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Medical education in Poland: a descriptive analysis of legislative changes broadening the range of institutions eligible to conduct medical degree programmes

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Abstract

Background The expansion of medical schools is one of the proposed solutions to shortages in health workforces. Poland has been struggling with limited human resources in healthcare for years. The aim of the study was to provide an analysis of the current situation of medical education in Poland and to describe the impact of the government's ongoing measures to provide a new influx of doctors.

Methods A retrospective, cross-sectional study presents a descriptive and comparative analysis of official governmental documents, showing the latest legal amendments, changes in admission limits, and geographical distribution of Higher Educational Institutions (HEIs) for the period of 2013–2023. We referenced the current number of physicians in each voivodship and used a dynamic index to analyse the changes in quotas. We performed statistical tests where needed, considering a p-value < 0.05 to be statistically significant.

Results The latest legislative changes enabled occupational HEIs to offer MD programmes. The mean distance between the two nearest HEIs decreased between 2013 and 2023. Total admission limits increased by 92.3%, reaching 10,289 available spots in 2023. The dynamic index was higher for quotas in private HEIs than in public institutions. The index was comparable, regardless of the teaching language. The number of students positively correlated with the number of physicians working in each voivodship.

Conclusions This study highlights the uncontrolled expansion of medical education in Poland, driven by workforce demands but lacking a long-term strategy. Legislative inconsistencies hinder regulation, while new medical schools in rural areas may improve regional healthcare if properly planned. Recent policy changes emphasize the need for a national strategy based on demographic data and healthcare needs. Strengthening accreditation and quality control is crucial for sustainable medical education reform.

Keywords Medical education, Doctors training, Undergraduate education, Human resources, Quality education

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Background

For many years, Poland has faced an increasing lack of doctors due to a variety of factors, ranging from insufficient wages to lack of residency positions. This has led to a stable trend of doctors emigrating to other countries to seek work, while the number of doctors trained abroad who enter the Polish healthcare system is marginal. The Polish government has introduced multiple solutions to try and alleviate these issues with varying levels of success. We look to analyse the effectiveness of the latest attempts to tackle this issue and hope to serve as a lesson for other countries that faces similar problems.

In 2011 the Minister of Health decided to abolish the postgraduate internship, in an attempt to shorten postgraduate training for physicians by one year. This effort was unsuccessful, as the law changed before the first students covered by the reform graduated [1]. For many years, attempts have been made to determine the genuine number of practicing doctors in Poland. Estimates varied between 2.29 per 1000 citizens in 2015 and 3.3 per 1000 citizens in 2020. Difficulties in accurately determining the actual number of medical personnel results from irregularities in human resource management. As was presented in an earlier study [2], stakeholders' willingness to improve the situation of the health workforce is disproportionate compared to the influence that different players have. In recent years, new medical programmes have been established in many Polish HEIs without a clear long-term goal or objective targets. It was said to be a response to the shortage of doctors in Polish healthcare as part of a wider political agenda.

The problem of medical personnel shortages has been a topic of analysis and discussion in various contexts among policy makers for many years [3, 4]. The healthcare system will face a shortage of healthcare professionals, with a significant shift in demographics due to societal aging. Some attempts have been made to determine the most reliable model for forecasting workforce demands [5, 6], presenting various approaches. The most common are based on demands, supplies, targets, and needs. All of them are biased and affected by specific national/regional contexts and relations between variables, including population shifts, political and socioeconomic changes in a country. The analytical approach, contrary to the conceptual one, considers the factors mentioned previously and the mutual relationships between them. The planning of the national health workforce is a key responsibility of stakeholders, policy makers, and governments to build a resilient and stable economy.

Recently, characteristics of medical deserts were proposed. A scoping review on the topic indicated that the misdistribution of the workforce can negatively affect patient health and the healthcare system [7]. Factors defining the problem from the perspective of the population are divided into categories describing the population and the available services in the area and its accessibility in terms of travel time or distance. Limited human resources would result in deepening existing inequalities in accessibility to healthcare services. The Regional Office for Europe of the World Health Organisation [8] indicated medical deserts as one of the main priorities for Europe.

The Polish medical education system has undergone major changes since Janczukowicz's perspective [9] presented more than 10 years ago, from the political landscape to teaching methods and the educational environment. The postgraduate internships that had previously been abolished, were reintroduced in 2015. Since then, many other changes have been implemented in medical education and the healthcare system; e.g. many new higher education institutions (HEIs) were allowed to open medical degree programmes (MD), an official question bank was introduced for the national medical licencing examination (*Lekarski Egzamin Końcowy*, *LEK)* where 70% of the questions for the examination came directly from the question bank, and the medical residency application process was reformed.

The European Union (EU) in its documents does not provide any guidelines or recommendations of criteria required to be met by an institution to train medical doctors. In the literature we can find some examples presenting a step-by-step approach to establish a new medical school. However, they do not consist of information regarding the legal status of the institutions. We can also find articles presenting a variety of policies on medical education expansion around the world. However, the picture is dominated by English-speaking countries like Australia, the United States or Canada, with limited representation of the European perspective [10]. To our best knowledge, there has been done little research focusing on the legal aspects, distribution and the number and type of HEIs offering MDs from Europe, especially the central and eastern regions.

In our study we sought to fill that gap by providing an analysis of the latest changes in Polish legal regulations. The aim of the study was to conduct a descriptive analysis of the recent changes in Polish legislation on the establishment of new higher educational institutions and opening medical programmes across the country. We aimed to verify whether the changes caused a significant increase in the number of HEIs offering MDs and if that substantially affected access to MDs for the general population.

