

SHORT THESIS FOR THE DEGREE OF
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**Workforce crisis in the Hungarian
primary health care:
in a longitudinal follow-up study**

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I. INTRODUCTION

Primary care is the first meeting point for the population with the healthcare system, serving a key role in the fields of appropriate health promotion, disease prevention, curative and rehabilitation services, pursuant to the policy consensus of the Alma-Ata Declaration. As a locally available provider, primary care is able to grant the widest accessibility to healthcare services. With the adequate efficiency, it is also able to significantly contribute to dismantling social inequalities. These capabilities were emphasized by the 2018 Astana Declaration, which noted that strengthening primary care is the most efficient way of achieving and maintaining physical and mental well-being while also contributing to the sustainability of a fully comprehensive healthcare system. A 2020 study by the OECD states the following: strong primary care (1) may reduce the unreasonable resource usage of more costly healthcare services and improve the efficiency of the healthcare system; (2) it may improve the population's health status indicators and the capability of the healthcare system to react to the population's needs; (3) it may improve equal access to the healthcare system. In the light of the above it is paradoxical that primary care does not receive sufficient attention in the vast majority of countries, even though its significance has been known for a long time. The prevalence of this phenomenon is substantiated by the fact that primary care systems around the world struggle with exacerbating workforce shortages, especially in the case of providers operating on the periphery of the healthcare system.

Since the workforce crisis reduces the output capacity of primary care, it has an extraordinarily adverse effect on the health indicators of the

population receiving insufficient care; furthermore, it increases the rate of emergency and hospital treatment, and the rate of avoidable mortality.

Numerous factors affect the performance of primary care, among others the composition, capacity and authority of the workforce, the level of coordination, the evaluation and incentivisation of performance, and the available financial and infrastructural conditions. This research has attempted to examine the changes in the general practitioner (GP) and paediatrician supply in the past decade from some of the aforementioned aspects.

Considering the number of its population and the fact that the workforce crisis in primary care unfolded over a time span (the past decade) that can be examined well, Hungary proved to be an ideal ground for a research aiming to introduce the inception and exacerbation of a countrywide workforce crisis.

II. LITERATURE REVIEW

II.1. The global state of workforce supply in healthcare

The critical workforce shortage in healthcare has been a global phenomenon for decades. In 2006, the WHO pointed out 57 countries where the number of health professionals was insufficient to meet the necessary requirement for basic healthcare provision (2.28 professionals/10.000 persons). According to estimations this meant the shortage of 2.4 million doctors, nurses and midwives. The shortage may be further exacerbated with time and the increasing population. In 2013, 83 countries were not able to meet the same threshold according to the WHO. The study estimated a global shortage of 7.2 million professionals and prognosticated a 12.9 million shortage by 2035.

II.2. The global state of workforce supply in primary care

Although the critical workforce shortage covering the entire spectrum of healthcare is primarily characteristic in low- and middle-income countries, the workforce crisis in primary care has become an evident tendency in high-income countries as well. Key factors like financing, workforce composition, responsibilities and degrees of authorization to organize healthcare provision vary in primary care systems, making the comparison of processes in different countries limited. On the international level we cannot speak of a homogenously defined field. However, for the sake of being comprehensible I will be using the GP nomenclature in all cases.

Primary care workforce supply in developing countries

Working as a doctor in primary care requires different training and qualifications in different countries. The Asia-Pacific and the Sub-Saharan region in Africa are two characteristic fields of developing countries. Here, the shortage of doctors is severe in primary care; the available workforce is often low-qualified and low-paid. The shortage of doctors is more pronounced in the underdeveloped regions, creating significant inequalities in access to healthcare services.

Primary care workforce supply in developed countries

Due to ageing populations and increasing need for healthcare services, the commonality between the examined healthcare systems is the ever-growing strain on primary care coupled up with an increasing workforce demand. Tackling these issues is a serious difficulty in all examined countries.

Among these countries it is the USA that devotes the most resources, approximately 17% of its GDP to healthcare. Despite these efforts a significant shortage of doctors is to be expected in primary care; an issue mainly due to demographic changes and expanding services resulting in higher workforce demand. Estimations in 2015 prognosticated a shortage of 33.238 doctors by 2035, that is, unless the capacities of resident training are expanded in primary care.

The lack of GPs in the United Kingdom is correlated with doctors leaving their profession or retiring and taking on fewer working hours. The growing workforce shortage is typical in the entire country; in 2016, England alone was approximately 6.500 GPs below the ideal figure. The workforce distribution is uneven; the most severe shortages are found in

the most deprived regions of the UK. In 2008, the ‘Equitable Access to Primary Medical Care’ program was, resulting in the improvement of GP supply in the most deprived areas.

In Germany the GP shortage is mostly typical in rural practices on the peripheries of the healthcare system. In 2017, the Federal Ministry of Health launched a program that aims to (1) develop medical school curriculums from a practical aspect, and (2) incentivise work in rural areas. Due to the program, federal states may grant 10% of medical school positions to those who agree to work in rural or reduced capacity areas of primary care for at least 10 years following their graduation.

