ORIGINAL ARTICLE

SOCIO-ECONOMIC PATTERNS OF LABOR MARKET FUNCTIONING IN THE PUBLIC HEALTH: CHALLENGES CONNECTED WITH COVID-19

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ABSTRACT
The aim: To form a methodological basis for assessing socio-economic trends in operation of the labor market in the health care.
Materials and methods: The article analyzes the scientific methods of the investigation the labor market, determines their main advantages and disadvantages. The proposed model is based on the evaluation of supply and demand for the vocational medical professionals. Both for all indicators, the study initially set the calculation base and then this parameter was multiplied by a number of correction determinants.
Conclusions: The market of the vocational medical professionals became the most influenced from the pandemic tendencies. The list and scope of educational services provided by regional vocational educational institutions should clearly correspond to the needs of regional level in the condition of the pandemic COVID-19.

KEY WORDS: vocational medical education, labor market, COVID-19

INTRODUCTION

The relevance of the study consists in the existing need for specialists with medical vocational education in the labor market. The COVID-19 epidemic indicates problematic aspects of the medical sector operation, particularly in terms of medical training. According to the Ministry of Health of Ukraine, the biggest challenge for the health care system during a pandemic is the lack of staff, namely junior medical workers. The key target of the current stage in the regional educational system development should be harmonizing relationships in the system "education – the labor market needs."

Traditionally, the following factors define the demand in the labor market: the need to consider current and forecast trends (demand for specific professions and requirements for their level and qualifications), educational reforms and administrative-territorial structure, determining the level of authority and responsibility for training.

A qualitative breakthrough in forming a system of reliable forecasts for the labor market development leads to the construction of conceptual principles and applied tools to predict its development. At the same time, the formation of labor market forecasts should consider such factors as trends in socio-economic development, pandemic challenges, the needs of a particular area (region, city, local community), the level of budget funding for education, the available human resources of education.

The formation of research methodology requires an analysis of existing methods and tools and forecasting of labor market conditions. The results of the analysis indicate the following aspects: 1) each country has a number of academic and governmental institutions that develop forecasts of structural changes taking into account economic indices (citizens' employment indices in terms of qualifications, occupations, economic activities, industries, gender, age, nationality , employment status, etc.) [1, 2, 3]; 2) forecasts are made mainly in the medium term and are adjusted on average once a year [4, 5, 6, 7]; 3) many models consider the impact of technological and social changes in the economy, global economic conditions, changes in consumer preferences, productivity, labor and geographical mobility of the population on future demand for labor and their supply [8, 9, 10, 11]; 4) most models use quantitative economic and mathematical methods (econometric methods, intersectoral balance matrices, macroeconomic modeling, analysis of structural changes, etc.) [12, 13, 14, 15]. Most of these models particularly use large and complex data sets. It is their main drawback. 5) In addition to quantitative methods, qualitative ones are used (analysis of trends and threats, investigation of development scenarios, numerical negotiations, surveys and questionnaires of graduates and employers) [16, 17, 18].

THE AIM

To form a methodological basis for assessing socio-economic trends in operation of the labor market in the health care.

MATERIALS AND METHODS

In this study, the basic category "unrealized demand for labor" assesses the need for medical professionals in

vocational education in the labor market of the Sumy region. This is due to the fact that the available vacancies will define the amount and direction of financial flows from local budgets and subventions from the state budget for the development of professional (vocational) and vocational education in the medical field of specialists' training [19].

The estimated base is the number of vacancies for the workers of the proper profession. This study considers the fact that there is an objective discrepancy between the relevant and official data on the number of vacancies in the region, which are collected by the employment service and published regularly (since not all employees are officially employed, and based on a wide range of possible sources for labor search by employers).

Factors influencing the unrealized demand for medical specialists in vocational education, mentioned in this study, include [20, 21]:
- the cost of labor of appropriate qualifications;
- the level of the region's citizens' aging;
- the level of labor replacement by capital in the medical field (investing in the modernization of equipment and the introduction of new technologies in medicine. It leads to the displacement of manual labor, making many low-skilled workers unemployed);
- the sectoral development potential. For the "Healthcare" sector, the development potential of the sector is measured by the basic population growth rate in the region per each year. It is calculated by the following formula:

$$k_t^{GM} = \frac{KN_t}{\frac{1}{T}\sum_{t=1}^{T} KN_t}$$

(1)

k_t^{GM} – the generalized index of the "Healthcare" sector development potential in the region in the t-calendar year (as of the end of the year);

$\frac{1}{T}\sum_{t=1}^{T} KN_t$ – simple average absolute population for the considered period (1995-2019 period is the range of calculations for this industry range).