Methods

In this retrospective cross-sectional study, the authors performed a descriptive and comparative analysis of official governmental documents introducing the latest changes in Polish higher medical education. These were: the Act of 20 July 2018 Law in Higher Education and Science, as amended [11], the Regulation of the Minister of Education and Science of 29 September 2023, amending the regulation on education standards for training to practice as a physician, dentist, pharmacist, nurse, midwife, laboratory diagnostician, physiotherapist, and paramedic [12] and the ordinances of Minister of Health on admission limits for MD and dental programmes issued between 2013 and 2023 [13–23]. They were obtained by one researcher (RK) from the Journal of Laws of the Republic of Poland between June and December 2023. Data describing HEIs were collected from the RADon system (http://radon.nauka.gov.pl) which is part of the Integrated Network of Information on Science and Higher Education, the largest public system in Poland consisting of reports, analyses, and data on higher education and science in Poland. Using official documents published by state institutions provide transparency and validation of our data. We performed a quantitative comparative analysis on admission rates for medical programmes in public and private Polish higher education institutions between 2013 and 2023. Data on the Polish population were obtained from Statistics Poland. Many regulatory changes have been introduced in this area in recent years. In order to capture the trend of these changes, the analysis was carried out for the years 2013–2023.

The ratio of first-year MD students per 100,000 citizens in each Polish province (voivodship) was calculated using a formula $(a \times 100000)/b$, where a stands for the number of students in the voivodship and b stands for the number of citizens in the region. We calculated the changes in quotas between years, comparing year to year (e.g. 2014 to 2013, 2015 to 2014, etc.) and compared the border years (2023 to 2013). We used a dynamic index (DI) to present the pace of change in the enrolment limits in the analysed period. It was calculated using a formula y_n/y_{n-1}, where y_n stands for the limit in the year n. DI presents the pace of the change as a ratio, making the parameter easier to compare between different HEIs, minimising the sample bias between each institution.

To assess the accessibility to the HEIs that offer MDs, we estimated distance between cities they are in between 2013 and 2023 based on geographical coordinates using a formula: $l = \cos^{-1}(\sin\phi_1 \sin\phi_2 + \cos\phi_1 \cos\phi_2 \cos(\lambda_1 - \lambda_1)) \cdot 6371km$. Later, we estimated the average nearest distance between two HEIs and compared them between 2013 and 2023. The distance between each city was calculated with the presented formula to objectivise it, as it would be difficult to assess the real driving distance between given locations due to multiple driving routes being available of varying distance. The distance between cities provides us with information of the density of MDs (the minimal distance between two HEIs) and secondary to that the accessibility to MDs.

We estimated the density of physicians per 1000 population in the whole country and each voivodship using the most recent data provided by the Supreme Medical Chamber and Statistics Poland on their official websites. The geographical distribution of HEIs and the changes in the density of enrolled students in each voivodship were performed.

The analyses were performed by using Mann-Whitney test for skewed data. We used frequency and percentage for categorical data (e.g. type of HEIs). Sperman's rank correlation coefficient was used for correlations. The analyses and calculations were performed using Microsoft Excel 2016 and IBM SPSS (IBM Corp. 2022 Statistics for macOS; version 29.0; IBM Corp, Armonk, NY, United States). Two-sided p-values of < 0.05 were considered statistically significant. Figures were created using Microsoft Excel 2016 and mapchart.net.

Results

Medical education – the pathway to become a doctor

Poland, as a member of the EU, incorporates regulations of the automatic recognition of qualifications [24], which determine the minimal requirements for physician training to ensure that their diploma is recognised in the EU. Subsequently, the Regulation of the Minister of Education and Science [12] incorporates these regulations. According to these documents, the MD is a long-cycle programme that lasts 12 semesters. During this time, students are expected to acquire comparable knowledge and skills in various fields of medicine and related disciplines. The first phase of training is preclinical and usually lasts between 2 and 3 years, during which students are obliged to complete courses in subjects such as anatomy, physiology, pharmacology, biochemistry, and microbiology. During this phase most classes take place in laboratories (chemical, anatomical, etc.), while during the subsequent, i.e. clinical phase, they complete rotations in medical specialties in hospitals or clinics. The last year is devoted entirely to practical clinical teaching where students complete rotations in internal medicine (240 h), paediatrics (120 h), surgery (120 h), obstetrics and gynaecology (60 h), psychiatry (60 h), emergency medicine (60 h), family medicine (60 h), and clinical electives (180 h of an independently chosen medical specialty). The MD consists of at least 5700 h and has at least 360 ECTS points assigned. Upon completion of the programme, graduates are awarded the title of *lekarz* (physician), with a medical license issued by the regional medical chamber, while the

title of *doktor* is reserved for those who complete a doctoral degree.

Legal background of higher education in Poland

The Act [11] introduces the two main types of HEIs: academic and occupational/vocational. Each programme is assigned to a discipline and a field at the bachelor's (at least 6 semesters) or master's (at least 3 semesters) level. All HEIs are regularly evaluated in 4-year intervals by an external national institution, the Research Evaluation Committee, a branch of the Ministry of Higher Education and Science, that analyses the academic performance of each institution. If they receive a score of A+, A, B+ (on a scale from A + to C, where A + is the top score and C is the bottom) in at least one discipline, the HEI is classified as an academic institution. It may be called a university (*uniwersytet*), polytechnic (*politechnika*), or academy (*akademia)*. It is used to differentiate between different kinds of institutions and is related to its rank. However, recently, another kind of vocational HEI was introduced – the Academy of Applied Sciences. The name is given to an occupational HEI that meets specific criteria shown in Fig. 1. Nowadays, the name "*akademia*" may be misleading, as it is used by both occupational and academic institutions.

