Reshaping jobs in healthcare sector based on digital transformation

Bunduchi Elena
Institute of National Economy, Romanian Academy, Romania; „G.E.Palade" University of Medicine, Pharmacy, Sciences and Technology of Târgu Mureş, Romania

Vasile Valentina
Institute of National Economy, Romanian Academy, Romania

Ștefan Daniel
Institute of National Economy, Romanian Academy, Romania; „G.E.Palade" University of Medicine, Pharmacy, Sciences and Technology of Târgu Mureş, Romania

Comes Călin-Adrian
Institute of National Economy, Romanian Academy, Romania; „G.E.Palade" University of Medicine, Pharmacy, Sciences and Technology of Târgu Mureş, Romania

ABSTRACT

Digitization in the health sector is unequally distributed by activities and specializations, but it remains a trend that will change the employment model, with jobs disruption and infusion of financial capital and associated technologies. The facilities offered by digitalization not only offer solutions to adapt medical services to the challenges / restrictions of Covid-19 but also offer multiple possibilities to access expert services or reduce waiting times on the value chain of services, allowing to increase quality in perspective. patient-centered treatments. The aim of the research is to identify to what extent factors such as the level of economic development, the financing of the health sector and the external mobility of specialists influence the digital reform in the health sector. The results confirm the significant influence of the level of economic development and health spending on the potential for digitization of jobs in the health sector. It also highlights that e-health services have a reverse impact on the migration of doctors.

Keywords*: health, digital reform, jobs, migrant health worker*

INTRODUCTION

The impact of digitalization is felt in all spheres of life, from processing industries (Çela et al., 2021; Herman, 2020) to services sector with activities like education (Timus et al., 2020), health and culture. Practically, digitalization is transforming our lives as we knew it before. Although many industries, such as retail, tourism, and entertainment have begun to grow with the advent of the Internet, health is a sector in which digitalization has failed to exert rapid

influence due to financial, technological, and legislative, but also cultural, differences. For example, until 2018, teleconsultations in Germany were not allowed (Olesch, 2021), unlike in Switzerland, where remote treatment has been widely used for more than seventeen years (Behringer, 2018). However, healthcare is currently undergoing a digital revolution. Big Data, mobile devices, surgeries assisted by artificial intelligence (AI) and other innovations, including in health technological processes management are opening up new frontiers in medicine, a trend that has become especially visible during the COVID-19 pandemic. According to some studies (Siemens Healthineers, 2021), as a result of the COVID-19 pandemic, more and more medical institutions are investing in digital tools and AI. At the same time, they find that most of the investments have been made in equipment and programs that contribute to improving communication between medical staff and patients. Smartphone applications are tracking the spread of the virus, provide preliminary recommendation for treatment route and alternatives for access the proper services and AI as facilitator for better and faster diagnosis is helping doctors to increase the quality and efficiency of treatment.

The connections between patients and their caregivers can be secure, easier, and faster due to the use of technologies and digital tools, which aim to reduce physical distances and can give sometimes better result than usual face-to face medical services (Oliviera Hashiguchi, 2020). Consequently, the relational mechanism between patients and medical staff is starting to be based more and more on the concept of limiting face-to-face interaction with patients and faster communication through digital platforms. Monitoring the health of patients at home through telemedicine technology will allow them to benefit from diagnosis and quality outpatient treatments while they are at home, without the need for their physical presence in hospital units (Sundberg et al., 2015). This shift to home care is only possible with the help of digital decision support tools, including big data on similar cases, that can identify the optimal approach for treatment model and the right people/cases for outpatient home care. Through distance and telehealth care, patients will gain more transparency in their own care and become more active and aware of their own health and symptoms and take needed measures to prevent diseases (Player et al., 2018). The use of digital mHealth tools promotes patient empowerment, while enhancing the connection between patients and health personnel (Qudah & Luetsch, 2019). In addition, telemedicine has a significant impact on people with disabilities and mental disorders (Toquero, 2021; Groyer & Campbell, 2018). Thus, patient monitoring and symptom surveillance can be performed remotely and treatment can be much more beneficial (Berrouiguet et al., 2016), with patients finding themselves in a familiar environment contributing to a positive response to the treatment. Farrell (2016) illustrates the use of

smartphones by health personnel in acute care and it has shown that its are a very important digital tool used in communication between patients, nurses, and other healthcare professionals.