II.3. The situation of GPs and primary care in Hungary, the main factors affecting the state of workforce

Examining three dimensions of healthcare, namely control, economic conditions and the state of workforce, primary care in Hungary displays characteristics of the European average, however, coordination and the range of healthcare services are deemed to be poor. According to the study of Schäfer and his colleagues, the time Hungarian GPs dedicated to curative care increased by 10.1%, while time spent on preventive care decreased by 52.2% between 1993 and 2012.

In Hungary, more than 97.5% of GPs with local provision obligation are self-employed contracted to the National Health Insurance Fund Manager. They operate through capitation-based insurance coverage, which, given certain conditions, is alienable and resumable. Their workforce is organized on a practice-by-practice level, usually on a 40 hour/week basis. Their main responsibilities include primary and secondary preventive care, the treatment of most acute, non-emergency

level diseases and chronic, non-communicable diseases; furthermore, they take part in primary emergency-level treatment and the fulfilment of certain official duties. An average practice serves approximately 1550–1600 reported persons. Paediatric practices are typically somewhat smaller, while adult practices are somewhat larger. Smaller settlements usually have one provider; in cases of settlements with a population lower than 1000 persons, a single practice often operates at multiple locations. In these areas the organization and provision of primary care is more vulnerable, as they depend on the presence or absence of a single GP.

In the decade examined, the population of Hungary decreased by 2.7%, however, the rate of elderly population (65 years old and above) increased by 13.9%. The strain put on the healthcare system and primary care is tightly connected with the ageing population, this is clearly indicated by the fact that the number of chronic, non-communicable diseases significantly increased in the past ten years.

Although approximately one fourth of graduating doctors should be incentivised to replace the ageing and retiring GPs in primary care in the following decade, this career model does not receive sufficient emphasis in medical education. The annual number of qualified graduates provides an accurate picture regarding the GP supply; between 2015 and 2019, this figure has barely reached 100–120 persons per annum. Examining the paediatrician supply is more complicated due to the complex qualifying exam (also encompassing infant medical care), however, the fact that primary care practice only takes up 2 of the total 60 months in paediatric education indicates the lack of primary care

focus. The preference of young doctors for working in Budapest or other major cities is concerning with regard to the GP supply of deprived rural areas.

For decades, GP services in Hungary have been based on individual practices where one doctor and one nurse serve as providers. In an experiment between 2012 and 2017, this model was challenged by the Public Health Focused Primary Care Model Programme supported by the Swiss Contribution. The Programme created GPs' clusters in four disadvantaged subregions with the cooperation of six respective GP practices, involving local health visitors as well as dietitians, physiotherapists, public health professionals, community nurses, health psychologists and health mediators. The Programme's main objective was to shift the traditional focus of GP services from patient care towards a more community-oriented primary care, which is able to provide meaningful public health services as well. Due to the Programme's success, the Hungarian government decided in 2018 to expand the model and started to gradually disseminate the GP cluster structure. In 2021, a new decree created the legal framework for the nationwide expansion of GP clusters. By April 9th 2021, 85.6% of practices had successfully joined one of the GP clusters.

III. RESEARCH AIMS

The objective of the research is to examine the changing numbers and distribution of unfilled practices as well as GPs and paediatricians operating through capitation-based insurance coverage with regard to age, sex and geographical distribution. The research focuses on a decade marked by the inception of workforce crisis; it also pays special attention to the socio-economic conditions and mortality of the served population. The research aims to identify ongoing and expected developments that have definitive effects on primary care; it then attempts to suggest solutions to the identified problems.

IV. MATERIALS AND METHODS

The research focuses on GPs operating through capitation-based insurance coverage, on practices operated by them, and on the served population, regarding the changes in the field between 2007 and 2017. The research also examines the effects of unfilled practices on the populations' premature mortality rates between 2006 and 2014.

IV.1. Data analysis of the changes related to GPs and practices

During the studied period, the data provided by the National Health Insurance Fund Manager on the 1st of each year was analysed. The number and status of practices, the number, age, sex and sex distribution of GPs were examined. The changes were compared based on practice types as well. The average age and age distribution of GPs, as well as the secular variations of the above were analysed. In a system with ideal distribution GPs with right of practice fulfil their duties without hiatus between the ages of 27 and 64, while their age distribution is uniform. Utilizing population pyramids, the actual number and distribution of doctors by age groups were analysed and compared with the ideal distribution.