Given that the unrealized supply may be influenced by other factors not included in the above list, the calculated value of the unrealized supply of medical specialists in vocational education, based on available statistical information, another component is added [22, 23, 24]. It is a standard deviation of this index defining the lower and upper limits of its possible values. This makes it possible to consider the probable variation in the value of the unrealized supply due to the influence made by additional factors [25].

Based on the above, the volume of unrealized supply for medical specialists in vocational education in the region in the t-calendar year (as of the end of the year) was calculated as follows:

$$S_t = (G_t + U_t + Q_t) \cdot k_t^c \cdot k_t^a \cdot k_t^m \pm \sigma_S$$

(2)

G_t – the number of graduates of medical educational institutions of professional higher education in the region

of the respective profession (specialization) in the t-calendar year (as of the end of the year);

U_t – the number of unemployed citizens in the region in the t-calendar year (as of the end of the year);

Q_t – the number of newly created labor force after training and retraining of the unemployed citizens in the region in the t-calendar year (as of the end of the year);

k_t^{cS} – adjustment coefficient that characterizes the cost of appropriate qualification labor in the region in the t-calendar year (as of the end of the year);

k_t^m – adjustment coefficient that characterizes the labor migration level in the region in the t-calendar year (as of the end of the year);

σ_S – the standard deviation of the unrealized supply for medical specialists of vocational education in the region for the considered period (it enables to establish the probable limits of fluctuations in the volume of the unrealized supply for medical specialists).

This study takes the structural approach to the labor market conditions analysis. According to it, the difference between the volume of unrealized demand and unrealized supply for medical specialists in vocational education in the Sumy region allows establishing the labor market condition type of the appropriate sector (equilibrium, labor shortage, labor surplus).

When quantifying the labor demand and labor supply, it is important to know the share of demand that provides 100% of supply, or in other words, what percentage of supply is for 100% of labor demand.

The "gap" between supply and demand (INN_t) is assessed to directly calculate the need for staff (deficit or surplus) in the medical field. This gap describes the shortage or surplus of labor in the Sumy region in the t-calendar year (as of the end of the year):

$$INN_t = (S_t - D_t) \pm \sigma_{INN} = ((G_t + U_t + Q_t) \cdot k_t^{cD} \cdot k_t^a \cdot k_t^m) - (V_t \cdot k_t^{cS} \cdot k_t^d \cdot k_t^s \cdot k_t^p) \pm \sigma_{INN}$$

(3)

where σ_{INN} – the standard deviation of the gap between the demand and supply of the medical sector in the Sumy region for the considered period (it allows establishing the probable limits of fluctuations in the need for staff).
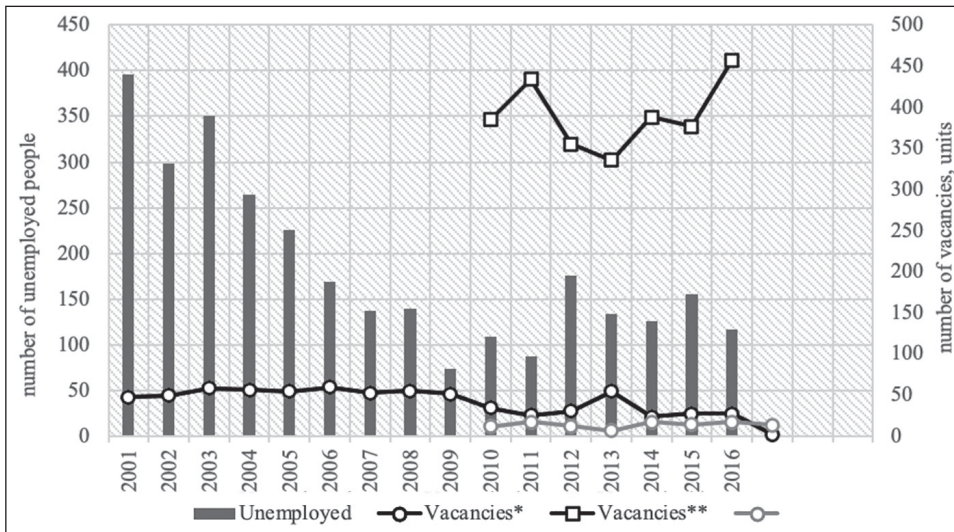
RESULTS

During the analysed period there is a reduction in the number of graduates in the vast majority of regional educational institutions of higher medical education.

