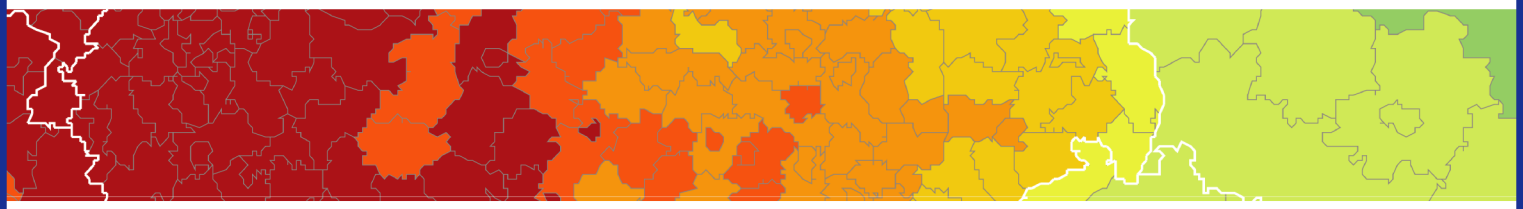

eHealth – Future Digital Health in the EU

Targeted Analysis

Final Report
Version 25/03/2019

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Final Report

Future Digital Health in the EU

Version 25/03/2019

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Abbreviations

AI	Artificial Intelligence
BaHIS	Base for Health Information System of Bulgaria
CEF	Connecting Europe Facility
CRM	Customer Relations Management
CRPD	Central registry of patient data
DESI	Digital Economy and Society Index
DHR	Digital Health Revolution
DSI	Digital Service Infrastructure
EC	European Commission
ECESA	Electronic Commerce and Electronic Signature Act of Slovenia
EDPR	Europe's Digital Progress Report
EGA	Electronic Governance Agency
EHCIC	Electronic health care identity card in Slovenia
eHDSI	European eHealth Digital Service Infrastructure
eHGI	eHealth Governance Initiative
EHF	Estonian eHealth Foundation
EHIF	Estonian Health Insurance Fund
EHR	Electronic Health Record
EHTEL	European Health Telematic Association
EIP on AHA	European Innovation Partnership on Active and Healthy Ageing
ELGA	Austrian Electronic Health Record
EMR	Electronic Medical Records
EPR	Electronic Patient Record
epSOS	Smart Open Services for European Patients
EU	European Union
EU MS	European Union Member States
ERN	European Reference Network
FinOHTA	Finnish Office for Health Technology Assessment
GDP	Gross Domestic Product
GDPR	EU General Data Protection Regulation
GP	General Practitioner
HDRA	Slovenia's Healthcare Data Records Act
HTA	Health Technology Assessment
HWISC	Estonia's Health and Welfare Information Systems Centre
ICT	Information Communication Technologies
IHIS	Integrated Health Information system of Bulgaria
IoT	Internet of Things
IT	Information Technologies
ITU	International Telecommunications Union
KanTa	Finnish Electronic Patient Record System
KaPA	Finnish National Architecture for Digital Services
Kela	Social Insurance Institution of Finland
LIS	Laboratory Information System
MEC	Finland's Ministry of Education and Culture
MEE	Finland's Ministry of Employment and Economy
MH	Ministry of Health of Slovenia
MS	Member State
MSAH	Finland's Ministry of Social Affairs and Health
MoEAC	Estonia's Ministry of Economic Affairs and Communications
MoSA	Estonia's Ministry of Social Affairs
NCP	National Contact Point
NCPeH	National Contact Points for eHealth
NCPHA	National Centre for Public Health and Analysis of Bulgaria
NeRN	Nordic eHealth Research Centre
NGO	Non-governmental Organisation
NHA	National Health Act

NHIF	National Health Insurance Fund of Bulgaria
NHP	Slovenia's National EHealth Project
NIIS	Nordic Institute of Interoperability Standards
NIIS	National Insurance Institute of Slovenia
NIJZ	National Institute of Public Health
NIPH	Slovenia's National Institute for Public Health
NIVEL	Netherlands Institute for Health Services Research
NOMESCO	Nordic Medico-Statistical Committee
NOSOSCO	Nordic Social Statistical Committee
ODA	Personal Digital Value-added services in Finland
OECD	Organisation for Economic Co-operation and Development
OYS	Oulu university hospital
PACS	Finnish Picture Archiving and Communications System
PAEHR	Patient access to Personal Health Records
PDPA	Slovenia's Personal Data Protection Act
PHR	Personal Health Records
PIS	Personalised Information System
PPP	Public Private Partnership
RENATA	Rehabilitation aftercare program for an optimal transfer into daily life
RHIE	Finnish Regional Data Exchange Systems
RIS	Finnish Radiology and Laboratory Information Systems
RNPHC	Resolution on National Plan of Health Care of Slovenia
R&D	Research and Development
R&D&I	Research and Development and Innovation
SEGA	State e-Government Agency of Bulgaria
STM	Finnish Ministry of Social Affairs and Health
THL	National Institute for Health and Welfare of Finland
WHO	World Health Organisation
ZEPEP	Slovenia's Electronic Commerce and Electronic Signature Act

Preamble

This document is the Final Report, the forth deliverable (D4) in the framework of a study entitled Future Digital Health in the EU, commissioned by ESPON EGTC from Technopolis Group in December 2017.

1 The progress in digitalising healthcare services in the EU

1.1 eHealth challenges across the EU

In recent years, digitisation of health services in the EU has been on the rise with the adoption of eHealth agenda across the EU MS in a drive to improve healthcare services. eHealth has both the potential to increase the quality of services and access to health information for users and can save time and reduce the workload and associated costs for health service providers on the longer term.

Developments in eHealth however have also pointed to the need for a more consistent and comprehensive policy and regulatory framework that would facilitate data exchange among service providers across EU MS and ensure equity of access to eHealth services for all citizens. The concerns over the legislative, governance, technological and ethical issues surrounding eHealth have been recognised at the regional, national and EU levels.

There are various digital solutions that can be used in eHealth and include telehealth, electronic health records (EHR), online prescription and health information systems. These solutions however require ease of use (user acceptance) and training for widespread adoption as well as ensuring the availability of adequate infrastructures so that the quality of services can be maintained and used throughout the health services. Further challenges include interoperability of health information systems, the lack of protocols in telematics procedures, updating the administrative and organisational structures of existing health institutions, legal aspects and the availability of funding for the design, implementation and running of eHealth services.

Ethical challenges cut cross the above-mentioned issues such as getting the informed consent of patients with regards to their data and medical records, ensuring confidentiality and even having the users practice their autonomy when it comes to the services being offered. Other ethical issues can be closely linked to the legal issues raised above.

1.1.1 Fostering adoption of eHealth policies across EU MS

In 2004, the European Commission issued a communication on eHealth stating the common challenges:[1] 1) leadership of health authorities; 2) interoperability of health information systems; 3) interoperability of EHR; 4) patient identifiers; 5) mobility of patients and health professionals; 6) enhancing infrastructure and technologies; 7) conformity testing and accreditation for an eHealth market; 8) leveraging investments; and 9) legal and regulatory issues.

[1] Commission of the European Communities, Communication from The Commission to The Council, The European Parliament, The European Economic and Social Committee and The Committee f The Regions - e-Health - making healthcare better for European citizens: An action plan for a European e-Health Area. Available at: http://ec.europa.eu/information_society/activities/ict_psp/documents/com_2004_0356.pdf, 2004

This communication led EU MS to develop eHealth strategies followed by the launch of the Lead Market Initiative (LMI)[2] which included eHealth among the six target areas to receive better policy support, coordination and interoperability.[3] By 2011 it was noted that under LMI eHealth interoperability has been increasing with notable success in the form of establishing the CALLIOPE network for interoperable eHealth services.[4] Efforts continue to ensure interoperability of patient records, notably through a constant monitoring as well as evaluation of the implementation of eHealth services since 2004. In 2013, European Commission published the study "European Hospital Survey - Benchmarking Deployment of eHealth services (2012-2013)". The study benchmarked the EU 28 and Iceland and Norway on how eHealth was adopted and in active use in acute hospitals. The study was based around the indicators (gathered during 2 separate surveys) that were aggregated into 2 categories of composite indicators: 1) eHealth deployment (indicators deals with infrastructure to develop, deploy, maintain eHealth, security, privacy, etc.) and 2) eHealth availability and use (eHealth solutions that are implemented and in use). The report showed that for eHealth being deployed in hospitals Northern Europe had the best results with Denmark (66%), Estonia (63%), Sweden and Finland (both 62%).[5] Later on, a report by the WHO “From Innovation to Implementation eHealth in the WHO European Region”[6] was published and presented the European results of the 2015 WHO global survey on eHealth.

- 70% of the EU MS had national eHealth policies or strategies in place by 2015.
- 59% of the EU MS had a national EHR system, and 69% of those had legislation on its use by 2015.
- 62% of the EU MS had national policies or strategies addressing telehealth by 2015.
- 13% of the EU MS had a national policies or strategies regarding the use of big data in the health sector. 9% of EU MS had legislation specifically on how big data could be used by private companies.
- 80% of the EU MS had legislation in effect that protected the privacy of health-related data in electronic format by 2015.

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[2] European Commission (2008). Lead market initiative to unlock innovative markets. Available at: http://europa.eu/rapid/press-release_IP-08-12_en.htm

[3] Stroetmann et al. (2011). Developing national eHealth infrastructures – results and lesson from Europe. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243126/, AMIA Annual symposium.

[4] European Commission (2011). Lead Market Initiative – speed up time-to-market of innovations and pilot new innovation policy in Europe. Available at: http://ec.europa.eu/growth/content/lead-market-initiative-%E2%80%93-speed-time-market-innovations-and-pilot-new-innovation-policy-0_en

[5] European Commission (2013). European Hospital Survey - Benchmarking Deployment of eHealth services (2012-2013). Available at: https://ec.europa.eu/digital-single-market/en/news/european-hospital-survey-benchmarking-deployment-ehealth-services-2012-2013

[6] WHO (2016). From Innovation to Implementation eHealth in the WHO European Region. Available at: http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf?ua=1

A key aspect, however, is that legislations associated with eHealth are not defined at the EU-level, as responsibilities to finance and deliver healthcare remains with the EU MS and their regions. Current national legislations are not comprehensive enough but focused on specific aspects of eHealth, relevant for the status of implementation by the country or national body. For cross-border applications of eHealth, policies are drafted at inter-governmental level, with countries being at different stages of policy development and implementation of eHealth solutions.[7]

Table 1. Fostering adoption of eHealth policies across EU MS

Key points, background, barriers and actions related to how eHealth policy adoption is being fostered across EU MS	
Key points	• Digital healthcare has been increasingly targeted by policy attention at the EU level. • A number of barriers (issues regarding trust, interoperability, cost of implementation) have kept healthcare frameworks from benefitting from ICT solutions. • EU initiatives now aim at bringing together the EU MS policy makers responsible for eHealth to foster a common approach towards developing eHealth that would in turn result in cross-border operability in the near future.
Background	• The EU has been directing attention towards ICT usage in healthcare among its MS. By 2012 it considered that healthcare was severely behind in terms of ICT adoption when compared to other areas of public services. This in turn led the EU to increase support directed towards national and international actions that foster eHealth across EU MS.
Barriers	• Lack of awareness of, and confidence in eHealth solutions among patients, citizens and healthcare professionals. This situation is further worsened by inadequate or fragmented legal frameworks including the lack of reimbursement schemes for eHealth services. Transparency regarding the utilisation of data collected by ICT is also a barrier. • Lack of interoperability between eHealth solutions. The interoperability issue partially results from a lack of legal clarity and differences between healthcare institutions employing different eHealth applications. • The cost of setting up eHealth systems and adoption of eHealth services, with limited evidence available about the cost-effectiveness of eHealth tools and services.
Actions	• The EU action plan for eHealth calls attention to the need to foster eHealth adoption both nationally and cross-border. • eHealth Network. Established as part of the EU action plan for eHealth, the Network operates to connect national authorities responsible for eHealth. At the present the Network is highly involved in facilitating cross-border eHealth. • Health Programme 2014-2020. The programme is aimed at examining the EU MS legal frameworks on EHR in order to make recommendations to the eHealth Network on legal aspects of interoperability. • Digital Single Market strategy[8]. The strategy incorporates new ambitions on expanding digitised healthcare including: 1) enabling cross-border

[7] Maurice Mars, Richard E. Scott (2010). Global e-Health policy: A work in progress. Health Affairs. 29(2): E-Health in The Developing World. Available at: https://doi.org/10.1377/hlthaff.2009.0945

[8] European Commission (2018). Communication on enabling the digital transformation of health and care in the Digital Single Market; empowering citizens and building a healthier society. Available at: https://ec.europa.eu/digital-single-market/en/news/communication-enabling-digital-transformation-health-and-care-digital-single-market-empowering

	sharing of healthcare data (patient summaries and ePrescriptions among the first solutions to be targeted for cross-border interoperability); 2) increased availability and usage of health data for innovative research; 3) increased access for citizens to their health data.

Source: Author's compilation based on sources used in this chapter

1.1.2 Data Protection, Governance and Confidentiality across EU MS

Data governance is an essential element of oversight and decision-making procedure related to eHealth services, especially as health data has the potential to cross institutional and national borders. Big data in eHealth refers to health datasets that are made up of large volumes of data that is generated at a higher speed and thus requires higher processing speed than regular data. Big data may originate from many sources such as electronic medical records, also mobile phones, social media text and pictures, and videos uploaded to the internet. As the WHO Euro eHealth report notes, "few Member States reported having national policies or strategies regulating the use of big data in the health sector or national regulations on the use of big data by private companies".[9]

Data governance and data ownership continues to be an important topic for deliberation within the EU MS especially as directives on personal data protection (Directive 95/46/EC) and the protection of privacy in electronic communications (Directive 2002/58/EC) were transposed into national and regional laws of EU MS. However, as each country is allowed to transpose the legislation differently into law, the resulting legal differences in the national contexts may pose a barrier for exchange of eHealth data.[4] The recent EU General Data Protection Regulation aims to tackle this issue and provide protection of citizens' personal data and fundamental right to privacy across the EU.

Much of the health data contained in EHR are supplied by several actors in the health system and thus compliance of all actors to the prevailing data protection frameworks is crucial. Processing data also has to be safeguarded as data may be used for purposes other than treatment of the patient. Legal frameworks on EHR should ensure not only the confidentiality of patients' data but also the accountability of healthcare providers. Unified legislations would therefore be needed to allow for smooth functioning of health data exchange while still sharing responsibilities.

Attitudes towards data security and privacy differ among countries: the UK and Baltic countries are generally more open and accepting of data being shared online, while Germany is less accepting.[10] As there are variations on how health records are collected, stored and adopted in the different MS, with differing options for both patients and healthcare workers to access them, it also serves as a challenge when considering cross-border healthcare.

