

## MEASURING HEALTHCARE DIGITALISATION IN THE EUROPEAN UNION: TRENDS AND CHALLENGES

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**Abstract:** E-health represents an important tool for improving quality and accessibility of healthcare for citizens. The EU4Health is the core health policy for 2021-2027 in European Union and one key dimension in the implementation of this program is digitalisation. The purpose of our study is to show the differences and progress among the EU member states in e-health adoption and healthcare digitalisation. The premise of the research is that the indicators used in most available studies are relevant for the first stage of the e-health adoption, and there are many focused on specific areas or age groups. In this context, we aim to provide a deeper and broader image on e-health adoption and healthcare digitalisation in EU countries, by analysing 4 indicators for the period 2016-2022: seeking online information about health, making an appointment with a practitioner via a website, accessing personal health records online, using internet for other health services via a website or app instead of having to go to the hospital or visit a doctor. These were selected considering the literature and data availability. The conclusion is that internet use for health-related purposes lags the use for other personal services. Also, the internet use is a necessary but not a sufficient condition for accessing healthcare services online. Although the trends are similar, there are still significant differences among EU countries related to the e-health adoption, and catch-up national policies could be the answer to the main challenge - avoiding the digital divide in health services.

**Keywords:** digitalisation, e-health, e-health indicators, EU, seeking health information online, personal health records

**JEL classification:** I15: Health and Economic Development

### 1. Introduction

The adoption of e-health in the European Union (EU) is becoming increasingly important as the demand for accessible, efficient, and high-quality healthcare continues to rise. E-health involves the use of digital technologies, such as telemedicine, electronic health records, and health information exchanges, to improve healthcare delivery and patient outcomes. The EU is committed to promoting the use of e-health to improve the quality and accessibility of healthcare for its citizens. By leveraging the latest digital technologies, healthcare providers can improve the efficiency of their services, reduce costs, and provide better care to patients. Additionally, e-health enables patients to take a more active role in their own healthcare, enabling them to access health information, communicate with healthcare providers, and manage their own health data more effectively. As such, the adoption of e-health is a critical component of the EU's efforts to provide its citizens with the best possible healthcare services.

The aim of this paper is to show the differences and progress among the EU member states in e-health adoption and healthcare digitalisation. We first evaluated existing health indicators in different

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international and European databases, selected 4 indicators on the use of the internet for health related purposes and made a statistical analysis to identify the differences across EU countries in the period 2016-2022. Second, we analysed the data for a linear association between variables.

"E-health" and "digital health" are often used interchangeably, but they can have slightly different meanings depending on the context. Generally, e-health refers specifically to the use of electronic technologies to deliver healthcare services and information, while digital health encompasses a broader range of technologies and applications, including mobile health, telehealth, and wearable devices. However, the exact definitions and scope of these terms can vary depending on the source and context in which they are used.

According to WHO European Programme of Work 2020–2025, "Digital health" helps expand the concept of e-health to cover areas such as (WHO, 2022):

- telemedicine – ensuring people have access to health services no matter where they live;
- health data and health information systems – ensuring authorities have the information they need to develop health policies;
- artificial intelligence and big data – supporting clinicians, providers and policy makers in planning or implementing interventions; and
- countering the online infodemic – helping people trust high-quality health information.

A systematic review of the studies on seeking health information online (Jia et al., 2021) identifies some general behavioural patterns, influenced by factors such as age, gender, income, employment status, literacy (or education) level, country of origin and places of residence, and caregiving role. They identify facilitators and barriers, and also provide some policy recommendations in three directions: social media platforms, health related workers and professionals, and for governments and health organisations. Surveys related to specific areas (Bujnowska-Fedak, 2015; Osei Asibey et al., 2017; Bujnowska-Fedak, 2019; Bach&Wenz, 2020; AIMuammar et.al., 2021; Nazir&Soroya, 2021), age groups (Osei Asibey et al., 2017; Park & Kwon, 2018; Quittschalle, J. et al., 2020; Merkel & Hess, 2020; He et al., 2022, Acilar A., 2022), bring valuable information about different groups' behaviour when seeking online health information. Their findings are related to questions such as who are the users, why they need the internet for health issues and what should be done to increase the favourable impact of digitalization on the health services.

