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DOCTORS CONTINUING PRACTICE AT RETIREMENT AGE IN THE REPUBLIC OF KAZAKHSTAN: RISK ASSESSMENT MODEL FOR FUTURE PHYSICIAN SHORTAGE

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Abstract

Background. Currently, the retirement age in the Republic of Kazakhstan is 58 for women (will be 63 in 2027) and 63 for men. Globally, many doctors continue to work after reaching the retirement age that is also a matter of concern for Kazakhstan.

Aim: The aim of this study is an analysis of the age structure of medical doctors (MDs) working in the government healthcare sector of Kazakhstan & to propose a model for assessing the age-related imbalance of the physician workforce and the risk of staff shortage in the medium and long term.

Materials and methods. We analyzed the national and the regional age structure of MDs for 2017 by dividing them into three age groups: <30 years, 31-55 years, and >55 years. The data were obtained from the Ministry of Health.

Results. Overall, in 2017 there were 54,405 practicing MDs in the country. Of them, 677 MDs (1.2%) retired in 2017, which constitutes 80% of the irrevocable outflow. According to estimates, the number of doctors who are supposed to retire in the period from 2018 to 2025 is 5,500 people (10%). The largest proportion of MDs of retirement age practice in the Kostanay region: 25% (426 out of 1,723), while the lowest proportion works in the South Kazakhstan region: 5% (364 out of 7,922). At the same time, there were 2,146 MDs aged 65 and older and 211 doctors over 75 years of age, the majority of whom (28%) worked in Almaty city. Officially, by the end of 2017 the national shortage of MDs composed 3,011 people and to consider the number of doctors who continue to work after retirement, this number is at least two times higher.

Conclusion. The proposed assessment model allows us to assess the situation at the level of individual regions and specialties. The most favorable is the progressive type of workforce replenishment that exists in the South Kazakhstan, Mangystau and Kyzylorda regions. Particular attention should be paid to regions with a regressive type of replenishment and a high proportion of doctors continuing their practice at retirement age: in the Kostanay region – 25% and in the Atyrau region – 19%.

Keywords: healthcare human resources, imbalances in the health workforce, aging physician workforce, risk assessment.

Резюме

РАБОТАЮЩИЕ ВРАЧИ ПЕНСИОННОГО ВОЗРАСТА В РЕСПУБЛИКЕ КАЗАХСТАН: МОДЕЛЬ ОЦЕНКИ РИСКА БУДУЩЕГО ДЕФИЦИТА ВРАЧЕБНЫХ КАДРОВЫХ РЕСУРСОВ

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Актуальность. В настоящее время пенсионный возраст в Республике Казахстан составляет 58 лет для женщин (в 2027 году - 63 года) и для мужчин - 63 года. Во всем мире многие врачи продолжают работать после достижения пенсионного возраста, что также вызывает озабоченность и в здравоохранении Казахстана.

Цель. Целью данного исследования является анализ возрастной структуры врачей, работающих в государственном секторе здравоохранения Казахстана и предложение модели для оценки возрастного дисбаланса врачебных кадров и риска возникновения дефицита врачебного персонала в среднесрочной и долгосрочной перспективе.

Материалы и методы. Мы проанализировали национальную и региональную возрастную структуру врачей в 2017 году, разделив их на три возрастные группы: <30 лет, 31-55 лет и > 55 лет. Статистические данные были получены из Министерства здравоохранения.

Результаты. В целом, в 2017 году в стране было 54 405 практикующих врачей. Из них 677 врачей (1,2%) вышли на пенсию в 2017 году, что составляет 80% от безвозвратного оттока. Согласно оценкам, количество врачей, которые должны выйти на пенсию в период с 2018 по 2025 год, составляет 5500 человек (10%). Наибольшая доля продолжающих работать врачей пенсионного возраста практиковало в Костанайской области: 25% (426 из 1723), а самая низкая доля работала в Южно-Казахстанской области: 5% (364 из 7 922). В то же время в системе здравоохранения РК после выхода на пенсию продолжали работать 2146 врачей в возрасте старше 65 лет и 211 врачей старше 75 лет, большинство из которых (28%) работали в городе Алматы. Официально к концу 2017 года национальный дефицит врачебных кадров составил 3 011 человек, но учитывая то количество врачей, которые продолжают работать после выхода на пенсию, этот показатель как минимум в два раза выше.

