximately 5% of GMPs were vacant during the study period, while the distribution of vacant practices showed significant territorial heterogeneity across different regions of the country.

Proportion of patients received the care in 2015

The proportion of patients who received care was between 12.58% (12.56%–12.61%) (referral rate) and 77.69% (77.57%–77.81%) (HbA1c measurement) across investigated PHC indicators.

Effect of characteristics of patients and general medical practices on primary healthcare indicators

The variation attributable to GPs as a grouping factor was low after adjusting for patients and GMP characteristics (ICC: 0.77% to 17.95%). The indicators of the proportion of patients with hypertension aged 55 to 69 year-old (ICC = 0.77%) and the proportion of patients with hypertension aged 40 to 54 year-old (ICC = 0.86%) had the lowest coefficients. The ICC was not higher than 10% in most indicators, and the proportion of variability explained by the patient-level factors was the lowest for influenza vaccination (ICC = 17.95%).

According to the multilevel regression analysis, the age and gender of patients had a significant effect on performance. The relative education was associated with 10 out of 12 indicators. A higher level of education was positively associated with indicators of chronic disease management (COPD: OR = 4.17 (3.21–5.42), HbA1c measurement: OR = 3.35 (2.58–4.36), serum creatinine measurement: OR = 2.78 (2.35–3.29), lipid measurement (OR = 2.73 (2.28–3.26)), ophthalmological examination: OR = 2.22 (1.88–2.63), mammography screening: OR = 2.00 (1.66–2.41) and influenza vaccination: OR = 1.69 (1.16–2.46)). The urban settlement type had a significant relationship with nine indicators. Providing care in

urban settlement increased the quality of care mostly for lipid measurement (OR = 1.25 (1.21–1.29)), HbA1c measurement (OR = 1.24 (1.19–1.3)) and serum creatinine measurement (OR = 1.23 (1.19–1.27)). The county of GMP was identified as a determinant of variations, but the direction of the effect was not consistent. All counties were positively associated with the proportion of patients with hypertension aged 55 to 69 years. The vacancy and size of GMP had a significant effect on a few indicators. Vacancy of practices showed a negative association with immunization against influenza, mammography, antibiotic use and referral rate. Patients of smaller practices were less likely to be redeemed antibiotics. Larger GMPs showed a significant relationship with higher patient participation in mammography screening.

Similar results were found by analyzing the data of previous years where most of the above mentioned variables showed a stable relationship with performance in practices between 2012 and 2015. The value of the indicators in the practices also proved to be stable over time from year to year, taking into account the investigated practice characteristics.

Characteristics of GMPs by the gender of GP in 2016

The share of physicians was 48.4% (N=2213) female and 51.6% (N=2362) male ($p < 0.001$) in the investigated 4575 GMPs providing care for adults. Female GPs were found to be younger (55.3 years vs. 57.8 years, $p < 0.001$), under 55 years the female GPs (N=945 (42.7%) vs. N=842 (35.6%)), and above 65 years male GPs were overrepresented (N=699 (29.6%) vs. N=456 (20.6%)). Female physicians were more likely to practice in urban settlement (75.8% vs. 62.0%; $p < 0.001$) and practice in smaller GMPs (<1200 patients: 17.3% vs. 16.5%; $p < 0.001$). A higher proportion of female patients (54.6% vs. 52.31%; $p < 0.001$) and higher relative education of patients (1.026 vs. 0.989; $p < 0.001$) were observed in practices with female GPs.

Proportion of patients received the care by gender of the GP in 2016

There were significant differences among male and female physicians in the proportion of patients who received care. Serum creatinine measurement (70.9% vs. 66.5%), lipid measurement (64.5% vs. 59.7%), and HbA1c measurement (80.6% vs. 76.8%), eye examination (41.3% vs. 38.2%), and mammography (46.7% vs. 44.8%) were more likely to be implemented among patients of female GPs. Patients with COPD were more likely to be managed properly (79.1% vs. 77.3%). Although there was significant difference in

immunization against influenza, the difference was small (20.1% vs. 19.9%). IHD patients of male GPs were more likely to receive beta-blockers (52.3% vs. 53.5%).