There are earlier cross-country studies on e-health, including some focused on the European Union and EU e-health policies. Lang & Mertes (2011) explains the variance in the application of e-health tools across 24 EU member states, concluding that the political factors are the most important for the successful implementation of the policies, along with information and communication technologies, whereas economic and health-related variables have a lower impact on the cross-country variance. Oberer and Erkollar (2013) highlights the benefits and limitations of establishing a EU-wide e-health network, based on the impact assessment of the implementation of the policy tools related to the management and monitoring of health systems.

Developing relevant tools for measuring e-health was a long-term challenge for e-health studies. Moghaddasi & Rabiei (2013) proposed a method for assessing the e-health status based on 5 dimensions: medical informatics education or health informatics, electronic medical records and electronic health records system; national e-health program; laws and regulations (telemedicine, electronic health records, electronic prescriptions). Ammenwerth, E. et al, (2020) used six basic health indicators, organised on three dimensions (availability of patient-related information, access to health record data for patients and their caregivers, and the ability of patients to fully add relevant data).

## **2. Healthcare digitalisation in the EU**

### **2.1. European Union Health Programme**

The EU4Health programme 2021-2027 was adopted as a response to the COVID-19 pandemic and to reinforce crisis preparedness in the European Union. With a €5.3 billion budget, the programme is an unparalleled EU financial support in the health area (European Commission, 2022a).

The main actions of the programme are clustered under **four directions**:

- I. Crisis preparedness** - to support activities, to enhance and/or improve national public health WGS and/or RT-PCR capacity at national, regional and local level.
- II. Health promotion & disease prevention** - to implement projects on disease prevention and health promotion for reducing cancer, diabetes and cardiovascular diseases in member states.

The health system is responsible for preventing health problems (prevention) and addressing acute or chronic health problems when they arise (treatment). Quality of care can be assessed through measuring structures, processes, and outcomes but there are currently no standardised sets of health promotion and prevention indicators published.

In 2019, EuroHealthNet members established a Thematic Working Group (TWIG) on Health Promotion and Disease Prevention Programme Registers as the “best practice portals”. These portals, which exist at national level in some EU countries as well as at European level, are designed to help practitioners, policy makers and researchers to find evaluated tools and interventions for health promotion and disease prevention.

- III. Health systems & healthcare workforce** – to increase the administrative capacity of member states in health workforce planning and forecasting, understand principles for using extended datasets and tools for workforce planning and forecasting and to analyse and adapt the specific education and training requirements for the health workforce to the skills and competences needed for future care delivery models.

Healthcare workforce in EU is affected by external issues (technological innovation, changing care demands, migration patterns) and internal issues (workforce ageing, recruitment and retention, skills and geographic mismatches). It is required to tackle these challenges, by: improving workforce planning and forecasting; anticipating future skills’ needs; improving the recruitment and retention of health professionals; mitigating the negative effects of migration on health systems.

- IV. Digital** – to support the development of patient access to translated health data, offered through mobile apps or patient portals (primary use of health data); and to support the development and deployment of the planned European Health Data Space (EHDS) for secondary use of health data core services especially for health research and development, policy-making and regulatory activities.

There are different levels of digital health maturity in the EU countries. Regarding the primary use of health data, some member states have reached a high level of digitalisation and interoperability within their borders, while others are in the process of taking the necessary steps. Myhealth@EU infrastructure is currently operational in ten countries and supports access to health data by healthcare professionals, but there are plans to extend the functionality for patients and for all members states to join by 2025.

Two electronic cross-border healthcare services are gradually implemented in the EU:

- “ePrescription” and “eDispensation” that allow EU citizens to obtain their medication in a pharmacy from other EU country, through the online transfer of their electronic prescription;
- “Patient Summaries” that provides information on important health-related aspects such as allergies, current medication, previous illness, surgeries, etc.

These services exist in two-thirds of member states and are most accessed via an online portal, but only in a few countries can be used across borders and 11 countries are still using paper printouts for prescriptions.