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[9] WHO (2016). From Innovation to Implementation eHealth in the WHO European Region. Available at: http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

[10] Health inequalities and eHealth (2014). Report of the eHealth Stakeholder Group

A 2014 study found that, according to health payers, patients currently do not have access to the necessary information to make an informed decision about medical treatment in another MS.[11] The (expectedly) first information source for medical treatment in another EU MS for any EU citizen should be the National Contact Points for eHealth (NCPeH) that are established as part of the eHealth Network.[12] In theory the National Contact Points should supply citizens accessing their website with relevant healthcare information of the particular country and provide the directions on how citizens could proceed to navigate the healthcare system. However, the information currently provided by the national NCPeH websites regarding cross-border healthcare is far too complex for patients to be of use. This points to the need to have the right data available in the right format to stimulate citizens uptake of healthcare services cross-border. [13]

To enable progress of eHealth across the EU, the European Commission has supported two relevant platforms: the eHealth Network[14] and the eHealth Governance Initiative[15] (eHGI) to provide coordination, structure and guidance on eHealth across the EU. The eHGI operated as a preparatory body for the eHealth Network decisions and as an initial link for EU MS for cooperation in cross-border eHealth. From 2014 eHGI's role has been partially taken over by the Connecting Europe Facility (CEF), particularly the CEF Telecom sector that funds and promotes cross-border integration of services by developing and utilising digital service infrastructures.[16]

[11] European Commission (2014). Impact of information on patients' choice within the context of the Directive 2011/24/EU of the European Parliament and of the Council on the application of patients' rights in cross-border healthcare. Available at: https://ec.europa.eu/health//sites/health/files/cross_border_care/docs/cbhc_information_patientschoice_en.pdf

[12] European Commission. (2015). eHealth Network. Available at: https://ec.europa.eu/health/sites/health/files/ehealth/docs/ev_20151123_co01_en.pdf

[13] European Commission (2014). Impact of information on patients' choice within the context of the Directive 2011/24/EU of the European Parliament and of the Council on the application of patients' rights in cross-border healthcare. Available at: https://ec.europa.eu/health//sites/health/files/cross_border_care/docs/cbhc_information_patientschoice_en.pdf

[14] EU eHealth Network (2018). eHealth: Digital health and care. Available at: https://ec.europa.eu/health/ehealth/policy/network_en

[15] EU eHealth Governance Initiative. Available at: http://www.ehgi.eu/

[16] Connect Europe Facility (2018). CEF Telecom. Available at: https://ec.europa.eu/inea/en/connecting-europe-facility/cef-telecom

Most recently, the Digital Single Market strategy[17] introduced plans for digitisation of health data and the relation such actions will have with the EU citizens. A public consultation[18] organised by Directorate General Communication Networks, Content & Technology / CNECT.H.3 - eHealth, Well-Being and Ageing was conducted to inform the Commission on the needs and direction for policy measures that would be used to transform eHealth across the EU. Responses (stakeholder groups included patient organisations, healthcare providers, research organisation, citizens, among other) to the consultation indicated that priority should be given to: 1) cyber security; 2) standardisation of health records; 3) increased interoperability. Considering the results of the consultations, the Digital Single Market strategy outlines 3 thematic areas where actions will take place to further develop eHealth across the EU.

- Citizens' secure access to and sharing of health data[17]. With increased rights offered by the General Data Protection Regulation it is recognised that citizens should have greater access to their healthcare data. At the same time the Commission expects to expand efforts in healthcare data sharing across borders. With cross-border ePrescriptions and patient summary sharing being launched in 2018, the Commission believes further steps will be taken towards cross-border sharing of EHR – a system that should be based on an open standard, European EHR exchange format (the development of which is expected to be funded through Connecting Europe Facility and Horizon 2020 programmes).
- Better data to promote research, disease prevention and personalised health and care.[17] Recognising the growing importance of "personalised medicine", the Commission expects to increase international cooperation in sharing medical data (particularly genomic data) to facilitate scientific breakthroughs. By establishing links between bio-banks and similar institutions (with strong emphasis on data security), it is expected that 1 million sequenced genomes will be available for access in the EU by 2022 and sequenced genomes of at least 10 million people by 2025.
- Digital tools for citizen empowerment and for person-centred care[17]. The last thematic area deals with the ageing population in Europe and the need to move from treatment to health promotion healthcare models with patient-centric approaches facilitated through digital tools. This in particular deals with the health technology sector (i.e. wearable medical devices) and how the European Commission can facilitate international cooperation to develop new healthcare models that promote citizen awareness and empowerment when it comes to their personal health.

[17] European Commission (2018). Communication on enabling the digital transformation of health and care in the Digital Single Market; empowering citizens and building a healthier society. Available at: https://ec.europa.eu/digital-single-market/en/news/communication-enabling-digital-transformation-health-and-care-digital-single-market-empowering

[18] European Commission (2017). Public consultation on Transformation of Health and Care in the Digital Single Market. Available at: https://ec.europa.eu/info/consultations/public-consultation-transformation-health-and-care-digital-single-market_en

Table 2. Data Protection, Governance and Confidentiality across the EU MS

Key points, background, barriers and actions concerning how data protection, governance and confidentiality for eHealth is being addressed across EU MS	
Key points	• The health sector handles some of the most sensitive personal data where data controllers and data processors must ensure that patients' information will remain private and fully compliant with the latest regulations. • Data processing has to be especially safeguarded in the case data is used for other purposes than treatment.
Background	• Health data has the potential to cross institutional and national borders. • Data governance is an essential element of oversight and decision-making procedure related to eHealth services. • Efforts continue to ensure interoperability of patients' data and records notably through a constant monitoring by the EC as well as evaluation of the implementation of eHealth services.
Barriers	• Attitudes towards data security and privacy vary across EU MS. • Each MS may transpose the EU legislation differently into national law on personal data protection and the protection of privacy in electronic communications; these differences may act as barriers for cross-border exchange of health data. • Heterogeneity of EHR systems and lack of technical interoperability impede cross-border access and transfer of health data along with patients crossing borders.
Actions	• The EU General Data Protection Regulation is a new legislation enforced since May 2018, that protects EU citizens fundamental right to privacy and the protection of personal data, including health data. • Availability of eHealth Network which facilitates patient-centred care and protection of patients' data. • EC is building an EU-wide Digital Service Infrastructure (DSI) for eHealth, which will allow health data to be exchanged across borders (see Section 1.3). EU MS will be able to connect their health systems to the DSI through a national contact point adhering to the interoperability guidelines of the EC[19] (see Section 1.3).

Source: Author's compilation based on sources used in this chapter

1.2 Involvement of institutions and stakeholders

In 2012, the European Commission set up an eHealth stakeholder group of users and industry members, represented by European umbrella organisations active in the eHealth sector. The group has contributed to the development of legislation and policy related to eHealth, including the Digital Agenda for Europe on eHealth and the eHealth Action Plan. This has integrated the main stakeholders in Europe, covering healthcare and informatics professionals, healthcare providers, standardisation bodies and patient/consumer organisations.

Specific disease areas may have a closer link to eHealth applications and expected outcomes. For example, in 2015, the European Society of Cardiology published a policy paper on eHealth related to cardiovascular diseases and prevention. It signalled the desire to play a pro-active role in all aspects of the eHealth agenda, helping to develop, assess, and implement effective

[19] European Commission (2016). eHealth Network, eHealth: connecting health systems in Europe, (2016) Available at: https://publications.europa.eu/en/publication-detail/-/publication/0e52a10e-294f-11e6-b616-01aa75ed71a1

ICT innovations in support of cardiovascular health and health-related activity across Europe. It also pointed to the need of established guidelines for eHealth trials to contribute to evidence-based eHealth solutions.

In Europe, public actors implement twice as many eHealth functions as private actors[20]. This however does not imply that there is a lack of interest or capacity from private stakeholders. Private organisations are also involved in the work of the eHealth stakeholder group, via associations like EHTEL which issues opinions and has task forces on key aspects of eHealth.[21] Private actors and the civil society, particularly technology developers and service providers, have an important role in the ongoing development of eHealth solutions[22]. Nevertheless, only 9% of the EU MS have a national policy or strategy regulating the use of big data by private companies,[22] often leading to subsequent additional cost to society. In contrast, Public-Private Partnerships provide platforms for knowledge transfer that enable public authorities to learn from private organisations and gain experience in designing and implementing projects.[23] A clear link was found between capacities and experience of governments and relevant eHealth legislation in countries.[23]

Other examples of organisations funding eHealth include private and public insurance companies, or public technology or innovation agencies. The private financing of eHealth is rather common in the EU MS. At the EU level, the Health Technology Assessment (HTA) serves as an important part of evidence-based decision-making on financing interventions in most EU countries.[24]

During the Estonian EU Presidency in 2017, a new movement was born to connect all actors of digital health ecosystem in Europe: the EU MS, regional governments, healthcare providers and professionals, industry representatives, research organisations, health insurers, citizen and patient groups, and the third sector. This open community is called Digital Health Society[25], enabled by the European Connected Health Alliance, and has over 200 members already and aims to provide a platform for thought leadership, exchange of knowledge, ideas and experiences. It also aims to accelerate experimentation in digital health and support deployment

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[20] WHO (2016). From innovation to implementation eHealth in the WHO European Region. Available at: http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

[21] EHTEL (2018). About us. The European eHealth Multidisciplinary Stakeholder Platform. Available at: https://www.ehtel.eu/about-us

[22] WHO (2016). From innovation to implementation eHealth in the WHO European Region. Available at: http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

[23] Lang A. (2014). Government capacities and stakeholders: what facilitates eHealth legislation? Global Health. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3925445/

[24] Areas of potential collaboration are implemented through the EUnetHTA Joint Action and includes government appointed organisations (from EU countries, EU-accession countries, EEA and EFTA countries), and a large number of relevant regional agencies and not-for-profit organisations.

[25] https://echalliance.com/page/digitalhealthsociety

of large-scale innovative solutions. It has a number of taskforces to lead discussions on standardisation, data governance, legal framework and change management in health and social care organisations. It defined a 'moon-shot' target to reach 100 million digitally connected healthy EU citizens by 2027.

1.2.1 EHR and PHR – challenges and drivers for cross-border application

The definition of EHR covers different types of health records in digital format, as defined by the EC.[26] EHRs are in use in all the EU MSs but there are various forms of EHRs at all levels of the healthcare system, some of which are not designed for shared access. A recent study analysed the legal requirements applying to national EHR systems in view of participation in a European-wide sharing system.[27] It found that standard terminology and coding were lacking, and legislations across the EU require different level of details with regards to content of EHRs. Similarly, large variations were observed regarding obligations of healthcare providers to access and update health data to ensure patients' continuity of care. The EU therefore needs to adopt a legislation for exchange of EHRs between countries based on standards enabling patients' access to their EHR.[30]

In contrast to EHR, which is maintained by healthcare providers, personal health record (PHR) containing health data and other information related to the care of a patient is maintained by the patients themselves. By 2012 it was already evident that patients valued the potential of PHR as an easy method to renew prescriptions, even though they were concerned about the security of their health data and the risk of unauthorised access.[28] According to a recent public consultation on digital health conducted by the European Commission, over 93% of respondents believe that "citizens should be able to manage their own health data" and 81% of respondents believe that "sharing of health data could be beneficial to improve treatment, diagnosis and prevention of diseases across the EU".[29] In fact, a recent plan of the Commission seeks to improve consumers' access to their own health data. 64% of respondents to the EU questionnaire are in favour of developing a "cross-border infrastructure to pool access to health data and scientific expertise more securely across the EU".[30]

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[26] Commission Recommendation of 2 July 2008 on cross-border interoperability of electronic health record systems. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008H0594

[27] Overview of the national laws on electronic health records in the EU Member States and their interaction with the provision of cross-border eHealth services. (2014) Milieu Ltd and Time.lex. Available at: https://ec.europa.eu/health/sites/health/files/ehealth/docs/laws_report_recommendations_en.pdf

[28] Cruickshank, J., Packman, C. & Paxman J. (2012). Personal Health Records - Putting patients in control?, 2020 health record, Available at: http://www.2020health.org/2020health/Publications/publications-2012/Public-Health-Records.html

[29] European Commission (2018). Consultation: Transformation Health and Care in the Digital Single Market. Available at: https://ec.europa.eu/health/sites/health/files/ehealth/docs/2018_consultation_dsm_en.pdf

[30] European Commission (2018). Consultation: Transformation Health and Care in the Digital Single Market. Available at: https://ec.europa.eu/health/sites/health/files/ehealth/docs/2018_consultation_dsm_en.pdf

However, there is evidence that citizen awareness of EHR or PHR systems are still lacking in the EU MS. A 2016 report by the Royal College of Physicians of the UK found that EHR and PHR systems lacked monitoring tools to fully answer what data patients are interested in or which functions they are able to carry out using their PHR. The report also concluded that information on the number of EHR and PHR users (both in terms of patients and care providers) was limited, further indicating the need for future monitoring.[31] The report also identified success factors for increased EHR and PHR awareness and use:

- Healthcare providers directing their patients towards using the EHR and PHR systems.
- EHR and PHR systems being promoted on multiple channels for maximum outreach across different groups.
- Patients being given live demonstration on how the EHR and PHR systems functioned (i.e. in the hospitals, by general practitioners).

Patient access to EHR (PAEHR) is a growing focus in all countries. The governmental eHealth strategies aim at providing their citizens with continuous, electronic access to their health data. One study compared national PAEHR policy and PAEHR services in ten countries and discussed the implications of differences, from a patient perspective. [32] In the 10 countries studied, different types of patient login procedures are identified for secure access:

- *One login/one service* enabling patients to access data from different care providers via one interface to a single PAEHR system. Countries: FR, FI, DK, EE.
- *One login/multiple services* where two PAEHR services use the same login procedure. The main problem was for patients receiving care in different regions who had to manually switch between the services as data could not be transferred. Countries: SE, NO.
- *Multiple logins/multiple services* where PAEHR services used different login procedures. In those cases, the situation for patients receiving in different regions was even more problematic. Countries: AU, NL, US, NZ.

One login/one service appears to be the easiest option for citizens, since without a national identification, it is difficult to unambiguously identify the same patient across different medical organisations, posing a barrier to interoperability of health records.**Error! Bookmark not defined.**

Table 3. Cross-Border application of EHR and PHR

Key points, background, barriers and actions that influence cross-border application of EHR and PHR	
Key points	• Patient access to EHR is a growing focus in all of the EU MS.

[31] Royal College of Physicians (2016). Personal health record (PHR) - landscape review. Available at: https://www.rcplondon.ac.uk/projects/outputs/personal-health-record-phr-landscape-review

[32] Essén, A et al. (2018). Patient access to electronic health records: Differences across ten countries, Health Policy and Technology. Available at: https://doi.org/10.1016/j.hlpt.2017.11.003

	• Benefits of EHR can be improved access, efficiency and quality of health care services. • Differences and lack of interoperability of national healthcare networks pose significant challenges.
Background	• The current status quo around EHR and PHR developments could be regarded both as a driver and obstacle, when considering integrating digital healthcare networks across Europe. • Patients are regularly seeking cross-border care across the EU.
Barriers	• Heterogeneity of EHR systems and lack of technical interoperability. • No uniform legislation which raises challenges for the harmonisation of healthcare systems. • Appropriate planning, necessary infrastructure and funding.
Actions	• The GDPR requires that consumers should be able to take their personal data from one health provider to another and be in control of how companies use their data.[33] This is supported through the Digital Single Market Strategy, particularly the thematic area for "Citizens' secure access to and sharing of health data".[17] The Commission plans to support the requirement of the GDPR by adopting a Commission recommendation for a European EHR exchange format. The Digital Single Market Strategy foresees that the proposed European EHR exchange format should address data protection safeguards and security of patient health data in compliance with the General Data Protection Regulation.