Effect of the gender of GP on primary healthcare indicators

Female GPs were more likely to provide care in case of diabetes and hypertension related indicators according to the guidelines (HbA1c measurement: OR=1.18, 95%CI (1.14-1.23), serum creatinine measurement: OR=1.14, 95%CI (1.12-1.17), lipid measurement: OR=1.14, 95%CI (1.11-1.16), eye examination: OR=1.06, 95%CI (1.03-1.08)), mammography screening (OR=1.05, 95%CI (1.03-1.08)), management of COPD (OR=1.05, 95%CI (1.01-1.09)), and the composite indicator (OR=1.08, 95%CI (1.07-1.1)). GP gender showed no association with influenza immunization and beta-blocker application. The proportion of total variability attributed to GP varied between 2.4% and 17.9% across the indicators after controlling for characteristics of patient, GP, and GMP.

Population-level impact of GP's gender

Overall, 5.9% (5.77% - 6.02%) of missed care events were attributed to the male gender of GP, which corresponds to 144 871 events during the investigated year. Restricting exclusively to indicators which showed a significant relationship with physician gender (excluding influenza immunization and beta-blocker usage), the number of missed events was 144 373. The highest relative deficit was estimated for lipid measurement (AP = 7.93% (7.71% - 8.16%)), while the lowest AP was observed for influenza immunization (AP = 0.97% (0.49% - 1.44%)) compared to the GMPs with female GPs. Serum creatinine measurement (AP = 6.4% (6.18% - 6.61%)), ophthalmological examinations (AP = 8.04% (7.4% - 8.67%)) and HbA1c measurements (AP = 5.09% (4.65% - 5.54%)) accounted for a significant proportion of missed care interventions which was attributed to the male gender of GPs. Mammography screening were not performed for 4.36% (4.00% - 4.71%) of women in the 45-65 age group, while pulmonary function testing in COPD was missed for 2.33% (1.61% - 3.04%) of patients if the GP was male. Only beta-blocker usage among IHD patients showed excess care events which were attributable to male gender of physician (AP=2.42% (1.53% - 3.31%).

DISCUSSION

The impact of patient and organizational factors on performance

The variability observed in performance between GPs mainly arose from age and gender composition and education of patients, and settlement type and county of GMPs, which factors are beyond the physician's control. The proportion of total variability which could be attributed to GP varied between 0.77% (Hypertension prevalence among 55–69 year-old patients) and 17.95% (Influenza immunization) across the process indicators after adjustment for characteristics of the patient and general practice.

Our results underscored that patient characteristics (age, gender, educational level) are contributed to the variability in performance. The education was identified as a determining factor of the efficiency of chronic disease care, especially in hypertension and diabetes, which is in line with the literature. Accordingly, those with a higher level of education are more likely to avoid health-risk behaviors and tend to participate in preventive examinations.

The type of settlement of GMP had a significant impact on most indicators, thus taking into account in the assessment is justified. Variability in performance was also recognized across counties. Since a central goal of health policy is to reduce inequalities in health via decreasing the unjustified disparities in healthcare services, regions with low performance should deserve special attention in PHC management. The geographical location and settlement type of GMPs are constant variables, therefore the observed variety in the effect's direction might be explained by rather changes in the legal, financial and organizational environment.

The size of GMP was associated with a limited number of indicators, which underlines that there is no uniform solution on ideal GMP size to reach the optimal healthcare outcomes in general. The vacant status of GMP had limited importance in respect of PHC indicators in our study.

GP's age was associated with quality of care in most indicators. GPs' older age was found to be a risk factor for lower quality of care.