Strengthen the administrative capacity of member states in e-health area is considered. The European ICT infrastructure represented by the eHealth Digital Service Infrastructure (eHDSI) is an infrastructure that ensures the continuity of care for European citizens when travelling abroad in the EU and the cross-border exchange of eHealth data. For Myhealth@EU to be integrated into and supported by the eHealth ICT infrastructure, sufficient mobile coverage, internet connection and regular power supply should be ensured.

As regarding secondary use of health data, it is intended to support the development of a governance model and rules for sharing of public health data for secondary use, as well as the development, deployment and operation of an IT system and data tool that will enable access to health data for research, innovation, policy making and regulatory purposes. Only 13 states proposed more centralized national systems for access to data, but there is no link between them at EU level. In addition, the European Core Health Indicators (ECHI) Data Tool has been revised and enhanced to be a graphic tool and an interactive application to present relevant and comparable information on health and health systems across Europe, consisting of 88 indicators, grouped in five chapters, for the period 2004-2019 (European Commission, 2022b): demographic and socio-economic factors; health status; determinants of health; health interventions: health services and health promotion.

To address vulnerabilities and dependencies and to accelerate investments in the digital area, the European Commission proposed the policy program “Path to the Digital Decade” based on the DESI index and a description of national policies, with concrete targets for 2030. In the frame of digital agenda, the European Commission selected various indicators, divided into thematic groups, which illustrate some key dimensions of the information society (Telecom sector, Broadband, Mobile, Internet usage, Internet services, eGovernment, eCommerce, eBusiness, Digital Skills, ICT specialist, Rural in digital, eHealth, Research and Development (European Commission, 2022c).

## 2.2. Methodology

Healthcare digitalisation is one of the areas included in the EU4Health programme 2021-2027, given the potential benefits that digital services have to offer to citizens and businesses.

In this study, we evaluated existing health indicators in various international and European databases - European Core Health Indicators (ECHI) Data Tool, Eurostat Health indicators, WHO European Health for All database, and OECD Health data - and selected those which best represent the digital direction, depending on data availability.

For our research, we explored e-health and information society indicators and selected the following:

- *seeking online information about health* (individuals using internet, in the last 3 months, seeking information about health: injury, disease, nutrition, improving health, etc.);
- *making an appointment with a practitioner via a website* (individuals using internet, in the last 3 months, for making an appointment with a practitioner via a website);
- *accessing personal health records online* (individuals using internet to access personal health records);
- *using internet for other health services* via a website or app instead of having to go to the hospital or visit a doctor (individuals using internet for other health services).

We used data from Eurostat health database (Eurostat, 2022a) and “Health in the European Union – facts and figures” Eurostat online publication that provide recent statistics on health in the EU focusing on different areas (Eurostat, 2022b). Because of the limited data availability for our topic, we did not use European Core Health Indicators.

## 2.3. E-health adoption in the European Union

In recent years, the digitalisation of health services in the European Union has increased considering the EU e-health agenda and policies. Moreover, COVID-19 pandemic has had a substantial impact on how people consult doctors.

In 2013 and 2018, the European Commission conducted two surveys to measure the use of ICT and e-health applications in EU countries (European Commission, 2013, 2018) based on four dimensions: Electronic Health Records (EHR), Health Information Exchange (HIE), Telehealth and Personal Health Records (PHR). An overall e-health adoption average score – the e-health composite index of adoption – was calculated. The analyses showed that e-health adoption in the EU member states has increased from 2013 to 2018 (EU average index from 1.776 to 2.069), but there are differences

among the countries: states with the highest level of adoption are Denmark, Estonia, Finland, Spain, Sweden and United Kingdom (scores between 2.365 and 2.673); and states with the lowest level of adoption are Greece, Lithuania, Luxembourg, Malta, Romania and Slovakia (scores between 1.647 and 1.785) (Table 1).