Source: Author's compilation based on sources used in this chapter

A 2015 study on 6 EU countries identified three factors relevant for the development of eHealth services:[34]

- The size of the state. The study found that generally smaller states such as Denmark and Estonia experienced less issues when implementing nation-wide eServices. These two countries are the most advanced, with a high percentage of eServices' users. In Estonia, 47% of citizens and 95% of doctors use EHR, and in Denmark almost 100% of doctors use it. Similarly, the use of ePrescriptions among patients in Denmark is almost at 88% and in Estonia around 95%. In comparison, a larger country like Germany - characterised by 16 federal states, a large population and a complex health system organisation – has more difficulties in the implementation of these eServices.
- The digitisation of the state. Countries with a lower rate of digitisation or great disparity of digitisation between rural and urban areas are less successful at introducing eServices. As transition to eServices is only possible if the health care system is fully digitised. Countries with more financial resources at their disposal are naturally more successful. In the Netherlands, high level of internet access and usage also lead to a leading position in the adoption of digital healthcare services in Europe.

[33] BEUC website (2018). Press statement 25 April 2018, Online access to health data: EU Commission new plan benefits consumers. Available at: http://www.beuc.eu/publications/online-access-health-data-eu-commission-new-plan-benefits-consumers/html

[34] Stanković A. & Stančić, H. (2016). Development of Health Care e-Services in the European Union, 2015, Available at: https://bib.irb.hr/datoteka/786912.9-01_Stankovic_Stancic_Development_of_Health_Care_e-Services_in_the_EU.pdf

- The information literacy of the citizens. In countries where information literacy is lower, the study showed less interest and willingness from citizens to use such services. Denmark and Estonia are among the most advanced European countries for ICT usage, which explains the high percentage of eHealth service users.

More recent developments suggest that cross-border interoperability of healthcare systems is gaining increased attention among the EU legislators. During the 6th Conference of Partners of the European Innovation Partnership on Active and Healthy Ageing (held in February 2018), a specific panel discussion was held for making EHR systems interoperable across borders. It agreed that cross-border healthcare literacy remains an issue whereby patients that find themselves in need of treatment in another EU country may not be at all familiar with the country's healthcare system. Similarly, the language of digital healthcare services needs to be considered so that EU citizens can access relevant information; both the literal use of different languages to present health information on relevant portals as well as the user friendliness of information provided. This led to suggestions that cross-border eHealth projects should be closely followed by cross-border healthcare "literacy" projects for better engagement between citizens, healthcare providers and healthcare systems. The key point being that only so much data can be exchanged between countries before interoperability faces issues of incompatible approaches between healthcare systems. It was noted that while the EU MS focus on introducing common practices for eHealth nationally, consensus on cross-border healthcare (digital or otherwise) pose a real challenge.[35]

There are a number of initiatives that aim at facilitating digital standardisation and cross-border exchange of healthcare data. eStandards was a collaborative project funded by the EU under Horizon 2020 in support of the Digital Single Market.[36] One of the main aims of the project was to produce guidelines for electronic standards for eHealth. These guidelines ultimately resulted in a Roadmap, published in 2017, that outlined procedures and standards to be taken and adopted to align and consolidate eHealth standards in the EU.[37]

Table 4. eHealth User Adoption Awareness and Acceptability

Key points, background, barriers and actions affecting adoption, awareness and acceptability of eHealth for users	
Key points	• Great disparity of digitisation between rural and urban areas makes it more challenging to introduce eHealth services. • Nationwide eService implementation is easier in smaller EU MS. • There are concerns over the security of health data and the risk of unauthorised access by users.

[35] European Commission (2018). EIP AHA - Conference of Partners 2018. Available at: https://webcast.ec.europa.eu/eip-aha-conference-of-partners-2018-1#

[36] eStandards (2015). About the project. Available at: http://www.estandards-project.eu/index.cfm/about/

[37] eStandards (2017). Roadmap for collaborative and sustainable standards development. Available at: http://www.estandards-project.eu/eSTANDARDS/assets/File/deliverables/eStandards-D3_5-Roadmap_v1_2a.pdf

Background	• Adoption of new eHealth services is challenging due to the need to fit new IT systems and processes into an existing organisational system. The complex relationship between existing processes, implementers and users of the technology needs to be considered and a clear understanding reached about the value of the new technology. • A survey conducted by the European Commission on the deployment of eHealth by practitioners noted that eHealth adoption in hospitals is low: out of a maximum sore of 1 (composite index of eHealth adoption in hospitals) the EU-average is at 0.44 for eHealth deployment and 0.30 for availability and use.[38]
Barriers	• Disparity in digitisation across the different EU regions. • Disparity in ICT knowledge and usage creates barriers among potential users who may not desire to switch to a digitised form of healthcare provision. • Availability and affordability of eHealth technologies.
Actions	• The EU MS during the Conference of Partners of the European Innovation Partnership on Active and Healthy Ageing were called to improve the adoption of digital technology in both primary care and hospitals and support actions that facilitate user adoption of these technologies (i.e. increase digital literacy for online health services). • eStandards supported a wider adoption of standards in eHealth deployment for digitised healthcare products and services.

Source: Author's compilation based on sources used in this chapter

1.3 Technology infrastructure facilitating eHealth

In 2004, the European Commission issued a communication on eHealth[39] stating that interoperability of health information systems and enhancing infrastructure and technologies are common challenges across the EU. Subsequently, the EU MS developed eHealth strategies followed by the launch of the Lead Market Initiative and an eHealth task force to identify better coordination and interoperability in the EU eHealth market.[40] A US study published during that same year highlighted the need for the healthcare sector to understand how big data can be used in healthcare and move towards adoption of digitisation. This was made all the more poignant when the report pointed out that the healthcare sector had historically lagged behind other sectors when it came to adopting new technologies.[41] This situation has more recently been observed in the EU in general where a 2016 study "eHealth and quality in health care: implementation time" noted that the healthcare sector was behind

[38] OECD (2016). eHealth adoption in general practice and in hospitals. Available at: https://www.oecd-ilibrary.org/docserver/health_glance_eur-2016-62-en.pdf?expires=1551945384&id=id&accname=guest&checksum=1DDE7DAEF4774FB98C31A5373C4149ED

[39] Commission of the European Communities (2004). Communication from The Commission To The Council, The European Parliament, The European Economic and Social Committee and The Committee Of The Regions - e-Health - making healthcare better for European citizens: An action plan for a European e-Health Area. Available at: http://ec.europa.eu/information_society/activities/ict_psp/documents/com_2004_0356.pdf

[40] Stroetmann et al. (2011). Developing national eHealth infrastructures – results and lesson from Europe. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243126/, AMIA Annual symposium

[41] Centre for US Health System Reform Business Technology office (2013). The big data revolution in healthcare

industries such as the banking or travel industry where digitisation is steps ahead.[42] Other studies pointed out that the healthcare sector has had more difficulty in attracting people with the ICT skills necessary to develop eHealth technologies.[43]

The infrastructures to consider when developing eHealth depend on the sort of services offered to citizens. For example, services that are functional (e.g. ePrescription) require different infrastructure than patient-oriented services (eHealth platforms). The new infrastructure can be built on an existing infrastructure or may be a new system entirely. According to recent research,[44] higher chances of success can be expected when the new infrastructure supports and aligns with existing work practices and using simple technological solutions that are built upon existing technologies. It is crucial to start by distinguishing what elements of the current system are to be kept and which to be discontinued and how to do so.

The development and use of ICT infrastructure as well as digital literacy of the population differs considerably across EU countries as was noted during the 6th Conference of Partners of the European Innovation Partnership on Active and Healthy Ageing. However, the concept of eHealth literacy itself poses a significant question in terms of how it should be measured. The ongoing project "IC-Health" has noted several existing tools to measure the digital health literacy of a population; however, also pointing out their limitations which primarily relate to their lack of objective indicators.[45] A patient might indicate positive signs of digital health literacy, but these would be based on their subjective perception of how useful the medical data they found was. This is made more complicated by the fact that a patient might consider the medical data they found on the internet to be of sound medical quality while in fact the information could be false or not applicable to the patient due to medical considerations the patient was unable to accurately judge. The report by "IC-Health" suggests that digital health literacy is a sequence of actions:[45]

- First, patients have to have IT literacy skills.
- Second, patients should have health literacy skills which enable patients to understand information related to their health.
- Third, patients need the skills to appraise online health information and determine whether the information is of high enough quality, accuracy and is applicable to the medical issue in question.

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[42] Ossebaard H. C., Gemert-Pijnen L. (2016). eHealth and quality in health care: implementation time. Available at: https://academic.oup.com/intqhc/article/28/3/415/1750408

[43] Grood C., Raissi A., Kwon Y., Santana M. J. (2016). Adoption of e-health technology by physicians: a scoping review. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4975159/

[44] Aanestad et al. (2017). Strategies for building eHealth infrastructures. Available at: https://link.springer.com/content/pdf/10.1007/978-3-319-51020-0_4.pdf

[45] IC-Health (2017). Report on key factors, drivers, barriers and trends on digital health literacy. Available at: https://ichealth.eu/wp-content/uploads/2018/06/D1.1-Report-on-key-factors-drivers-barriers-and-trends-on-digital-health-literacy.pdf

- Lastly, patients should be able to apply online health information for health management in everyday life, provided they could determine that the digital health information they found was applicable to them.

It has been noted that more wide-spread use of eHealth and patient-centred approaches would increase the quality of care and allow citizens to assume responsibility for their own health and improve their well-being. There are notable examples across Europe where eHealth services are successfully implemented and used. This section describes some of these eHealth initiatives for the benefit of the stakeholder regions and the other EU member states.

During the 6th Conference of Partners of the European Innovation Partnership on Active and Healthy Ageing, the effects of the EU General Data Protection Regulation were also discussed. One particular point was raised regarding the increased challenges of managing big data under the new EU law while maintaining patient privacy. In this new legal environment, block-chain technology was suggested as an opportunity to ease the process of ensuring anonymity through faster certification speeds. It was also suggested that classification of patient data is an important factor which would further facilitate health data transfer.[46]

An example where the EU has invested heavily is the 5G Infrastructure PPP initiative working on a cutting edge 5G communication network in Europe.[47] A study focusing on how 5G networks will be affecting the future of healthcare concluded that digitalised healthcare operating in a 5G environment will move from a supplier-led to a patient-led ecosystem. These conclusion stem from the way 5G development is intertwined with Health 4.0 (as part of the larger concept of Industry 4.0). Health 4.0 sees a shift towards personalised medicine, personal data, real-time data monitoring and individualised prescriptions – all of which is supported by the technical capabilities of 5G networks.[48] However, the same study also notes that while the 5G Infrastructure PPP initiative has gained a lot of industry attention and participation, the healthcare sector has been represented more by policy makers, health R&D organisations rather than healthcare providers. This poses a risk in the future, as involvement of healthcare providers in the development of eHealth (with potential for cross-border applicability) is of key importance.

To facilitate the mobility of patients seeking cross-border care, the EC is building an EU-wide Digital Service Infrastructure (DSI) for eHealth, allowing health data to be exchanged across borders, with a focus on ePrescriptions and patient summaries. EU MS will be able to connect their health systems to the DSI through a national contact point adhering to the interoperability

[46] European Commission (2018). EIP AHA - Conference of Partners 2018. Available at: https://webcast.ec.europa.eu/eip-aha-conference-of-partners-2018-1#

[47] European Commission (2013). 5G Infrastructure PPP: The next generation of communication networks will be “Made in EU”. Available at: https://ec.europa.eu/research/press/2013/pdf/ppp/5g_factsheet.pdf

[48] Wireless World Research Forum (2017). A New Generation of e-Health Systems Powered by 5G

guidelines of the EC.[49] The implementation of the DSI for eHealth, including the Interoperable Patient Registries, will facilitate exchanging information, patient data and prescriptions data. It is planned to be operational by 2020.[50] Until the DSI is implemented and operating, cross-border healthcare is supported through more limited means. Under Directive 2011/24/EU, there is a cross-border patient summary service to ensure continuity of care. With this document, when a citizen makes an unplanned cross-border healthcare visit to a health provider in the EU, the health professional will have access to the person's patient summary.[50]

Table 5. Integrating eHealth technologies into healthcare services across the EU MS

Key points, background, barriers and actions on how EU MS are integrating eHealth technologies into healthcare services	
Key points	• eHealth infrastructure and technologies availability need to be enhanced. • The new infrastructure can either be built on an existing infrastructure or be a new system entirely.
Background	• There are various digital solutions that can be used in eHealth and these include telehealth, electronic health records, online prescription, and health information systems. • These solutions require ease of use (user acceptance) and training for widespread adoption as well as ensuring the availability of adequate infrastructures.
Barriers	• Conformity testing and accreditation for an eHealth market needs to be in place. • Differing levels of Digital health literacy. • Different infrastructure requirements for different services, e.g. services that are functional (e.g. ePrescription) require different infrastructure than patient-oriented services (eHealth platforms). • Lack of favourable market conditions for businesses to develop and implement their eHealth solutions. • Limited scale of implementation and business models for reimbursement.
Actions	• The EU MS will be able to connect their health systems to the DSI through a national contact point adhering to the interoperability guidelines of the EC[51]. The implementation of the DSI for eHealth, including the Interoperable Patient Registries, will facilitate exchanging information, patient data and prescriptions data cross border. •

Source: Author's compilation based on sources used in this chapter

[49] European Commission (2016). eHealth Network, eHealth: connecting health systems in Europe. Available at: https://publications.europa.eu/en/publication-detail/-/publication/0e52a10e-294f-11e6-b616-01aa75ed71a1

[50] European Commission (2017). eHealth – updated in June 2017. Available at: https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/2017/05/30/eHealth

[51] European Commission (2016). eHealth Network, eHealth: connecting health systems in Europe. Available at: https://publications.europa.eu/en/publication-detail/-/publication/0e52a10e-294f-11e6-b616-01aa75ed71a1

1.4 Economic and social impacts of digitalising services in the health sector

The efficiency and effectiveness of eHealth is commonly measured against the percentage of GDP and government spending on healthcare prior to and after adopting eHealth systems in a given country. The change in selected countries and the EU average is shown in Table 6, representing cases in which spending has either decreased or increased after the incorporation of eHealth solutions. To provide sufficient context, the analysed countries (Estonia, Finland, Slovenia and Bulgaria) within the scope of this analysis are added, as well. Note that there may be many confounding factors in a complex health economy and additional research would be needed to identify the relationship between these effects and the introduction of eHealth solutions.

