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# EXPERT REPORT ON INNOVATIONS IN HEALTH CARE IN POLAND

2022

## Expert report on innovations in health care in Poland

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## **Introduction**

In today's turbulent times, organizations operating in the health sector have to cope with many complex demands, which in practice means adapting to change. To a large extent, these changes require a new approach to their management. That is all the more important as the changes to date within the health care system in Poland have not produced the expected results and have not solved the numerous problems arising in this area. Inconsistent law, the unstable financial situation of units, limited access of patients, especially to specialist services and costly procedures are only selected problems of functioning in the conditions of the health care sector in Poland. Health care units are facing profound organizational changes. In addition, the interpenetration of economic, social, organizational, decision-making, relational and other aspects further complicates of managing health care units.

Poland has a compulsory universal health insurance system regulated by the Act of 24 August 2004 on health care services financed from public funds (Journal of Laws No. 210, item 2135, as amended). According to Article 68 of the Polish Constitution, everyone has the right to health protection. Regardless of their material situation, citizens shall be provided by public authorities with equal access to health care services financed from public funds.

Participants in the system can be divided into the following categories:

- Beneficiaries - i.e. patients.
- The health insurance institution that acts as the payer - i.e. the National Health Fund.
- Health care providers: (health care institutions, which can be divided by the founding body into public (SPZOZ) and non-public (NZOZ), medical, doctor-dentist, nursing and midwife practices, pharmacies, other health care providers.
- Control and supervisory bodies: State Sanitary Inspection ("Sanepid"), Pharmaceutical Inspection,
- the provincial governors and their provincial public health centres and the provincial consultants in the individual medical specialities.
- The Ministry of Health, which sets the direction of the country's health policy and has control powers, as well as its national consultants in individual medical specialities.

Mandatory health contributions are paid by the Social Insurance Institution (ZUS) to the National Health Fund (Narodowy Fundusz Zdrowia) and amount 9% of salaries. Financing is based on a financial plan of the Fund. The National Health Fund finances health

services provided to the insured and reimburses medicines. Some health contributions, for example, for students and farmers, are financed from the state budget and particular purpose funds. Labour offices finance contributions for the unemployed. Persons insured with the NFZ, apart from the insurance premium, do not bear other treatment costs. Exceptions include medicines, some of which are available for a lump sum or partial payment: sanatorium care and adult dental care, some of which are paid for by the patient.

The Ministry of Health plays a fundamental role in managing the health sector, although it shares this responsibility with three levels of local government:

- municipalities - oversee primary health care;
- counties - responsible for (often) smaller district hospitals;
- voivodeships - responsible for larger provincial hospitals.

The Ministry of Health oversees highly specialized care facilities.

Private facilities provide primarily outpatient care, while most inpatient care is provided in public hospitals. This highly fragmented nature of health system management poses a significant challenge for achieving effective coordination across the health system. The National Health Fund (NFZ) is the sole purchaser of the universal health insurance system. This Fund operates through 16 provincial branches that manage purchasing health care services in their respective provinces. The valuation of medical services (tarification) is based on data collected by a government agency - the Agency for Health Technology Assessment and Tarification. Services in primary care are financed on the basis of a capitation rate, while in other scopes, especially in hospital treatment, a system of valuation of homogeneous groups of patients (JGP) applies.

The health care sector in Poland is currently experiencing difficulties related to the multifaceted process of change. Healthcare entities faced the task of maintaining relevance in an environment where medical information, technology and stakeholder relationships are undergoing dynamic transformation [1]. Demographic changes are forcing medical entities to modify their areas of operation continually. In addition, pressure from governments to reduce operating costs while improving quality is often an impossible task [2]. Thus, in Poland, like in other European countries, there is an ongoing discussion about structural changes that may alter the way health systems operate [3].

In Poland, as in other economies across the world, the healthcare sector is characterized as complex, turbulent, fragmented and at the same time closely interconnected. Innovation in

such an environment can prove to be a driving force in the pursuit of balancing the cost and quality of healthcare [4].

In healthcare, innovations related to the management process are process innovations and innovations in diagnosis, and treatment methods are product and service innovations. Thakur et al. [5] focus on product and service innovation and define healthcare innovation as the adoption of best-proven practices that, when implemented, simultaneously ensure safety and best outcomes for patients, the adoption of which can also affect organisational performance. On the other hand, service innovation in the healthcare sector refers to the provision of new, expanded, customized and ubiquitous services at a lower cost [6]. In the healthcare sector, work, management and innovation may differ from other industries. Therefore, the goals of innovation may differ dramatically [7]. In addition, the higher specificity and complexity of healthcare services require higher levels of advanced knowledge and information resources, which means that knowledge sharing can be an important goal to achieve due to the positive impact of knowledge sharing on the efficiency of healthcare actors [8].

Healthcare innovation is defined as a set of behaviours, habits and ways of doing things, together with associated technologies and administrative systems, which:

- 1) are perceived as new by key stakeholders;
- 2) are related to the delivery or support of health;
- 3) are not a continuation of previous practices and solutions;
- 4) are aimed at improving health outcomes, operational efficiency cost savings or user experience; and
- 5) are implemented in a planned and coordinated manner by individuals, teams or organizations [9].

It is important to emphasize that in healthcare all, activities mentioned above are undertaken to improve treatment, diagnosis, education, better access to services, improved prevention and research, together with long-term increases in quality, safety, improved outcomes, efficiency and cost reduction [10]. Greenhalgh particularly highlights a feature related to the discontinuity of existing practice. This way of looking at innovation in health service delivery suggests that innovations do not have to be entirely 'new', making the concept related to change management and quality improvement processes [10]. Innovation in the health sector can also be defined as 'the deliberate introduction and application, in a group, in a position, in an organisation; of ideas of processes, products, procedures; new in a particular

area to an individual, group or wider society'. This definition has been endorsed by a large group of researchers on the topic of innovation in the health sector [11], as it includes three key components of innovation:

- 1) the novelty element;
- 2) the application factor;
- 3) the intended benefit [4].

Innovation in healthcare plays a significant role, as it generally leads to better patient care. The development of these innovations is becoming essential in Poland due to the problems in the Polish healthcare system. Through innovative solutions and, in particular, the development of the e-health system, the state of healthcare can be substantially improved.

The e-health system in Poland has become the main topic of this report. The report is divided into five main chapters. The first part of the report includes the aims and methodology of the study, and the second part presents the current situation in the health care sector in Poland and the challenges that appear in that field. The following two parts cover the evaluation of the implementation of e-health solutions and the development of medical startups in the Polish market. Finally, at the end of the report, the directions of future studies and the conclusions are given.

## 1. Research goals, methodology and data sources

The research goals are:

- identification of health problems in Poland,
- describing healthcare innovation system in Poland,
- to assess the degree of implementation of e-health elements,
- identification of future research directions.

The study uses the literature review research method. That methodology is commonly adopted when the study aims to provide an overview of a certain issue or research problem. Likewise, it is employed to identify research gaps in a chosen area [12]. Thus, we found the literature review as the best research method to map the development of e-health in Poland over time and discuss future research directions in that field.

The data were collected from various literature sources, both in print and online. In order to gather information about the e-health system in Poland, the literature review covered reports from the Central Statistical Office (Główny Urząd Statystyczny), publications of The Center for e-Health (Centrum e-Zdrowia) and resources on e-health of National Health Fund (Narodowy Fundusz Zdrowia). Moreover, the data on e-health were achieved from articles, books, conferences and internet materials in the field.

The database of OECD was used to complete the demographic data about the age structure of Poland's inhabitants' live births and deaths per 1000 Polish inhabitants and the life expectancy at birth of men and women. Finally, to gain economic data on the Polish economy, the database of the Ministry was explored.

The literature review was completed in September 2022, and its conclusions are presented in the report.