**Table 1: E-health composite index in the EU countries in 2013 and 2018**

Countries	2013	2018
Austria	1.914	2.131
Belgium	1.752	2.067
Bulgaria	1.582	1.809
Croatia	1.684	2.180
Cyprus	1.674	1.934
Czechia	1.857	2.063
Denmark	2.308	2.673
Estonia	1.478	2.417
Finland	2.087	2.644
France	1.876	2.054
Germany	1.781	1.941
Greece	1.605	1.785
Hungary	1.848	2.028
Ireland	1.851	2.103
Italy	1.972	2.185
Latvia	1.497	1.826
Lithuania	1.346	1.647
Luxembourg	1.614	1.776
Malta	1.531	1.695
Poland	1.540	1.837
Portugal	1.844	2.118
Romania	1.695	1.788
Slovakia	1.517	1.756
Slovenia	1.577	1.998
Spain	2.167	2.365
Sweden	2.010	2.522
United Kingdom	2.071	2.517

Source: (European Commission, 2018)

There are some studies that provide an overview of the implementation of the main e-health solutions in the EU and the existing disparities in the European countries regarding the difficulties of adopting e-health (Stankovic & Stancic, 2015; Lobont et al., 2019; Luca et al., 2021).

The final report of the ESPON Cooperation Programme “Future Digital Health in the EU” (ESPON, 2019) analysed the digitisation of healthcare and cross-border implementation of e-health in Estonia, Finland, Slovenia and Bulgaria and identified some socio-economic benefits of e-health and recommendations for future policies.

The OECD report “Health at a Glance: Europe 2022” (OECD, 2022) insists on supporting the digital transformation of health systems to make the most of health data and new digital tools and presents data for 2019-2020: in-person consultations fell by almost 20% on average in EU countries, by more than one-third in Lithuania and Spain, and by less than 10% in the Czech Republic and Finland; the share of teleconsultations has doubled from 11% to 22% in 12 countries; before the pandemic, consultations via phone or video accounted for less than 10% in all but two EU countries and Denmark had the highest share of teleconsultations pre-pandemic, at 45%.

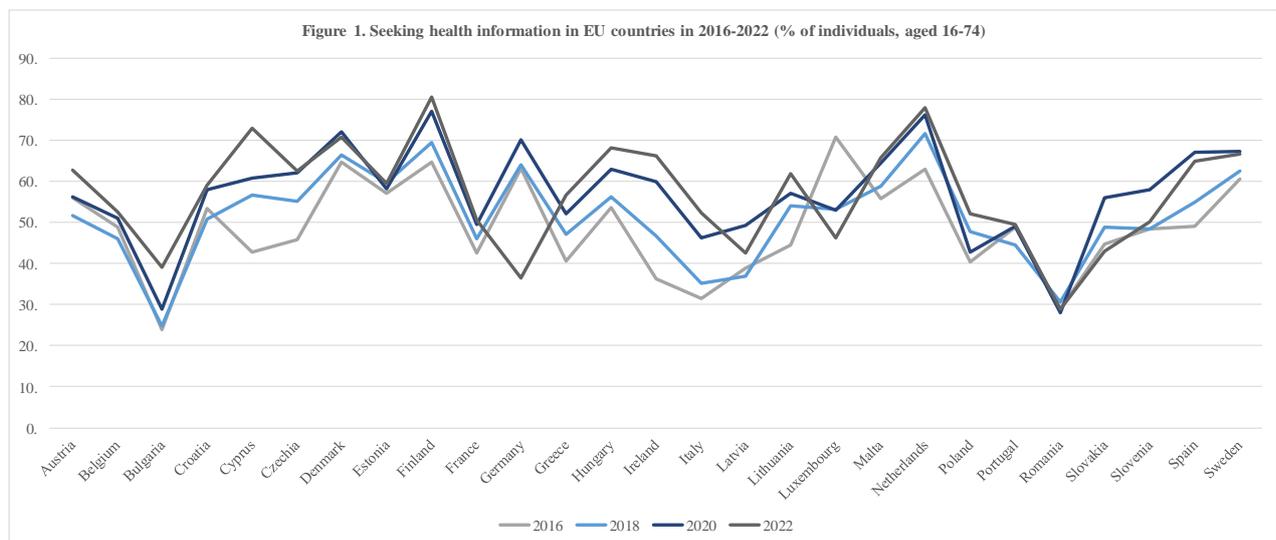
### 2.4. Digital healthcare and e-health indicators – evolutions and discussions

Internet use has grown rapidly in the EU over the years, from 80.4% in 2016 to 83.4% in 2018 and 90.5% in 2022. According to Eurostat, in 2022, 90.5% of people aged 16-74 in the EU countries used the internet during the previous 3 months, ranging from 79.1% in Bulgaria to 98.2% in Luxembourg.