Выводы. Предложенная модель оценки позволяет оценить ситуацию на уровне отдельных регионов и специальностей. Наиболее благоприятным является прогрессивный тип воспроизводства, имеющийся в Южно-Казахстанской, Мангыстауской и Кызылординской областях. Особое внимание необходимо уделить регионам с регрессивным типом воспроизводства и высокой долей работающих врачей пенсионного возраста: в Костанайской области – 25%, в Атырауской области – 19%.

Ключевые слова: кадровые ресурсы здравоохранения, дисбаланс кадровых ресурсов здравоохранения, стареющие врачебные кадры, оценка рисков.

Түйіндеме

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНДА ЗЕЙНЕТКЕРЛІК ЖАСТАҒЫ ЖҰМЫС ІСТЕЙТІН ДӘРІГЕРЛЕР: ДӘРІГЕРЛІК КАДРЛЫҚ РЕСУРСТАРДЫҢ БОЛАШАҚТАҒЫ ТАПШЫЛЫҒЫНЫҢ ҚАУІПТІЛІГІН БАҒАЛАУ МОДЕЛІ

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Өзектілігі: Қазіргі уақытта Қазақстан Республикасында зейнетақы жасы, әйелдер үшін 58 жас және (2027 жылы - 63 ж), сондай-ақ ерлер үшін - 63 жас болып табылады. Бүкіл әлемде көптеген дәрігерлер зейнеткерлік жасқа жеткеннен кейін жұмыс істеуді жалғастыруда, бұл сондай-ақ Қазақстанның денсаулық сақтау саласында да алаңдаушылық туғызуда.

Мақсаты. Бұл зерттеудің мақсаты Қазақстанның мемлекеттік денсаулық сақтау секторында жұмыс істейтін дәрігерлердің жас құрылымын талдау, сонымен қатар орта мерзімді және ұзақ мерзімді болжамда дәрігер қызметкерлерінің жетіспеушілігінің туындау қаупін және дәрігерлік кадрлардың жас тепе-теңсіздігін бағалау үшін үлгі (модельін) ұсыну болып табылады.

Әдістер мен материалдар. Біз 2017 жылы дәрігерлердің ұлттық және өңірлік жас құрылымын талдап, оларды үш жас тобына бөлдік: <30 жас, 31-55 жас және> 55 жас. Статистикалық мәліметтер Денсаулық сақтау министрлігінен алынды.

Нәтижелер. Жалпы, 2017 жылы елде 54 405 тәжірибелі дәрігер болған. Оның 677-і (1,2%) 2017 жылы зейнеткерлікке шықты, бұл қайтарусыз кетудің 80% құрайды. Бағалауларға сәйкес, 2018 жылдан 2025 жылға дейінгі кезеңде зейнетке шығуға тиісті дәрігерлер саны 5500 адамды (10%) құрайды. Жұмыс істеуді жалғастырушы зейнеткерлік жастағы дәрігерлердің ең үлкен үлесі Қостанай облысында: 25% (1723-дің 426-ы), ал ең төмен үлесі Оңтүстік Қазақстан облысында жұмыс істеді: 5% (7 922-дің 364-і). Сонымен қатар, ҚР Денсаулық сақтау жүйесінде

зейнетке шыққаннан кейін 65 жастан асқан 2146 дәрігер және 75 жастан асқан 211 дәрігер жұмыс істеді, олардың көпшілігі (28%) Алматы қаласында жұмыс істеді. Ресми түрде 2017 жылдың соңына қарай дәрігерлік кадрлардың ұлттық тапшылығы 3 011 адамды құрады, бірақ зейнеткерлікке шыққаннан кейін жұмыс істейтін дәрігерлердің санын ескере отырып, бұл көрсеткіш кем дегенде екі есе жоғары.

Тұжырымдар. Ұсынылған бағалау моделі, жағдайды жекелеген өңірлер мен мамандықтар деңгейінде бағалауға мүмкіндік береді. Оңтүстік Қазақстан, Маңғыстау және Қызылорда облысында бар ұдайы өндірудің прогрессивті түрі неғұрлым қолайлы болып табылады. Ұдайы өндірудің регрессивті түрі және зейнеткерлік жастағы жұмыс істейтін дәрігерлердің үлесі жоғары өңірлерге ерекше назар аудару қажет: Қостанай облысында – 25%, Атырау облысында – 19%.