## 2. Current state and challenges in health care in given country

### 2.1 Demographic situation in the period 2017-2021

Poland's population in 2017-2021 was respectively:

2017	2018	2019	2020	2021
38 411 623	38 411 123	38 382 651	38 265 012	38 036 098

[13]

#### Age structure

Analysing the age structure in the 2017-2021 timeframe, a relatively constant trend can be noted. The largest group in the given age brackets in each year is made up of people aged 15-64. Their % share at the end of 2021 was 66.54%. The % share of those aged 65+ over the period analysed increased from 16.95% in 2017 to 18.34% at the end of 2021. People aged 0-14 account for 15.12% of the population at the end of 2021 [13,14].

#### Life expectancy

Based on the data from the analysis of live births and deaths per 1,000 inhabitants, a clear advantage in the value of deaths over births can be identified.

In the case of life expectancy for both women and men, there has been a decrease since 2017.

At the end of 2021, life expectancy from women is 71.7 years and from men is 79.7 years.

A detailed summary of the data presented is shown in the table below [13,14].

**Table 1.** Age structure of inhabitants, live births and deaths, life expectancy in 2017-2021

year	2017	2018	2019	2020	2021
<b>indicator Age structure of inhabitants, 2017-2021 (in %)</b>					
0-14					
years	14,88	15,05	15,19	15,22	15,12
15-64					
years	68,19	67,43	66,69	66,04	66,54
65+ years	16,93	17,52	18,12	18,74	18,34

indicator	Live births and deaths per 1 000 inhabitants, 2017-2021				
births	10,6	10,2	9,9	9,4	8,7
deaths	10,6	10,9	10,8	12,6	13,6

indicator	Life expectancy at birth – men and women, 2017-2021				
men	74,0	73,9	74,1	72,6	71,7
women	81,8	81,7	81,8	80,7	79,7

Source: Health at a Glance OECD 2017-2021

### Standardized mortality according to selected causes of death

In Poland the main causes of deaths are cardiovascular diseases, neoplasms and respiratory diseases. According to recent data they caused 74% of all deaths in 2018. It is worth noting that in that year there was a slight increase in almost all mortality rates in all age groups and for both sexes. Presently, the primary causes of death in Poland are cardiovascular diseases, over 40% of deaths are caused by these diseases. Since 1992 the share of this diseases has been decreasing in total number of deaths (52% in 1992, 33% in 2020). The reason for this decrease is mainly the reduction of risk factors: a decrease in the average of total cholesterol concentration in blood of the general population, lower prevalence of smoking among men and a decrease in average blood pressure values among women, and progress in cardiological therapy. The improvement of treatment of the coronary heart diseases and negative effects of such illnesses has a very significant impact on the decline of mortality from cardiovascular diseases. In 2018 due to cardiovascular diseases for every 100 thousand people 349 died – 4 less than in 2017 – despite this, the intensity of deaths as a result of these diseases is still very high. The cardiovascular disease mortality rate among men aged less than 45 is more than three times higher than among women of the same age. This also concerns people at age of 45-59 (more than 3.5 times higher mortality for males), however, the level of this rate is several times higher than among younger people. After a significant increase of men's death rate from these diseases at age of 45-59 in the 80s, in the next decade a decrease was observed. Still it is one of the most common, apart from neoplasms, causes of death among men at that age. The oldest age group is characterized by the fact that male death rate from these diseases is only slightly higher than female, while in younger age groups the mortality for males is much higher than for females. The second highest cause of deaths are neoplasms, causing – 26.4% of all deaths in 2018. The numbers of deaths caused by external reasons (mainly accidents and injuries) make up 4.9% of all deaths. A positive tendency of decreasing the mortality level can be observed. In 2018 standardized

death rate was 49,1 per 100 thousand persons and constituted only 55.8 External causes are the most frequent reasons of death among young men aged below 45. In fact, in 2018 it comprised 37.2% of all deaths among males at this age. The death rate among men aged 0-44 is almost six times higher than among women. Similar in age 45-59 and above 60 two times. People above 60 years old suffer from accidents, injuries and poisonings less frequently – share of all causes of death is 3.4% for males and 1.9% for females. In Poland respiratory diseases were responsible for 6.7% of all deaths in 2019. Similar changes concern death rates caused by digestive disorders, but at a slightly lower level. Changes to the general mortality caused by digestive disorders are mostly influenced by increase of mortality of males aged below 60 years [13,14].

## 2.2 Evaluation of selected economic indicators in the period 2017-2021

### 2.2.1 Evaluation of selected economic healthcare indicators in Poland at the international level

Spending on health as a proportion of GDP was 6.5 per cent in Poland in 2019 and 7.15 per cent in 2020 (projected). In turn, per capita expenditure in 2019 was USD 2289. The price level in the health sector compared to the OECD average in 2017 in Poland was 34%. The volume of health services per capita compared to health expenditure per capita compared to the OECD average was 75.7 per cent (volume) and 62.7 per cent (expenditure) in 2017. Health expenditure by type of funding in 2019 in Poland is presented in the table below. In Poland, as in the other V4 countries, a system of compulsory health insurance prevails.

**Table 2.** Health expenditure by type of financing, 2019

	<b>Government schemes</b>	<b>Compulsory health insurance</b>	<b>Voluntary health insurance</b>	<b>Out-of-pocket</b>	<b>Other</b>
<b>Poland</b>	<b>10 %</b>	<b>62 %</b>	<b>6 %</b>	<b>20 %</b>	<b>2 %</b>
Czech Republic	13 %	69 %	-	14 %	4 %
Slovak Republic	2 %	77 %	-	19 %	1 %
Hungary	9 %	60 %	2 %	28 %	2 %
OECD38	35 %	39 %	5 %	20 %	1 %

Source: Health at a Glance OECD 2021

Health expenditure from public sources as a share of the total in 2019 in Poland compared to other V4 countries and the OECD average is shown in the table below.

**Table 3.** Health expenditure from public sources as a share of total, 2019

	Government transfers	Social insurance contributions
<b>Poland</b>	<b>11 %</b>	<b>60 %</b>
Czech Republic	28 %	54 %
Slovak Republic	2 %	77 %
Hungary	47 %	21 %
OECD38	71 %	-

Source: Health at a Glance OECD 2021

Health expenditure from public sources as a share of total government expenditure in 2019 in Poland was 11 per cent. Financing sources of compulsory health insurance in 2019 are presented in the table below. Almost entirely these sources are social insurance contributions. In addition, available data from the Czech Republic and Hungary was presented.

**Table 4.** Financing sources of compulsory health insurance, 2019

	Transfers from government	Social insurance contributions	Compulsory prepayment	Others
<b>Poland</b>	<b>2 %</b>	<b>98 %</b>	<b>1 %</b>	<b>0 %</b>
Czech Republic (69 %)	21 %	78 %	-	-
Hungary (60 %)	64 %	35 %		1 %

Source: Health at a Glance OECD 2021

Health expenditure by type of service in 2019 in Poland is presented in the table below. Inpatient care accounts for the largest share (37%), followed by outpatient care (32%) and medical (22%) goods, 7% share relates to long-term care. The table below also shows the values for the other V4 countries and the OECD average.

**Table 5.** Health expenditure by type of service

	<b>Inpatient care</b>	<b>Outpatient care</b>	<b>Long-term care</b>	<b>Medical goods</b>	<b>Collective services</b>
<b>Poland</b>	<b>37%</b>	<b>31%</b>	<b>7%</b>	<b>22%</b>	<b>4%</b>
Czech Republic	26 %	34 %	14 %	18 %	9 %
Slovak Republic	30%	33 %	0 %	32 %	5 %
Hungary	31 %	29 %	4 %	30 %	6 %
OECD31	28 %	33 %	14 %	19 %	6 %

Source: Health at a Glance OECD 2021

Spending on primary health care services as a share of current health expenditure in 2019 in Poland is presented in the table below. Within this, general care and ambulatory expenditure accounts for the largest share. The table below also shows the values for the other V4 countries and the OECD average.