In this context, we analysed 4 selected indicators on the use of internet for health-related purposes in the EU countries in the period 2016-2022.

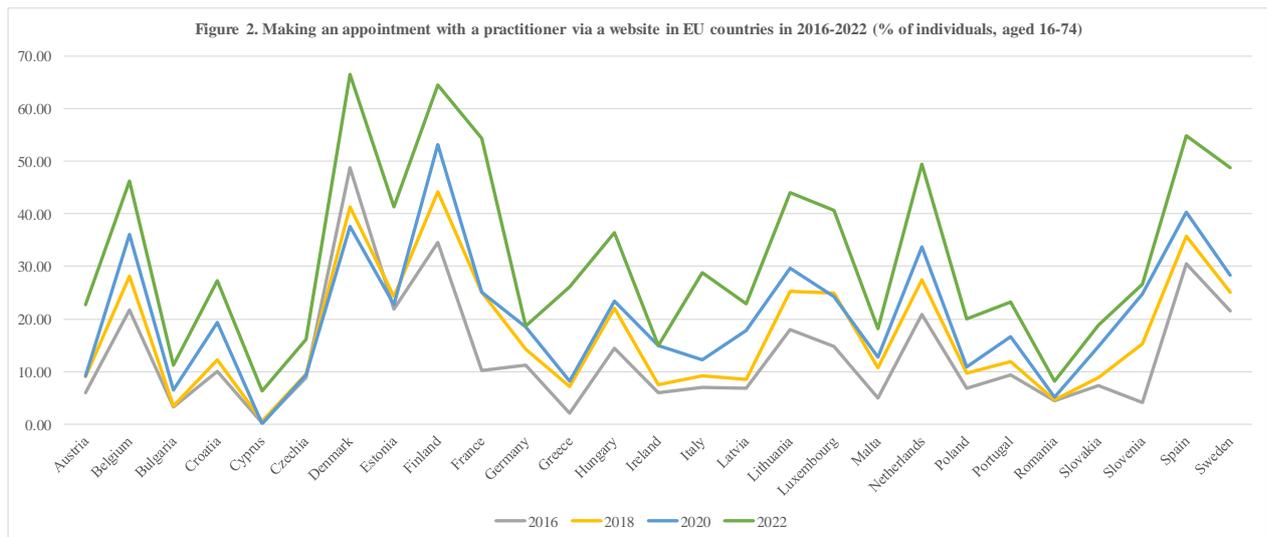
People are increasingly going online to access information and interact with the provider of different services, including health. At the EU level, in 2022, 57% of people reported using the internet to seek health information, while 31.7% to make an appointment with a practitioner via a website, 33.4% accessed personal health records online, and 20.5% used it to access other health services via a website or app instead of having to go to the hospital or visit a doctor.

In recent years, the share of people *seeking health information online* in the European Union has risen from 48.8% in 2016 to 57.0% in 2022 and varied across EU countries (Figure 1). In 2022, the highest share was recorded in Finland, where 80.50% of people aged 16-74 searched online for health-related topics, followed by the Netherlands (78%), Cyprus (72.9%) and Denmark (70.8%). In contrast, the lowest shares were observed in Romania (28.9%), Germany (36.6%), Bulgaria (39%), Latvia (42.6%) and Slovakia (43%). The highest increase was recorded in Cyprus (42.7% in 2016 to 72.9% in 2022), followed by Italy (31.4% in 2016 to 52.2% in 2022), Czechia (45.8% in 2016 to 62.4% in 2022) and Greece (40.6% in 2016 to 56.6% in 2022), while the lowest increases (0-2 pp) were observed in Romania, Portugal and Slovenia, and decreases in Germany (63.1% in 2016 to 36.6% in 2022) and Luxembourg (70.7% in 2016 to 46.4% in 2022).