Түйін сөздер: денсаулық сақтаудың кадрлық ресурстары, денсаулық сақтаудың кадрлық ресурстарының теңгерімсіздігі, қарт дәрігерлік кадрлар, қауіптерді бағалау.

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Introduction

Healthcare human resource planning is a complex analytical process that takes into account the effect of certain factors, both from the health system and the community of health service users. Deficit, imbalance and misallocation of healthcare human resources persist in many countries [1,2,7,11,13,14]. Training more doctors is seen as one of the ways to overcome shortage of healthcare staff in the future that may be caused by an aging workforce. WHO's contribution to the development of a global strategy for human resource planning for the period of 2016–2030 reflects a growing recognition of the importance of this issue [4,12]. Researchers have identified several key causes of the shortage, including aging medical staff, natural attrition, outflow for various reasons, and a lack of young professionals [9].

More doctors in the world continue to work after they reach retirement age [3,8,10]. If retirement is unplanned – early due to illness or late due to the lack of younger staff – this might cause a risk to the labor market in healthcare as well as to patient safety [5,6].

Studies suggest that the average age of doctors awaiting retirement is 60 years old while the actual retirement age is closer to 69-70 years old [10]. This is on average 6 years later than the retirement age of the population as a whole.

The standard retirement age for women in the Republic of Kazakhstan increased from 55 in 2016 to 59 years old in 2019. Currently, Kazakhstani men retire at 63, while for women a gradual increase in the retirement age up to 63 is expected till 2027. Therefore, quantitative data may not be considered in a gender perspective and apply generally to the population of doctors. The concept of “pre-retirement age” is not used in the labor legislation of the Republic of

Kazakhstan. However, according to the data on personnel services, it is accepted to consider it as 55 years old.

When describing the imbalance of human resources for health, both abroad and in the Republic of Kazakhstan, geographical, gender imbalances as well as imbalances in specialties and health care sectors are mainly evaluated. To date, we have not found suitable tools for assessing the age-related imbalance of physician workforce that could help healthcare managers adequately assess the risks of impending natural attrition and minimize the possible consequences of staff shortage in a timely manner.

The purpose of our study is to propose a model for assessing the age-related imbalance of physician workforce and the risk of staff deficit in the mid and long term for the formation of staff policies in the regions.

Materials and methods

Study design: one-stage (transverse), analytical study.

For the calculations, we used the aggregated data from 2018 on the qualitative and quantitative composition of practicing doctors of the regions of the Republic of Kazakhstan obtained from the automated information system “Personnel” (“Medinform”). From 2000 to 2018, Medinform Limited Liability Partnership carried out the development, implementation and maintenance of software products for medical organizations and public health authorities of the Republic of Kazakhstan, as well as the preparation and publication of analytical collections on the state of public health and healthcare in the country. The data used are not the intellectual property of Medinform LLP. They are statistical data on the health care activity of the Republic of Kazakhstan and are used in the work of interested bodies of authority in the field of healthcare.

This study did not require the approval of the topic at a meeting of the Ethics Committee since it does not address

personal interests and does not contain personalized information.

Statistical methods included the assessment of the structure through the calculation of extensive indicators, as well as the changes of indicators over the years. To assess the situation, we conducted an analysis of the age structure of physician workforce, determined the age limits of "professional life" and proposed a method for quantitative and qualitative assessment of it.

For the subsequent qualitative assessment, we suggested to adopt the approach of assessment model of Types of population reproduction in demography which includes regressive, stationary and progressive types of population reproduction, comparing the "extreme" cohorts – up to 15 years and 50 years and older. In this approach, if the share of the minimum age group (up to 15 years) prevails over the share of the maximum age group (50 years and older), it is assessed as the progressive type of reproduction. The prevalence of the proportion of persons of the maximum age group over the proportion of persons of the minimum age group is estimated as a regressive type of reproduction. Equal shares of these two age groups are regarded as a stationary type of reproduction. Furthermore, for risk assessment, we used the traditional risk assessment scale with gradation: low risk, medium risk, and high risk.

In this study, at the stage of a quantitative risk assessment, 3 cohorts of physician workforce were identified, according to the periods of their "professional life":

First period – professional "youth" – first 5-6 years at work (staff joining the work and professional community

after graduation). Into the first cohort – group of professional debut, we included physicians up to 30 years old with 10 years of practical experience. This group characterizes the ability of the system to replenish the physician workforce.