IV.2. Characterizing the extent of deprivation, mapping of vacant practices, association between the served area's deprivation indices and vacant practices

In order see the relationship between the distribution of unfilled practices and the socioeconomic status of the affected settlements, association analyses were carried out. The socioeconomic status was characterised by the deprivation index, an area-based composite indicator at the municipality level. The deprivation index was built from

seven different indicators: income, the level of education, the rate of unemployment, the rate of one-parent families, the rate of large families, the density of housing, and car ownership. Data needed for the index were provided by the Hungarian Central Statistical Office and the Hungarian Tax and Financial Control Administration. The development of the deprivation index was carried out by using principal component analysis. All variables were first transformed by using the natural log-transformation and then standardised. Settlements with higher index values are municipalities with a lower socioeconomic status. This method to calculate deprivation index values has been published and successfully used in several studies before. The same or similar approaches measuring socioeconomic status have also been applied in studies carried out in out all over Europe.

A hierarchical Bayesian binomial model was used to predict the relative vacancy ratio at the municipality level. The data consisted of the observed number of practices with unfilled GP posts and total number of practices for each municipality. The utilized Bayesian hierarchical convolution model incorporates both a heterogeneous and spatially structured random effect. The parameters for the spatial model were estimated via Integrated Nested Laplace Approximations (INLA) directly in R using the package INLA. The relative vacancy rate and exceedance posterior probabilities were examined. Using the Rapid Inquiry Facility, the association between deprivation and vacancy for GPs was calculated. Relative frequencies of vacancy in relation to the national average were calculated by deprivation index quintiles. χ^2 tests for homogeneity and for linear trend were also carried out to test the global association of the deprivation index and the vacancy.

Processes in GP care were examined with regard to the deprivation status of the settlements. We also focused on uncovering the effects of the settlements' socioeconomic status on unfilled practices, the migration of doctors, and the number of the underserved population.

IV.3. Educational level of the served population, the age of GPs, mapping the association between vacant practices and premature mortality

In a different research covering all the vacant adult and mixed practices from 2006 and 2014, we investigated if there was an association between the educational level of the served population and vacant practices/premature mortality; between the age of GPs and premature mortality; between vacant practices and premature mortality. The study population for each year was defined as all adults 18–64 years old who had not changed GPs in the 5 years prior to the investigated year; the number of deaths by any cause was counted for each year. The administrative database of the National Health Insurance Fund Manager used for the analysis did not contain client-specific data.

The socioeconomic status of the population receiving care at each practice was approximated by gender- age-standardized relative education (rEDU). For general medical practices providing care for more than one settlement, the weighted settlement-specific rEDU was calculated. The proportion of vacant practices was examined among practices serving populations above the median standardized educational level. The aggregate risk of premature mortality was examined according to the age of GPs, the vacancy of practices and the educational level of the population.

Age- and gender-specific standardized mortality ratios (SMR) were calculated in an annual, practice-based manner. National, stratum-specific reference rates of mortality were calculated based on gender and age groups for the indirect standardization. Annual and practice-specific expected number of deaths was determined by age- and gender-specific mortality rates and the demographic composition of served adults in practices. SMRs were determined as quotients of observed and expected deaths.

Multiple linear regression models were used to analyse the associations between year-specific practice parameters and standard mortality rates normalized by Box-Cox transformation. Linear regression coefficients and standardized linear coefficients were computed to ensure direct comparability between the effect sizes of risk factors. Statistical analysis was performed by PASW Statistics 18.

Besides the linear regression coefficients, standardized linear regression coefficients were computed in order to describe the comparative effect sizes of risk factors (relative educational level of the served population; the age of GPs; vacancy of practices). Semipartial correlation coefficients were computed to estimate the impact of explanatory factors on premature mortality.

V. RESULTS

V.1. Changes regarding GPs and practices

In the studied period the number of GPs continuously decreased in all practice types. This process was accompanied by the increase of GPs' average age and the increasing rate of female practitioners. The geographical distribution of vacant practices shows correlation with the level of deprivation in the affected areas. Migration of GPs from deprived to less deprived areas was clearly observed.

Changes in the number of GPs and practices

At the beginning of the studied period there were 6427 obligation to provide in-area primary care practices serving the population, and at the end of the period only 6350 remained. This means that the number of practices decreased by 77, approximately by 1.2%. This reduction is mainly due to a decrease in paediatric (−50) and mixed (−32) practices, meanwhile the number of adult practices slightly increased (+5). At the beginning of the studied period there were 6247 GPs, ten years later there were only 6003. The number of GPs working in primary care practices significantly decreased in all practice types, mainly in mixed (−109 GPs; −7.7%) and paediatric (−99 GPs; −6.5%) practices, and less intensively in adult practices (−36 GPs; −1.1%). This resulted in an overall 3.9% decrease regarding the number of GPs in obligation to provide in-area primary care by the end of the decade.