Table 6. General government expenditure by function (COFOG)

Countries	% of GDP			% of Government Spending		
	Average before adoption	*Average after adoption*	*Change*	*Average before adoption*	*Average after adoption*	*Change*
EU average	5.6	6.2	+ 0.6	13.9	15.1	+ 1.2
Netherlands	5.9	8.1	+ 1.2	13.1	17.8	+ 4.7
Greece	5.8	4.6	- 1.2	12	8.8	- 3.2
Estonia	4.5	4.9	+ 0.4	11.8	12.8	+ 1.0
Finland	6.4	6.9	+ 0.5	11	13.2	+ 2.2
Slovenia	6.4	6.6	+ 0.2	13.9	13.7	- 0.2
Bulgaria	4.3	5.3	+ 1.0	11.5	13.9	+ 2.4

Source: Eurostat (2018)

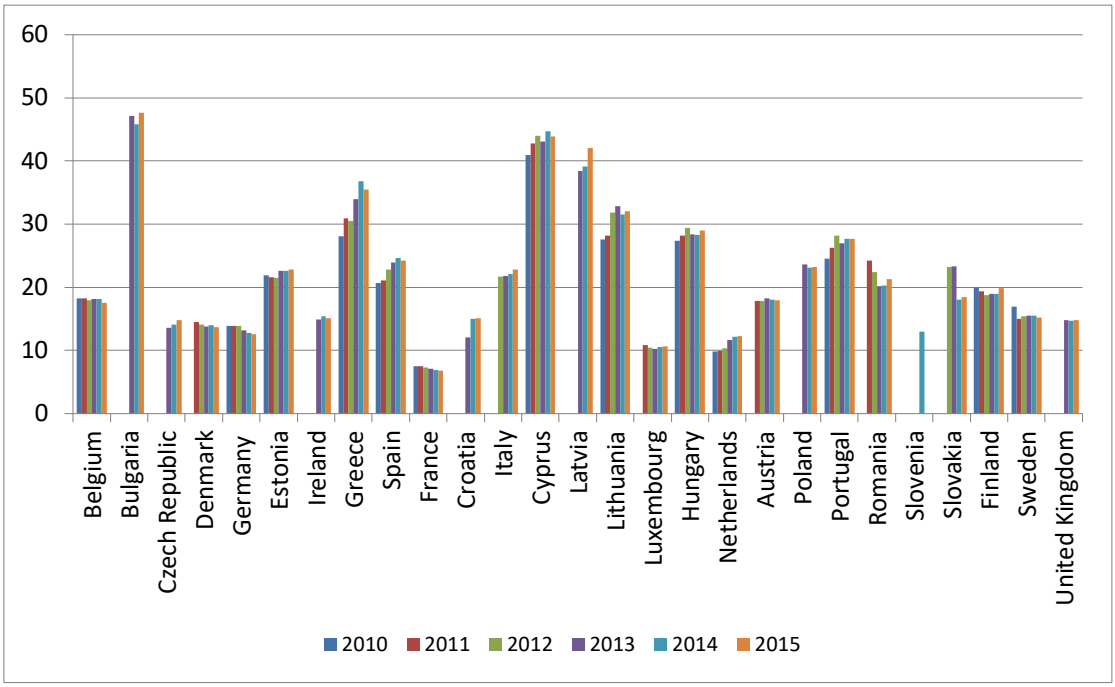
Nevertheless, we observe that the average healthcare spending in the EU has increased (relative to GDP or overall government spending) after the implementation of eHealth services. In some countries the increase was substantial, such as represented by the Netherlands which stand out as the most distinct nation in this respect, while in others the relative healthcare spending has decreased, most notably represented by Greece as a contrary example to the Netherlands (possibly due to the severe economic crisis and general cutbacks on public expenditure). It should however be remarked that increased government spending on healthcare is a general trend of the past decades,[52] irrespective of the introduction of eHealth services. Without detailed counterfactual, we can only assume that the introduction of eHealth systems in specific countries limited the extent of increase of government spending on healthcare.

Another indicator to test the effect of eHealth is its possible impact on patient spending. Figure 1 illustrates the development of healthcare spending by patients per member state over the past five years. By 2015, all EU MS had implemented some form of eHealth system. Financial

[52] World Health Organisation (2016)

relief for consumers, however, can only be observed in some countries such as Belgium, Germany, France, Finland, and Sweden, whereas in other MS, patients have been increasingly charged for access to healthcare systems. Once more, a more contextualised explanation of this phenomenon may be warranted; for instance, the prevailing nature of healthcare provider (public vs. private) or further regulative and market-driven mechanisms, as well as demographics influence patient spending beyond the scope of merely eHealth.[53]

*Figure 1. Patients out-of-pocket expenditure on healthcare (**%** of total current health expenditure)*

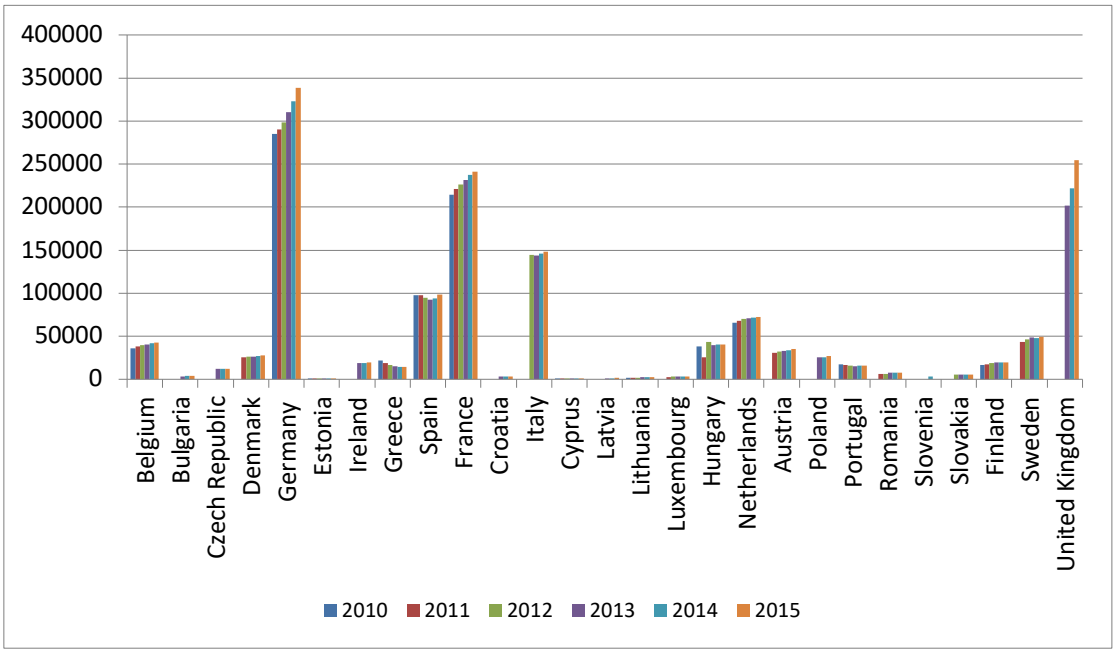


Source: Eurostat (2018)

In a similar vein, and partially already alluded to, healthcare provider expenditure has largely increased in the concerned timeframe. Only providers residing and operating in Greece, Cyprus, and Portugal reduced healthcare expenses, which, however, may be traced back to the generally worsened economic climate in these countries. Please note that only the EU MS were considered and data for Malta was not available for either statistical analysis.

[53] OECD/EU, (2016)

Figure 2. Annual Healthcare Expenditure by Providers (million Euro)



Source: Eurostat (2018)

While the economic data overall suggests that eHealth solutions resulted in some changes in healthcare expenditure for governments, providers or patients, it is possible that the key impact of digitalising healthcare is to allow to focus expenditure in other high-burden areas; reduction of costs should not be the only or primary aim of introducing eHealth. Instead, other measures, including increased access and quality of healthcare services, should also be considered. For instance, the OECD's composite index of eHealth adoption among general practitioners in the EU is about 1.8 (on a scale from 1 to 4), where Denmark stands out as leading (2.5) and Lithuania as trailing (1.3). The composite indicator of eHealth adoption in hospitals shows a need for improvement: the EU average is at 0.44 for eHealth deployment and 0.30 for availability and use.[54] These figures ultimately reflect different policy priorities, objectives and actions in individual MS. In fact, while almost 80% of all the EU MS claim to have implemented a universal health coverage strategy, little more than 70% adopted an eHealth strategy, and less than 60% of all MS have formulated a healthcare information system policy[55]. An apparent discrepancy within the EU is also indicated by the relative measure of MS with a national EHR system and related legislation: while about 90% of all MS have some form of EHR legislation in place, only little more than half of them have actually rolled out and incorporated an effective EHR system.[55]

[54] OECD/EU (2016)

[55] World Health Organisation (2016)

1.5 Obstacles to digitisation services in the health sector

While public funding for eHealth policy implementation is generally available within the EU, non-public, or public-private provision of funds for eHealth solutions is only available in 11 member states which signal a disparity between public and private efforts in facilitating the emergence of eHealth.[55] A similarly crucial topic is the capacity and availability of non-financial resources to implement eHealth solutions. While the vast majority of MS provide students with training on how to use information and communication technologies and eHealth, a considerably smaller share consequently follows up on this premise by establishing eLearning services. Furthermore, a lack of standards and interoperability within and amongst MS hampers a wider recognition of eHealth. A strong national (inward) focus and lack of use of big data opportunities prevent eHealth to act as an optimal mechanism for healthcare to operate across borders.[55] Further barriers noted and to be explored further are a lack of awareness of, and confidence in, eHealth solutions by the EU citizens, inadequate or fragmented legal frameworks, a lack of reimbursement models, and regional differences in accessing ICT services.

However, the momentum has been established and digital health is on the EU agenda. The adoption has been slow due to the various complexities that have been discussed such as lack of guiding legislature and policy, awareness and adoption of eHealth services, funding etc. Health systems on their own are already regarded as complex adaptive systems with a huge range of actors needed to ensure smooth working and delivery of services. The adoption of a national legal framework to complement the General Data Protection Regulation would provide the much-needed legislature. This however would need to be carefully monitored and updated to keep abreast with the rapid developments in the eHealth arena.

The 2017 eHealth monitor report has identified a number of key aspects to focus on for policy makers: increase of motivation of users and care providers to use eHealth, medication safety to avoid medication interactions, focus on target groups such as chronically ill persons, best practice sharing between primary care organisations to organize eHealth applications. This can be complemented by integrating private stakeholders more in public discussions on eHealth. Regular meetings and conferences involving stakeholders to share best practices and provide communication via multiple channels in this arena would go a long way. Involving patients and professionals at the design, development and testing phases would also promote success, especially moving towards patient-centric eHealth solutions.

2 Healthcare system and institutional structures

Healthcare systems and institutional structures are key enabling factors for potential progress in digitisation in the healthcare and medical sectors. The following chapter presents a brief look at the healthcare systems set in place in the analysed countries of Estonia, Finland, Slovenia and Bulgaria. It describes the main governing bodies, key legislation and funding of healthcare. For a more detailed look at the healthcare systems in Estonia, Finland, Slovenia and Bulgaria, see country profiles included in the Scientific Annexes. A direct cross-country-based comparison concludes the chapter highlighting key performance indicators as well as aspects currently lacking.

2.1 Healthcare system and institutional structures in Estonia, Finland, Slovenia and Bulgaria

Table 7. Healthcare system and institutional structures in Estonia, Finland, Slovenia and Bulgaria countries

Estonia	
Healthcare system	• Health care provision has been almost completely decentralised since the passing of the Health Services Organization Act which came into effect in 2002 with primary care provided by private sector operators. More recent reforms aim to strengthen primary health care by establishing health centres with a broader scope of services, which is expected to improve access, care coordination and management of chronic diseases. Secondary care health services are provided by publicly or privately-owned health care providers (hospitals and outpatient care clinics) operating under private law.
Institutional structure	• The health system in Estonia is overseen by the Ministry of Social Affairs (MoSA). • The financing of health care is mainly organised through the independent Estonian Health Insurance Fund (EHIF). Recent changes in the EHIF-related regulation (including creation of preconditions for a healthcare innovation fund) and in the management board (including the recruitment of a Digital Transformation Officer) indicate that the EHIF is expected to strengthen its role in eHealth governance. • The Health and Welfare Information Systems Centre (HWISC of Estonia is a state agency administered by the MoSA). Tasks of the HWISC include development of information systems, standards, databases and eServices; maintenance of services and infrastructure; providing information security; and data analysis to support policy making, reporting, productivity monitoring and supervision.
Healthcare funding	• The Estonian health care system is mainly publicly funded through solidarity-based mandatory health insurance contributions in the form of an earmarked social payroll tax. • In 2017, as the culmination of more than a decade of discussions on the financial sustainability of the Estonian healthcare system, the Estonian government took the historic step of expanding the EHIF's revenue base by including a gradually increasing (until 2022) state contribution on behalf of pensioners. The reform is widely considered to be as important as the initial decision to establish the health insurance system in the 1990s and is expected to make the health system financially more sustainable.
Finland	
Healthcare system	• Finnish healthcare system is a highly decentralised and comprised of a three-level publicly funded healthcare system as well as a considerably smaller private sector. The Government decides on general national strategies and priorities and proposes bills to be

	discussed by the parliament. Finnish citizens have universal access to healthcare.
Institutional structure	• The Finnish Ministry of Social Affairs and Health (STM) is the government institution charged with the management of Finland's welfare and healthcare policy, national eHealth legislation and coordination. • Regional or local authorities are ultimately responsible for the provision of healthcare to their residents. • Health and Social Services Reform is currently being developed in Finland. One of the major aims is to transfer responsibilities to institutions and entities that are bigger than municipalities, namely counties. Social welfare and healthcare services will be combined to meet these new implementation objectives and trajectories. These structural changes imply an organisational shift from the current national-municipal handling to a more comprehensive and cohesive national-county-municipal doctrine. The reform will enter into force on 1 January 2021 with plans to introduce changes gradually.
Healthcare funding	• In general, funding for the entire healthcare system comes from several sources: The State, the municipalities, the Social Insurance Institution Kela and private parties, such as households and insurance companies. • Municipal funding schemes are based on taxes and their distribution and are primarily channelled to cover primary healthcare costs and services. Municipal authorities have furthermore the right to collect user fees for consultation and primary healthcare services, which are either set to moderate maximum rates for single visits or made dependent on the income of the respective patient for longer illnesses. • National Health Insurance is based on compulsory fees.
Slovenia	
Healthcare system	• Health care system In Slovenia is highly centralised. Functionally it consists of prevailingly public health care service providers while private providers act in a more complementary role (private providers represent less than 10% of the market). • The operation and the functions of eHealth solutions are regulated by the special 'Healthcare Data Records Act' – HDRA since 2000. This act covers the collection, processing, archiving and usage of data and database management in the entire field of healthcare in Slovenia, including all eHealth services, relevant stakeholders and beneficiaries.
Institutional structure	• Ministry of Health (MH) is responsible for the overall national health care policy development and implementation, operation of the health care system, its monitoring and evaluation. • National Insurance Institute of Slovenia (NIIS) is a public health insurance company, whose basic function is to collect all contributions paid by employees within a compulsory health insurance system and to efficiently finance health services, i.e. cover the expenses of providers of healthcare. • The National Institute for Public Health (NIPH) of Slovenia is currently responsible for strategic planning, coordination, development and implementation of an integrated national health information system in Slovenia, as well as for the development of nation-wide eHealth services. NIPH has been authorised as the responsible institution concerning collection, maintenance and use of all medical databases, granting access to this data to other stakeholders and commercial users. In principle, only health service providers are allowed to access this data.
Healthcare funding	• Slovenia has a public health care system based on the compulsory health care insurance, which includes about 99% of population.
Bulgaria	

Healthcare system	• Before 1998, the Bulgarian healthcare system was based on the "Semashko" model – healthcare was universal for all citizens and unlimited in terms of intervention types, number or volume, while all expenses were funded through the National Budget and all healthcare service providers were state-owned. Today Bulgarian healthcare system is a hybrid between public and private funding. Both public and private suppliers of healthcare services provide medical services to the public and receive payment for those through a fixed remuneration system and price list controlled by the National Health Insurance Fund (NHIF). • In Bulgaria, digitisation of healthcare processes and the development of eHealth is a key initiative and a crucial milestone in the government's action plan since 2008. The National Healthcare Strategy 2014-2020 was ratified and accepted with corrections in December 2015. – In 2014, the Ministry of Health approved and proposed for public discussion the Programme for the Development of Electronic Healthcare, an implementation plan for the National Healthcare Strategy. Its key goal was the creation of a National Health Information System which would connect all providers into an integrated system with real-time exchange and control of data, electronic patient records, user authentication, registration and data exchange with health service providers.
Institutional structure	• The Ministry of Health oversees the development of policies and strategies that target healthcare (eHealth included). It is supported by: – National Health Insurance Fund (NHIF) which should act as a consulting entity. The Fund is public - managed by the central government – and it is filled through the insurance fund contributions of all health-insured citizens. – The National Audit Office which performs audits on implementation of healthcare strategies.
Healthcare funding	• NHIF manages the insurance contributions of all insured citizens. The contributions are obligatory for all citizens working on a labour contract or practicing a free profession. Contributions are calculated as a percentage of the income, so citizens that earn more pay more (in absolute terms). Private health insurance funds exist, but only as an add-on to the obligatory NHIF insurance. Citizens can choose to pay private contributions on top of the NHIF ones and to receive larger additional services.