**Table 6.** Spending on primary health care services as a share of current health expenditure, 2019

	<b>General care</b>	<b>Dental care</b>	<b>Home-based curative care</b>	<b>Prevention</b>	<b>Ambulatory</b>
<b>Poland</b>	<b>12,5 %</b>	<b>3,2 %</b>	<b>0,4 %</b>	<b>0,6 %</b>	<b>17 %</b>
Czech Republic	5,0 %	4,7 %	0,0 %	1,3 %	11 %
Slovak Republic	5,3 %	4,8 %	0,0 %	0,0 %	10 %
Hungary	6,7 %	4,4 %	0,2 %	0,9 %	12 %
OECD24	6,8 %	5,1 %	0,4 %	1,0 %	13 %

Source: Health at a Glance OECD 2021

Health expenditure by provider in 2019 in Poland is presented in the table below. In this respect, hospitals and ambulatory providers have the largest share. The table below also shows the values for the other V4 countries and the OECD average.

**Table 7.** Health expenditure by provider, 2019

	<b>Hospitals</b>	<b>LTC facilities</b>	<b>Ambulatory providers</b>	<b>Retailers</b>	<b>Other</b>
<b>Poland</b>	<b>42 %</b>	<b>1 %</b>	<b>25 %</b>	<b>21 %</b>	<b>11 %</b>
Czech Republic	42 %	8 %	22 %	15 %	14 %
Slovak Republic	35 %	-	20 %	32 %	13 %

Hungary	38 %	3 %	21 %	30 %	8 %
OECD34	39 %	9 %	26 %	17 %	10 %

Source: Health at a Glance OECD 2021

Annual capital expenditure on health as a share of GDP, average over 2015-19 is presented in the table below.

**Table 8.** Annual capital expenditure on health as a share of GDP, average over 2015-19

	Intellectual property product	Machinery and equipment	Total construction	No split
<b>Poland</b>	<b>0,0%</b>	<b>0,2%</b>	<b>0,2%</b>	<b>0,4%</b>
Czech Republic	0,1%	0,3%	0,2%	0,5%
Slovak Republic	0,0%	0,2%	0,1%	0,3%
Hungary	0,0%	0,2%	0,2%	0,4%
OECD 38	0,1%	0,2%	0,3%	0,6%

Source: Health at a Glance OECD 2021

### 2.2.2 Evaluation of selected economic healthcare indicators in Poland at the national level

According to preliminary estimates, current spending on health care in 2021 amounted to PLN 172.9 mld (accounting for 6.6% of GDP), and was higher than in 2020 by about 21 mld (relative to preliminary data for 2020, which amounted to PLN 151.9 mld). The increase in spending was observed in both public and private spending (table below).

**Table 9.** Current expenditure on health care (according to the National Health Account)

Year	Current expenditure on health care								GDP in mln zł
	Total		Public expenditure (HF.1)		Private expenditure (HF.2)		Household expenditure (HF.3)		
	in mln zł	in % GDP	in mln zł	in % GDP	in mln zł	in % GDP	in mln zł	in % GDP	
2013	105 635,1	6,4	74 639,1	4,5	6 018,1	0,4	24 977,9	1,5	1 646 724

2014	107 457,9	6,3	75 928,6	4,4	6 679,0	0,4	24 850,2	1,5	1 711 244
2015 <sup>b</sup>	115 177,4	6,4	80 329,4	4,5	8 314,1	0,5	26 533,9	1,5	1 801 112
2016 <sup>b</sup>	121 774,1	6,5	84 415,0	4,5	9 571,9	0,5	27 787,2	1,5	1 863 487
2017	130 535,8	6,6	90 445,5	4,5	10 411,1	0,5	29 679,2	1,5	1 989 835
2018	134 244,4	6,3	95 977,1	4,5	10 854,2	0,5	27 413,2	1,3	2 121 555
2019	147 838,5	6,4	106 113,9	4,6	12 022,7	0,5	29 701,9	1,3	2 293 199
2020 <sup>c</sup>	151 873,5	6,5	109 752,7	4,7	12 452,3	0,5	29 668,4	1,3	2 338 996
2021 <sup>d</sup>	172 884,6	6,6	125 476,5	4,8	13 593,3	0,5	33 814,8	1,3	2 622 184

a- Excluding direct expenditures from households, which according to the SHA 2011 methodology are included in a separate category HF.3

b- Data updated, according to OECD database <http://stats.oecd.org> as of 14/07/2022.

c- NRZ preliminary data

d- Preliminary estimates.

Source: GUS: Signature information: Health care expenditures in 2019-2021

Public spending on health care in 2020 accounted for 72.3% of current spending on health care and an estimated 72.6% in 2021 (table below).

**Table 10.** Current spending on health care by funding patterns (based on the National HealthAccount)

Year	Total	HF.1	HF.1.1	HF.1.2	HF.2	HF.2.1	HF.2.2	HF.2.3	HF.3
		Public expenditure	Government sector diagrams	Compulsory premium-based health insurance schemes	Private expenditure <sup>a</sup>	Voluntary health insurance schemes	Funding schemes for nonprofit institutions	Financing schemes by private companies	Direct household spending
in mln zł									
2013	105 635,1	74 639,1	10 533,6	64 105,6	6 018,1	4 237,9	1 166,7	613,5	24 977,9
2014	107 457,9	75 928,6	10 016,6	65 912,0	6 679,0	4 868,9	1 130,1	680,0	24 850,2
2015 <sup>b</sup>	115 177,4	80 329,4	10 897,0	69 432,4	8 314,1	5 752,1	1 199,9	1 362,1	26 533,9
2016 <sup>b</sup>	121 774,1	84 415,0	11 828,3	72 586,7	9 571,9	6 540,2	1 087,8	1 943,9	27 787,2
2017	130 535,8	90 445,5	13 515,1	76 930,4	10 411,1	7 361,3	1 437,6	1 612,2	29 679,2
2018	134 244,4	95 977,1	13 381,8	82 595,3	10 854,2	8 196,6	1 560,3	1 097,3	27 413,2
2019	147 838,5	106 113,9	14 693,6	91 420,3	12 022,7	9 166,5	1 642,4	1 213,8	29 701,9
2020 <sup>c</sup>	151 873,5	109 752,7	14 939,4	94 813,3	12 452,3	9 023,9	2 222,6	1 205,8	29 668,4
2021 <sup>d</sup>	172 884,6	125 476,5	.	.	13 593,3	.	.	.	33 814,8
in %									
2013	100,0	70,7	10,0	60,7	5,7	4,0	1,1	0,6	23,6
2014	100,0	70,7	9,3	61,3	6,2	4,5	1,1	0,6	23,1
2015	100,0	69,7	9,5	60,3	7,2	5,0	1,0	1,2	23,0

2016	100,0	69,3	9,7	59,6	7,9	5,4	0,9	1,6	22,8
2017	100,0	69,3	10,4	58,9	8,0	5,6	1,1	1,2	22,7
2018	100,0	71,5	10,0	61,5	8,1	6,1	1,2	0,8	20,4
2019	100,0	71,8	9,9	61,8	8,1	6,2	1,1	0,8	20,1
2020 <sup>c</sup>	100,0	72,3	9,8	62,4	8,2	5,9	1,5	0,8	19,5
2021 <sup>d</sup>	100,0	72,6	.	.	7,9	.	.	.	19,6

- a- Excluding direct expenditures from households, which according to the SHA 2011 methodology are included in a separate category HF.3
- b- Data updated, according to OECD database [http: stats.oecd.org](http://stats.oecd.org) as of 14/07/2022.
- c- NRZ preliminary data
- d- Preliminary estimates.

Source: GUS: Signature information: Health care expenditures in 2019-2021

Expenditures on treatment services accounted for the largest percentage (58%) of current health care expenditures in 2020 – table below.