Second period – professional "maturity" – period of stable medical practice for 25-30 years. The second age group includes doctors from 31 to 54 years old which makes up 40-60% of medical staff in various regions. The group was defined by us as more stable in terms of the dynamics of the number of people. We did not include this group in the comparative analysis as it was neutral in terms of inflow of staff and natural attrition.

Third period – professional "fading" and attrition of personnel (natural attrition). To the third age group we included doctors of pre-retirement and retirement age – 55 years and older, which was accordingly defined by us as a group with the highest risk of natural attrition from the professional community.

When the proportion of doctors of Group 1 was higher than that of Group 3, we defined this type of replenishing the workforce as the progressive type, which was assessed as the one with the lowest risk of natural attrition.

The equal number of doctors in these two groups was regarded by us as a stationary type of workforce replenishment, which is considered to be the group with average risk or the group with potential risk.

The prevalence of the share of the third subgroup over the first was considered as a regressive type which is established by us as the group with the highest risk (Table 1)

Table 1.

Assessment of the type of structure and level of risk.

Type of workforce replenishment	Group 1, up to 30 years old, %	Group 2, from 31 to 55 years old, %	Group 3, 55 years old and above, %	Risk level
Progressive	> 25%	≈ 50%	< 25%	Low
Stationary	≈ 25%	≈ 50	≈ 25%	Average
Regressive	< 25%	≈ 50	> 25%	High

For the analysis, the difference was calculated between the proportion of doctors under 30 and the proportion of doctors over 50 years old. A negative difference or the absence of a difference in the above age groups (regressive and stationary types of replenishing the workforce) characterizes a delay in meeting the shortage of staff, which can be assessed as a risk of staff shortage in the future.

Results

According to statistics, 54,405 doctors worked in the healthcare system (public sector) in the Republic of Kazakhstan at the beginning of 2018, of which 39919 (73%) were female doctors and 14516 (27%) were male doctors. Data for the regions of the Republic of Kazakhstan are presented in Table 2.

Table 2.

The number and gender composition of doctors in the healthcare system of the Republic of Kazakhstan in 2017.

Region	Total number of doctors		Female doctors		Male doctors		Working retirees	
	Abs	%	Abs	%	Abs	%	Abs	%
Republic organizations	5851	10,8%	4152	71,0%	1699	29,0%	526	9%
Akmola region	1921	3,5%	1377	71,7%	544	28,3%	315	16%
Aktobe region	2507	4,6%	1908	76,1%	599	23,9%	309	12%
Almaty region	4129	7,6%	3070	74,4%	1059	25,6%	542	13%
Atyrau region	1331	2,4%	1014	76,2%	317	23,8%	251	19%
West Kazakhstan	1602	2,9%	1211	75,6%	391	24,4%	266	17%
Jambyl region	2521	4,6%	1756	69,7%	765	30,3%	304	12%
Karaganda region	3852	7,1%	2926	76,0%	926	24,0%	717	19%
Kostanay region	1723	3,2%	1211	70,3%	512	29,7%	426	25%

Продолжение Таблицы 2.

Region	Total number of doctors		Female doctors		Male doctors		Working retirees	
	Abs	%	Abs	%	Abs	%	Abs	%
Kyzylorda Region	2373	4,4%	1739	73,3%	634	26,7%	228	10%
Mangistau region	1671	3,1%	1318	78,9%	353	21,1%	168	10%
South Kazakhstan	7922	14,6%	5372	67,8%	2550	32,2%	364	5%
Pavlodar region	2253	4,1%	1642	72,9%	611	27,1%	364	16%
North Kazakhstan	1437	2,6%	1007	70,1%	430	29,9%	230	16%
East Kazakhstan	3682	6,8%	2801	76,1%	881	23,9%	575	16%
Astana city	3645	6,7%	2921	80,1%	754	20,7%	279	8%
Almaty city	5985	11,0%	4494	75,1%	1491	24,9%	695	12%
TOTAL:	54405	100%	39919	73,4%	14516	26,7%	6559	12%

Irrevocable outflow of staff includes retirement, disability, death, and migration. The retirement makes up 80% of irrevocable outflow. Analysis of dynamics for the period of 2013-2017 showed that on average about 1.2% (\approx 550 doctors) of the total number of doctors retire annually,

which is shown in Table 3. The dynamics of this indicator has an uptrend. For example, the number of those leaving due to retirement in 2017 was 677 which is almost 20% more than in 2016 (568 doctors). Over 5 years, the overall growth of irrevocable outflow increased by 25%.