During 1995-2019, the regional health care institutions employed an average of 4.6 thousand doctors of all specialties. The provision index in 2019 was 40.4 doctors per 10 thousand citizens, which is 19.5% higher than in 1995. A slight increase in doctors' provision per 10 thousand citizens affected by the decrease in doctors' number occurs due to population changes.

During 1995-2019, the number of unemployed citizens in the health sector of Sumy region decreased by 3.4 times (Fig. 1).

The active development of the private practice of surgeons, dentists, ophthalmologists, orthodontists, psychia-

* data from Sumy regional employment service
** data of the Healthcare Department of Sumy Regional State Administration

Fig 1. Dynamics of the number of unemployed people and vacancies in the health care in the region during 2001-2019
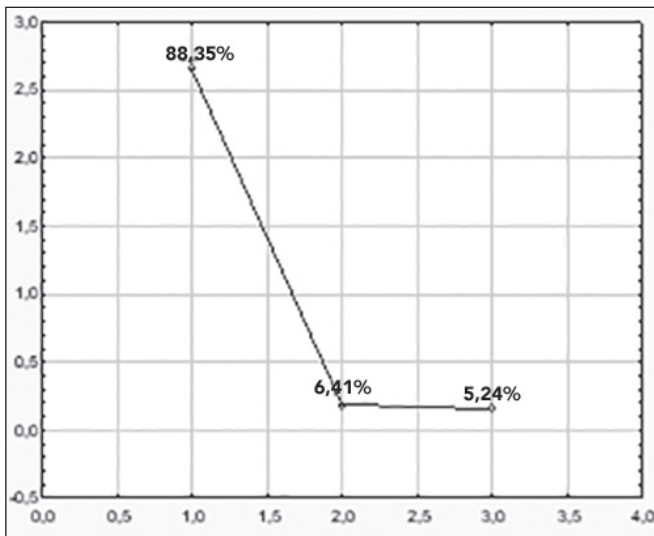

Fig. 2. Graphical representation of the «scree» method to determine the number of factors influencing the volume of unrealized supply for specialists in health care selected for further analysis (fragment of the screen in the program Statistica 8)
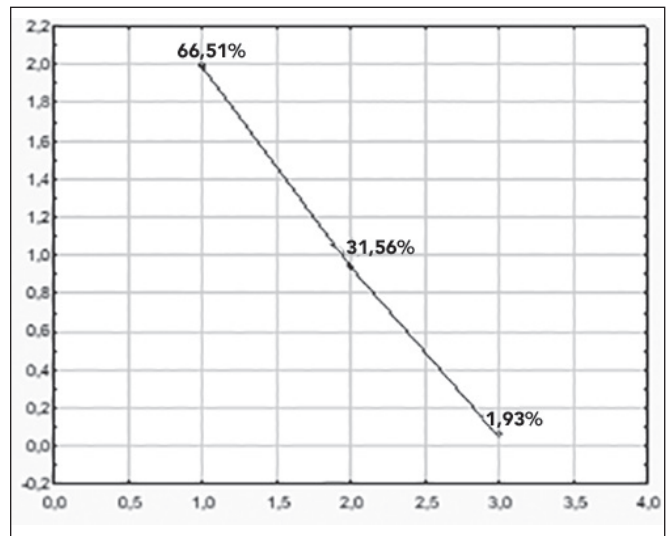

Fig. 3. Graphical representation of the «scree» method to determine the number of factors influencing the volume of unrealized demand for vocational specialists in health care, selected for further analysis (in the condition of spreading COVID-19) (fragment of the screen in Statistica 8)

trists, therapists and other specialists explains this situation. The creation of modern private clinics and medical centers provides new jobs and reduces unemployment among doctors and junior nurses [26]. Besides, the COVID-19 pandemic will only exacerbate the negative trends in the medical sector in terms of the increase in the number of vacancies in medical institutions and the increase in the unemployment rate in the sector.

The analysis of general trends in health care development in the Sumy region and patterns for creating the labor market segment form the basis for a full set of input information. It analyzes the satisfaction of the labor market need for specialists of vocational education in the health care sector in the Sumy region in the context of pandemic crises COVID-19.