**Table 11.** Current expenditure on health care by function (based on the National HealthAccount)

Year	Total	HC.1	HC.2	HC.3	HC.4	HC.5	HC.5.1	HC.5.2	HC.6	HC.7	HC.0
		Treatment services	Rehabilitation services	Long-term care (health)	Auxiliary health care services	Medical articles	Drugs and non-durable materials	Therapeutic equipment and durable goods	Prevention and public health	Management and administration of health care financing	Other health care services, not elsewhere classified
in mln zł											
2013	105 635,1	59 304,4	3 819,6	6 239,9	4 979,8	25 307,5	22 926,9	2 380,6	2 725,7	2 758,2	500,0
2014	107 457,9	60 845,2	3 920,6	6 133,8	5 080,3	25 647,2	23 069,0	2 578,2	2 908,2	2 457,7	464,8
2015	115 177,4	64 245,7	5 591,5	6 412,8	5 936,9	27 215,0	24 432,8	2 782,3	2 742,1	2 231,1	802,2
2016	121 774,1	69 702,6	5 753,5	7 143,6	4 561,5	28 286,8	25 551,6	2 735,1	3 430,5	2 319,0	576,6
2017	130 535,8	75 954,3	6 283,4	7 879,4	4 843,4	29 588,6	26 539,0	3 049,6	3 106,9	2 325,6	554,2
2018	134 244,4	77 092,3	6 896,9	8 300,0	4 979,2	30 723,4	27 914,8	2 808,5	3 065,4	2 446,6	740,6
2019	147 838,5	87 111,2	6 686,1	9 936,5	5 535,7	32 187,1	29 123,3	3 063,7	3 085,6	2 478,9	817,4
2020	151 873,5	88 117,5	6 416,5	12 547,8	5 938,8	33 007,5	29 971,9	3 035,6	2 926,3	1 703,0	1 216,1
in %											
2013	100,0	56,1	3,6	5,9	4,7	24,0	21,7	-	2,6	2,6	-
2014	100,0	56,6	3,6	5,7	4,7	23,9	21,5	2,4	2,7	2,3	0,4
2015	100,0	55,8	4,9	5,6	5,2	23,6	21,2	2,4	2,4	1,9	0,7
2016	100,0	57,2	4,7	5,9	3,7	23,2	21,0	2,2	2,8	1,9	0,5
2017	100,0	58,2	4,8	6,0	3,7	22,7	20,3	2,3	2,4	1,8	0,4

2018	100,0	57,4	5,1	6,2	3,7	22,9	20,8	2,1	2,3	1,8	0,6
2019	100,0	58,9	4,5	6,7	3,7	21,8	19,7	2,1	2,1	1,7	0,6
2020 <sup>a</sup>	100,0	58,0	4,2	8,3	3,9	21,7	19,7	2,0	1,9	1,1	0,8

a- Data updated, according to OECD database [http: stats.oecd.org](http://stats.oecd.org) as of 14/07/2022.

b- Preliminary estimates.

Note: The latest available data by function (HC) is preliminary data for 2020.

Source: GUS: Signature information: Health care expenditures in 2019-2021

Expenditures on treatment services accounted for the largest percentage (58%) of current health care expenditures in 2020 – table below.

**Table 12.** Current spending on health care by providers of goods and services (based on the National Health Account)

Year	Total	HP.1	HP.2	HP.3	HP.4	HP.5	HP.6	HP.7	HP.8	HP.9
		Hospitals	Stationary long-term care facilities	Outpatient health care providers	Providers of ancillary health care services	Retailers and other suppliers of medical goods	Providers of preventive health services	Entities coordinating the administration and financing of health care	Other units within the economic sectors	Abroad
in mln zł										
2013	105 635,1	37 246,9	1 545,8	27 246,7	5 086,4	25 122,9	134,0	4 178,2	4 554,0	520,1
2014	107 457,9	38 154,0	1 457,4	28 397,2	4 968,6	25 424,5	140,8	3 912,0	4 492,3	511,0
2015 <sup>a</sup>	115 177,4	43 403,8	1 193,8	31 113,0	3 379,3	26 470,6	169,8	3 700,3	5 163,6	583,2
2016 <sup>a</sup>	121 774,1	46 255,1	1 268,1	32 623,3	3 536,8	27 807,0	227,7	4 135,9	5 230,4	689,7
2017	130 535,8	51 327,1	1 501,6	34 472,0	3 701,4	29 112,9	336,4	3 967,8	5 401,1	715,4
2018	134 244,4	55 123,3	1 593,6	32 640,8	3 989,8	30 001,1	323,9	4 061,6	5 674,2	836,1
2019	147 838,5	61 644,8	1 895,2	36 846,7	3 743,0	31 710,1	311,1	4 124,3	6 661,3	902,0
2020 <sup>b</sup>	151 873,5	61 329,1	2 069,4	39 162,9	4 403,0	32 341,5	287,2	3 207,1	8 183,8	889,6
in %										
2013	100,0	35,3	1,5	25,8	4,8	23,8	0,1	-	4,3	0,5
2014	100,0	35,5	1,4	26,4	4,6	23,7	0,1	3,6	4,2	0,5
2015	100,0	37,7	1,0	27,0	2,9	23,0	0,1	3,2	4,5	0,5
2016	100,0	38,0	1,0	26,8	2,9	22,8	0,2	3,4	4,3	0,6
2017	100,0	39,3	1,2	26,4	2,8	22,3	0,3	3,0	4,1	0,5
2018	100,0	41,1	1,2	24,3	3,0	22,3	0,2	3,0	4,2	0,6
2019	100,0	41,7	1,3	24,9	2,5	21,4	0,2	2,8	4,5	0,6
2020 <sup>b</sup>	100,0	40,4	1,4	25,8	2,9	21,3	0,2	2,1	5,4	0,6

a- Data updated, according to OECD database [http: stats.oecd.org](http://stats.oecd.org) as of 14/07/2022.

b- Preliminary estimates.

Note: The latest available data by health care provider (HP) is preliminary data for 2020.

Source: GUS: Signature information: Health care expenditures in 2019-2021

Poland's healthcare system is characterized by large imbalances in terms of service provision (infrastructure is mainly concentrated in the hospital sector); inadequate provision of outpatient care, diagnostics and long-term care; and poor coordination of inpatient care with other types of care. The number of hospital beds is high, with 6.2 beds per 1,000 residents in 2019, compared to an EU average of 5.3, but their availability is uneven across the country. Current reform plans include converting emergency care into other types of beds, such as long-term care beds, rather than reducing their number. According to Eurostat, Poland has the lowest number of practicing doctors per 1,000 residents in the EU (2.4), and the number of nurses (5.1 per 1,000 residents) is also among the lowest in the EU [15, 16, 17]

According to preliminary data published by the Central Statistical Office, the average gross monthly salary for 2021 for the "health care and social assistance" section amounted to PLN 6.12 thousand and was 16.8% higher than the nominal gross salary for 2020 [18]. It should be noted, however, that as of July 1, 2022, new legal regulations related to salary increases for specific professional groups employed in the health sector in Poland are in force.

### **2.3 Determination of problems influencing economics and management in health care**

The process of population ageing will put increasing pressure on the system of healthcare. Older people require much more extensive and intensive care than people in other age groups, as fitness declines with ageing and there is an increasing likelihood of developing one or even more chronic diseases. For many of the experts taking part in the in-depth interviews, it was clear that given the scarcity of resources, it will be difficult for the Polish health care system to respond to meet the increased - and significant - demand for health services. However, as far as the necessary actions to face this challenge are concerned, the following solutions were pointed out

The most important of them are the following:

- the development of effective and widespread prevention to reduce the number of people with the sick and in advanced stages of the disease,
- the development of coordinated care dedicated to the needs of older people (e.g.

geriatric teams combining health and social services),

- the widespread introduction of remote care, which will improve the availability of services but also spreading the model of home care for seniors.

As a commentary, it can be added that also all other measures aimed at to improve the health and cost-effectiveness of the health system are also desirable to cope with the increased demand for services. The digital transformation in the health care system in Poland is progressing intensively. Technological progress generates changes and introduces new solutions. These relate to prevention, diagnosis, the process of they concern prevention, diagnosis, the treatment process, rehabilitation, management of the broadly understood public health, as well as issues related to research and development (R&D), education of medical personnel, financial settlement of health services, management.

The project will also cover issues related to research and development (R&D), training of medical staff, financial settlement of health services, management of medicinal products and creation of drug policy, as well as conducting various types of analyses. various types of analyses. The most important link in the health care system in Poland is the patient. Physical, psychological and social well-being, at every stage, depends on many factors, including lifestyle, genetic conditions, health care providers and other factors. lifestyle, genetic predisposition, available healthcare, physical environment, among others. Modern technologies support patient institutions and patients themselves in maintaining health. It is the patient who should be the focus of digital transformation efforts, so that they can actively participate in the pursuit of good health and well-being. Solutions should be supported based on self-care or care provided by family members, undertake preventive and health promotion activities, provide prevention and health promotion, ensure efficient communication between the patient and the health professional.