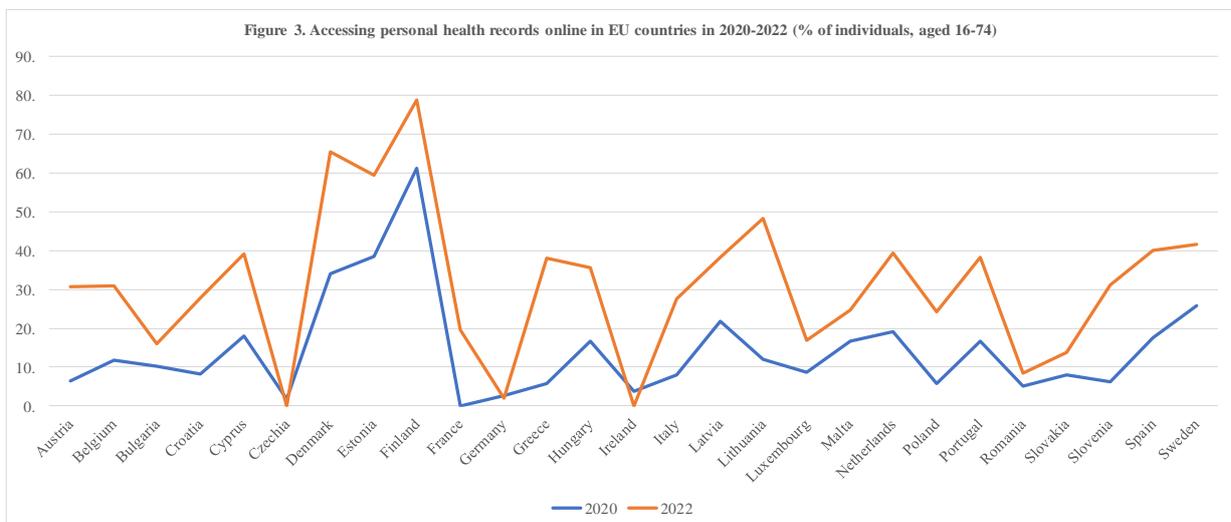
Source: (Eurostat, 2022)

The percentage of individuals in the EU who used the internet to *make an appointment with a practitioner via a website* gradually increased in the period 2016-2022 (Figure 2): as EU average from 13.2% in 2016 to 17.3% in 2018, 20.5% in 2020 and 31.8% in 2022. Among the EU states, Denmark and Finland registered the highest shares of people using the internet to make an appointment with a practitioner via a website, 66.44% respectively 64.5% in 2022. The lowest shares were in Cyprus (6.3%), Romania (8.0%) and Bulgaria (11.2%).



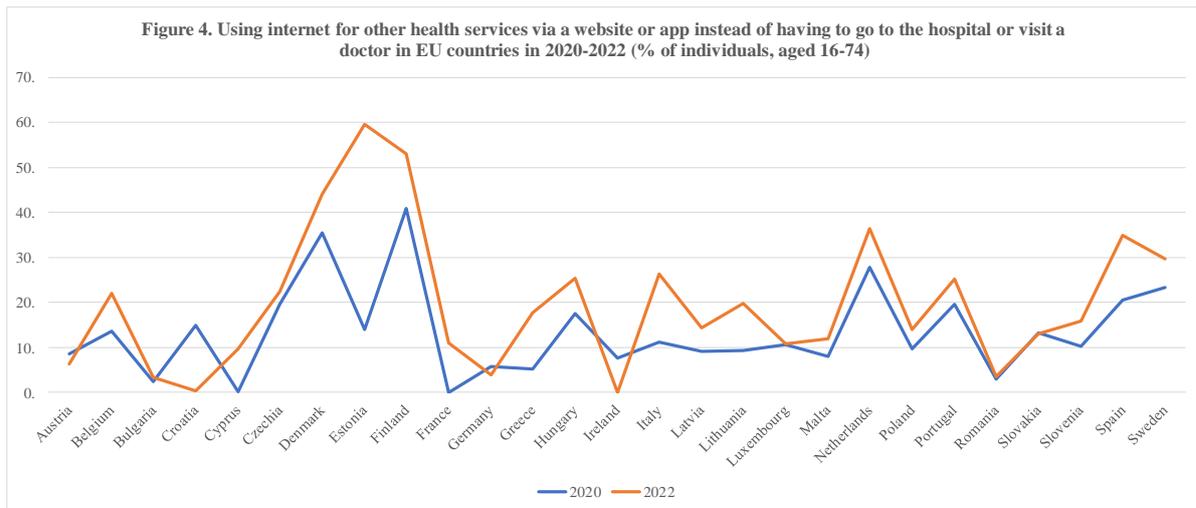
Source: (Eurostat, 2022)