Changes in the number of vacant practices

In a decade, the number of vacant practices nearly doubled (increasing from 180 to 347), in other words, 5.46% (95% CI 4.91 to 6.02) of all practices became vacant. The chronic workforce shortage is aptly

illustrated by the number and rate of practices unfilled for more than a year. Their number nearly tripled (increasing from 81 to 240) as their rate increased from 45% to 69.16%. The vacancy rate significantly increased in all practice types. The vacancy rate in mixed practices was significantly higher (8.03%, 95% CI 6.61 to 9.44) compared to other practice types even in 2007, and due to the highest level of increase the vacancy rate rose to 14.63% (95% CI 12.70 to 16.55) by the end of the decade. Initially, the vacancy rate of paediatric practices was only 1.44% (95% CI 0.84 to 2.04) which then increased to 4.98% (95% CI 3.85 to 6.11) by the end of the studied period. The least amount of change occurred in the case of adult practices; their vacancy rate only increased from 1.36% (95% CI 0.96 to 1.75) to 2.62% (95% CI 2.08 to 3.17).

Changes in the age distribution of GPs

The GP workforce significantly aged during the studied decade. This is primarily true for paediatricians, whose average age increased by 5.4 years ($p<0.001$). The average age of GPs in mixed practices increased by 4.2 years ($p<0.001$), while the average age of GPs in adult practices rose by 3.7 years ($p<0.001$). On January 1st 2017, the average age of paediatricians was 59.5, the average age of GPs in adult practices was 57, and the average age of GPs in mixed practices was 56.4.

By comparing the resulting population pyramid with the ideal one (assuming an annually equal number of doctors entering the healthcare system, hence calculating with an average number of 173 doctors in all cohorts between the ages of 27 and 64), the severe workforce deficit in younger age groups becomes apparent. The 27–39 age group only

consisted of 652 GPs compared to the ideal 2249 in 2007, and this number further decreased to 526 by 2017. The deficit significantly increased in the older age groups as well: the number of GPs decreased from 642 to 442 in the 40–44 age group with the decrease being even more severe in the 45–49 and 50–54 cohorts, where the number of GPs saw a reduction from 1042 to 620, and from 1269 to 739 respectively. In the number of GPs decreased less sharply from 1190 to 1054 in the 55–59 age group. Overall, it can be noted that the number of GPs under the age of 60 radically decreased by 1424. Conversely, the number of GPs in the 60–64 age group increased from 902 to 1164, while the number of GPs above the age of 65 increased from 550 to 1470. Most remarkably, the number of GPs above 70 increased from 131 to 639.

In the studied decade, the decrease was 18.40% in the case of GPs born in 1952; it reached 50% among the GPs born in 1944, and two thirds among those born in 1940; ultimately, it reached 100% among GPs born in 1930 and before.

Changes in the sex distribution of GPs

During the studied period, female GPs started to outnumber male GPs more significantly; initially female GPs only outnumbered their male counterparts by 283, this gap increased to 743 in a decade. The number of female GPs increased by 3.3% (+108 GPs), while the number of male GPs decreased by 11.8% (–352 GPs) in ten years.

The drastic decrease in male GP supply under the age of 40 (–124 GPs), and the stagnation of the female GP supply (–2 GPs) resulted in a significant female majority of 60.46% by 2017, compared to the modest male majority of 50.92% in 2007. However, as the population pyramid

also indicates, the number of male and female GPs under the age of 60 decreased in a practically identical manner (by 713 and 711 GPs respectively) between 2007 and 2017. The number of GPs above the age of 60 increased significantly among both sexes, in the case of men by 361, in the case of women by 819.

V.2. Associations between deprivation and vacant practices

Mapping the deprivation index values shows that the most deprived areas were found in the north-eastern and south-western parts of Hungary. The least deprived sections were areas in the north-western part of the country and in the capital city of Budapest and its neighbouring areas. The areas with the highest relative vacancy rates were found along the north-eastern border of Hungary and in the mid-eastern and south-western parts of the country. The relative vacancy rates were lower in Budapest and in the surrounding areas of most county seats.

Settlements in Hungary with an unfavourable deprivation index and practices with vacant GP posts show remarkable overlap. The resultant pattern of excess vacancy rates showed a correlation with a spatial pattern of deprivation, as is verified by the results of association analysis for deprivation index quintiles and practices with vacant GP posts. The results of the risk analysis showed an exponential association between relative vacancy rate and deprivation (χ^2 homogeneity=232.18; $p<0.001$, χ^2 linearity=168.87; $p<0.001$).

On January 1st of 2017, the GP shortage affected the primary care of 519 settlements with a highly uneven distribution. Based on deprivation

index values, in the areas of highest deprivation (quintile V), nearly a fifth (18.31%, 95% CI 15.83 to 21.16) of the practices had a vacancy for a GP; this rate is nearly triple that of the Hungarian average vacancy rate (6.39%, 95% CI 5.88 to 6.94). In quintile IV of the municipalities, 8.21% (95% CI 6.96 to 9.69) of the practices had vacant GP posts, that is, the vacancy rate exceeded the national average by 29%. In the least deprived areas, the vacancy rate was 4.07% (95% CI 3.05 to 5.32), which was only 64% of the national average. The vacancy rates between the areas of deprivation quintiles I, II and III did not differ significantly, they did, however, in the cases of quintiles IV and V.