Activities related to the digitalisation of health care take place both at national level, regional level (e.g. regional e-health platforms), as well as local level (e.g. IT systems of individual medical entities). healthcare entities). Activities at these levels are aimed at cooperation and should be complement each other. Only then will it be possible to fully exploit the potential of individual Only then will it be possible to fully exploit the potential of individual stakeholders, as well as to provide secure, user-friendly solutions facilitating their functioning in the health care system. The activities to date clearly indicate that the digitalisation of the health care area in Poland is already intensively used - allows to provide

electronic services at a high level of maturity, It contributes to the streamlining of business processes and, consequently, enables the efficient provision of healthcare services. Nevertheless, this process requires further action to optimise the resources used in the context of dynamic changes in the environment.

### 3. Use of modern digital technologies in healthcare

#### 3.1. State of electronization in healthcare

Digital solutions in healthcare are being introduced in Poland by a unit of the Ministry of Health called the e-Health Centre (in Polish: *Centrum e-Zdrowia*). The e-Health Centre began its work in 2020. It continues the activities of the Centre for Health Information Systems, a previous unit of the Ministry of Health established on 1 July 2010 by the Minister of Health. The tasks of the e-Health Centre include [19]:

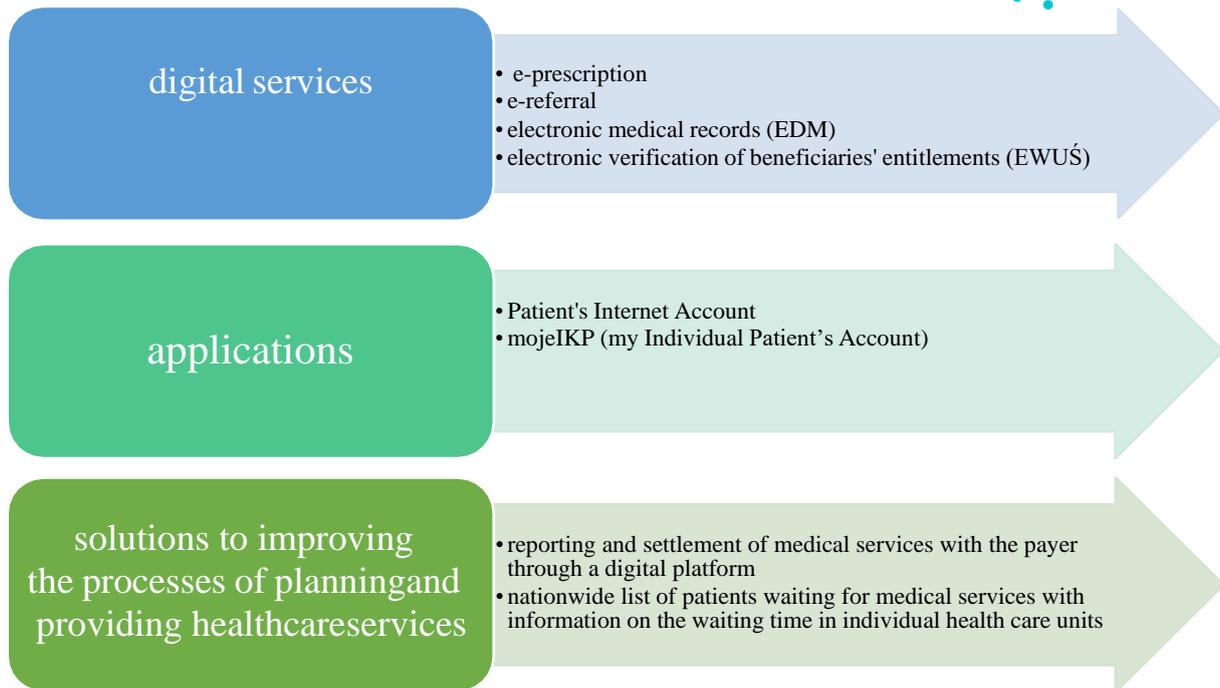
1. carrying out tasks in the field of e-health development in particular:
  - a. creation, implementation, development and maintenance of ICT systems and provision of e-services for patients, medical professionals, entities performing medical activities and other stakeholders of the health system in order to improve the quality and availability of medical services and optimise the processes operating in the health system,
  - b. monitoring of the planned, created and operating ICT systems at the central and regional levels, within the scope of their complementarity and interoperability with the Centre's ICT systems, including conducting analyses, expert opinions and providing necessary advice,
  - c. cooperation and information exchange with other public entities on the created and used solutions in the area of public e-services,
  - d. preparing analyses, opinion reports, and contributions to documents, including drafts of legal acts or assumptions of legal acts, prepared by the office serving the minister in charge of health,
  - e. proposing objectives and priorities for the development of e-health in Poland and initiating actions aimed at their implementation,
  - f. conducting information activities related to the scope of the Centre's operation,
  - g. performing the function of an entity responsible for the operation or technical and organisational maintenance of information and communication systems within the scope defined in legal acts,
  - h. performance of tasks of the National Contact Point for Cross-border Healthcare concerning the exchange of cross-border prescriptions in electronic form,

- i. conducting, to the extent indicated by the minister in charge of health matters, inspections concerning the correctness of operation of ICT systems in the health system,
  - j. performing the function of a key service operator within the meaning of the Act of 5 July 2018 on the national cyber security system;
2. activities in the field of public statistics, as defined by law, including the conduct of statistical research of public statistics in health care for the use of the health policy of the minister competent for health matters and public statistics;
3. implementation of other tasks commissioned by the minister responsible for health matters.

The main project that the eHealth Centre has carried out concerns creating an e-Health system (system e-zdrowie). That system constitutes the basis of Poland's digital ecosystem of medical services [20]. It covers the e-Health platform that offers digital public services in health care by providing a central IT infrastructure and corresponding software solutions [21]. It gathers data on the course of all treatments from all medical entities, regardless of their financing source. Importantly, it enables the collecting, processing and sharing digital resources on patient medical events and electronic medical records (EDM) indexes. Moreover, it covers patients' visit history and gives them easy access to these data via his/her Internet Patient Account, which is called in Polish *Internetowe Konto Pacjenta* [22].

The e-Health system includes e-prescriptions (introduced in January 2020) and e-referrals (introduced in January 2021). Besides, the e-Health system offers other special solutions for medical entities, which improve the processes of planning and implementing healthcare services [21]. Moreover, it enables the medical units to check if the patient is insured (electronic verification of beneficiaries' entitlements (EWUŚ)). Therefore it supports the daily work of medical entities, medical professionals and public administration responsible for the functioning of the healthcare sector in Poland. At the same time, the system makes it easier for patients to manage their own and their loved ones' health.

The main elements of the e-Health system in Poland are presented in Figure 1.



**Figure 1.** The main elements of the e-Health system in Poland  
Source: Own elaboration.

The data from the e-Health Centre shows that 1.2 billion e-prescriptions and 88 million e-referrals have already been issued [22]. Patients and doctors have quickly adopted E-prescriptions, thanks to their benefits. For patients, the main advantage of E-prescriptions is the possibility of gaining them without leaving home - the doctor can issue the prescription after a telephone consultation with the patient. Using e-prescriptions, patients may quickly buy medicines in any pharmacy and at any preferred time. In the pharmacy, it is enough to have a four-digit PIN code, which can be received by SMS or by e-mail. Moreover, realising e-prescription is possible by showing a QR code in the application myIKP. However, e-prescriptions are a comfortable and safe solution not only for patients. That is also a convenient solution for doctors. With e-prescriptions, they can monitor patients' adherence to treatment because they can check whether a prescription has been purchased.