2.2 Data management and IT infrastructure in Estonia, Finland, Slovenia and Bulgaria

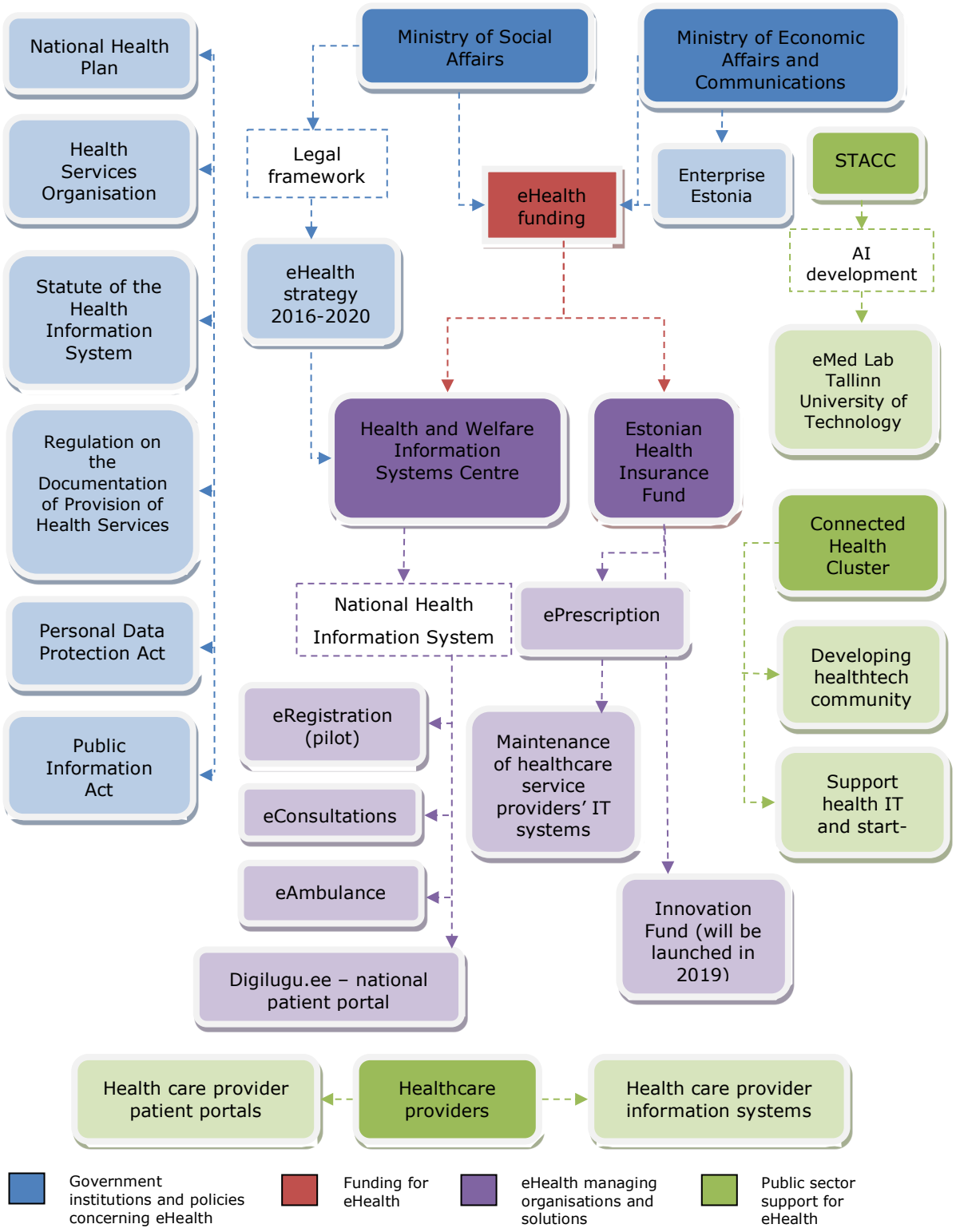
Table 8. Data management and IT infrastructure in Estonia, Finland, Slovenia and Bulgaria

Estonia	
Health information system	• Estonian electronic health record (EHR) encompasses all health services providers and users connecting them to an information-exchange platform which also allows data exchange with various other databases. The platform enables patients to access their health data. Healthcare providers are connected to the system and patient health data is stored centrally. • All healthcare providers have a legal obligation to send certain health data to the health information system. Usually the ambulatory epicrisis is most often entered. Doctors can also draw up electronic referrals or referral responses.

System organisation	• The system aggregates and standardises healthcare data from different healthcare providers and state registries, rather than requiring institutions to use a standard form.
Data access	• Data exchange is available only to healthcare service providers and some public services (databases). The patients (citizen) can access and view their data but do not participate in exchange of data. • Collected health records are open by default and healthcare professionals can request patient data unless the patient has made their data inaccessible in the system. Access to the data is granted only to licensed medical professionals. Healthcare professionals have the right to request data when they are engaged in treatment of the patient (i.e. when the patient makes an appointment or receives first aid care). Data only needs to be entered once, and each doctor in Estonia uses their own information. • The data belongs to the data subject. Citizens can access and control their own and their children's health data in the national patient portal (web portal).
Finland	
Health information system	• Finland was one of the first countries to set up electronic health record (EHR) system that includes both the public and the private sectors: – 100% use of EHR by primary health centres and secondary care hospital districts – 100% coverage of EHR in the public sector – 80% coverage of EHR in the private sector.
System organisation	• The responsibilities of contributing to building the eHealth IT framework and ecosystem are shared between the Ministry of Health and Social Affairs and the Ministry of Employment and Economy that is the leader of the implementation of the National Health Sector Growth Strategy for Research and Innovation. • The national health IT infrastructure is built on the KanTa platform which acts as the central managing entity that processes patient data. My KanTa is the patient interface of the Kanta platform. Through My KanTa patients can access information on healthcare providers, referrals, treatment summaries, patient consents and any log data. • Public healthcare provides can choose the developers for their IT infrastructures (following public procurement procedures).
Data access	• To access medical records through KanTa patients have to have a Finnish identity number. Data of non-Finnish patients who receive medical treatment in Finland is not directly stored in KanTa. • Patients cannot block access to their data from healthcare providers if the provider is currently in a medical relationship with the concerned patient.
Slovenia	
Health information system	• Management of eHealth ICT infrastructure in Slovenia is centralised on the national level and managed by the two institutions - National Insurance Institute of Slovenia (NIIS) and the National Institute of Public Health (NIPH). • The primary eHealth platform in Slovenia is z-Vem which serves as the access point for both the electronic health records (EHR) and patient health records (PHR).
System organisation	• As noted previously, data management and related ICT infrastructure is centralised on the national level and divided between two institutions: – The National Insurance Institute of Slovenia (NIIS) - management, development of ICT infrastructure and solutions related to healthcare beneficiaries

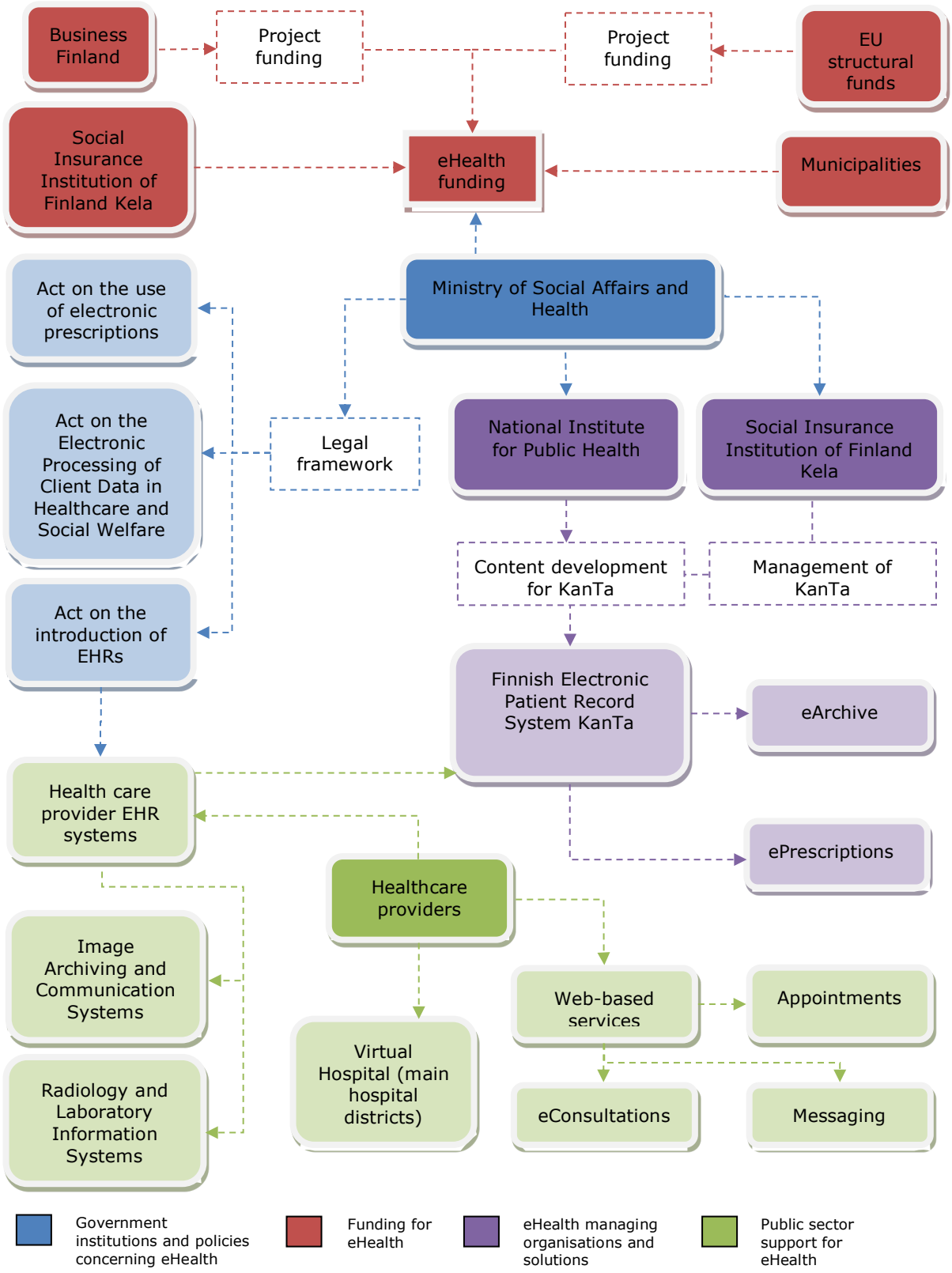
	– The National Institute of Public Health (NIPH) - management of ICT infrastructure for all other eHealth services • The eHealth architecture is designed around z-Vem platform which connects healthcare providers and users, incorporates Central Repository of Patient Data (CRPD) with EHR and PHR and allows data exchange via dedicated network zNet. All healthcare service providers are obliged to send relevant data to CRPD. • In addition to this 'national' infrastructure, all hospitals have for their own internal business and professional needs, their own ICT solutions and related infrastructure, which is not yet fully integrated into the national eHealth system.
Data access	• Patients can access their own data via digital certificate. Medical personnel have access to these data via their own professional health eID card restricted according to their privileges.
Bulgaria	
Health information system	• In Bulgaria, the Ministry of Health has identified as priority the creation of an integrated electronic healthcare system. Between 2012 and 2015 the Ministry has launched three separate tenders for the creation of such system, all of which were unsuccessful because of the absence of a preliminary analysis of the existing processes, databases and systems, and consequently no clarity on requirements and expectations regarding the integrated system. • Thus, there is no true electronic healthcare system. The closest equivalent was a solution launched by the National Health Insurance Fund - the Personalised Information System (PIS). The project launched in 2010 with hardware and software problems becoming evident by 2012. Currently PIS continues to function through partial automation with many of the activities performed manually and offline.
System organisation	• A preliminary baseline analysis identified weakness in current processes, data flows and infrastructure in the Bulgarian healthcare systems and concluded that a switch to an integrated information system requires a long-term approach.
Data access	• PIS does not cover all patients, but only those that are covered by the obligatory health insurance, limiting access to only those citizens that are ensured. • Beyond that, data access is limited by both limited by the low exposure of potential users to PIS making it a case of limited access due to limited use (and limited use due to limited usefulness based on user survey).

Figure 3. Estonian eHealth institutional framework



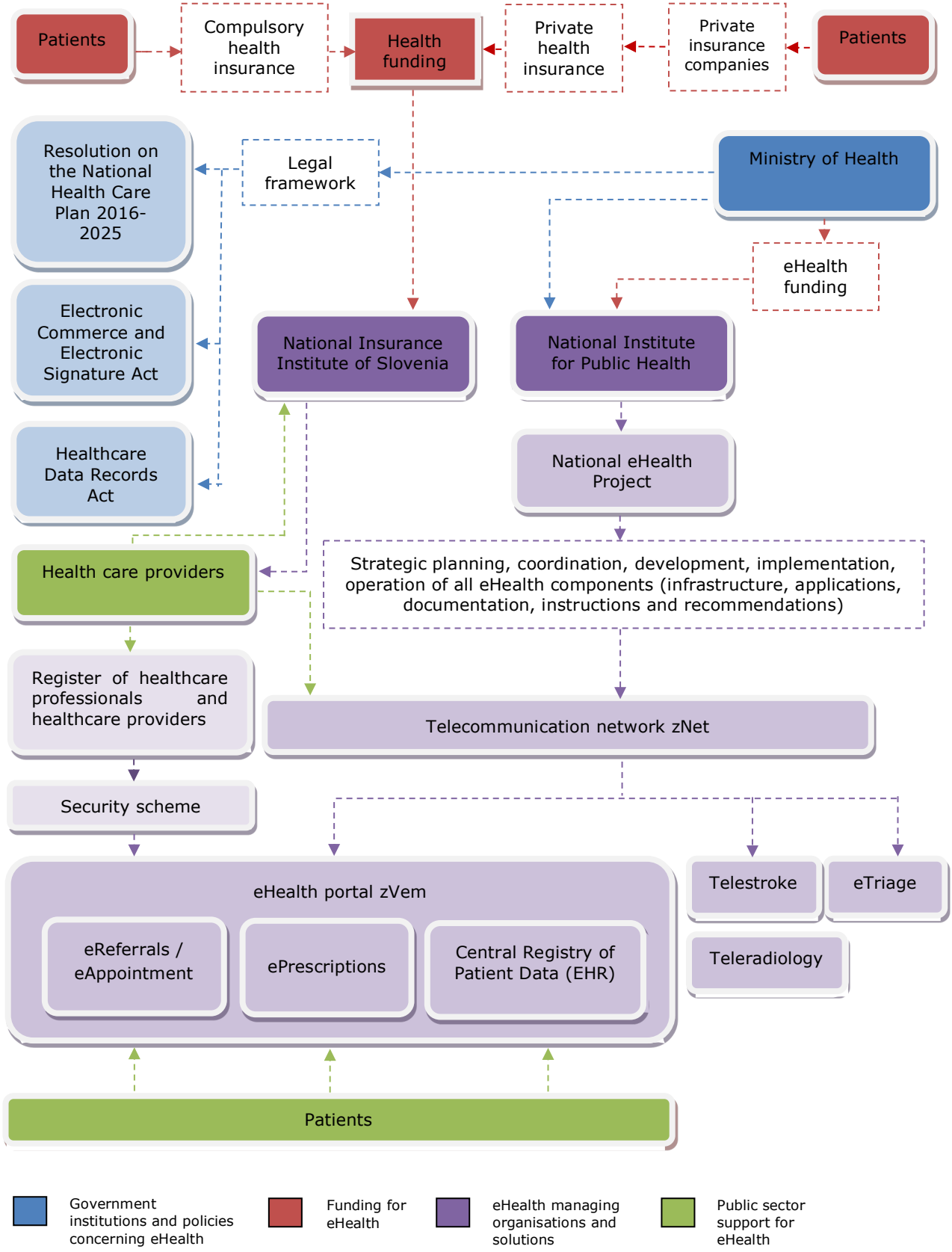
Source: ESPON (2018)