Migration of GPs within primary care

In the period examined, a definitive movement of GPs from the more deprived municipalities to the least deprived ones could be detected. In the least deprived (quintile I) areas, the number of GPs increased by 2.22% (95% CI 1.21 to 3.24), while in the most deprived areas (quintile V) it decreased by 8.43% (95% CI -5.86 to -10.99). Overall, municipalities in quintile IV and V areas were losing GPs while those in quintiles I, II and III were gaining them. Overall, this trend affected the geographical distribution of GPs in a negative way, exacerbating the population's inequitable access to primary care services.

Analysing the migration of GPs within primary care by quintiles could also characterise the retaining capacity of these areas. During the examined ten-year period, more than one-fifth of the workforce in the most deprived areas (20.62%, 95% CI 16.89 to 24.35) changed practices. This figure is 3–3.5 times higher than the average frequency in quintiles I, II and III. Corresponding with the trends related to the

deprivation index, the retaining capacity of settlements in quintile IV was also low (with a 9.77% frequency of changing practices, 95% CI 8.13 to 11.41) compared to less deprived areas.

Changes in the rate of underserved population

Parallel with the increasing vacancy rate, the rate of people with no primary care service provision by their own GP was also increasing between 2007 and 2017. The rate of people (number of persons/100.000 people) with no primary health care service provision significantly increased in all deprivation index quintiles by the end of the decade, however, a marked difference remained between the most and the least deprived areas. In 2007, there were nearly 5500 more persons/100.000 people in quintile V (compared to quintile I) who only had access to limited primary care services; this rate increased to 7000 by 2017.

V.3. Association between the served populations' education, the age of GPs, vacant practices and premature mortality

In a separate study regarding the period from 2006 to 2014, we examined the possible associations between the educational level of the served population and vacant practices/premature mortality; the age of GPs and premature mortality; vacant practices and premature mortality. The number of involved practices varied between 4759 and 4813, while the number of adult population varied between 5.979.558 and 6.028.690. 1.06% of the annual client data was excluded from the analysis due to these clients having changed practices within 5 years. A total of 246.285 premature mortalities occurred in the period examined.

The vacancy rate was significantly lower among practices serving populations above median relative education levels. While 50.13% (95% CI 49.66 to 50.61) of the practices were serving populations above median relative education, these only amounted to 19.47% (95% CI 17.30 to 21.64) of the vacant practices.

The aggregated SMR was significantly higher (1.25, 95% CI 1.22 to 1.28) among populations of vacant practices during the entire studied period, while the age of GPs (up to and over the age of 65) was not accompanied by additional mortality risk.

According to the multivariate linear regression analysis, the strongest protective factor against premature death was higher level of education ($\beta = -0.175$; $p < 0.001$). The mortality risk was higher in vacant practices than in practices served by GPs under the age of 65 ($\beta = 0.010$; $p = 0.033$), while the mortality risk in practices served by GPs over 65 did not differ from the risk in practices served by GPs under 65 ($\beta = 0.0003$; $p = 0.995$). In the period from 2006 to 2014, the number of premature deaths that can be attributed to vacant practices was 23.54.

VI. DISCUSSION

Primary care is the only segment of the healthcare system which is constantly in contact or is able to establish contact with the entire population. Consequently, local preventive services which improve the healthy life expectancy, work capacity, and self-sufficiency of the entire population could be efficiently implemented in primary care. Due to its complex role, maintaining the safe operability of primary care is pivotal. Numerous factors affect the operability of primary care; this research focused primarily on the changes in physician supply and its characteristics.

Main changes observed regarding the state of workforce in primary care

The workforce crisis of primary care requires urgent interventions worldwide. In the framework of this research, we identified the following main phenomena and tendencies in the Hungarian primary care over the period examined:

- The number of general practitioners decreased, especially in paediatric and mixed practices.
- The average age of active GPs increased.
- The rate of female GPs increased.
- The number of vacant practices markedly increased.
- Strong associations could be observed between vacant practices and the deprivation of the served area.
- The migration of GPs from deprived to less deprived areas was significant.

- The rate of underserved population was initially higher in the most deprived areas; during the period examined, this rate increased even further.
- Regarding the premature mortality rate, lower educational levels pose a serious additional risk factor, while the rate of vacant practices poses a minor additional risk factor.

The reducing service output of vacant practices

Health services for the population of vacant practices are usually provided by a GP in a different primary care practice, thus resulting in an automatically reduced service output. This is also due to the relevant government decree, which only requires locum GPs to fill these practices in 50% of the normal consultation hours. In effect, the number of consultation hours does not even meet this legal requirement in the most deprived areas, due to the significantly higher rate of vacant practices. The increased workload could also reduce the working hours of the substitute doctors in their own practice.