In addition to the benefits of digital communication between patients with various diseases and medical staff, it improves access to health services for people in rural or remote areas, especially due to the fact that worldwide 43.85% of the world's population still lives in countryside (World Bank, 2021). van Dis (2002) results show that people in rural areas are more prone to health problems, such as poor dental hygiene, high risk of mental illness, chronic illness, substance abuse, alcohol, and tobacco use, all of which lead to poor general health and low quality of life. Health status disparities for people in rural areas compared to urban ones are due to lack of access to health services. One way to address the issue of access to health care for people in those areas, but also for people from urban area would be to implement telemedicine and communication between patients and healthcare professionals through digital tools. These services would allow early diagnoses, prescribing treatments and disease prevention actions, without the need to travel to medical units, which are sometimes too far from home, or if those units do not have enough qualified staff.

Besides the impact that digitalization has on the relations between patients and medical staff, the technology has made it easier for the health staff to communicate between them beyond geographic borders, being possible to organize teleconferences, webinars, and videos, or even to perform operations or other medical treatments / interventions together, saving time with the physical movement of specialist doctors.

However, it is important to carefully address patients' distrust of digital tools and to explain their benefits, without creating communication barriers between patients and healthcare professionals, both digital and face-to-face. Studies show that although telemedicine contributes to better patient – doctor communication, some patients are not satisfied with these services due to the fact that they do not have adequate training on the use of digital tools, they do not have a high level of digital readiness, problems with internet connection or even concerns about the confidentiality of data and discussions with medical staff (Bagchi et al., 2018; Parker et al., 2018). Even if there are people who would prefer face-to-face meetings with their doctors, the long waiting time makes them finally to accept online consultations (Collins et al., 2004).

The problems identified by patients are not the only barriers, the medical staff is not fully prepared for the digitization of medicine as well. For example, in Romania it can be difficult to digitize medical services, especially due to the fact that many young medical

graduates have migrated to practice abroad and the remaining doctors are older and have difficulties in relation to new technologies, a problem identified and by Reßing (et al., 2018).

Besides improving communication and connectivity between patients and healthcare professionals, technological development and the digitization process have a major impact on changing the content of services and the use of Artificial Intelligence in health sector becomes a common denominator for health care model transformation. Official data (Statista, 2021) show that in 2020, medical institutions that used AI and have automation strategies reached over 90% compared to 53% in 2019. AI is used both to improve management for some categories of services and for several professions or fields of medicine, and the incidence of digitization is different. The most common use of AI is in laboratory medical services, which aims to reduce the number of errors in diagnosing patients, compare results with AI-database query, optimize AI decision and AI assistance in interpreting laboratory results (Apostu et al., 2021). Digitalization and AI have a significant impact not only in medical services, but in medical intervention and treatment as well. Studies revealed that AI can be successfully implemented from preoperative planning (Hashimoto, Rosman, Rus, & Meireles, 2018) and guidance operations during surgery to its integration into surgical robots (Zhou, Guo, Shen, & Yang, 2020), intended to assist physicians in the first instance, and to replace them in the easiest surgeries in the future, all for the highest quality patient care. At the same time Perkins (et al., 2020) observed that AI improve the ability of surgeons to decide the need for an acute surgery. As other example, in the field of ophthalmology, AI technology has the ability to detect cataracts or other eye diseases early, and AI laser-assisted surgery is 93% more accurate than unassisted (Jayadev & Shetty, 2020).

Although there are conflicting opinions and fears that AI will replace medical specialists (Shuaib et al., 2020), digitization will actually contribute to changing the job content of highly qualified doctors, requiring not only professional skills but also technological knowledge for digital assisted procedures/activities. Practically, digital disruption in healthcare has a predominance of enriching the content of work through digital knowledge and skills than the total replacement of some jobs with AI. Technologicalization and digitalization of medical services must be seen as tools used to increase the quality of medical services that will benefit patients, aiming to better tailor treatments in a patient-centered approach. And e-health services by definition are patient-centered medical services, which can be practiced both in preventive or curative / maintenance medicine, and in various subfields of medicine. The connection range between digitization and health services is very wide, from the activities in the psychiatric / psychological counselling offices, (where a face-to-face connection is important in order to

increase the quality of services, but not indispensable) where is a high degree of digitization as a result of the computerization of the entire system of evidence of the patient's progress (treatment sheet, diagnosis, progress, remissions) and implementation of new digital tools such as, chatbots, digital apps and virtual reality (Torous et al., 2021) to the services of family doctors. And in family medicine, digitalization has changed traditional relationships, not only from the perspective of communication and connectivity with patients, but also from the perspective of centralizing information on a single basis. This allows to keep a health history of each patient and, most importantly, by creating databases that combine all the electronic health records of patients from different specialists, any interference in the treatment administered over a period of time can be tracked (Atasoy et al., 2019), thus preventing adverse medical conditions.