Table 3.

Retirement of doctors in 2013 – 2017.

Region	2013	2014	2015	2016	2017
Republic organizations	55	28	16	67	69
Akmola region	26	22	26	31	26
Aktobe region	33	43	22	20	27
Almaty region	36	12	47	33	41
Atyrau region	18	15	8	6	30
West Kazakhstan	16	23	21	15	12
Jambyl region	35	30	33	30	42
Karaganda region	59	42	68	70	62
Kostanay region	41	41	32	27	35
Kyzylorda Region	17	27	23	31	43
Mangistau region	5	4	2	6	18
South Kazakhstan	55	42	56	55	60
Pavlodar region	14	28	21	32	26
North Kazakhstan	18	21	13	21	26
East Kazakhstan	47	59	56	78	76
Astana city	19	18	21	14	25
Almaty city	40	40	28	32	59
TOTAL	534	495	493	568	677

At the same time, about 6550 doctors continue their practice after retirement in the healthcare system of the Republic of Kazakhstan – this is 5400 female doctors and about 1150 male doctors, which is 12% of the total number of working doctors and is 10 times the amount of those retiring annually. According to preliminary estimate, the number of doctors of pre-retirement age who must retire until 2023-2025 is also high, reaching 5500 (10%).

The highest percentage of doctors of retirement age works in the Kostanay region – 25% (426 out of 1723) – i.e. every fourth doctor continues to work after retirement. Also, a high indicator of 19%, is registered in the Atyrau region (251 out of 1331) and in the Karaganda region (717 out of 3852 doctors). The smallest proportion of doctors of retirement age works in the South Kazakhstan region – 5% (364 out of 7,922).

Moreover, among the doctors practicing at retirement age, 2146 doctors are over 65 years old (every third doctor in this cohort). Also, as of the beginning of 2018, 211 doctors over 75 work in the Republic of Kazakhstan: 28%

(60) of them work in Almaty, 32 doctors (15%) in the Karaganda region and 20 doctors (9%) in the East Kazakhstan area. The lowest number of this indicator is noted in the North Kazakhstan and Aktobe regions.

Among doctors who are over 75 years old and continue to practice, the proportion of male doctors is 0.6% of the gender group of employees, which is two times higher than the proportion of female doctors (0.34%) in the gender group of the same age.

We further assessed the structure of physician workforce in regions. A qualitative assessment using our model showed that 8 out of 16 regions (50%) have a regressive and stationary types of filling staff shortage. Regions with a progressive type are: Astana – 32% of doctors under 30 years old and 13% of doctors over 55 years old, South Kazakhstan region (27% and 10%), Mangistau region (30% and 15%), and Almaty city (31% and 16%), respectively.

The stationary type was detected in the Karaganda region, where 25% of doctors are under 30 years old and

25% of doctors are over 55 years old and Pavlodar region (25% and 24% under 30 and over 55, respectively). A regressive type was detected in the Kostanay region with 24% of doctors being in the age group of under 30 years old and 35% of doctors – over 55 years old (Table 4).

A quantitative assessment showed that in the Kostanai and Atyrau regions, there is an extreme imbalance, which indicates that the rates of filling the staff shortage are behind potential natural attrition.

Discussion

Doctors continuing to work after retirement age partially solve the problem of physician shortage. Considering the shortage of up to 3010 doctors in Kazakhstan as of the beginning of 2018, according to official statistics, which is 5% of working doctors, it is necessary to take into account the

hidden deficit (12%), temporarily compensated by doctors of retirement age, and the number of doctors entering pre-retirement age who are able to retire (10%). This shortage risk is likely provided that all doctors of retirement age leave their work and retire on time, which could exacerbate the real situation.

This issue has a high level of uncertainty regarding intentions of voluntary retirement and state of health of aging physicians, which also increases the likelihood of deficit risks occurring. In total, statistics show that more than 20% of doctors are potential candidates for irrevocable outflow in the medium and long term. Therefore, working after retirement age should be classified as a risk and considered as a risk associated with a hidden deficit of personnel and therefore, of medical practice.

Table 4.

Age cohorts of doctors, quantitative assessment KRI.