The most important factors influencing the formation of supply and demand for specialists in vocational education in the medical field are selected using the principle components method in the following sequence:

1. Formation of an input information set regarding the factors influencing the volume of unrealized demand and supply in health care sector during 2001-2019. The main factors influencing the volume of unrealized supply in the labor market in the health care sector include the gap in the labor forces cost in the health care sector, migratory growth of labor force, the number of able-bodied population aged 15-70 years, loss of medical workers due to dismissal of the spreading of COVID-19. The unrealized demand for vocational education specialists in the health care sector includes such factors as the gap in the labor forces cost in

Table 1. Intermediate calculations for method of constructing a matrix of factor coordinates of variables

Variables	Factor coordinates of variables		
	Factor 1	Factor 2	Factor 3
Gap in the labor cost	-0.982183	0,075510	0,172089
The level of population aging	-0.378381	-0,924872	-0,037929
Industry development potential (amplified by the spread of COVID-19)	-0.941977	0,292777	-0,164199

Table 2. Periods, when abnormal values of factors influencing the supply and demand for vocational specialists in the health care sector in the Sumy region

Indicator	Years when the anomaly was defined	
	Anomaly in the trend component (main trend, the Irwin method)	Anomaly in seasonal and cyclic components, connected with the COVID-19 (modified Irwin method)
Number of graduates of medical schools in the Sumy region		
Specialists in biology and agronomy	absent	absent
Support staff in modern medicine, physiotherapy, pharmacy and veterinary medicine	absent	absent
Nurses and midwives assisting professionals	absent	2017
Number of the unemployed people in the appropriate professions		
Specialists in biology and agronomy	absent	absent
Support staff in modern medicine, physiotherapy, pharmacy and veterinary medicine	absent	absent
Nurses and midwives assisting professionals	absent	2015
Number of vacancies	2012, 2018	2011-2012, 2016, 2019
Factors on which the volumes of unsold supply and demand are adjusted		
The level of population aging	absent	2002, 2006, 2008
The gap in the cost of health care sector	absent	2003, 2005, 2007, 2010-2012, 2019

the health care sector (especially in the condition of pandemic crises), the level of population aging, the potential for health care development.

2. Determination of the number of factors most affecting the unrealized supply and demand in the labor market in the health care sector using the "scree" method. It is implemented using the program Statistica 8 (Fig. 2, 3).

3. Formation of the list of factors most affecting the unrealized supply and demand in the labor market in the health care sector. The method of constructing a matrix of factor coordinates of variables (intermediate calculations are in Table 1) is implemented for this task.

Based on the calculations, it is found that the most statistically significant factor is the "gap in the labor forces cost in the health care sector", strengthening by the pandemic COVID-19. It adjusts the volume of the unrealized supply of higher education specialists in the health care sector and deficit of the vocational staff in the medical institutions. The most significant factor influencing the demand for higher education specialists in the health care sector is population aging in the Sumy region.

For the most reliable results, the input data is checked for homogeneity, eliminating the influence of anomalous values that may adversely affect the calculation of the current and forecast labor demand level. For this purpose, the

Irwin method and modified Irwin method are used. Table 3 contains generalized results of detecting anomalies in changing the studied indices in terms of the two methods.

The results obtained using the Irwin method (Table 2) indicate that there are small anomalous levels for the considered time series (clearly expressed significant trends). The modified Irwin method confirms the seasonal and cyclical fluctuations (connected with the COVID-19) in the whole set of considered indicators. The detected anomalous values are replaced by the corresponding values along the curve that approximates the indicator.

The next stage of the study is to calculate the adjustment factors for each and the significant factors influencing labor supply and demand. The calculated values of these adjustment factors are in Table 3.

The calculated coefficients presented in table 4 indicate that the adjustment will lead to:
- an increase in unrealized demand by almost a quarter (due to the creation of jobs in the health sector by increasing the number of people who will retire);
- a decrease in the volume of unrealized supply by almost a quarter (within three years this adjustment factor is less than one (about 0.7). A decrease in its dynamics indicates a decrease in the attractiveness of the health sector in terms of employment since medical workers

Table 3. Dynamics of adjustment factors for unrealized demand and supply of specialists in vocational education in the health care sector in the Sumy region in the condition of the pandemic COVID-19, fr. unit.