The criteria that HEIs have to meet to be able to launch an MD programme have been the subject of political dispute. In recent years, numerous HEIs have been granted approval to launch MD programmes by the Ministry of Higher Education and Science, even though they were formally occupational institutions and their preparedness (including lack of infrastructure, staffing shortages, quality management) was negatively assessed by the Polish Accreditation Committee (PAC), an independent national institution that cooperates with the Ministry of Higher Education and Science. PAC operates on ten criteria [25] which are strictly related to the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) [26] which cover the wider perspective on higher education such as design of a programme, student admissions, staffing, facilities, student support and quality assurance. A parliamentary amendment proposed by a group of members of parliament has been accepted, which reduced the minimum criteria that HEIs must meet to establish an MD programme [11]. Details are presented in Figs. 1 and 2.

As per evaluation criteria, only 12 academic researchers in the discipline of medical sciences (without necessarily having completed MD) for whom the HEI is the primary place of employment are required to open an MD programme. According to the amendment, an MD programme can be started at any HEI that has received a score of A+, A or B + in medical or health sciences or has a score of A + or A score in at least 3 different disciplines, which do not necessarily need to be related to the MD programme. HEIs that already have programmes in nursery, midwifery, physical therapy, paramedicine, pharmacy, laboratory diagnostics, dentistry, and have been positively scored, can apply to open their own MD programme.

Higher educational institutions with MD programme

In 2013, there were 12 universities offering MD programmes. At the time of submission of this article, there are 38 HEIs offering MD programmes in 20 different cities. We excluded 1 HEI from further analyses,

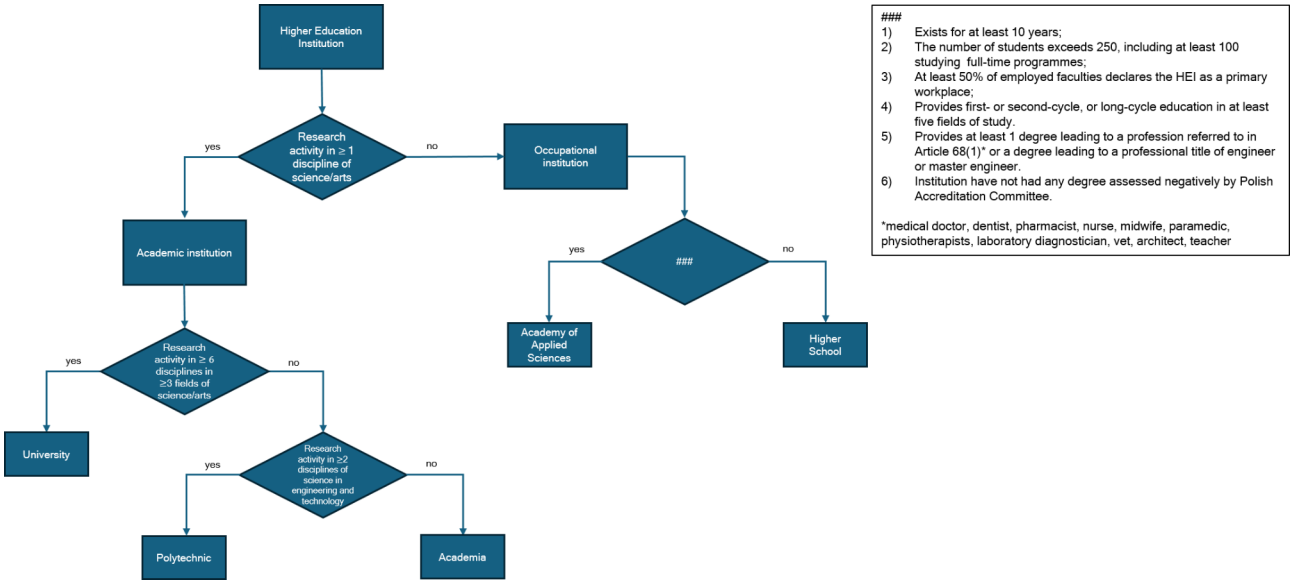

Fig. 1 Classification of different types of HEIs in Poland with required criteria. Source: own work, based on the Law on Higher Education and Science of 20 July 2018