VI.1. Changes regarding GPs and practices

The changing number of GPs, practices and vacant practices

The chronic shortage of doctors in primary care can be traced back to low salaries, limited postgraduate training and career progression opportunities, and poor working conditions. For a long time, all this has been a well-known fact worldwide, however, the number of vacant practices only started to exponentially increase in several countries over the past decade. A similar phenomenon can be detected in Hungary, where the number of vacant practices nearly doubled, while the number

of practices unfilled for more than a year tripled between 2007 and 2017. The latter change is a stronger pathognomonic sign, since a fresh vacancy may only be a transient situation (e.g. due to the purchase of the practice), while a vacancy lasting for more than a year clearly qualifies as a substantive situation.

The decrease in GPs numbers was significant in all practice types, but it only became markedly extensive in mixed and paediatric practices. The rate of vacancies was the highest among mixed practices at the beginning and at the end of the examined decade as well; this indicates that working in mixed practices was deemed the least attractive option. A possible explanation for this phenomenon is that mixed practices are usually situated in sparsely populated settlements, which are not attractive for young doctors. The popularity of mixed practices could be further decreased by the fact that they are often the only primary care providers in the settlement, thus young GPs feel the most vulnerable in these practices (from a professional and organizational aspect as well). It is a highly concerning sign that every seventh mixed practice was vacant even in 2017.

The number of paediatricians decreased in the examined period most likely due to the paediatrician medical specialisation's main focus on training doctors for hospital roles. Towards the end of the examined period, the situation was exacerbated by paediatrician shortages in several hospitals, allowing younger doctors to easily choose the more attractive tertiary care, which offered more straightforward career perspectives. In 2017, every fifth vacant practice was a paediatric

practice. Based on these trends, increasing the supply of physicians requires targeted intervention in both practice types.

The examined period also saw a decrease in the number of practices. This only affected paediatric and mixed practices, the number of adult practices slightly increased. The phenomenon is explicable by the merger of practices. This reduced the number of vacancies, since the total number practices decreased by 77 in a single decade. Without the measure, the doctor shortage would have been 22% larger by 2017.

Changes regarding the average age of GPs, and shifting age distribution

The average age of GPs significantly increased in Hungary. On average, this increase was twice as large as that of the total population's average age. The most significant increase occurred among paediatricians, while the lowest increase occurred among GPs in adult practices. The ageing of primary care physicians is a phenomenon that can be observed in other countries as well. In the examined period, the number of GPs under 40 decreased by approximately 20%, and the number of GPs between 40 and 49 decreased by nearly 40% (the number of doctors in these age groups was already low at the beginning of the decade), while the number of doctors above 60 increased by more than 60%; these changes illustrate the phenomenon quite well in Hungary. Relying on the work of GPs is substantiated until they reach the retirement age of 64. In 2017, almost every fourth GP was 65 or older, indicating that the operability of primary care became more vulnerable over the past decade.

Some of the new doctors in primary care did not arrive after receiving their degrees but gradually, up to the age group turning 49 in 2017. Doctors who join the primary care later in life are only available as workforce for a shorter period, thus incentivising earlier entry to primary care is recommended. Aside from later entry to primary care, the phenomenon of early departure can also be observed. Regardless of many doctors still working above the retirement age, the number of GPs is decreasing in younger cohorts. Although we did not examine the background of this phenomenon, it is certain that making work in Hungarian primary care more attractive, as well as preserving and developing GPs' health could provide additional workforce reserves. Considering the representation of ageing GPs in the healthcare system, this field also requires targeted intervention. During the examined period, leaving the healthcare system became dominant among doctors born in 1944 and before. This draws attention to the fact that the workforce reserve provided by GPs above the retirement age is temporally finite. It can be stated that the Hungarian primary care only remained operational by the end of the examined period because the ageing of doctors did not coincide with their retirement. Since the number of young physicians is insufficient, and approximately 44% of the doctors were already 60 years old or older in 2017, the retainment of the older age groups in the following years is essential for the healthcare system's operability.

Changes in GPs' sex distribution

In the period studied, the Hungarian primary care was more and more characterized by an increasing role of women who eventually

outweighed men. The number of doctors younger than 60 practically decreased at the same rate among both sexes, however, among the GPs over 60, female doctors markedly outweighed male doctors. This is mainly due to cohorts comprised mostly of women taking the role of cohorts mostly comprised of men. During the period examined, the female majority grew more prevalent since male doctors stopped operating their practices at an earlier stage on average. It is presumable that (in accordance with the general population's demographic trends) the earlier mortality of men also played a role in this phenomenon.

Among the doctors under 40, we experienced that the initial, approximately 50–50% distribution transformed into a more than 60% female majority over the course of a decade. The reason for this was that while the number of female doctors was stagnating, the number of male doctors choosing to work in primary care practices decreased by approximately 40%. For female GPs, having children can result in several years of hiatus from practices, hence a transient labour shortage in primary care. For this reason, the practices operated by female GPs must be supported, so that the lack of reliable locum tenens physicians does not hinder female doctors from having children, and it does not create substantive workforce shortage.