Both patients and the other medical entities also fully accepted e-referrals. However, it must be emphasised that it is not yet possible for a doctor to issue an e-referral in all cases [21]. At the moment, e-referrals can be issued in the following areas [23]:

- outpatient specialist services,
- hospital treatment,
- nuclear medicine treatment,
- computed tomography,

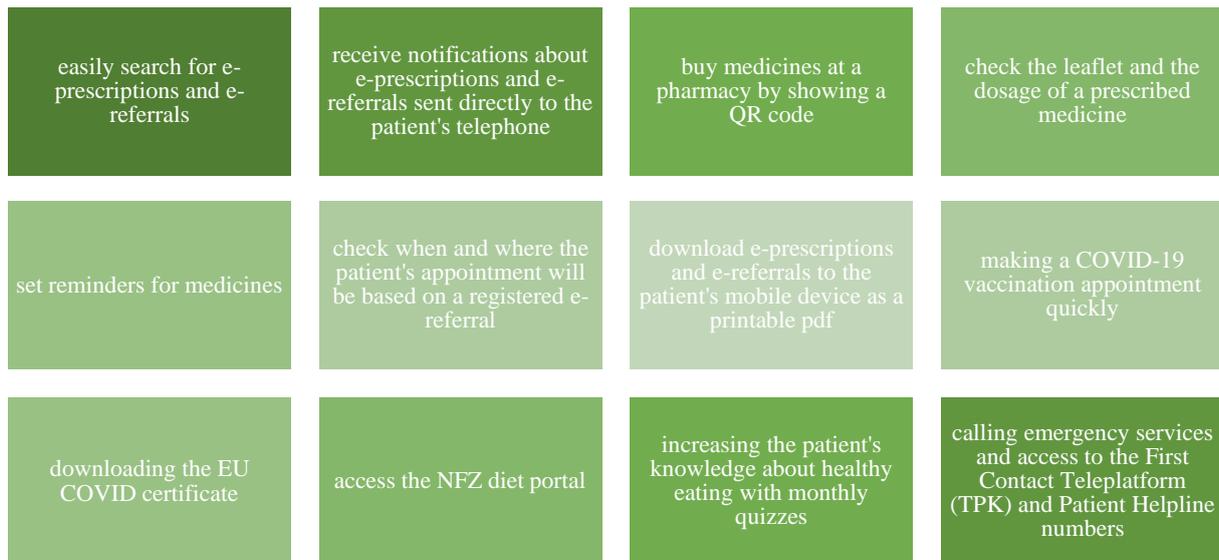
- magnetic resonance imaging,
- gastrointestinal endoscopy,
- fetal echocardiography,
- rehabilitation.

In other areas, e-prescribing is yet to be introduced. That is awaited by various medical entities, as e-referrals enable the complete electronic monitoring of the treatment referral process.

Another electronic solution from the eHealth system, which has been quickly adopted by patients, doctors, and different market entities (i.e. firms), is e-sick leave, known as e-ZLA [21]. It was introduced in December 2018. The doctors (or medical assistants) automatically upload it to the profile of the Electronic Services Platform of the payer of contributions and the Health Insurance Company (ZUS) system. It is considerable facilitation for patients. Thanks to this, patients do not have to deliver sick leave to the employer (if you are an employee) or to ZUS (if you run a business).

All e-prescriptions, e-referrals and e-sick leaves are available for patients in their Internet Patient Account. It is also possible to access e-prescriptions and e-referrals through an application called myIKP. According to the data from e-Health Centre, 1.6 million people have already set up an Internet Patient Account, and 3.4 mln people have installed the myIKP app [22].

Notably, an Internet Patient Account gives the patient remote and permanent access certificates of his vaccinations. However, similar possibilities for the patient can also find in an app myIKP. The functions that offer the patient application myIKP are presented in Figure 2.



**Figure 2.** The main possibilities that offers the patient application myIKP

Source: Own elaboration.

The e-Health system is still developing, and gradually it incorporates additional functionalities. For example, new features of Electronic Medical Records will appear. It is planned that specific information provided to the e-Health system by one healthcare provider will be able to be seen by another healthcare provider to use this information when diagnosing or continuing the treatment of a specific patient [21].

The Ministry of Health sets out in the strategic plan the directions for future activities in the field of the whole e-Health system. The main strategic document for the health sector currently covers the years 2021-2027. It is entitled “Healthy Future. A Strategic Framework for Health System Development 2021-2027, with an Outlook to 2030” (in Polish - Zdrowa przyszłość ramy strategiczne rozwoju systemu ochrony zdrowia na lata 2021–2027, z perspektywą do 2030 r) [21]. The strategy involves action in four main interdependent areas: patient, process, development and finance. It aims to ensure that citizens have equal and adequate access to quality health services through a friendly, modern and efficient health care system. In the field of e-Health, the strategy is focused on reinforcing health data, digital tools and services, and the digital transformation of healthcare.

### **3.2. Evaluation of the use of selected modern technologies including economic benefits**

The use of solutions in this area is relatively poorly monitored in Poland and there is no extensive research on the economic impact of their implementation.

#### **3.2.1 Telemedicine and smart devices**

The latest research on the use of telemedicine solutions is included in a report by the Polish Agency for Enterprise Development. The analysed areas were divided into 3 levels in this respect:

- keeping medical records, electronic systems for storing them and sharing for the improvement of treatment and management processes.
- remote patient care, which includes various solutions allowing for remote consultations and remote monitoring of the patient's health condition (using appropriate mobile devices or applications)
- analysis and use of large data sets (big data) to improve the quality of health services health services and the efficiency of medical facilities. Modern analytical tools analytical tools, including artificial intelligence (learning algorithms), offer the possibility to analyse large data sets, which can be used to evaluate treatment outcomes, clinical trial results clinical trials, and then to modify medical procedures in facilities. Similarly data relating to patient movement, utilisation of various types of resources, can be used to improve the efficiency of treatment processes from the management side. In Poland, the most common solutions are from the first level, which can be described as the most basic. Electronic medical records are in operation (not yet integrated, these issues are described in the section above this paper). These are systemic solutions, implemented throughout the sector. The use of digital technologies in other areas: remote care, data analysis, are not systemic, depend on the initiative and capabilities of individual institutions and are much less frequent [24].

Within remote care, it can be assumed that the big test was the introduction of teleportation during the pandemic period. However, a quality standard for teleportation was not introduced. When thinking about mature remote care models, solutions combining online remote consultation with monitoring of the patient's condition must be introduced in this area. Some novelty in this respect was the introduction of the provision of pulse oximeters to monitor the condition of sick patients during the pandemic in the home treatment setting. It is difficult to determine to what extent remote care solutions other than teleportation are used in the healthcare system. In this respect, it is certainly possible to mention solutions used on a pilot or systematic basis in areas such as:

- monitoring the health of pregnant women - electronic ktg

- monitoring of general health parameters, including cardiology
- improvements in rehabilitation procedures
- improvements in psychiatric care.

An example of a solution in this area is AMULET, which was developed by a consortium led by the Military Medical Institute in Warsaw. There were two main research pathways in the project. The first is an ambulatory point-of-care model led by nursing staff, where the patient undergoes a detailed clinical and haemodynamic assessment (using bioimpedance methods) and the results are consulted remotely by a cardiologist. The second is a home care model with monitoring of a single-channel electrocardiogram and haemodynamic parameters with a focus on conductivity (device prototype) and clinical symptoms (mobile app).

The AMULET solution is innovative in terms of: organisational (new telecare model applicable to inpatient and remote (home care)); diagnostic (use of detailed patient assessment using bioimpedance methods); technological (multifunctional telemedicine platform, home device for assessment of chest hydration and other haemodynamic parameters) [25].

Telecare according to this model reduced the risk of cardiovascular death or urgent hospitalisation for exacerbation of heart failure symptoms by 31 per cent. Analysis of secondary points showed that this effect was due to a significant reduction in the number of hospitalisations, both the first: by 38 per cent, and all in all: by 36 per cent [26].

### **3.2.2 Robots**

In 2021, the development of robotic surgery in Poland accelerated significantly. This trend is continuing and was similar in the first half of 2022. - According to the latest Modern Healthcare Institute (MHI) report 'Development of robotic surgery in Poland. Facilities. Benefits. Profitability. Prospects for market development'. It predicts that, after years of stagnation, robotic surgery will also develop faster in our country in the next few years. This is expected to be the case in private as well as public centres.