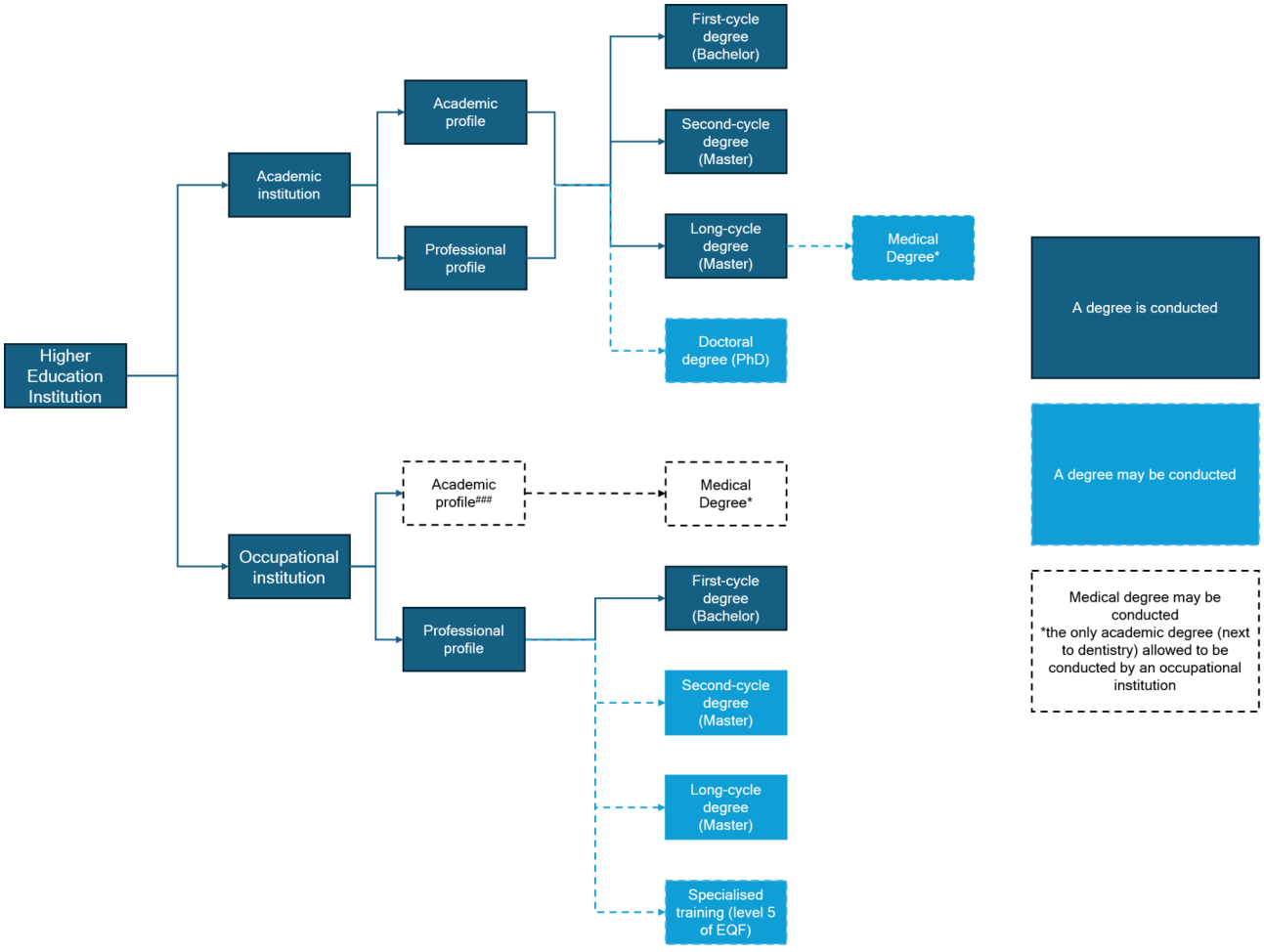

Fig. 2 Differentiation of HEIs in Poland and the cycles and degrees they are eligible to conduct. Source: own work, based on the Law on Higher Education and Science of 20 July 2018; ### mandatory criteria which have to be met in terms of establishing MD or dentistry programme, compare Fig. 1

as no official confirmation of the launch of their MD programme was found. In 2013, the HEIs with MD programmes were mainly medical universities ($n = 9$, 75%), together with academic universities with a long tradition and experience in teaching and research ($n = 3$, 25%). The most recent medical faculty founded at that time was from the Warmia and Mazury University, established in 2007. In 2015 another 3 public universities received permission to establish medical faculties. Since then, almost every year brought Poland subsequent medical programmes across the country, as presented in Fig. 3.

The biggest change occurred in 2023, when 12 HEIs obtained a positive decision to start MD programmes, an increase by 44% in the course of a year and currently there are 39 HEIs eligible to train future physicians: 10 private HEIs (25.6%) and 29 public HEIs (74.4%). There were 9 medical universities (23.1%), 2 polytechnics (5.1%), 15 non-medical universities with medical faculties (38.5%), 6 academic HEIs (15.4%), and 7 occupational HEIs (18.0%). Details are presented in the Additional file 1. Two HEIs opened their MDs in branches located in other cities. There is one HEI that obtained permission to offer an MD, but no official information was found on their official websites or in the Bulletins of Public Information (*Biuletyn Informacji Publicznej*, *BIP)*. It was not included in the further analysis.

Geographical distribution of HEIs

In 2013, the universities with MDs were in different voivodships. The majority of the newly established MD programmes are located in central and southern Poland. Four new programmes were offered in Warsaw – the capital city of Poland (the largest and most populated city of Poland with a total population of 1,863,100 individuals), which together with the MD programmes in Radom, Siedlce, and Płock results in seven new MD programmes in the Masovian voivodship in total. Four programmes were opened in the Lesser Poland voivodship, three in the Silesian voivodship, two in the Greater Poland and Kuyavian-Pomeranian voivodships, and one each in the