The transformation of medical services through digitalization affects all categories of staff in the medical sector, digital skills being just as important with the digital inclusion of patients. Basically, the medical service is redefined, it changes radically from a technological point of view, from the perspective of going through the value chain, from investigation and diagnosis to post-intervention surveillance and establishing the strategy of preserving the post-treatment regained health status.

So, the digital transformation of health jobs is the direction to follow in the future, reconfirmed and shaken by the Covid-19 crisis, but the dynamics depend on technological, economic, social, and cultural factors. In this paper we will analyze the extent to which the dynamics of digitization is facilitated or not, directly or indirectly, by a) the financial resources allocated to the health sector, as a support for technological adaptation; b) depends on the level of economic development of the country, as the basis for medical inclusion (health services for all) and the acceptance by the beneficiaries of the e-health services model and c) is obstructed / slowed or not by the migration of human resources, health specialists.

METHODOLOGY AND DATA DESCRIPTION

The aim of the research is to identify to what extent factors such as the level of economic development, the financing of the health sector and the external mobility of specialists influence the digital reform in the health sector.

In order to achieve the purpose of the research, we set out to test the following economic hypotheses:

H_1 - the level of economic development of the countries has a positive influence on the financing rate of the health sector;

H_2 - the migration of doctors from the countries of origin is determined by the investments in health in the countries of destination and their level of digitalization and the use of AI.

To test the proposed hypotheses, we will use both descriptive statistics and econometric data analysis.

The empirical study is based on OLS method with fixed and random effects for panel data, with the following general matrix form:

$$Y_{it} = \beta_0 + \beta_1 * X_{1it} + \beta_n * X_{nit} + \epsilon_{it}$$

Where,

Y_{it} – the value of dependent variable;

β_0 – the scalar;

β_1 – represents a $k * 1$-dimensional vector;

X_{1it} – the value of the independent variable;

ϵ_{it} – the discrepancy variable or deviation;

i and t indicate the analyzed countries and time period, respectively.

To test the proposed economic hypotheses, we will apply the following econometric models:

H_1:

$$health\ exp_{it} = \beta_0 + \beta_1 * \log(gdp/cap_{it}) + \epsilon_{it} \quad (1)$$

H_2:

$$\log(migr\ doct_{it}) = \beta_0 + \beta_1 * health\ exp_{it} + \epsilon_{it} \quad (2)$$

$$\log(migr\ doct_{it}) = \beta_0 + \beta_1 * health\ exp_{it} + \beta_2 * DESI_{it} + \epsilon_{it} \quad (3)$$

The explanatory and dependent variables are presented in Annex 1.

The data used in this research include EU Member States and OECD countries, except for some countries due to lack of data availability.

Regarding the econometric model (1) and (2), the database used covered all OECD countries for the period 2007-2019, except Australia, Chile, Colombia, Costa Rica, Iceland, Japan, Korea, Mexico, Norway, Switzerland, and Turkey. We selected the OECD database, both due to the availability of data on migrant workers employed in the labor market, and in health sector, in the OECD destination countries, and due to the fact that Romanian doctors traditionally migrate mainly to these countries (Apostu et al., 2022; Boboc et al., 2011), as can be seen also from the Table 2.

The econometric model (3) includes the following EU Member States for the period 2016-2019: Austria, Belgium, the Czech Republic, Denmark, Estonia, France, Germany, Hungary, Italy, Latvia, the Netherlands, Poland, Slovenia, and Sweden.

The lack of data availability for certain states or short periods of time is the limitation of the research, and this aspect will be remedied in subsequent research.

Econometric analysis was performed using the R programming language.