In some procedures, such as radical prostatectomy (removal of a prostate tumour), robotic surgery is expected to compete even with laparoscopy, not just traditional surgery. From 1 April 2022. The Ministry of Health has introduced separate pricing for a radical prostatectomy procedure performed with the assistance of a surgical robot. This is now twice as high as procedures performed by laparoscopic or open (classic) methods. This was enough for as many as 17 facilities to notify the National Health Fund of their willingness to bill for

these procedures within the first three months of this decision. And in doing so, they are committing to performing a minimum of 100 procedures per year.

According to the report, the second major factor in the Polish surgical robot market is the increased competition among surgical robot manufacturers, which has translated into more favourable financing. Until now, the US da Vinci robots from Intuitive Surgical had dominated for many years, but a UK company, CMR Surgical, which produces the Versius operating system, has emerged. Its approach to the financing method proved groundbreaking. By offering leases, deferred payments or billing the purchase with the procedures performed, the financial barrier for hospitals of a large one-off expense disappeared. As a result, as many as five Versius robots appeared in Polish hospitals during the first six months of 2022. At the same time, only two new facilities started performing procedures with da Vinci systems. More manufacturers are already lining up to join this market competition. Increased competition will force down the prices of these systems, as well as after-sales services for hospitals [27].

### **3.2.3 Innovative tools for disease diagnosis**

All Visegrad countries present delays in access to healthcare in ten strategic disease areas, according to analyses conducted with the GAP tool. In Poland, the most significant barriers to access to diagnosis and treatment occurred in rare and chronic diseases. Access Gap (GEARING UP ACCESS PROPOSAL FOR V4) is the first interactive web-based platform presenting access to innovative medicines and diagnostic solutions in ten disease entities. Ten disease entities, for which at least a few innovative therapies have been approved in Europe in the last decade, were included in the study. These include rare oncological and non-oncological diseases. The conditions analysed included ovarian cancer, lung cancer, breast cancer, prostate cancer, cystic fibrosis, acute myeloid leukaemia, lymphoma, SMA, MS and diabetes. This approach made it possible to assess the extent to which they had become accessible to patients

Selected disease areas were assessed by looking at eight indicators covering various aspects of patient access to treatment, including but not limited to: access to modern diagnostics and reimbursement of innovative therapies. The report identifies the core problem of relatively low access to innovative therapies in all Visegrad countries, breaking it down into its components. These can be divided into two general categories: restrictions on

allowing a medicine to be reimbursed and the time it takes from registration to reimbursement of a medicine. The most worrying findings concern the indicator that shows what proportion of patients in the target population are treated with innovative medicines. On average, just over 20 per cent of potential patients have access to innovative therapies. The main reason for this is the lack of regular reimbursement and protracted reimbursement processes. The average time from registration to reimbursement for all drugs included in the study was 940 days - for such a long period, patients could not be treated with the latest therapies. The average time from registration to reimbursement varies from more than 2.1 years in the Czech Republic to 3.4 years in Poland.

Identifying problems in this area is crucial, as delayed access to treatment potentially translates into a perceived burden on society, and indirectly on quality and length of life. Positive solutions in this area therefore indirectly affect the functioning of society as a whole. Poland shows the longest possible waiting period between the registration of a drug and its reimbursement. It amounts to 7.4 years and concerns therapies for the treatment of patients with cystic fibrosis. It is immediately followed by pharmaceuticals used in the treatment of diabetes, with a waiting period of 5.2 years. The shortest waiting period, on the other hand, occurred for drugs used to treat patients with non-small cell lung cancer (NSCLC) - 2.3 years and spinal muscular atrophy (SMA) - 1.6 years. The greatest limitations in access to innovative treatments are observed for rare and chronic diseases. Reimbursement restrictions are a significant barrier. The report showed that one of the weakest points in access to innovative therapies is the percentage of available medicines among those recommended in the clinical guidelines between 2010 and 2021. In each of the analysed diseases, limitations in access to the latest therapeutic options, but also to rapid diagnosis, were diagnosed. This means that patients in the Visegrad countries are not being treated optimally according to clinical guidelines. Poland performs relatively well in the area of ovarian cancer treatment. Systemic solutions have proven themselves in this area. The cited report can become a powerful tool for stakeholders towards closing treatment gaps and, consequently, improving the quality and length of life of patients [28].

Additionally, in this regard, it is worth mentioning the increasingly widespread diagnostic and screening health programmes at regional and national level.

### **3.2.4 Big Data Processing**

The area of the use of Big Data in the Polish healthcare sector is quite a challenge. Apart from ongoing scientific projects, often of a pilot nature, there are no fully integrated system solutions developed.

The analysis of large data sets to support treatment and management processes is still very rare at the level of medical facilities. However, there are emerging indications of the need to use this type of data; an example is the planned project of the National Institute of Cardiology examining the effectiveness of treatment of patients with atrial fibrillation [29].

## 4. Mechanisms supporting creation of start-ups in health care

### 4.1. The existing system of state and private support and conditions for establishing start-ups

The report on medical startups in Poland, *"Top Disruptors in Healthcare"* (2022), identifies 300 medical startups that function in the Polish market. The data gathered in that report indicate that the number of medical startups in the Polish market is increasing yearly. Likewise, their potential is growing, especially in medical innovation [*Top Disruptors in Healthcare*].

Medical startups in Poland offer solutions to significant market problems for patients and institutions providing medical or peri-operative services. It is worth emphasising that many of these solutions are based on artificial intelligence and machine learning [30]. Startups whose products are developed based on artificial intelligence focus on oncology, cardiology and radiology [31].

Financing medical technology startups involve considerable expenses, primarily related to the certification of the medical device in various markets [31]. The high operating costs of innovators in the medical market are also due to the need to meet rigorous legal standards and conduct clinical trials. It should also be noted that medical startups must have the financial resources to hire highly specialised experts [MEDmeetsTECH]. Interestingly, according to the "MEDmeetsTECH" report, the company's funds are the leading source of funding for medical startups in the Polish market. However, they also use funds from the Polish Agency for Enterprise Development (PARP) or the National Centre for Research and Development (NCBR) and VC funds from business angels. At the same time, the report shows that financing is the most significant barrier to the development of medical startups [MEDmeetsTECH]. Similarly, the report *"Top Disruptors in Healthcare"* (2022) shows that medical startups often struggle with financing. In particular, they have problems attracting investors [30].

The report *"Top Disruptors in Healthcare"* (2022) also shows that although medical startups do not have problems in identifying customer needs and creating a business model, they are hampered in their development by the promotion and marketing of the solution [30]. It is worth noting that the results of the research presented in the 'Top Disruptors in Healthcare' (2022) report are, in this respect, in line with the results of the study presented in the 'MEDmeetsTECH' report. They indicate that medical startups in Poland have difficulty reaching customers, and likewise, they complain that their networks with the environment are insufficient. However, it seems optimistic that one in ten medical startups participating in this study indicates that they do not experience any barriers to growth.

Most medical startups in Poland offer products tailored to the needs of doctors and other medical professionals. Besides, medical startups operating in the Polish market often target medical entities and patients with their products. Thus, startups in Poland are creating solutions that can make a real contribution to relieving doctors in their daily work and increasing the efficiency of carrying out diagnostic, treatment and prevention procedures with due diligence [30].

Polish innovative medical startups are mainly focused on cooperation with medical institutions. They want to implement their solutions in cooperation with these institutions and know that their products must to be verified in the clinical environment. However, it should be emphasised that medical startups cooperate with universities, research institutes, business accelerators, and incubators. In contrast, a relatively small number of startups cooperate with other startups [30].

#### **4.2. The way in which universities, research institutes and private companies are involved in setting up start-ups in healthcare**

According to the 2019 Global Innovation Index (GII) report, Poland is ranked 39th in the world in terms of medical innovation. In contrast, it ranks 26th among European countries [32].

The main activities undertaken in this area concern the creation of start-ups within the framework of business incubators, which operate at universities. Their aim is to exploit knowledge and human potential and build a bridge between science and research and business. These activities are intended to translate into the development of the economy in the field of medicine and health. Their main role is to incubate new business ventures while providing administrative support at all stages of commercialisation. Examples in this respect are the incubators operating at the Medical University of Łódź [33] and the Medical University of Warsaw [34].