VI.2. Associations between the served areas' deprivation indices and vacant practices

It is a worldwide recognizable phenomenon that deprived areas are not attractive for GPs. A strong association between the areas' deprivation status and the rate of vacant practices can also be observed in the Hungarian primary care. The distribution patterns of areas with salient

vacancy indices showed a correlation with the spatial patterns of deprivation. In 2017, nearly every fifth practice was unfilled in the most deprived (quintile V) areas, a frequency almost three times higher than the national average. With regard to deprived areas, the following statements can be made:

- The local population's health condition is poor; therefore its healthcare demands are higher.
- The rate of low-qualified population is higher. Their adherence regarding healthcare services is lower, which increases the average timespan of healthcare provision.

Between 2007 and 2017, the access to healthcare decreased to the greatest extent for the most vulnerable, socioeconomically most disadvantaged population that has the highest need for healthcare provision. This phenomenon further exacerbated already existing inequalities. Resolving these issues requires prompt, targeted, systemic intervention that strongly supports primary care in the most deprived areas.

Migration of doctors within primary care

The migration of GPs from more to less deprived settlements could be observed in primary care. Areas in quintile IV, and mostly in quintile V suffered great workforce losses, with every twelfth doctor leaving their practice in the areas of the most deprived quintile. Conversely, settlements of quintiles I, II and III had a migration surplus in the same period. The substantially poorer capacity of disadvantaged areas to retain doctors also calls attention to the vulnerability of primary care in these areas. If a practice serving a deprived area on the periphery of the

healthcare system becomes vacant, it is much more difficult to fill its GP post. New doctors in primary care find unfilled positions more easily in more attractive, less deprived areas. Their intention to do so may be fostered by the fact that there is no substantive financial difference between practices operating in different deprivation index quintiles. The phenomenon urges prompt intervention.

The effect of GPs' migration abroad

In Western and Northern Europe, the salaries of GPs are significantly higher than in Hungary. Following internal medicine, the general practice specialization was the second most common qualification which official certificate requests were submitted for in the decade examined. Although these requests do not automatically mean migration, they do hint towards a strong intention (partly due to the costly procedure). The number of GPs who requested official certificates to have their qualification recognized abroad was 547 during the ten years examined, 300 of them submitted their requests between 2012 and 2016. Taking into consideration that the GP shortage increased most significantly between 2012 and 2016 may lead us to believe that a greater rate of migration abroad also played a role in the phenomenon.

Underserved population

During the decade examined, the number of underserved population significantly increased in all deprivation index quintiles. This increase is strongly associated with the deprivation status of the affected areas. Throughout the decade, a marked difference could be observed between the numbers of underserved population in the least deprived (quintile I) and the most deprived (quintile V) areas, indicating that the access to

healthcare became most difficult for the most vulnerable population with the worst socioeconomic indices.

The main strengths and limitations of the research discussed in subsections VI.1.–VI.2

- The study was conducted based on a comprehensive, longitudinal, countrywide research with the aim of identifying the main changes in the numbers and geographical distribution of general practitioners.
- The research utilized an area-based, complex indicator in order to characterize the association between deprivation and the GP shortage.
- The research analysed the migration of doctors between practices, however, it does not uncover the detailed reasons behind this phenomenon.
- All data used was pertinent to the first days of each year examined, thus the study did not trace changes that occurred within these years.

The interpretation of our findings is made more difficult by (a) the fact that our research is ecological in nature, based on the premise that the individual members of the researched group all possess the attributes indicative of the group, whereas changes observed on the group level do not necessarily mean that they are also pertinent to any individual of the group; (b) the limitation that we did not have the possibility to study how certain changes implemented during our research in the healthcare system affected the state of workforce in primary care.

VI.3. Association between the educational level of the served population, the age of GPs, vacant practices and premature mortality

The separate research conducted between 2006 and 2014 showed that vacancies and premature mortalities were much less common in practices serving populations above median relative educational levels. This finding is in accordance with findings of previous studies.

According to our analysis, the age of GPs did not have significant effects on premature mortality. Premature mortality rates mildly, but significantly increased in vacant practices. Thus, the public health impact of vacancies on premature mortality remained low. (The univariate analysis of vacant practices suggested significant additional risks on premature mortality stemming from vacancies, these, however, were not verified by the age-sex-standardized multivariate analysis of premature mortality risks. This implies that the significant risk suggested by crude rates is mostly explicable by other attributes of the practices.)

Aside from premature mortality, and from a public health perspective, numerous important sets of data would need to be analysed in order to substantially characterize the effects stemming from the shortage of GPs and consequently from reduced service output. It is certain however, that increasing vacancy rates oblige doctors to perform more locum duties in the affected areas, which further decreases the service output of vacant practices.

The main strengths and limitations of the research discussed in subsection VI.3.

The study is based on a comprehensive, longitudinal, nationwide survey. The high case numbers provided strong statistical relevance for the analysis. The analysis was restricted to patients who had not changed GPs in the 5 years preceding the evaluation. Due to this fact, distortive effects stemming from patient migration did not need to be considered.