RESULTS AND DISCUSSION

In order to be able to carry out the technologically assisted medical activity and AI, it is important to invest financial resources, both by the national public authorities and by the private sector, in order to develop and digitize it. According to Chart 1, we notice significant differences in the European Union in terms of investments in health, their share ranging between 5% and 12% of total GDP.

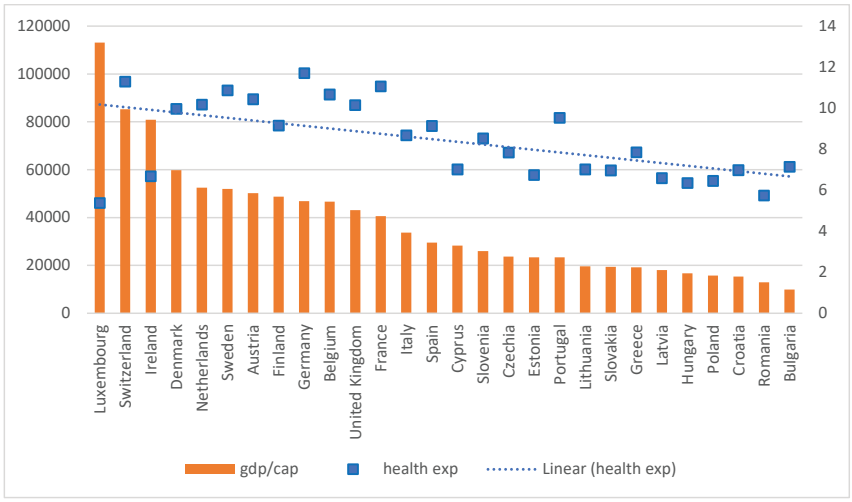

Chart 1. GDP/capita ($) and health expenditures as a share of GDP (%) at EU level in 2019

Source: Authors' calculation based on the Eurostat (2021a) data

The significant differences in the financing of the health sector are also observed depending on the level of economic development, the more developed the countries, the higher the share of investments in GDP compared to the less developed countries, except for Luxembourg (the share of expenditures is reduced due to the absolute value of GDP - $ 73.31

allocates less money on health expenditures compared to the European Union average (5 times less Euros/capita of around 3200, or 2 times less Euros PPP of 2572, in 2019- OECD / EU 2020), also observed in the number of medical staff per 100,000 inhabitants (1.7 times less than EU average - Chart 3) and migratory tendencies of the medical staff, which tends to work in other destination states, not only from the perspective of higher earnings, but also of precarious working conditions supported by the limited resources allocated.

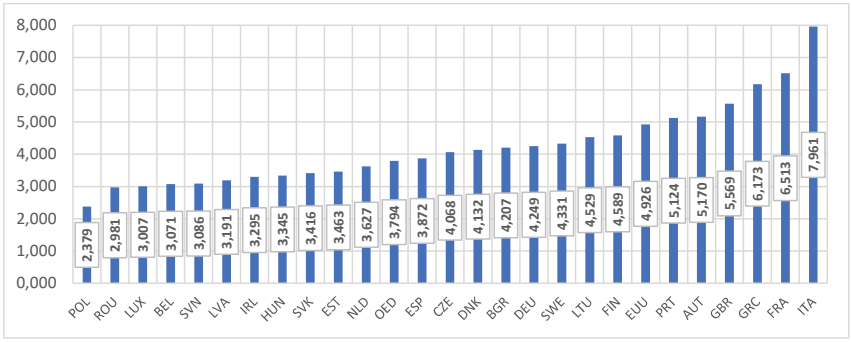

Chart 3 Physicians (per 1,000 people) - European Union 2017
Source: WB database, For Bulgaria, 2018,

In addition to the low level of health care in Romania, which does not allow the purchase of modern equipment and the use of the latest technologies and AI, another problem facing the Romanian medical system is the high share of elderly medical staff, whose level of digital Readiness does not allow them to use new technologies. At the same time, studies (Reßing et al., 2018) show that they are not adept at providing e-health services, preferring to offer traditional health services. Thus, in the last 10 years, there has been an increase in the number of medical staff over the age of 65 and staff aged between 50-64, and on the other hand, the number of young staff up to the age of 25 is declining.