Figure 4. Finnish eHealth institutional framework



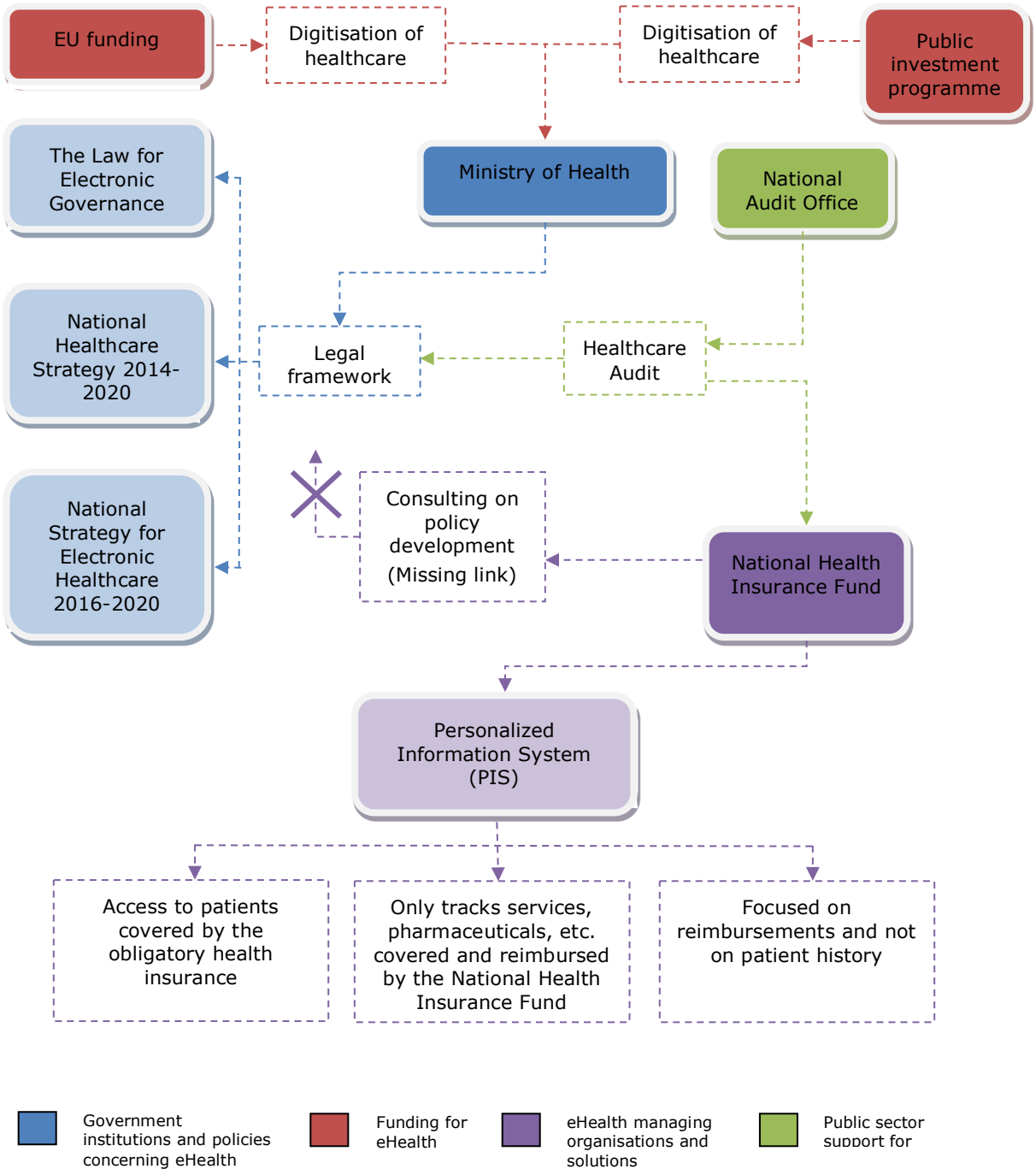
Source: ESPON (2018)

Figure 5. Slovenian eHealth institutional framework



Source: ESPON (2018)

Figure 6. Bulgarian eHealth institutional framework



Source: ESPON (2018)

2.3 Comparative analysis of healthcare systems and institutional structures in Estonia, Finland, Slovenia and Bulgaria

Developing an eHealth platform, applications and solutions in any country requires substantial **investment** in new data infrastructure and processes, finding new organisation and reimbursement models. This investment may or may not form part of the overall healthcare

budget of the country. Several differences in funding structures were found between the countries in this analysis.

In Estonia, digitisation is already embedded in broader public services, including healthcare, and thus funding for running and maintaining the established systems of eHealth is part of the regular healthcare services' funding of the country. The development of new eHealth services is funded mainly on a project basis from the EU Structural Funds. Finland follows a more decentralised approach. Accordingly, municipal and national authorities each cover specific geographic and thematic scopes, which together enable them to provide adequate funding for all healthcare-related services, including digitalised services. Similar to Estonia, Slovenia's funding for digitisation in healthcare is largely integrated into the mainstream healthcare system. In general, funding for eHealth processes in Estonia, Finland, Slovenia and Bulgaria are channelled through their respective Ministries of Health, which are responsible for paying for services performed under the nationwide compulsory health insurance. Bulgaria, in contrast, pursues an ad-hoc approach, as development of eHealth solutions is mostly led by institutions, using EU grants, rather than establishing integrated nationwide solutions. The limited volume of investment into digital health also points to Bulgaria's rather weak current position in the provision of eHealth services.

Beyond funding, digitalised healthcare needs reformed organisational practices regarding **data management**. For instance, in Estonia legislation is currently under revision to suit the changing needs for digital health. Similarly, Finland's legislation on secondary use of data, which is already in use, is currently being reviewed alongside other legislation concerning the storage and access to genetic information and biobanks. Slovenia mainly relies on its "Healthcare Data Records Act", introduced in 2000 and amended in 2011 and 2015, that outlines the main principles of how health and medical data should be handled. Similar efforts related to legislation for health data management have not yet commenced in Bulgaria.

Estonia, Finland, Slovenia and Bulgaria showed a variety of approaches regarding **technology and data standards,** often with scope well beyond health-related data. Estonia has a central network that standardizes health data from all healthcare providers who report according to their individual medical information systems. Institutions that don't have their own information system can use the doctors' portal (Arstiportaal) developed by the HWISC. Estonia has developed a secure data integration and exchange open source platform, called X-Road, which enables both the patient and healthcare provider to access personal medical data.[56] Finland however has not reached the nationwide interoperability yet due to its regional approach to healthcare. Finland and Estonia maintain close ties through the jointly established Nordic Institute for Interoperability Solutions that develops eGovernment solutions using the X-Road platform. As an example of this co-operation, Estonia and Finland will be the first countries in the EU to launch the cross-border ePrescription service in 2019 based on the European eHealth

[56] e-Estonia (2018). X-Road. Available at: https://e-estonia.com/solutions/interoperability-services/x-road/

Digital Service Infrastructure (eHDSI). As of 21st January 2019 ePrescriptions made in Finland are valid in participating Estonian pharmacies (those that have signed an agreement to participate in the service).[57] Slovenia follows a centralised approach to all ICT-related aspects of healthcare led by its National Insurance Institute, however, complemented by regional and hospital-bound information systems. Technology implementation is the responsibility of the National Institute of Public Health. Analysis of Bulgarian health data and technology standards has not led to notable insights.

Other important factors should also be considered relevant to eHealth services: **patients' privacy rights, their trust and level of usage of eHealth solutions**. According to the Estonian eGovernance principles, any data belongs to the data subject thus to the citizen. Collected health records are open by default and healthcare professionals can ask for data unless the patient has made their data inaccessible in the system. This high level of transparency contributed to patients' trust and a high level of usage of eHealth services, illustrated by the fact that only 500 citizens have opted out of the digital patient data exchange since its inception. In the case of Finland, transparency of data access by providers and patients enabled trust in the system and contributed to a comprehensive usage of electronic health records by primary health centres and secondary care hospital districts. In Finland, data is owned by register holders and individuals can manage the access to their data by giving consent. While there are positive developments observable in Slovenia regarding eHealth privacy rights and usage (between 2017 and 2018 at least 80% patients had at least one document in the Central Registry of Patients' Medical and Personal Health Records (CRPD) encompassing EHR and PHR with the trends indicating rapid growth in usage), Bulgaria currently lacks the necessary infrastructure, and has had numerous failures regarding eHealth (i.e. the launched Personalised Information System (PIS) indicates low adoption among users; during 2012-2015 a total of 3 unsuccessful public tenders were launched for realisation of a health information system).

[57] e-Estonia (2019). First EU citizens using ePrescriptions in other EU country. Available at: https://e-estonia.com/first-eu-citizens-using-eprescriptions-in-other-eu-country/

3 Digitisation of healthcare

Digitisation of healthcare is considered a particularly complex endeavour due to the multitude of stakeholders and sensitivity of data involved. Nevertheless, it is widely acknowledged that digitisation inevitably enters healthcare the way it has entered other domains of major public interest, with the ultimate promise of bringing enhanced quality and efficiency. The analysed countries of Estonia, Finland, Slovenia and Bulgaria vary greatly in their history and progress made in the past decades, as shall be elaborated on in the subsequent paragraphs.

3.1 Digitisation of healthcare in Estonia, Finland, Slovenia and Bulgaria

Table 9. Digitisation of healthcare in Estonia, Finland, Slovenia and Bulgaria

Estonia	
Context	• eHealth in Estonia is part of a broader framework of public eServices under the concept of eEstonia, which, in addition to eHealth, includes other services like eTaxes, eSchool, eCommercial registries, eElections, etc. • The Government CIO Office at the Ministry of Economic Affairs and Communications (MoEAC) is at the top of the eEstonia horizontal governance. eHealth future plans are written down in the eHealth strategy 2016-2020 document.[58] There are five focus areas: 1. High-quality health information and an infrastructure of health data. 2. Citizen-centred healthcare and personalised medicine. 3. Comprehensive case management and cooperation of organisations. 4. Effectiveness of health services and capacity for analysis. 5. Development of remote services.
Implementation	• Core activities and projects to implement the strategy include improving data capture and quality, and the development of a new event-based health information system (health information system 2.0); development of new patient portal, clinical decision support and personalised medicine; development of services for patient logistics, healthcare process coordination and integration of social and healthcare services; analytics for monitoring healthcare services; and development of the platform for telemedicine services. • Personalised medicine is being pushed further towards big data analytics and artificial intelligence. Both are developed in Estonia's competence centre and Tallinn University. AI is also explored in a 2018 cross-sectoral project by the government. This project should result in an AI strategy for Estonia elaborating the potential use of AI in the public and private sector, legal challenges, promotion of AI measures, etc. In essence these are the first exploratory steps being taken.
Finland	
Context	• Finland (alongside Estonia) ranks amongst the most advanced countries in the world regarding digitisation efforts and eHealth solutions. • In its current state, the Finnish approach to digitalised eHealth is multifaceted and offers relevant actors the opportunity to participate in a broad network, which, in its most simplified form, consists of patients, physicians, pharmacies, prescription centres, and the Finnish Electronic Patient Record System, KanTa. KanTa is the centralised platform connecting both patients (who have a separate access to their data through My KanTa service) and service providers

[58] Estonian eHealth Strategic Development Plan 2020 (2015). Available at: https://www.sm.ee/sites/default/files/content-editors/sisekomm/e-tervise_strateegia_2020_15_en1.pdf

	and houses many of the eHealth solutions active in the country (ePrescriptions, eArchive, electronic health records (EHR))). • Finland's eHealth and eSocial Strategy 2020 supports the renewal of the social welfare and health care sector, improving information management and increasing the provision of online services to citizens.
Implementation	• The new eHealth strategy is focusing on practices and processes and is funded by multiples sources like the Ministry of Social Affairs and Health STM (development of projects), regional authorities (development, piloting and deployment, infrastructure investments), local actors (e.g. cities, universities or hospital districts), and EU-wide programmes. However, eHealth requires more overarching platform financing while public funding focuses on individual projects. • Use of artificial intelligence (AI) in eHealth is also of growing interest in Finland, both among policy makers and service providers. At the current state AI and big data analytics can only be used in a limited manner in eHealth, as current legislation on secondary use of generated data foresees the granting of permissions on a case-by-case basis, where data from e.g. KanTa can only be accessed per patient and for treatment purposes only. New legislation concerning secondary use of healthcare data is currently in preparation. It is expected that this legislation will extend the possibilities for secondary use of healthcare data for the purposes of scientific research statistical analysis, development and innovation. Examples of current AI use in eHealth include the Finnish Medical Society "Duodecim" using AI in its decision support system, which checks the compatibility of different medications using ePrescriptions and EHR data.
Slovenia	
Context	• Slovenia launched its first eGovernment strategy in 2001 but this strategic plan didn't cover the field of healthcare. In 2005, the Ministry of Health launched the comprehensive, strategic National eHealth Project (NHP) which was to be completed by the year 2015. After a promising start in 2006/2007, the project essentially came to a halt in 2008 due to the global financial and economic crisis. • Due to political instability (frequent changes of governments), lack of political support, inadequate project management and lack of funding led to little progress in implementing the NHP until 2015.
Implementation	• Because of the instability, the information systems and solutions were developed individually by stakeholders. This causes an absence of coordination in health information systems in the country and delays in implementing eHealth solutions. As a result, real progress is observable primarily during 2015-2018 with the scale up of ePrescriptions and eReferrals/eAppointments on a national scale and a unification of solutions by healthcare providers under a centralised system (hospitals are obliged to send data. By 2018, all services that formed part of NHP were implemented.
Bulgaria	
Context	• The first efforts towards the development of digital healthcare in Bulgaria were made within the National Healthcare Strategy 2008-2013. In the beginning of 2012, the Ministry of Health launched the Integrated Health Information system (IHIS), as part of the Base for Health Information System (BaHIS) project. However, the project was discontinued and by 2015 the Ministry of Health launched an analytical study of the information process in the healthcare system in view of implementing a new integrated system.
Implementation	• Facing a multitude of challenges and organisational and technological gaps on different levels, the Ministry of Health decided to discontinue the pursuit of a one-off implementation of an integrated system and to implement the integration in stages, building the system in modules. Following the results of the 2015 analysis, the new National

	Strategy for Electronic Healthcare 2016-2020 plans for a less ambitious implementation plan which would develop a basic model for electronic healthcare (with an electronic health card) implemented through a phased expansion and upgrade of health information system modules.[59] • The existing Patient Information System (PIS) by design, is not a proper system for electronic patients' records. PIS tracks only services, pharmaceuticals and medical materials that are covered and reimbursed by the NHIF focusing on reimbursements and not on patient history. At its current state PIS has no relevance for medical or diagnostic purposes.