Year	Unrealized demand	Unrealized supply
	Adjustment factor characterizing the level of population aging in the Sumy region	Adjustment coefficient characterizing the level of the gap in the labor cost in the health care sector in the Sumy region
2014	1,235	0,7631
2015	1,238	0,7548
2016	1,241	0,7348
2017	1,243	0,7372
2018	1,245	0,7413
2019	1,251	0,7493

Table 4. Results of calculations of unrealized demand for specialists in vocational education in the health care sector in the Sumy region during 2014-2019, persons.

Year	Specialists in biology and agronomy	Support staff in modern medicine, physiotherapy, pharmacy and veterinary medicine	Nurses and midwives assisting professionals
2014	13	222	245
2015	12	217	238
2016	15	264	290
2017	17	276	312
2018	19	284	346
2019	21	292	392
The standard deviation	3,18	29,33	54,17

Table 5. The calculation results of the unrealized supply of vocational education specialists in the health care sector in the Sumy region during 2014-2019.

Year	Specialists in biology and agronomy	Support staff in modern medicine, physiotherapy, pharmacy and veterinary medicine	Nurses and midwives assisting professionals
2014	20	306	231
2015	18	290	246
2016	11	262	219
2017	15	254	221
2018	18	231	236
2019	12	224	245
The standard deviation	3,29	29,39	10,54

have lower wages compared to other sectors in the Sumy region and unsafety working conditions connected with the pandemic COVID-19).

Based on the formed information set and the calculated adjustment factors, the unrealized demand and supply of specialists in vocational education in the health care sector in the Sumy region are determined (Table 4).

Analyzing the data in Table 4, we can conclude that the demand for vocational education specialists in terms of each profession in the health care sector in the Sumy region has increased over the three observed years.

The calculation results of the unrealized supply in the labor market in the health care sector are in Table 5.

Thus, the situation on the labor market in the health care sector in the Sumy region was redundant for:
- specialists in the biology and agronomy field during 2016 – 2019;
- support staff in the field of modern medicine, physiotherapy, pharmacy and veterinary medicine during 2016-2019;
- nurses and midwives who assist professionals during 2014, 2016-2019.

Over the years under the study, the gap between unrealized demand and supply within the observed professions has not decreased and in the condition of spreading COVID-19 it increased.

DISCUSSION

Calculations for health service sector show that labor market conditions are redundant for these economic activities, the market is oversaturated with junior specialists in the health care sector. However, the gap between supply and demand exists within the studied professions.

In general, the list and scope of educational services given by the medical regional educational institutions, should clearly meet the needs of regional health care institutions. It necessitates the need to ensure that the labor market is updated by the necessary specialists in accordance with the rapidly emerging market demands related to the COVID-19 pandemic consequences.

Relevant areas for further research include the development of criteria for optimizing the network of medical vocational education institutions in the region, the amount of their funding, areas and levels of training.

Given that the analyzed labor market is mostly regional in nature, it is impossible to identify a regional demand for specialists and workers at the level of cities of regional significance, districts and integrated territorial communities. Thus, it is most rational to transfer the whole set of responsibilities related to medical vocational education to the regional level. The Polish experience regarding the decentralization of the vocational education confirms that the whole set of responsibilities related to vocational (technical) education must focus on the regional level (in Poland – at the voivodship level).

The reform of the vocational education financing system in the region should be based on forecasting the regional

labor market needs in the short and medium-term, given qualified medical personnel training. For countries where vocational education is funded from local budgets, these forecasts should form the basis for developing proposals to create a regional training order. Given the limited local budgets, it is essential to provide financial support to those educational institutions that train specialists the demand for whom is high in the region, and the supply does not cover it.

CONCLUSIONS

The system of vocational education in the region is analyzed from the standpoint of seeing its state and prospects for development; effectiveness in responding to the needs of the economy and the labor market; pandemic challenges, the effectiveness of demographic, social and inclusive needs; quality of the vocational education system; some aspects of management and financing.

The paper substantiates the existing need of the labor market for specialists in higher education in the medical field, which is exacerbated today by the pandemic crisis KOVID-19. When assessing the need for medical professionals in higher education in the labor market of Sumy region in this study, the basic category was "unrealized demand for labor", which allowed to take into account the available vacancies in medical institutions. In the future, this will determine the volume and direction of financial flows from local budgets and subventions from the state budget for the development of professional (vocational) and professional higher education in the medical field of training.

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A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis,
D – Writing the article, **E** – Critical review, **F** – Final approval of the article