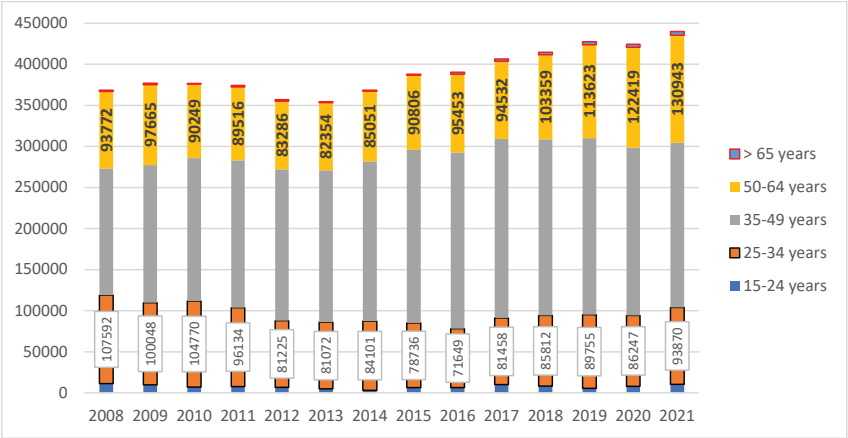

Chart 4. Evolution of the population employed in the health sector by age groups in Romania in 2008-2021, persons

Source: Authors' calculation based on the (National Institute of Statistics (2022) data

Exceptions are the years 2020 and 2021, when the authorities increased the number of residency places for young graduates (Ministry of Health, 2021), as a result of the COVID-19 pandemic, which keeps them in the short term for new graduates, but the problem is the uncertainty of the ability to retention and employment once they complete their residency studies. Even in these conditions of increasing number, forced by the pandemic, the number of employed persons in health sector of age group 25-34 fail to recover the level from 2008-2011.

According to the latest available data Eurostat (2021b; 2021c), we find that at the level of European Union, Romania is among the countries with the fewest doctors / 100,000 inhabitants (318), along with Latvia, Slovenia, France, and Belgium. In terms of the number of nurses, Romania is still on the last positions with 1,142 / 100,000 inhabitants, fewer nurses being only in Croatia (740 / 100,000 inhabitants).

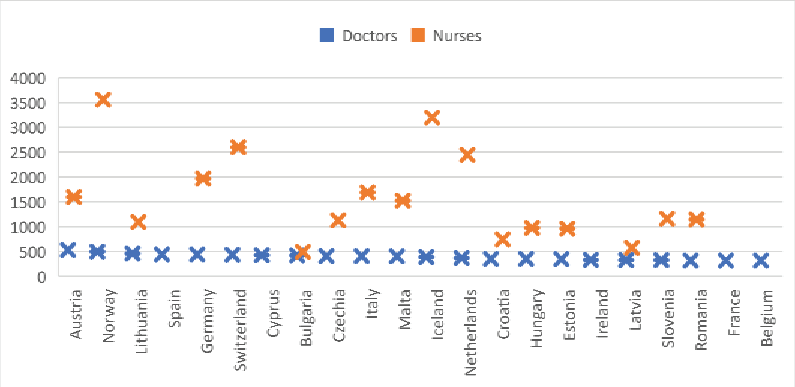

Chart 5. Medical doctors and nurses at EU level in 2019, staff/100,000 inhabitants
Source: Authors' calculation based on the Eurostat (2021b; 2021c) data
*This indicator is not available for: Spain, Cyprus, Ireland, France, and Belgium.

The reduced number of medical staff in Romania is not due to the decrease of the medical graduates, their number being increasing (Vasile et al., 2021) but rather to their migration to other destination countries. According to official data provided by the OECD (2020), over 30% of doctors born and educated in Romania have decided to migrate to other countries. Thus, Romania provides over 20,000 doctors (being on the 5th position in the top countries of origin) and 40,698 nurses (8th position) in the OECD area alone.