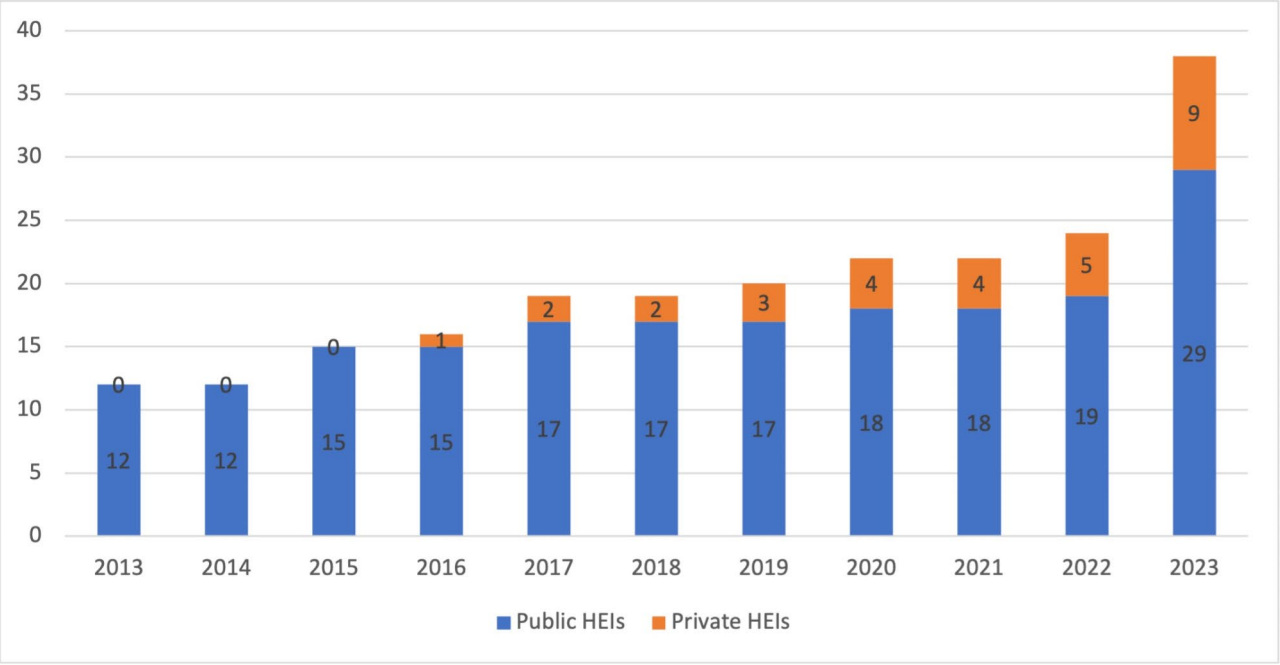

Fig. 3 The number of HEIs offering MD programmes in Poland in 2023. Source: own work

Warmian-Masurian, Świętokrzyskie, Lubusz, Opole, Subcarpathian, Łódź and Lower Silesian voivodships. No new MDs were launched in the Pomeranian, West Pomeranian and Podlaskie voivodships. Two universities have established new branches, in which they opened MD programmes. Details are presented in Fig. 4. There is at least one HEI with an MD programme in each region (min-max: 1–8, median: 2).

In 2013, the mean nearest distance between two cities with analysed HEIs was 127.6 km (median 127.2 km, min 62.3 km, max 195.5 km), while in 2023 it has decreased to 72.2 km (median 69.4 km, min 14.2 km, max 178.1 km). In 2013 there were only 2 cities closer than 100 km to each other, while in 2023 only 4 HEIs are more than 100 km apart from the nearest one. Detailed data is presented in the Additional file 1. In context, the longitudinal and horizontal length of Poland is, respectively, approximately 650 and 690 km. Figure 5 presents the location of the HEIs in 2013 and 2023, marking the expansion of MDs in Poland in the analysed period. It is presented in the Figure that most of the recently established MDs are located in southern Poland.

The admission limits

The Minister of Health has the ultimate responsibility for determining the number of medical training positions and, following consultation with the Minister of Higher Education, defines admission quotas for medical programmes for each academic year and each institution. Over the last 10 years, the total number of available spots has almost doubled from 5352 in 2013 to 10,289 in 2023, resulting in an increase of 92.3%. In the analysed period, the admission limits for Polish MD programmes increased further when compared to the MDs conducted in a foreign language (English): +4469 vs. +468 (change of 112% vs. 25.6%); however, the average DI was comparable (1.03 vs. 1.07, $p = 0.67$). Although the total increase in admission limits was higher in public HEIs than in private ones (+3702 vs. +1235), the DI of private HEIs was significantly higher (respectively, 1.30 vs. 1.04, $p = 0.001$). The individual HEIs have increased limits by between 9.6% and 300% of the initial limits from 2013 or from the first year of establishment (Additional file 1).

International students are present among enrolled students and may apply for programmes taught in Polish and in English. Between 2014/2015 and 2020/2021 (the only available data) Norwegians, Swedes, Germans, Saudi Arabians and Americans made up the majority of international students (Table 1).

As presented in Fig. 6, the highest ratio of quotas per 100,000 citizens of the region in 2023 is in the Łódź voivodship and the lowest in the Subcarpatian voivodship. Details are presented in the Additional file 1. In the analysed period, the number of students admitted to MDs has been increasing, while the population of 13 voivodships has decreased, with a decrease in the total population of Poland by 797,365 (from 38,495,659 in 2013 to 37,698,294 in 2023).

There was a moderate positive correlation between the number of first-year students per 100,000 citizens and the ratio of physicians per 1000 citizens ($r = 0.5452$, $p = 0.001$). In the voivodships with the lowest physician

Fig. 4 The total number of HEIs offering MD Programme in each voivodship. Source: own
Zachodniopomorskie – Werstern Pomerania voivodship, Pomorskie – Pomeranian voivodship, Warmińsko-Mazurskie – Warmian-Masurian voivodship, Podlaskie – Podlaskie voivodship, Lubuskie – Lubusz voivodship, Wielkopolski – Greater Poland voivodship, Kujawsko-Pomorskie – Kuyavian-Pomeranian voivodship, Mazowieckie – Masovian voivodship, Lubelskie – Lublin voivodship, Dolnośląskie – Lower Silesian voivodship, Łódzkie – Łódź voivodship, Świętokrzyskie – Świętokrzyskie voivodship, Opolskie – Opole voivodship, Śląskie – Silesian voivodship, Małopolskie – Lesser Poland voivodship, Podkarpackie – Subcarpatian voivodship