Levels of education are frequently used in international practice as proxy indicators of socioeconomic status; the fact, however, that we did not use a complex indicator for this purpose proves to be a limitation of our study. Having been unable to calculate the relative educational level of the served population on an annual basis is a further limitation.

Only practice-level aggregated data were analysed during our research. Indicators describing the morbidity status of the served population were not available, thus morbidity determining the risk of death was not included among the explanatory variables of the regression models.

VI.4. Measures reacting to the workforce crisis in primary care, further tasks

Between 2007 and 2012, GP salaries decreased in Hungary. From 2012 to 2017, practice financing increased, resulting in an average annual increase of 10.9% regarding GP salaries.

Since 2014, the National Health Insurance Fund Manager has been issuing tenders to incentivise work in practices which have been vacant for more than 12 months. The program provides substantial single grants to those who fill the GP posts of these practices for a longer period.

These single grants are important steps in the right direction; however, practices serving more deprived areas still do not receive additional monthly financing, a measure that would make work in these areas more attractive in the long term.

From January 1st 2021, a comprehensive salary settlement encompassing the entire public healthcare sector resulted in a significant increase in GPs' salaries as well. The extent of this increase depends on the timespan of the individual GP's prior activities in the healthcare system, and the integration level of the given practice in the GP cluster model. Also for doctors in primary care, the settlement enables the creation of a gradual salary scale corresponding with the number of working years; furthermore, it specifically incentivises cooperation between practices. The salary settlement will continue in a pre-determined manner throughout 2022 and 2023. Since the measure affects the entire sector, it does not make work in primary care specifically more appealing. The creation of the salary scale can nonetheless contribute to the retainment of older GPs, due to its effect of significantly increasing the contribution base for later pensions.

Based on the current trend, it can be established that there is no chance of halting the ever deepening workforce crisis in Hungarian primary care without substantially increasing GP salaries. This is also underlined by the fact that the number of vacant practices further increased by 86.2% to 646, while the number of practices that had been vacant for more than a year increased by 85.8% to 446 since the end of the examined period (according to data provided on July 1st 2021).

Intervention focal points

Information on efficient intervention strategies is quite scarce even on the international level. The English ‘Equitable Access to Primary Medical Care’ program, launched in 2007, deserves to be highlighted. The program increased capacities and created additional health services in disadvantaged, underserved areas, and provided guaranteed competitive salaries to affected GPs. It is remarkable, that the volume of services provided by GPs increased significantly more in England’s most deprived subregions than anywhere else in the country over the years following the intervention.

In Hungary, it is also the population with the worst socioeconomic indices that has the most limited access to healthcare, therefore the supply of doctors in these areas requires special attention; this only becomes possible if doctors receive competitive offers. If sourcing funds can only happen gradually, the primary focus should be on practices in quintile V then quintile IV, since these are the ones struggling mostly with shortages. The practices are to be strengthened by additional financing, workforce with extended authority, and quality assurance for the services coupled with incentives. Although discussing these suggestions in detail is beyond the bounds of this paper, the fact that doubling the budget of practices in quintile V would cost 9 billion forints per annum (based on data from 2019) can provide a basis for budgetary estimations. This increased sum could be received by all providers operating in quintile V that guarantee to provide enhanced primary care services. Since primary care is mostly provided by ageing GPs, systemic intervention cannot be delayed much further. Thus the

operational model outlined above could be expanded gradually for all practices, while maintaining the additional financing of more deprived areas.

VII. SUMMARY

The population is ageing, while its demand for healthcare provisions is increasing. Concurrently, the shortage of GPs and paediatricians is also increasing; furthermore, half of the active doctors is approaching or has already reached the retirement age. Replenishing the supply of doctors deserves special attention in the most deprived areas of the country, where the shortage is significant. The situation is made even more urgent by the migration of doctors from more to less deprived settlements. All these processes come with serious safety risks for patients; this sets a clear task for the Hungarian policymakers and the government.

The Hungarian primary care requires an independent, systemic operational strategy addressing doctor supply, training, authority, financing and quality assurance, which can be devised and implemented promptly in order to reverse current tendencies. The motivation of young and middle-aged doctors regarding specialization and work in rural areas need to be considered for the strategy. Work in primary care and practices serving disadvantaged settlements needs to be incentivised.

The goal of the intervention is to create a strong and widely accessible primary care system, which can meet the demands of the coming decades across the entire country.

VIII. KEYWORDS

Primary care, Vacant practices, Family doctor, Deprivation, Paediatrician, General practitioner, Inequality of access, Workforce crisis, Longitudinal, Socioeconomic status.

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List of publications related to the dissertation

1. **Papp, M. C.**, Kőrösi, L., Sándor, J., Nagy, C., Juhász, A., Ádány, R.: Workforce crisis in primary healthcare worldwide: Hungarian example in a longitudinal follow-up study.
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List of other publications

3. Katona, C., Gutási, É., **Papp, M. C.**, Varga, O., Kósa, K.: Facilitating equal access to primary care for all: work experiences of health mediators in a primary health care model programme in Hungary.
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