Table 2. Romanian medical doctors by destination country in OECD area, persons

Country / year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Austria	16	22	23	31	51	53	51	55	62	60	n/a
Belgium	566	744	866	975	1064	1172	1247	1300	1319	1371	1411
Chile	n/a	n/a	n/a	n/a	12	12	12	12	12	12	5
Czech Republic	-	1	2	1	1	6	8	8	8	11	11
Finland	38	44	46	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
France	n/a	2697	3099	3410	3705	3993	4272	4497	4697	4911	n/a
Germany	1269	1840	2559	3042	3363	3503	3661	3857	3978	4058	n/a
Hungary	1701	1652	1624	1623	1683	1630	1699	1819	1870	1963	n/a
Ireland	n/a	226	286	341	487	625	723	733	715	709	710
Israel	1206	1245	1252	1263	1308	1388	1445	1538	1635	1754	1913
Italy	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	266	335
Netherlands	43	47	43	45	46	57	60	64	57	n/a	n/a
New Zeeland	18	18	20	23	20	19	19	19	19	25	n/a
Norway	56	65	73	85	96	120	138	159	169	172	182
Poland	-	-	-	-	4	4	6	6	7	17	26
Slovenia	2	2	4	4	4	4	3	3	3	3	4

Sweden	421	485	564	628	735	569	729	814	921	n/a	n/a
Switzerland	148	156	178	204	230	248	276	305	334	365	395
Turkey	4	4	4	4	4	4					
Great Britain	435	582	639	764	852	872	949	1037	1129	1274	1347
US	2141	2324	2430	2457	2446	2457	2455	n/a	n/a	n/a	n/a
TOTAL	**8,064**	**12,154**	**13,712**	**14,900**	**16,111**	**16,736**	**17,753**	**16,226**	**16,935**	**16,971**	**6,339**

Source: Authors' calculation based on the OECD (2021) data
*Not all countries reported data for 2020

As we can see, the number of Romanian doctors (Table 2) and nurses (Annex 2) migrating to OECD countries has doubled in the last 10 years, with Romania being a significant provider of labor in the medical sector. Thus, the migration trend continues to increase for both doctors and nurses. However, Romania continues to export medical personnel, even during this global health crisis, with 231 medical staff leaving to Austria at the end of March (Euractiv, 2020), even if the pandemic have seriously affected the Romanian health sector and the shortage of doctors has increased further as a result of the large number of more than 1,000 diseases with the new virus among medical personnel (Romanian Government, 2020b).

Although statistics are predominant across the two categories of medical staff, we should also consider lower skilled workforces, such as stretchers or careers, who are also migrating, to similar positions or to other jobs, but unfortunately there are no official statistics available to the general public yet. This category of workers, although seemingly overlooked, are very important because it would change the pattern of health care retention on national labor markets, considering all workers, regardless of their skills and qualification level.

Therefore, developed countries are attractive to migrant physicians in other less developed countries, both because of the differential pay gap and better working conditions (Apostu et al., 2022; Ciuhu et al., 2018; Bazillier & Boboc, 2016) and because of the high level of digital development of health services provided to patients.

Table.3 The impact of health expenditures on foreign-trained doctors using OLS with random effect

	Coefficient	**Standard error**	**t test**	**p-value**
Intercept	1.083718	0.309187	3.5051	0.0004565 ***
Health exp	0.531229	0.032359	16.4169	< 2.2e-16 ***
p-value < 2.2e-16				
Hausman test – 0.2199				

The econometric analysis conducted by applying OLS with random effects supports the theory that states that invest a higher share of GDP are more attractive to migrant doctors from other less developed countries of origin. Thus, the 1% increase in the value of expenditures in

the health sector determines on average the 0.53% increase in the number of migrant doctors who choose to migrate to another destination state, thus H_2 is accepted.

Table.4 The impact of health expenditures and DESI Index on foreign-trained doctors using OLS with random effect

	Coefficient	**Standard error**	**t test**	**p-value**
Intercept	2.296355	1.030038	2.2294	0.02579 *
Health exp	0.577721	0.093673	6.1674	6.942e-10 ***
DESI	-0.049543	0.023461	-2.1117	0.03471 *
p-value 5.258e-09				
Hausman test – 0.832				

Developing the econometric model previously applied, by introducing a new independent variable, which measures the level of digitization in each country, we find that e-health services have a reverse impact on the migration of doctors. This phenomenon can be explained by the possibilities of providing e-health services without doctors being present in a hospital unit, allowing the practice of the profession remotely. E-health services can be provided with ITC devices, including for surgeries perform, and also patients can benefit from the consultations of the best doctors in any country, without having to travel long distances in other countries, so, some doctors no longer have to migrate for that higher salary differential from another destination country.