[59] Ministry of Health of the Republic of Bulgaria (2015). Health 2020. Available at: https://www.mh.government.bg/media/filer_public/2015/10/29/kontseptsiya-tseli-za-zdrave-2020_eng.doc

3.2 Cross-border implementation of eHealth in Estonia, Finland, Slovenia and Bulgaria

Table 10. Cross-border implementation of eHealth in Estonia, Finland, Slovenia and Bulgaria

Estonia	
Extent of cross-border efforts	• **Bilateral** with ePrescription service – The cross-border ePrescription service is in the process of development as of 2018 between Estonia and Finland. It is planned that in 2019 Estonian digital prescriptions will be valid in Finnish pharmacies. • **Regional** with Nordic Institute for Interoperability Solutions (NIIS) – Estonia and Finland founded the Nordic Institute for Interoperability Solutions (NIIS). Its mission is to develop eGovernance solutions and cross-border capabilities with specific respect to healthcare throughout the entire Nordics. The institute is started its operations in August 2017s. • **European** with eHDSI – Cross-border eHealth data exchange will be based on the European eHealth Digital Service Infrastructure (eHDSI), which is provided jointly by the European Commission and the national healthcare systems. ePrescriptions are scheduled to be ready for launch by March 2019. – The European Reference Networks (ERNs) is another EU lead initiative, the aim of which is to create cross-border virtual networks of healthcare providers across the EU to tackle rare diseases and conditions. From Estonia, two hospitals are involved in ERNs.
Benefits	• The opportunity to use ePrescriptions abroad will benefit both pharmacies and citizens. For citizens, it will make the management of medication and treatment easier, while pharmacies benefit from the improved data quality due to the standardised form in the local language.
Finland	
Extent of cross-border efforts	• **Bilateral** – Between Estonia and Finland, the cross-border ePrescription service is launched in January 2019 with Finnish ePresriptions valid in participating Estonian pharmacies (pharmacies had to sign up for the service). **Regional** – Participates in the creation of the Nordic eHealth Research Centre (NeRN) of the Nordic Council of Ministers. – Uses NOWBASE, a shared interface for the Nordic Medico-Statistical Committee (NOMESCO) and the Nordic Social Statistical Committee (NOSOSCO). – Estonia and Finland founded the Nordic Institute for Interoperability Solutions (NIIS). Its mission is to develop eGovernance solutions and cross-border capabilities with specific respect to healthcare throughout the entire Nordics. The institute is started its operations in August 2017s. • **European** – Finland, together with Estonia are part of the eHDSI project to exchange patient data on a regular basis. The first group of countries include Sweden, Finland, Portugal, Croatia, and Estonia with an additional five scheduled to join the network in 2019, and another group expected for 2020. As part of this project, countries within the network will share ePrescriptions.

Benefits	• The use of ePrescriptions abroad will benefit both pharmacies and citizens, especially in light of labour movement between Finland and Estonia which in part impacts the development of cross-border eHealth.
Slovenia	
Extent of cross-border efforts	• **Bilateral** – In 2013, a bilateral eHealth project (named e-HEALTH) between Slovenia and Italy was launched as part of the Interreg Programme financed by the EU. Within this project, an interoperability backbone has been developed, accessible via a special website, which enables exchange of medical documents between medical institutions on both sides.[60] – In 2017, Slovenia applied successfully for funding through the Connecting Europe Facility 2014-2020 mechanism (CEF Telecom Call CEF-TC-2017-2). The main objective is to support the establishment of the National Contact Point (NCP) and related efforts and become a part of a secure peer-to-peer network, allowing the exchange of patient summaries and/or ePrescriptions.
Benefits	• Slovenia established a portal of the NCP for information exchange on cross-border health services. This portal provides relevant information for Slovenian citizens seeking health services in other EU member states and providing relevant health service information for visitors to Slovenia. • Cross-border cooperation with neighbouring Italy and Austria is strongest due in part to the flow of migrant workforce between these countries and flow of tourists.
Bulgaria	
Extent of cross-border efforts	• There is no integrated national healthcare information system, cross-border exchange of information is not currently implemented and appears a remote opportunity. • In 2007 an electronic European health insurance card for Bulgarians - the eCard – was established. The eCard is an ID-like document to verify the insurance and confirm cross-border reimbursements. However, the eCard is rarely used, since it ultimately failed to provide enough benefits to go through the process of obtaining one.
Benefits	• Due to limited automation and often manual and offline processing of information, there are often delays in checking the status and issuing EU health insurance cards for Bulgarian citizens, as well as delays in confirmation of cross-border health-insurance status and healthcare cost reimbursement. Cross-border efforts would permit improvements in that regard.

3.3 Comparative analysis of digitisation of healthcare in Estonia, Finland, Slovenia and Bulgaria

The progress of digitisation in the healthcare domain significantly depends on an overarching framework and the endeavour to make digitisation a central element of the concerned country's general governance structure. With specific regards to the **digitisation of healthcare** in the analysed countries of Estonia, Finland, Slovenia and Bulgaria countries, several forms of **structural models** as well as degrees of national **specific governmental support** can be

[60] Parsek (2013). Cross-border clinical healthcare record. Available at: https://parsek.com/references/cross-border-clinical-healthcare-record

noted. **Estonia** has established a wide array of digital solutions under the framework of public eServices as regards the nationwide plan called eEstonia. The Baltic nation also continues to identify several long-term directions in its eHealth strategy 2016-2020 accordingly, which, however, still needs to progress to reach implementation. The Estonian eHealth structure is relatively well-defined and primarily steered by the Ministry of Social Affairs and the Ministry of Economic Affairs and Communications. Several legal framework conditions have been established, which form the context in which the aforementioned eHealth strategy functions. From the users' perspective, several digitalised solutions are already available and used, even though further steps are inevitably to be taken. An example is seen with the national eRegistration system (still in development) which would benefit users who show interest in being able to compare multiple service providers when registering (as opposed to using different systems from different providers – an approach that has not shown growth in usage or interest among patients). **Finland's** approach to digitalised healthcare is similarly advanced and established. In its current state, the Finnish approach to digitalised eHealth is multifaceted and offers relevant actors the opportunity to participate in a broad network, which, in its most simplified form, consists of patients, physicians, pharmacies, prescription centres, and the Finnish Electronic Patient Record System, KanTa. However, Finland is currently engaged in harmonisation of digital health nationally and focussing on patient-centric digital health. Finland's future challenge therefore lies in the broader healthcare reform that aims to centralise activities, which is expected to ultimately have an impact on national digitisation efforts. Furthermore, it is stressed that public funding modalities are not ideal for the kinds of environments and ecosystems eHealth requires as funding is primarily focussed on individual organisations and projects rather than on overarching and far-reaching platforms. An exception is represented by KanTa, which could be considered an overarching and hence considerably unified platform.

Box 1 Nordic Institute for Interoperability Solutions (NIIS)

The NIIS is an association founded jointly by Estonia and Finland. Its mission is to develop eGovernance solutions and cross-border capabilities with specific respect to healthcare throughout the entire Nordics. The institute is physically located in Tallinn and started its operations in August 2017 after the memorandum of association had been signed in June 2017. The institute functions as both a network and cooperation platform, with the aim of fostering practical collaboration, innovation and sharing experience. NIIS specifically focuses its operations on the X-Road technology, a secure data exchange layer for information systems, ultimately allowing private and public sector enterprises, actors and institutions to connect their respective information systems. As previously mentioned, Estonia and Finland use this opportunity to foster their understanding and management of health-related data across borders.

Keywords: eGovernance, eHealth, international collaboration

Compared to Estonia and Finland, **Slovenia** finds itself in a lagging position. Even though several advancements have been made and can be noticed, progress of digitisation of health services is rather slow and has been significantly influenced by the 2008 economic crisis. Since

2015, however, the economic recovery of the country has contributed to significant progress in implementing and using eHealth solutions. Following the events since the introduction of NHP in 2005, it is evident that the real progress was made in the last four years. In particular, implementation of vital eHealth solutions, like ePrescriptions and eReferrals/eAppointments together with CRPD on a national scale represent a breakthrough in digitisation of healthcare services in Slovenia. By 2018, all services that formed part of NHP were implemented[61]. In 2017, Slovenia applied successfully for funding through the Connecting Europe Facility 2014-2020 mechanism (CEF Telecom Call CEF-TC-2017-2). The main objective is to support the establishment of the NCP and related efforts and become a part of a secure peer-to-peer network, allowing the exchange of patient summaries and/or ePrescriptions. Nonetheless, it is once more necessary to stress that these ambitions are by all means less advanced than those found in Estonia and Finland. **Bulgaria** finds itself at the very beginning of a potential digitisation. While the new National Strategy for Electronic Healthcare 2016-2020 has a phased approach towards introduction of digitisation in the healthcare sector, by the end of 2018 no significant developments in this direction have been visible.

To conclude, while Estonia and Finland are clear technology leaders, Slovenia and Bulgaria distinctively lag behind as regards technical infrastructure. With respect to implementation, Estonia finds itself challenged with carrying out further steps that have already been laid out under its eHealth 2020 strategy whereas Finland tackles more structural issues, ultimately attempting to combat regional and institutional fragmentation and foster harmonisation of eHealth efforts. Bulgaria and Slovenia, on the other hand, lack more advanced structural or governmental support and strategic ambition.

Besides country-specific and -internal dynamics, ambitions to implement **eHealth across borders** are present as well, and vary considerably in their intensity and magnitude across benchmarked countries. For instance, **Estonia and Finland** are considered to be amongst the EU MS with the most progress made towards cross-border eHealth. By pursuing a relatively intense focus on digitalising healthcare, both countries have reached a point at which they not only are qualified and open to cross-border cooperation but embrace it in a pro-active manner. The two nations cooperate through the Nordic Institute of Interoperability Standards with the ambition to transfer learning in an international dimension and contribute to a better understanding and operating of cross-border activities. In addition, Estonia and Finland each engage in EU-wide programmes such as epSOS or eHDSI. Furthermore, Finland pursues intense cooperation with its Nordic neighbours. **Slovenia**, on the other hand, has not broadened its operational scope as regards cross-border cooperation beyond bilateral agreements with some of its neighbouring countries, where Italy and Austria are the main examples. The reasons why cross-border cooperation with Italy and Austria is the strongest are twofold. Namely, the flow of migrant workers between these countries is increasing every year, and a consistently

[61] Rant Živa et al. (2017). eZdravje danes. Uporabna informatika., Št. 3, letnik XXV, 2017

string flow of tourists in both directions can be noted. Albeit having established a basic framework for IT solutions that enables the exchange of data referring to expenses of urgent medical treatments of Slovenian citizens abroad and vice versa with more than ten EU states, more coherent and advanced approaches are currently absent. This current shortcoming sources from the fact that an overall coherent approach to eHealth could not be identified in Slovenia (see previous paragraph), as well as that the future outlook remains uncertain as no clear aspirations or intentions have been formulated for the timeframe beyond 2018. **Bulgaria** follows an even less distinct strategy towards cross-border operations and has in fact not progressed sufficiently with its eHealth strategy to establish either national or cross-border eHealth services, which can be categorised a remote opportunity. Instead, Bulgaria appears to be currently preoccupied with addressing aforementioned fundamental internal issues to establish a suitable infrastructure and rally its policymakers, citizens and other stakeholders around digital health and implement elements of the National Strategy for Electronic Healthcare 2016-2020. Essentially, Bulgaria first needs to strengthen its internal capabilities before cross-border activities can be pursued.

4 Most prevalent eHealth applications and their use

4.1 eHealth solutions in Estonia, Finland, Slovenia and Bulgaria

The services landscape in **Estonia** is dominated by the solutions developed centrally by the state and relies on the national health information system. The services described below do not constitute an exhaustive list of eHealth solutions being developed in Estonia. It is a selection of the most and least successful digital health developments in Estonia – that is, according to the opinion of experts interviewed.

Table 11. eHealth solutions in Estonia

Service	Description
National Health Information System (EHR)	Nation-wide information-exchange platform (acting as Estonians national EHR) was established in 2008. It connects all providers and allows data exchange with various other databases. Healthcare providers are connected to the system and patient health data is stored centrally. All healthcare providers have a legal obligation to send certain health data to the health information system. The system is a backbone for the different eHealth services, e.g. enables patients to access their health data via patient's portal (Digilugu.ee). 1.6 million people have documents in the system (Estonia has 1.3 million inhabitants), there are 34 million different documents stored: 21 million summaries of visits or treatments and discharge letters, 1.7 million referrals, 7.5 million diagnostic study reports and procedures.
National patient portal Digilugu.ee	The national patient portal is a single access point for citizens to their medical data stored in the national health information system. The web-based portal can be securely accessed with a Mobile ID or an ID card. It consists of case summaries, lab results, medical images, prescriptions, dental care documents, immunisations, health certificates and medical bills reimbursed by the EHIF. In addition, the portal allows people to declare intentions and preferences, for example, make organ donor declarations or to assign a representative who can access their health data. In order to ensure the transparency of the system, people can monitor logs to see who has viewed the health data (and what data) about them. In 2017 244,369 unique visitors accessed the portal (15% of the population).
ePrescription	A centralised paperless system for issuing and handling medical prescriptions. To use the ePrescription, a patient needs to present an ID card at the pharmacy. The pharmacist then retrieves the patient's prescription from the system and issues the medicine if it has been prescribed to the patient. It is considered the most successful eService as well as eHealth solution in Estonia. It is also the most used public eService (73% of people who have used internet within last two years have also used ePrescription) with the highest citizen satisfaction score (4.8 out of 5.0). 64% of citizens are aware of the possibility to view the prescriptions at the patient portal and 27% have also done so. The service offers extra features, for example the possibility to track the prescriptions history and costs, to compare the prices of alternative products and see the possible savings when choosing the cheapest option. The service was developed by the EHIF and launched in 2010. In 2016 the Drug Interaction Assessment Database was connected to the ePrescription in order to enable physicians to assess drug interaction at the moment when medicinal products are prescribed. The ePrescription covers 100% of used prescriptions, whereas 98% are prescribed digitally and the remaining 2% are entered in the pharmacy. The ePrescription is also the first use case for cross-border data exchange; the service launched in

	January 2019 between Estonia and Finland, with Finnish ePrescriptions valid in participating Estonian pharmacies, while Estonian ePrescriptions will follow suit later in the year.
eRegistration	A nationwide eRegistration service was one of the very first eHealth projects planned in Estonia already ten years ago (first being discussed by 2005), but not yet realised. Meanwhile, hospitals have developed their own patient portals and offer digital registration and management for the appointments where patients can schedule, pay, reschedule and cancel ambulatory appointments and order SMS and e-mail reminders. Still, currently the HWISC holds a mandate to develop the national system and the EHIF through the financing agreements will make it obligatory for the hospitals to deploy it; the piloting of the system is taking place at the North Estonia Medical Centre.
Information sharing solution(s)	
eConsultation	Through eConsultation family physicians can consult with specialists via the health information system without sending the patient to the specialist care provider. The results of the consultation are forwarded to the health information system by the specialist doctor and may contain recommendations for continuing treatment or invite the patient to attend an appointment. The eConsultation has to follow a standardised format (by specialty), which should better enable specialists to give adequate advice. Patients can see their eConsultations in the patient portal. The eConsultation supports family doctors in assuming more responsibility for patient care and improves cooperation with specialist doctors. In the pilot period the eConsultation was applied to limited number of specialties. After piloting it has expanded gradually and as of 2019 will be in use in 21 specialties. In the 3rd quarter of 2018, 670 family doctors had 4709 eConsultations, which is 50% more than at the same time the year before. Family doctors have stated the eConsultation as the best eHealth innovation of the last few years.
eReferral	eReferral was launched in 2009 and has been used mainly by family doctors linking their patients to the next level of care. In 2017 about 50% of referrals were digital. Patients can see their referrals in the national patient portal. As of 2018, all referrals must be entered digitally via the health information system. In 2013, eReferral was complemented with the eConsultation.