Region	Group 1, up to 30 years old	%	Group 2, from 31 to 55 years old	%	Group 3, 55 years old and above	%	Difference between Groups 1 and 3
Akmola region	471	25%	1009	53%	441	23%	2%
Aktobe region	583	23%	1407	56%	517	21%	3%
Almaty region	1135	27%	2159	52%	835	20%	7%
Atyrau region	318	24%	656	49%	357	27%	- 3%
West Kazakhstan	508	32%	691	43%	403	25%	7%
Jambyl region	649	26%	1381	55%	491	19%	6%
Karaganda region	982	25%	1888	49%	982	25%	0%
Kostanay region	405	24%	714	41%	604	35%	- 12%
Kyzylorda Region	694	29%	1300	55%	379	16%	13%
Mangistau region	506	30%	907	54%	258	15%	15%
South Kazakhstan	2127	27%	4989	63%	806	10%	17%
Pavlodar region	573	25%	1131	50%	549	24%	1%
North Kazakhstan	389	27%	709	49%	339	24%	3%
East Kazakhstan	993	27%	1835	50%	854	23%	4%
Astana city	1149	32%	2040	56%	456	13%	19%
Almaty city	1875	31%	3160	53%	950	16%	15%
TOTAL:	14674	27%	29570	54%	10161	19%	8%

The process opposite to the natural attrition is the training or replenishment of physician workforce, which takes from 7 to 15 years. More physicians joining the system should not only compensate for the natural attrition but also cover the needs of the growing population of the Republic of Kazakhstan in the main types of medical care. The delay in the succession may carry significant shortage risks in the future and should be evaluated using objective estimates of aggregated data and their analysis.

It should be noted that during the study in foreign management practice, we found no evidence for the development of assessment tools and analogues of the model for assessing the age imbalance of doctors. It is also important to note that the advantages of the proposed model are the simplicity of a quantitative assessment that can easily be used by local managers and the availability of data in the accounting systems of staff of medical organizations, in human resources departments of the regional healthcare department, and departments of the Ministry of Health that provide personnel planning for the medium and long term. Another advantage of the model is assessment of the current state of the system and the objectivity of the assessment. The model can be automated with the implementation of reports and visualization in the

human resources accounting system. This model can also be used to assess “aging” in certain specialties, which would allow to plan training in a residency ahead of risk. Another advantage is the possibility of embedding this risk in the global model for planning human resources for health. The elements of the assessment of this model have already been partially used in the planning and distribution of grants for undertaking residency in universities and scientific institutions of the Republic of Kazakhstan for certain specialties for the 2019-20 academic year, which was first carried out taking into account the risk assessment of the future deficit.

The limitations of the model in our opinion may be that the model does not take into account factors that influence the decision of doctors to continue working after retirement (the level of economic development of the region, higher life expectancy of population as a whole with the possibility of continuing professional realization, extensive experience and high level of professionalism in the elderly, etc). It is possible that the model will require correction in age gradation, taking into account the late age of joining the profession in medicine (an average of 28-30 years), and professional “youth” can be postponed considering their long training. We believe that this limitation can be adjusted empirically and is purely technical

in nature. We are also aware that the model requires approbation in dynamics and empirically its consistency and usefulness can only be verified by using the tool in practice. The authors plan further work on improving the model considering practical approbation and exploring ways to minimize the limitations of the study.

Conclusion

More than 10% of doctors in Kazakhstan are specialists of retirement age. This imposes certain risks on the entire healthcare system and requires careful consideration by politicians. The proposed assessment model allows a quantitative and qualitative assessment of the situation and risk at the level of each region and speciality. The replenishment of physician workforce in the regions of the Republic of Kazakhstan can be divided into three types. The most favorable is the progressive type of replenishment which exists in the South Kazakhstan, Mangystau and Kyzylorda regions. Special attention should be paid to regions with a regressive type of workforce replenishment and a high proportion of doctors practicing at retirement age: in the Kostanay region – 25% and in Atyrau region – 19%, where it is important to take preventive measures from now on to minimize future risks of staff shortages. Careful planning of the professional workforce is required since there is an uneven distribution of aging medical workers between the regions of the country.

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Contribution of the authors:

Semenova Yu.M. and Goremykina M.V. - conceived the research project, participated in the writing of the manuscript, and approved the final version of the manuscript.

Kyrykbayeva S.S. - collected information and analyzed data.

Kyrykbayeva S.S., Dauletyarova M.A., Nauryzbayeva A.A. - participated in the development of the model and coordination of the project.

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