Although the data for 2020 are not yet available, certainly the „forced" digitization of public institutions, especially medical institutions have contributed to the growth of the importance of e-health services in all countries of the world, especially for services that do not require surgery, hospitalization in hospitals or ICU.

CONCLUSIONS

Looking beyond the pandemic, digitalization in healthcare is expected to improve a broad range of outcomes, from the prevention and treatment of disease to nursing care. It will allow national health systems to use resources more efficiently, making them more effective and sustainable as societies age (Mihai et al., 2020) .

In this context of digitalization and redefining the health sector and health jobs - as essential jobs, the mobility of medical staff is undergoing a major change. On the one hand, we have the continuation of the trend of the last decades of attracting foreign labor in deficient jobs in the more developed countries of the world (this trend continues for all categories of personnel working in the health sector - auxiliary lower skilled personnel for activity in hospitals and clinics - stretchers, etc.; medium skilled - nurses and similar staff; high skilled -

specialists). On the other hand, the development of the e-health segment based on remote jobs (with important development on 2 subsequent: -preventive medicine and counselling services, including 2 opinions for diagnosis, which can be done by experts based on digitized documents and online consultations with patients - the intervention of highly qualified experts and doctors and their participation in interventions through the remote system. Given this, the mobility / migration of the health workforce will be developed on the 2 channels: - work abroad by establishing the usual residence of migrant workers and - by employment in telework system without physical mobility or with physical mobility occasionally, without changing the usual residence.

For countries of origin, like Romania, the migration / mobility of medical staff involves several externalities, such as:

Negative externalities

- Human capital loss of educated and experienced medical staff, with negative spillover effects on those who remain.
- Increasing the shortage of medical staff, especially in rural or remote areas.
- Reducing the level of medical care and medical conditions.
- Increasing mortality.
- The inability to manage extreme situations such as the COVID-19 pandemic.
- Loss of public education expenditures and scholarships for migrant doctors.
- The cost of investing in training to health professionals.
- Encouraging population migration as a result of a poorly developed medical system.
- Reduction in tax revenues and economic growth.

Positive externalities

- Gaining skills to use new technologies and AI.
- Increasing the level of digitalization by investing capital in new clinics.
- Offering teleconsultations to patients in Romania, with knowledge from the destination countries.
- Remittance receiving by the family members.

The general effects of medical staff migration on source countries depend on the interaction of various factors. These involve modifications in the stock of human capital and

skilled personnel, the number of graduates, the remittances received, the impact on the labor market and changes in the requirement of health care and the health status of the population.

As future research, we intend to extend the analysis to the pandemic period, by completing data not yet available, and identifying the effects of graduate migration on jobs' digital transformation in the Romanian health system, compared to the performance of countries of preference for migration of doctors and nurses.

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Annexes

Annex 1. Variables used in econometric analysis

Variables	Abbreviation	Data source
Inflows of foreign-trained doctors	migr doct	OECD
GDP per capita	gdp_cap	World Bank
Health care expenditures	health exp	Eurostat
Digital Economy and Society Index	DESI	European Commission

Annex 2. Romanian nurses by destination country in OECD area, persons

Country / year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Belgium	298	421	690	888	1068	1224	1329	1431	1598	1713	1791
Canada	430	448	472	508	515	520	527	524	518	513	n/a
France	68	115	147	164	179	193	203	221	238	250	n/a
Greece	22	22	22	22	22	22					n/a
Hungary				431	530	576	591	603	626	621	n/a
Israel	98	92	86	82	79	77	71	63	59	55	50
Italy	10570	11215	11531	11731	11820	12159	11714	10969	10690	10635	11253
Netherlands	n/a	n/a	n/a	n/a	n/a	9	12	14	13	n/a	n/a
New Zeeland	n/a	20	17	16	13	13	14	12	14	14	12
Norway	34	34	42	46	57	76	88	99	81	88	92
Sweden	2	4	8	17	24	30	49	58	73	n/a	n/a
Turkey	2	3	3	3	3	3	n/a	n/a	n/a	n/a	n/a
United Kingdom	1272	1909	2254	2606	3739	5997	8115	7725	7542	7407	7421
Total	12,796	14,283	15,272	16,514	18,049	20,899	22,713	21,719	21,452	21,296	20,619

Source: Authors' calculation based on the OECD (2021b) data
*Not all countries reported data for 2020