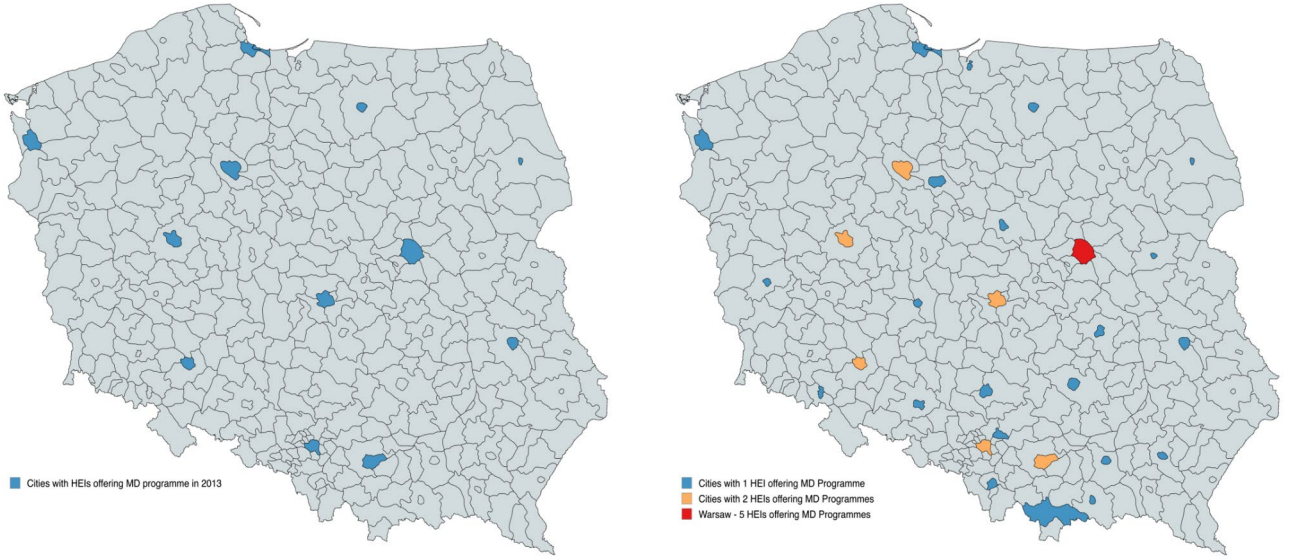

Fig. 5 Maps of Poland that present cities/county* that offer MD programmes in 2013 (left) and 2023 (right). Source: own work; *City of Nowy Targ is not a city with county rights, as are the others. Due to that, Nowy Targ County is highlighted on the right map; created on http://mapschart.net

Table 1 The largest groups of international students enrolled in MD programmes in Poland between 2014/2015 and 2020/2021

Year	Saudi Arabia	India	Germany	Norway	The United States of America	Sweden	Taiwan	The total number of international students	The percentage of the 5 biggest groups
2014/2015	568*	70	327*	1 280*	483*	1 036*	216	5 447	67.8%
2015/2016	645*	84	449*	1 276*	491*	1 056*	277	5 973	65.6%
2016/2017	644*	104	590*	1 207*	485*	1 037*	374	6 409	61.8%
2017/2018	608*	183	652*	1 141*	451*	924*	437	6 555	57.6%
2018/2019	539*	242	756*	1 101*	458	845*	486*	6 935	53.7%
2019/2020	417*	298	906*	1 032*	399	678*	555*	7 024	51.1%
2020/2021	312	390*	901*	999*	362	619*	566*	7 303	47.6%

Source: own work, based on Maps of health needs, form https://basiw.mz.gov.pl/en/maps-of-health-needs/map-of-health-needs-for-the-period-2022-2026/analyses/medical-staff/ * The 5 most represented nationalities in each year