A special type of activity is the creation of spin-off companies that have been spin off from medical research institutions with the aim of commercialising technology and transferring knowledge. Examples in this respect are the companies created at the Medical University of Gdansk and the Medical University of Warsaw.

An example of a particular form of integration of activities in the area in question is the creation of medical clusters. There are 3 examples in this area.

The medical cluster MedSilesia forms the Silesian Network of Medical Devices and operates at the Upper Silesian Agency for Entrepreneurship and Development [35]. It includes over 110 organisations. This cluster is counted among the national key clusters. The cluster:

- operates sectoral development services: POWER-MED, MED Think, GO Global;
- has specialist knowledge, especially with regard to obtaining EU funds for the medical industry;
- offers medical technology brokerage services;
- conducts international cooperation;
- has access to all key research units and universities in Silesia;
- cooperates with the most important companies in the sector.

Another cluster is the LifeScience Kraków cluster [36] which offers access to an organised cooperation network operating in the scientific and business environment of the life science sector. It too is counted among the national key clusters.

The network includes institutions diverse in terms of type, structure and size:

- service and production companies from the broadly defined lifescience sector (biotechnology, environmental protection, health care, clinical research, etc.),
- universities and scientific institutes with highly qualified staff specialising in life science,
- specialised hospitals with excellent staff, equipment and competence in all diseases and treatments.

Another example is the Nutribomed cluster [37]. The main idea behind the creation of the cluster was to build a strong Polish position in the industry offering dietary supplements, nutraceuticals and biomedical preparations, as well as using native, natural raw materials and modern technology for their production. Key to the operation of the entire consortium are the highly innovative spin-off technology companies associated in the cluster, which operate on the basis of their own know-how and modern technical solutions. One of the most important values of the cluster is open communication between associated companies from different industries, as well as enabling them to actively cooperate with the academic environment, which results in stimulating the development of competitiveness and entrepreneurship of these companies.

An example of further activities is the promotion of start-ups through competitions. An interesting initiative is the start-up competition organised as part of the Health Challenges Congress in Katowice.

In addition, attention should be paid to medical innovation projects funded by the National Center for Research and Development.

### **4.3. Access to health data by universities and private companies**

Universities and private companies can gain different data on health care in Poland from public statistic reports of the Central Statistical Office, called in Polish *Główny Urząd Statystyczny*. The website of the Polish Central Statistical Office has a special section on health issues [13]. There it is possible to find various information on different health-related areas. The Office publishes reports or summaries on, for example, outpatient health care, pharmacies and pharmacy outlets, emergency services activities, and the therapeutic activities of spa and inpatient rehabilitation facilities. It is worth noting that there are also summaries with general data on health care expenditure in individual years [13]. For the needs of external institutions, the Central Statistical Office can also carry out primary research on a specific thematic area for a fee.

Some of the data on health in Poland can also be accessed from the National Health Fund, called in Polish *Narodowy Fundusz Zdrowia*. The Fund's website contains reports and compilations on health issues. There are three different types of reports [38]:

- occasional reports - one-off reports devoted to a given issue (e.g. NFZ report on health. Hypertension),
- monitoring reports - reports created on a quarterly/semi-annual basis, devoted to monitoring the phenomena occurring in the system as a result of significant changes in the rules of providing and financing benefits (e.g. report on Eye Diseases),
  - cyclical reports - reports created every month, allowing for an analysis of the development of critical variables in a given area (e.g. Hospitalisation Analysis report).

The NFZ Portal also includes a Statistics section [38], which contains a set of data held by the National Health Fund regarding:

1. statistics of healthcare services in general, billing, medical and cross-sectional dimensions, which relate to catalogue products: JGP, Separate benefits, Benefits to be aggregated, Radiotherapy benefits, Highly specialised benefits;
2. pharmacy reimbursement statistics covering quantities of packages and values of medicines reimbursed by the National Health Fund, divided into medicinal products,

ATC groups and territorial areas of pharmacies performing prescriptions following the data provided to the National Health Fund by pharmacies having a contract for the performance of reimbursed prescriptions;

3. statistics of medicines in drug programmes, including the number of patients and the value of reimbursement (according to the amount settled) of medicines used in the catalogue of drug programmes by active substances, gender and age groups of patients;
4. statistics of drugs in chemotherapy, including the number of patients and the value of reimbursement (according to the billed amount) of drugs used in the catalogue of chemotherapy by active substances, gender and age groups of patients.

Different information on health and the directions for future activities in the whole health system in Poland can be gathered from the Ministry of Health (in Polish *Ministretwo Zdrowia*). That Ministry publishes its strategic documents for the health sector and differentiated reports concerning health issues.

Finally, the data on e-Health in Poland can be mainly accessed from the e-Health Centre (in Polish *Centrum e-Zdrowia*). On the internet webpage of that unit of the Ministry of Health, it is possible to find the main information on the e-health system development.

## 5. Proposed areas in health care including problems in order to solve joint projects

The report shows that in recent years, intensive efforts have been made to implement an electronic health data platform and related e-health tools in Poland. Consequently, various innovations have been introduced into the Polish healthcare system. Nevertheless, all these innovations are insufficient for the current needs of medical entities. Considering the shortage of doctors and nurses in Poland, there is a need to develop an e-health system that will give more extensive help to the work of Polish medical staff. For that aim, the innovation ecosystem for healthcare should be more developed. Thus, it would be valuable to conduct a project focused on institutions that effectively support innovation in healthcare. Moreover, to increase the effectiveness of the innovative solutions to be introduced for the support of medical entities, it would be beneficial to carry out a project aimed at identifying the educational needs of medical staff concerning e-health. As a result of such a project, a publicly accessible platform with training materials in the future could be created.

Another interesting area of future research covers the aspects of behavioural economics regarding patients' reactions to using e-services in healthcare and identifying their educational needs. In the case of that project, it would be valuable to conduct a primary survey with a selected group of patients. The project's findings in that field could be useful in the development of the digital competencies of patients.

Given that behavioural and environmental risk factors contribute to almost half of all deaths in Poland, there is also a considerable need to improve a prevention system and support a healthy lifestyle. Therefore, a project could also be undertaken to identify ways to encourage patients to use the materials prepared for them on e-health platforms.

Hospital economics and management is also an interesting area for further research. Since healthcare expenditure remains relatively low in Poland, a project focused on cost accounting and controlling is worth considering. In this context, it would be worthwhile to find out what the experience of the V4 countries is in implementing lean hospital management. Moreover, in the case of quality systems, it would be worth exploring the accreditation in health care, risk management systems, and modern management methods in all Visegrad countries.

Finally, to improve the development of the innovative healthcare system in Poland, it would be beneficial to make a platform for cooperation between scientists from the Visegrad countries in eHealth projects. Therefore, a project focused on creating an HCI Platform in Visegrad countries may be developed.

## **Conclusion**

The presented report contains fundamental issues related to the topic of innovation in the health care sector in Poland. A literature study found that, to a large extent, the pandemic has helped to accelerate the development of e-health and the introduction of innovative solutions in the health care sector. It has encouraged patients and doctors to use telemedicine. Moreover, it led to the better digitization of medical records, which enables the exchange of medical data and making systemic decisions based on them using predictive elements. Thus, it will be possible to use e-health solutions aimed at preventive patient action in the future.

The gathered data show that in the face of demographic changes and staff shortages, medical professionals should focus on their key activities with the support of IT solutions. The development of digital competence of employees and patients is also an important issue here. Furthermore, the creation of innovative projects in the health care sector in Poland requires the support of the innovation ecosystem and intensifying activities undertaken to date in this area. Thus, future research directions should move from the macro-level (health care system) to the micro-level (medical entities).

The exchange of experiences between Poland, other Visegrad Group countries (the Czech Republic, Slovakia, Hungary) and Israel may be valuable for accelerating the changes in Poland's health care sector. Such collaboration can also contribute to avoiding some mistakes and achieving better results in a shorter time.

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