As for using the internet to *access personal health records online*, in 2022 Finland had the first highest share of people (78.7%), followed by Denmark (65.5%) and Estonia (59.5%). Germany registered the lowest share of people accessing the internet for health records with only 2%, followed by Romania (8.4%) and Slovakia (13.7%) (Figure 3).



Source: (Eurostat, 2022)

The proportion of individuals aged 16 to 74 in the EU who used internet *for other health services* was 25.5% in 2022, up from 13.9% in 2020 (Figure 4). With 59.5% and 53%, Estonia and Finland reported the highest shares of people using the internet for other health services via a website or app instead of having to go to the hospital or visit a doctor. By contrast, this proportion was the lowest in Romania (3.4%) and Bulgaria (3.3%).



Source: (Eurostat, 2022)

In addition, we analysed the data for a linear association between variables (Table 2).

**Table 2: Correlation coefficients**

	Internet use	Seeking health information online	Making an appointment with a practitioner via a website	Accessing personal health records online	For other health services via a website or app
Internet use	1				
Seeking health information online	0.47776	1			
Making an appointment with a practitioner via a website	0.52978	0.485318	1		
Accessing personal health records online	0.39276	0.751905	0.645665	1	
For other health services via a website or app	0.48551	0.592413	0.714942	0.831874	1

The correlations between the percentage of individuals using internet and those seeking health information online, making an appointment with a practitioner via a website and using internet for other health services via website or app are moderate positive (0.48, 0.53, respectively 0.49). There is a weak correlation between internet use and accessing personal health records online (0.39). All of these figures suggest that internet use for health-related purposes lags behind use for other personal services and that internet use is a necessary but not a sufficient condition for accessing healthcare services online.

### 3. Conclusions

People are increasingly going online to access information and interact with providers of various services, including health services. In 2022, in the European Union, 57% of people reported using the internet to seek health information, while 31.7% made an appointment with a doctor via a website, 33.4%

accessed personal health records online and 20.5% have used it to access other healthcare services through a website or app.

Among the member states, Finland registered the highest share of people using the internet for health-related activities, with 80.5% of people using the internet to seek health information, 64.5% to make a healthcare appointment, 78.7% to access personal health records online and 53% for other health services. The lowest shares were observed in Romania and Bulgaria.

In recent years, the digitalisation of healthcare services in the European Union has increased considering the EU e-health agenda and policies, while COVID-19 pandemic has had a substantial impact on how people consult doctors. E-health adoption has grown but differences between countries remain (Denmark, Estonia, Finland, Spain, and Sweden, on the one hand; Greece, Lithuania, Luxembourg, Malta, Romania, and Slovakia, on the other).

In conclusion, digital technology has revolutionized the healthcare industry in the European Union, and e-health adoption has the potential to improve the quality and accessibility of healthcare services for all citizens. However, the digital divide remains a significant challenge, especially for vulnerable and disadvantaged populations or areas. In addition to the EU programs, national policies are needed to ensure that e-health services are accessible and affordable for all, regardless of socioeconomic status or geographic location. Such policies must focus on improving digital infrastructure, increasing digital literacy, and addressing privacy and security concerns. By bridging the digital divide, the European Union can ensure that e-health technology is used to its fullest potential, delivering better health outcomes and improving the overall well-being of its citizens.

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