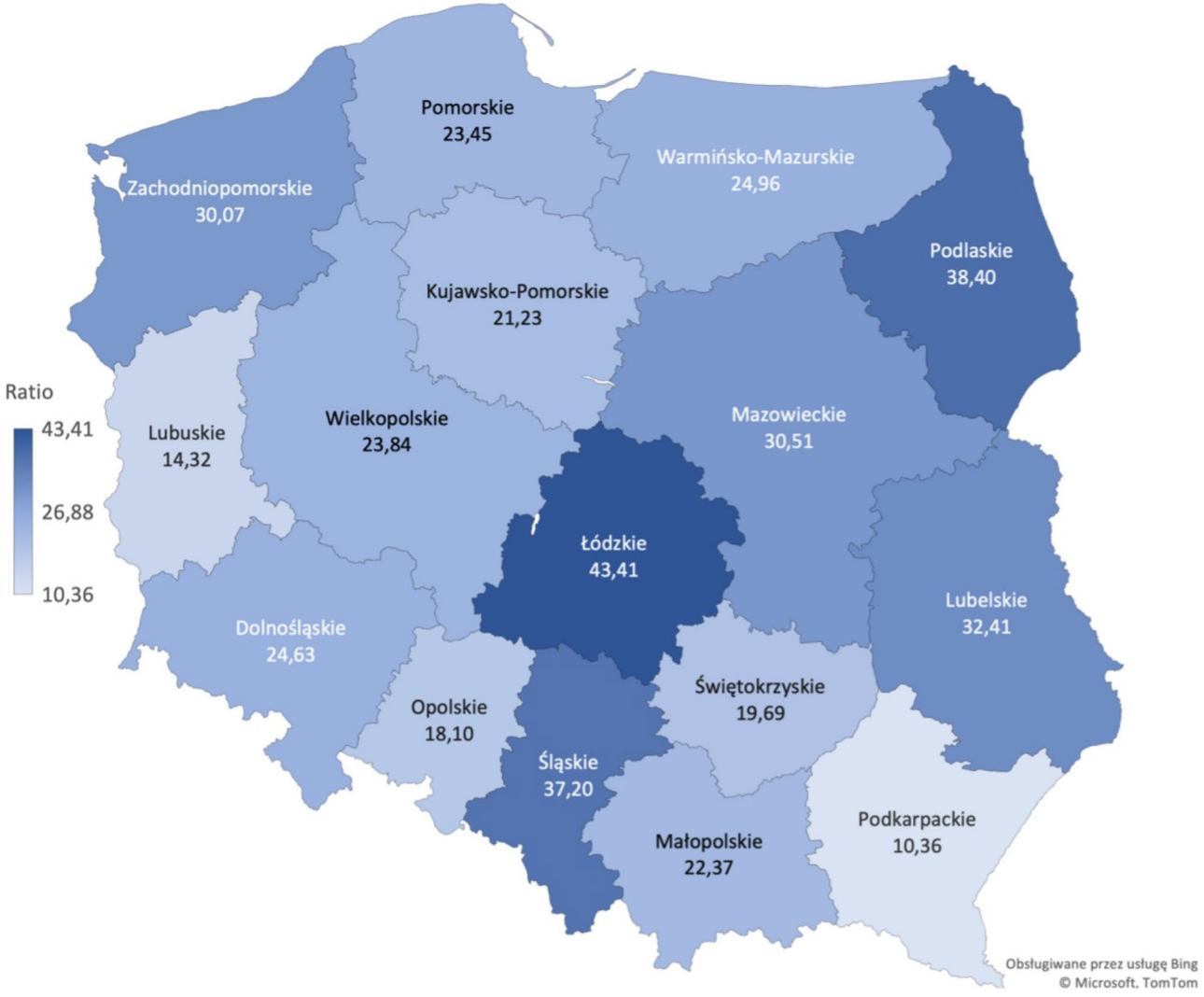

Fig. 6 Map of Poland with presented ratio of quotas to 100,000 citizens in each voivodship. Source: own work

ratio, the lowest student ratio was identified. Detailed data are presented in the Additional file 1.

All detailed data are presented in the Additional file 1.

Discussion

In this paper we presented the current legal status of medical education in Poland, considering the recent amendments which broadened the range of HEIs allowed to bid for permission to open a medical school, which led to an acceleration in opening new MDs in Poland. We showed that quotas for MDs increased in the last decade. The pace of growth in enrolments for MDs in Polish and English was comparable, whereas enrolment rates for private and public programmes differed significantly. We showed that the distribution of HEIs is not equal across the country but correlates with the size of the general regional population and physician distribution.

On the European level, the Directive of European Parliament and the Council [24] does not explicitly define HEIs that are allowed to offer medical degree programmes. Polish medical graduates receive a diploma upon completion of higher education in medicine, earning the title of *lekarz* (Polish title given to graduates of MDs, literally "physician") issued by a *szkoła wyższa* (higher school in Polish). However, there is no definition of *szkoła wyższa* given in any publicly accessible legal documents. The main Polish legal act defining and describing the Polish higher education system [11] contains the definition of *uczelnia*, which means "higher educational institution". European regulations do not indicate profiles or types of HEIs students should attend to have their qualifications recognised across the EU. This presents an inconsistency between the national and the European level, leading to potential misinterpretation and legal disarray.

External accreditation has been linked, on average, with better student performance [27] and has a positive effect, as it promotes a culture of continuous quality improvement, institutional self-evaluation and increases satisfaction of both trainees and trainers [28]. Some of the MDs were opened despite obtaining PAC's negative verdict on the readiness to establish the MD. The experts of PAC identified significant flaws, ranging from teaching and research infrastructure, lack of qualified faculty and insufficient internal quality control mechanisms [29–31]. Due to these opinions being nonbinding legally, the Minister of Higher Education granted permission to start these new MD programmes despite being aware of the indicated deficiencies. Because of this, an external quality monitoring system should be incorporated whose opinion is respected and enforced by decision makers.

Although the expansion of medical schools is not a new phenomenon in the educational world [32–34], it is still unclear what the best policy is to guarantee a proper number and distribution of medical personnel. In many cases medical schools are in urban or metropolitan areas leaving rural territories behind [3, 35, 36]. Examples from the United Kingdom [37, 38], the United States [39], Saudi Arabia [40] and Australia [41] show that medical school expansion may be conducted according to a systematic plan. Kirubakaran et al. in their scoping review [42] suggest factors worth considering when establishing a new medical school, which are very much in line with Snadden et al. AMEE Guide [43], even though they were published 13 years apart: location, students' needs and available infrastructural and human resources. These factors have not been fully considered in the past decade in Poland, e.g. in general it is the autonomous initiative of HEIs to appeal for permission to launch a new programme or to establish a branch. The MDs were started by HEIs whose infrastructure was not sufficiently advanced to enable high-quality training in basic sciences or clinical rotations. The approach chosen by the then ruling government was publicly commented on by different stakeholders, presenting predominantly negative opinions [44–48].

The unmet needs of the healthcare system are a crucial worldwide problem. Medical deserts remain a pressing challenge around the world [49, 50] and the misdistribution of medical doctors across rural and urban areas may cause significant negative health outcomes of local populations [10]. While the shortage of medical doctors and other health professionals has been discussed by many authors [51–53], in Poland, there is still a bias in terms of the actual number of active medical doctors. Different sources suggest different numbers: the Supreme medical Chamber reports 4.15 doctors /1000 citizens [54] while Statistics Poland reports 3.5 doctors per 1000 inhabitants [55]. According to Scheffler and Arnold's research [56], by 2030 the shortage of physicians in Poland should reach more than 39,000 physicians. However, the number of available positions has increased in the last 10 years as presented in this study, thus potentially reducing the estimated shortage and responding to the ageing of Polish physicians [57]. During the analysed period, the percentage of international students enrolled to MDs in Poland has also increased. Foreign students mainly decide to study in Poland due to financial reasons, but they usually leave Poland after graduation [58]. Undoubtedly, the Russian war in Ukraine affected migration trends. Many Polish students who had been studying in Ukraine before the Russian invasion fled back to Poland and sought continuation of their education at Polish universities. However, the disease burden of Ukrainian refugees [59] and the impact of general migrations across Europe may significantly disturb estimations. The government and the authorities should make regular predictions about the needed workforce in the healthcare system. Regarding

the migration of Polish doctors, it was proven that there is a constant number of those interested in emigration [2], although it is difficult to assess the real numbers, as doctors are not obliged to inform any state institution about their movement.