GPs' gender as a determinant of quality of care

Physicians play a significant role in influencing patient's participation in screening programs and examinations related to chronic diseases. According to our results, HbA1c, serum creatinine, and lipid levels of patients were more likely to be measured among female GPs' patients. Ophthalmological examination and pulmonary function testing were also completed

more often among them. In addition, gender concordance (female patients with female GPs) had a positive impact on screening mammography. The gender had no impact on influenza immunization and IHD management.

The size of this gender was found to be remarkable. Among patients of male GPs, approximately 144 000 care events were missed per year due to the gender effect in total. Primarily, missed lipid and serum creatinine measurements were responsible for this shortage. Secondary, but still considerable extent of missed care interventions was attributed to HbA1c measurements, ophthalmological examinations, and breast cancer screening tests.

Others found that both the frequency of HbA1c testing and the proportion of patients with appropriate target values were higher among patients of female physicians. Moreover, several studies have found that the gender of the physician is associated with the management of hypertension. Female GPs are prone to achieve both blood pressure and lipid target levels more frequently and control more intensively. They are focusing better on cardiovascular risk factors.

Implication of findings

Our findings suggest the adjustment for characteristics of patient and GMP. In order to ensure a more precise performance assessment, further research involving a wider range of factors beyond the control of physicians is essential. There may be more factors at patients and GMP-level which could contribute to the variability and remain unexplained in our research.

Our findings confirmed that exploring the details and mechanisms behind the gender effect requires further consideration in order to develop the targeted interventions. Patients with diabetes in an early phase may be more cooperative with a female physician. Nevertheless in a more advanced phase of the disease progression, realizing the possibility of severe consequences, they seem to be more sensitive to the guidance of male GPs. Accordingly, the onset and duration of the disease as well as the complex needs of patients, could further alter the observed gender effect. Furthermore, it would be worthwhile to explore the impact of gender on performance indicators which differs by the type of patients' health problems and their preferences.

Our study provides an opportunity for extension, as analysis of outcome indicators related to the care of patients with chronic disease is required to more accurately assess the public health significance of gender effect.

A possible way of quality improvement in primary care is to raise awareness of the importance of gender effect and the causes in the background. Our results indicate the significance of interventions targeting communication skills of medical students and physicians and also changing the attitude of GPs.

Acquiring practical knowledge of how communication skills and empathy can affect the quality of provided services in clinical practice can promote the development of a patient-centered care environment.

Teaching patient-oriented communication skills enhances the competency of medical students, patient satisfaction, and health outcomes. Therefore, it is widely recommended to include the training of effective communication skills in the medical school curriculum. Furthermore, it is recommended to add the gender-related attitudes and behavioral characteristics to the scope of this training.

Recommendations

A good indicator can be used to motivate physicians to change their unfavorable provision habits. Nevertheless, if the performance assessment has no benefit for the GPs, because the positive effects are covered by patient and GMP characteristics, eventually it could lead to the lack of interest in the system. Omitting the complexity of indicators causes unequal distribution of available resources, leaving areas without compensation where the GPs are working under difficult circumstances. Adjusted indicators allow measuring more accurately the physician's personal contribution. Moreover, they can also allow more efficient use of incentives, as well as more equitable and effective use of resources in PHC.

Using crude primary care indicators can provide information about professional guidelines that have been implemented. This type of approach is not suitable for the comparative assessment of GP's performance. Considering that the motivation of GPs could be increased by presenting them their real performance, the elimination of the influence of factors beyond the control of GPs can be used for motivation enhancement.

The gender of physicians had a significant impact on the quality of care, emphasizing that the gender-related communication style and attitude should be considered as influencing factors of the quality of provided services. Since the communication techniques can be learned, the scope of medical training should be completed with specific gender-related communication and behavioral features.

Given the observed feminization of the medical workforce in Hungary and other countries as well, a more accurate assessment of gender differences and the underlying causes is needed. Further investigations should involve a wider range of clinical and non-clinical factors.