Additionally, data from Polish Health Needs Maps [60] show that the distribution of doctors between urban and rural areas is uneven. A dedicated policy or strategy to handle those issues has yet to be introduced in Poland. However, the latest expansion of HEIs offering MDs may result in increased retention of doctors in underserved areas, as shown by Hogenbrik et al. [61]. The location of new medical schools or the branches of existing universities in rural areas have proven to exert a positive influence on the local community, their health awareness, and economic situation [62, 63]. The number of postgraduate training positions have yet to substantially increase in line with the forecasted influx of MD graduates, which may lead to filling the gaps in residency positions that were previously unmatched or to push young doctors to rural areas [64].

At the time of writing, we are not able to directly monitor and objectively measure the performance of students of the new MDs, as in Poland there is no official examination that would assess their progress. In terms of keeping quality of training high, to strengthen students' prospects post-graduation, HEIs need to pay attention to curriculum development, qualified teaching faculty and their well-being [65], ensuring a prosperous environment for research and further growth [29].

As presented in a systematic review by Bosak et al. [66] the most common prediction models are based on supplies, demands, and targets. It is crucial to promote and develop methodologies that include factors such as ageing of the population, migrations, multimorbidity, and the prevalence of diseases of civilisation [5]. An increasing trend of team-based care among medical specialities and a spreading model of a skill-mixed workforce cannot be omitted as variables. The models ought not to be resilient to change, but easy to introduce in different settings and adaptable to changing times, so that predictions can provide an opportunity to reconsider policymakers' decisions as has been presented by Russo et al. [67]. The main challenges that should be considered when planning the Polish healthcare workforce would be the geopolitical situation and migration trends of physicians from neighbouring countries, the increase in admission quotas, the demographics of the population, the burden of an ageing population and its health needs, and the preferences of professionals in terms of working conditions [68]. Furthermore, the German example [69] has shown that healthcare workforce monitoring based on a regional network of stakeholders and meticulous bottom-up data collection may result in effective human resource management.

This study is not free from limitations. We have no means of determining the quality of programmes in HEIs that have just started their MD programmes, as it is too early. We focused only on medical doctors, whereas many other medical programmes (such as nursing or paramedicine) are being opened across the country. We are unable to predict changes in enrolment, as they are established annually by the Minister of Health. After a change in the Polish political landscape, the next steps in this matter may be unpredictable. Since differences in the methodology of counting physicians in Poland were observed, the results regarding the current and past number of active physicians may be biased. The authors bring their own biases to the study as well; they are active medical doctors and researchers, whose perspectives may differ from those of other players.

The study underlines some pivotal factors affecting healthcare professionals, which should be given due consideration when planning the health workforce. Therefore, further research is needed to ascertain the potential impact of the legislative changes on HEIs' prosperity and their growth. Some work is needed to explore and fully understand the rationales behind applications for newly established programmes and candidates' perspectives on the ongoing expansion of medical education. The findings of the study could potentially serve as a valuable resource for international policymakers on incorporation of legislative changes and their subsequent impact on the training environment. The Polish example could serve as a source of knowledge for further analyses of the changes of medical education in Europe and other regions.

Conclusions

The study has revealed the changing landscape of medical education in Poland, which were due to the need to meet workforce needs of the healthcare system. The Polish example presents the consequences of the expansion of medical education without a clear long-term plan or a policy.

Legislative changes may be used to control the expansion of medical education, especially when the legal grounding remain inconsistent. Establishing new medical schools in the branches of existing institutions in rural areas may result in retention of graduates in those regions, improving the conditions of the local workforce and healthcare. It is a reasonable action to provide better accessibility to medical education across the country but it has to be introduced according to the health needs of the population and ensure equal distribution throughout country. The latest changes in national law, enrolment limits and uneven distribution of new medical programmes support the need for long-term policy that

would regulate physician training using demographic data based on the health needs of the population and the distribution of health professionals. An accreditation process and external quality control that is respected by the stakeholders may positively affect the training environment.

Abbreviations

DI	Dynamic index
EU	European Union
HEI	Higher dducational institution
MD	Medical degree programmes
OECD	Organisation for Economic Co–operation and Development

Supplementary Information

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Supplementary Material 1: Additional file 1 is attached to this paper. It is an Excel (.xlsx) file presenting the tabular data collected by the first author and used for the analyses presented in the text. The tables collected in the file present the detailed information on the Polish HEIs, the change in admission limits, the distance between each city, the ratios used and some maps with the included data. The content presented. in Additional file 1 should be used together with the main text of the manuscript

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Author contributions
RK conceptualized the project, RK wrote the first version of the main manuscript text, RK and IP wrote the final version of the main text, MS and AD participated in writing the final version of the main text, supervised the project. RK prepared all figures and tables, including supplementary material. All authors agreed on the final version of the manuscript.

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Data availability
Data presented in the study and come from the national legal acts can be found in the national online repository: https://isap.sejm.gov.pl/isap.nsf/home.xsp. Data regarding all institutions come from http://radon.nauka.gov.pl. Data regarding the number of the foreign students come from https://basiw.mz.gov.pl/mapy-informacje/mapa-2022-2026/analizy/.

Declarations

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The authors declare no competing interests.

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