NEW FINDINGS

The proportion of total variability attributed to physician was found to be relatively low (<18%) across process indicators.

After adjusting for characteristics of the patient and general medical practices, the proportion of total variation attributed to the physician varied between 0.77% and 17.95% by indicators.

The socio-demographic features (age, gender, and education), settlement type and regional location of GMP were significantly associated with GP's performance.

The age and the gender of patients were associated with all indicators. A higher level of education was related to better chronic disease management (COPD: OR=4.17 (3.21–5.42), HbA1c measurement: OR=3.35 (2.58–4.36), serum creatinine measurement: OR=2.78 (2.35–3.29), and lipid measurement: OR=2.73 (2.28–3.26), ophthalmological examination: OR=2.22 (1.88–2.63)), screening mammography (OR=2.00 (1.66–2.41)) and influenza vaccination (OR=1.69 (1.16–2.46)). Providing care in the urban area increased the performance for lipid (OR=1.25 (1.21–1.29), HbA1c (OR=1.24 (1.19–1.3), as well as serum creatinine measurement (OR=1.23 (1.19–1.27)). The county of GMP was also found to be a determinant of variability.

Although the use of crude primary care indicators can provide information about professional guidelines have been implemented, this type of approach is not suitable for the comparative assessment of GP's performance.

A significant association was found in all performance indicators with gender and age of the patients, while the relative education showed association with 10 out of 12 indicators.

Adjusted indicators allow to measure the physician's personal contribution more precisely, and they can also allow more efficient use of incentives, as well as more equitable and effective use of resources in primary healthcare.

Female gender of GP can be identified as a predictor of receiving a higher quality of care in respect of mammography screening and chronic disease management. Accordingly, incorporating attitude and communication techniques related to the female gender in medical training is highly recommended.

The female gender of GPs showed relationship with higher rates of hypertension and diabetes care related examinations (HbA1c measurement: OR=1.18 (1.14-1.23), serum creatinine

measurement: OR=1.14 (1.12-1.17), lipid measurement: OR=1.14 (1.11-1.16), eye examination: OR=1.06 (1.03-1.08)), mammography screening (OR=1.05 (1.03-1.08)), and management of COPD patients (OR=1.05 (1.01-1.09)).

The population level impact of GPs' gender were estimated, showing that a relative high proportion of care events were missed due to the male gender of physician, particularly in laboratory investigations.

According to our estimation, 59 723 lipid measurements (7.93% (7.71% - 8.16%)) and 52 130 (6.4% (6.18% - 6.61%)) serum creatinine measurements (out of 144 871 missed care events) loss among patients of male GPs in Hungary.



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List of publications related to the dissertation

1. **Kovács, N.**, Pálincás, A., Sipos, V., Nagy, A. C., Harsha, N., Kőrösi, L., Papp, M. C., Ádány, R., Varga, O., Sándor, J.: Factors associated with practice-level performance indicators in primary health care in Hungary: a nationwide cross-sectional study.
Int. J. Environ. Res. Public Health. 16 (17), 1-15, 2019.
DOI: <https://doi.org/10.3390/ijerph16173153>
IF: 2.849
2. **Kovács, N.**, Varga, O., Nagy, A. C., Pálincás, A., Sipos, V., Kőrösi, L., Ádány, R., Sándor, J.: The impact of general practitioners' gender on process indicators in Hungarian primary healthcare: a nation-wide cross-sectional study.
BMJ Open. 9 (9), 1-9, 2019.
DOI: <http://dx.doi.org/10.1136/bmjopen-2018-027296>
IF: 2.496

List of other publications

3. Franco, N. H., Batista, S. M., **Kovács, N.**, Nagy, A. C., Thiên, B. Q., Reis, F., Varga, O.: Assessing Scientific Soundness and Translational Value of Animal Studies on DPP4 Inhibitors for Treating Type 2 Diabetes Mellitus.
Biology (Basel). 10 (2), 1-18, 2021.
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