Finland has employed a multitude of different approaches, systems and structures to manage and direct digitisation efforts in healthcare. The key element of such efforts is to ensure a stable and mutually engaging link between patients, healthcare professionals and other entities concerned with data gathering and management. The following overview provides a snapshot of the most prevalent solutions of eHealth in Finland.

Table 12. eHealth solutions in Finland

Service	Description
Electronic Health Records (EHR)	Launched in 2007, the documentation of patient data in Finland is almost exclusively carried out by electronic means. The infrastructure in place for EHRs is not entirely uniform and differs between healthcare providers. Yet, certain trends that indicate standardisation can be seen, as the count of EHR trade names has decreased over the past years. Different rates and levels of coverage can be identified according to the nature of healthcare provider. For instance, while public primary healthcare centres and specialised healthcare hospitals uniformly and exclusively rely on EHRs (saturation rate: 100%),

	private healthcare service providers' saturation rate can be numerically approached by about 80%.[62]
eAccess: KanTa and My KanTa	Launched in 2007, the central instance and most noteworthy application in the healthcare sector is embodied by KanTa. This interface functions as a centrally managing entity charged with the processing of patients' information. KanTa is complemented by My KanTa, which is the user interface through which patients can access information on healthcare providers, referrals, treatment summaries, patient consents and any log data. One of the intended key features of this design is to give all actors that are relevant during a patient's treatment easy access to necessary data and a convenient opportunity to manage such. Accordingly, My KanTa enables patients to access their medical records and other digital healthcare services (i.e. ePrescriptions) on demand or by default, for instance. In addition to providing patients with access to their medical data, the system also allows users to monitor and manage which organisations access their personal information.[63] However, patients cannot deny healthcare providers from accessing the data that they have produced if the provider is currently in a medical relationship with the concerned patient. In order to access their medical records through KanTa, patients have to have a Finnish identity number; however, the data from patients outside of Finland is still recorded and stored in the Electronic Patient Record system. Non-Finnish patients who receive medical treatment in Finland cannot access the KanTa service as their data is not directly electronically stored in KanTa. In the event that Finnish citizens receive medical treatment in another country (or from a healthcare provider who is not registered in the Finnish Electronic Patient Record system), it is the patients' responsibility to ensure that their medical data is submitted. Healthcare data can usually be provided to patients in Finnish and Swedish allowing for greater language flexibility (as well as flexibility when treating people from abroad). If the patients submit their medical data, it is equally their responsibility to ensure that the information is submitted in the language requested by the healthcare provider.[64]
ePrescriptions	ePrescriptions were launched in Finland in 2007. The vast majority of physicians operating in Finland have electronic patient record applications and prescriptions that are generated electronically within the nationwide KanTa system. The concerned database is hosted by Kela and can be accessed by physicians and pharmacies alike. Once a prescription has been uploaded it cannot be deleted and will be kept within the ePrescriptions database for 30 months before being transferred to the eArchive. Prescriptions themselves can be viewed by physicians (after consent has been clarified) and are complemented by entire patient histories to minimise the risk of incompatibilities or side-effects. Finnish ePrescribing is fully incorporated with different EHRs and the Centralised Drug Database so as to ensure a complete, secure and up-to-date gathering of patient information and its management. ePrescription services also offer the patient the possibility to request prescription renewals or inquire information on dispensation.
Tervetuloa Terveyskylään (Virtual Hospital)	The Tervetuloa Terveyskylään which launched in 2018, is a collaborative effort by 5 hospital districts jointly developing the Virtual Hospital platform. At the moment the platform is composed of 5 virtual "houses" each of which focuses on a different area (disease) for

[62] Hyppönen, Hämäläinen, & Reponen (2015). E-health and e-welfare of Finland - Check point 2015. Available at: http://www.julkari.fi/handle/10024/129709

[63] Korhonen M. (2016). How Finland became a leader in eHealth adoption. Available at: http://healthaffairs.ucd.ie/wp-content/uploads/2016/03/MarittaKorhonenMSAH_National-eHealth-Summit-2015.pdf

[64] Choosehealthcare.fi (2018). Medical records in Finland. Available at: https://www.choosehealthcare.fi/healthcare-in-finland/medical-records-in-finland/

	patients to receive help. These "houses" focus on mental health, weight management, pain management, women, rehabilitation and rare diseases. However, only patients from the 5 hospital districts that have developed the platform can currently access the services.
Information sharing solution(s)	
eArchive	The eArchives, implemented in 2007, function as long-term memory for prescriptions and medical records of patients. It functions as data storage and a legal archive, which allows for the secure sharing of healthcare data between healthcare providers. This archive stores prescription details and data for as long as ten years. eArchives are integrated into KanTa.
Picture Archiving and Communication Systems (PACS)	The introduction of PACS began in 2000 and by 2007 PACS adaptation was nears 100% amongst most of healthcare service providers. Film imaging has been almost entirely replaced and made redundant. Similar to EHRs, PACS are offered by several different providers and market actors. In most scenarios, gathered images (i.e. x-ray scans) and recordings are seamlessly embedded in EHR interfaces.
Radiology and Laboratory Information Systems (RIS)	RIS introduction coincides with the development of PACS and is implemented during the period of 2000-2007. RIS enable the controlling and managing of the operations of radiological units through software-based solutions. The interface gives access to an overview of referral letters and appointment orders, and facilitates the management of work flow, reports or further operational activities. Hospital districts rely on this system and have entirely incorporated the according technology amongst all of its 21 representations. Healthcare centres follow suit and demonstrate a level of coverage of about 90%.
Laboratory Information System (LIS)	LIS introduction coincides with the development of PACS and is implemented during the period of 2000-2007. This software-based solution supports the identification and management of laboratory tests and their results. For instance, laboratory tests can be ordered, and gathered results sent back to the physician who initially ordered the examination. LIS are integrated into EHRs and form a vital part of their scope.
Hospital/Medical institutions	
Regional Data Exchange Systems (RHIE)	Since 2010, regional systems have been popular amongst healthcare organisations and institutions. In fact, many of these actors make use virtual private networks (VPN). Even though RHIE can exchange a multitude of data, their primary use lies in transferring narrative texts
Terveyskylä.fi: Virtual Hospitals	A project launched in 2016 sees Finnish university hospitals jointly develop a national virtual hospital, which is intended to support present infrastructure and specifically improve quality of and access to specialist care. Currently, multiple divisions (so-called "houses") are in place, expected to be expanded to more than 30 by the end of 2018.

In **Slovenia**, the eHealth solution landscape is by large the result of the implementation of the National eHealth Project launched in 2005 and successfully finalised in 2018. NHP has been focusing on the infrastructure, solutions and services, consolidating the fragmented digitisation efforts developed by individual institutions, which represent the backbone of the national eHealth information system in Slovenia. All highlighted solutions and services that were developed on a national level, are now available for the whole state and accessible to all healthcare service providers in the country (of which some, i.e. ePrescriptions, are mandatory for healthcare providers). The list does not include numerous eHealth solutions developed at different hospitals and internally used.

Table 13. eHealth solutions in Slovenia

Service	Description
Central Registry of Patients' Medical and Personal Health Records (CRPD)	Introduced in 2017 the CRPD includes all medical documentation related to a patient (EHR) and a summary of Patient Health Records (PHR). However, CRPD still does not contain all medical data records of the patient, as certain healthcare providers still do not send all documents to the CRPD. Patients can access their personal EHR through the zVem platform using a digital certificate. According to the available data in May 2018 at least 80% of the patients had at least one document in the CRPD and about 36% of patients had summary of their patient records. The trends indicate that the usage of this database is growing very fast.
zVem	The national eHealth platform[65], launched in 2016, which gives all citizens and medical institutions/professionals safe access to information about health service providers, all key eHealth services, waiting times, access to CRPD, i.e. EHR and PHR etc. Access to zVem portal in order to get information about health services, service providers, waiting times etc. is open. Access to CRPD requires relevant digital certificate.
ePrescriptions	Introduced in 2016 on a national level and its use is mandatory for all health service providers in the country. All ePrescriptions are stored in the CRPD i and in 2018 more than 92%[66] of all prescriptions issued were digital. Physicians issue paper-based prescription only exceptionally at special circumstances (i.e. visits at home). The main aims of the application were to increase quality of the services for the patient with reducing number of errors, better overview over prescribed drugs individually as well as cumulatively, simplification of the procedures, reduced administrative costs, less visits to the GPs etc. All pharmacies in the country have access to the central database of ePrescriptions. According to the public opinion surveys, more than 90% of the patients are very satisfied with the service.
eReferrals/eAppointment	Implemented in 2017 on a national level eReferrals/eAppointments are mandatory for all GPs in Slovenia equipped with the application that enables issuing of electronic referrals. All eReferrals are collected in the CRPD in EHR and accessible to health service providers. Healthcare service providers must daily update central database on waiting times and free capacities. In this way, via zVem health portal, patients get information on relevant service providers, waiting times etc. They can select the hospital or clinic, in which they want to be examined or treated and make an appointment via eAppointment service. In August 2018, the percentage of eReferrals exceeded 96% of all referrals issued.
Information sharing solution(s)	
Teleradiology	This system[67] enables transmission and exchange of all radiologic data/images between points of examination and all other Slovenian hospitals and/or medical centres included in the system. Currently there are 19 medical centres included in the service, but the usage is low because the financial burden/division of costs is not clearly defined.
Hospital/Medical institutions	

[65] zVem (2018). Portal zVem. Available at: https://zvem.ezdrav.si/idp/register-start

[66] Nacionalni institute za javno zdravje (2018). Uveljavitev eRecepta in eNaročanja v slovenskem zdravstvu. Available at: http://www.nijz.si/sl/uveljavitev-erecepta-in-enarocanja-v-slovenskem-zdravstvu NHP (2018). Nacionalni projekt eZdravje'. Available at: http://www.ezdrav.si/ezdravje/

[67] eZdravje (2018). Teleradiologija. Available at: / http://www.ezdrav.si/category projekti/teleradiologija/

eTriage	Based on the Manchester Triage System, eTriage[68] assists medical personnel in cases of large numbers of incoming patients who cannot be treated simultaneously. Its aim is to help identify patients who cannot wait safely and need urgent treatment. Currently only three medical institutions are included in the system, the reason for low usage being weak integration with the back-office systems.
Prevention solution(s)	
Telestroke	This is one of the most successful services within the whole eHealth system in Slovenia in terms of death prevention, since it very efficiently contributes to the successful treatment of stroke[69]. The system was introduced in 2015 and works via an audio-visual conference system. It includes 12 regional hospitals in the country, thus covering the whole territory of the state. At the time of reporting (September 2018), more than 2500 patients were treated.
Infrastructure and communication solution(s)	
zNET	Special private eHealth backbone telecommunication network[70], available and in use among all health care stakeholders in the country. It provides secure and reliable exchange of all medical data/documents among all health care entities in the country on the basis of a unique interoperability protocol, which simplifies exchange of data/documents between different users.
Electronic health care identity card (EHCIC)	Represents the key infrastructural element in the whole structure of eHealth services in Slovenia. It is a digital certificate used within the healthcare system compatible with international standards. There are two types of EHCIC, one for the users of the services/patients and 'professional' EHCIC for the medical staff. Introduced nearly twenty years ago, but it is still not clear what the future role of it is going to be. Namely, Slovenia did not yet introduce the electronic identity card. In order to access eGovernment services, citizens need 2 separate digital certificates, one for general public services accessible via national eGovernment Portal and another for health care services – the electronic healthcare identity card, both based on a smart card technology.

Bulgaria is lagging behind other EU countries in the digitisation efforts of public services. Through a combination of unimplemented but regularly revised strategic documents and a series of unsuccessful public tenders, the government has realised only one notable eHealth solution – an electronic register of medical services and interventions reimbursed by the NHIF for patients. Although the Personalised Information System (PIS) which was implemented n 2012 works similarly to an electronic patient register, its implementation and the processes of filling-in and updating its contents present challenges that severely limit its use for healthcare purposes. Apart from this solution, the Ministry of Health has made a number of attempts to create an integrated healthcare information system, but due to the lack of analysis, clear requirements and standards, as well as technological basis and available experience, these initiatives so far have not progressed. The newly formed State eGovernment Agency (SEGA)

[68] eZdravje (2018). E-Triaža. Available at: http://www.ezdrav.si/category/projekti/etriaza/

[69] Nacionalni institute za javno zdravje (2018). Uveljavitev eRecepta in eNaročanja v slovenskem zdravstvu. Available at: http://www.nijz.si/sl/uveljavitev-erecepta-in-enarocanja-v-slovenskem-zdravstvu

[70] zNet (2018). Portal zNet. Available at: http://znet.ezdrav.si/

appears to have the right intentions, but since its establishment in 2016, it has not implemented any eHealth solutions. With the lack of public headway, many private healthcare providers and health-related businesses have opted for developing and implementing smaller-scale solutions, either to optimise existing processes or to introduce new business and revenue models. Some prominent examples include the pregnancy and child-care information portal and mobile app of FEIA.bg, the medical advice platform that connects patients and doctors also through a mobile app of amedichome.com, the online appointment and medical specialist catalogue of superdoc.bg, and the platform and mobile app of healthykid.eu that connects parents to paediatric specialists and hospitals according to proximity and symptoms. Although all of these applications have their valuable uses and audience, they target niche audiences and needs and usually resolve simple information problems related to search, access of specialised information and advice. Larger-scale investments with coverage and more complex functionalities like electronic health records, remote monitoring, self-managed apps, is currently beyond reach. These ad-hoc developments of private applications rely on subscriptions or advertisements, and thus most solutions do not share a common data format or information standards, with no interoperability or possible exchange of data for the future.

4.2 Comparative analysis of the most prevalent eHealth applications and their use in Estonia, Finland, Slovenia and Bulgaria

Several eHealth applications are present in Estonia, Finland, Slovenia and Bulgaria: ePrescriptions, eConsultations, eRegistrations as well as national patient portals, with the exception of Bulgaria. These tools tend to work in an integrated manner with the respective national patient portal and enable a generally seamless information flow between authorised parties.

Backed by strong national political support, Estonia integrates relevant functions centrally and links services to the **national health information system** effectively. Slovenia also introduced eHealth services at a national level in recent years, as usage was made mandatory for all healthcare providers. Concerned health information systems feature **single access points** for both, physicians and patients alike. Finland with its more fragmented regional as well as organisational approach, offers specific options which are nonetheless bundled within its national patient system. These differences, however, are purely of structural and managerial nature and do not seem to affect the effective usability. Finland, however, needs updated information systems, as most related infrastructure had been developed more than a decade ago and have remained largely unchanged. Bulgaria lags behind with no comprehensive approach for digitalised health services. A major reason for Bulgaria's position is considered to lie in a generally passive public sector engagement in pursuing unified, nationwide eHealth development. Meanwhile, healthcare providers create their own internal systems for tracking patients and activities, but these systems are barely connected to bigger national or regional authorities, and almost entirely operate within their organisational boundaries. Bulgaria thus finds itself exposed to a poorly integrated and coordinated governmental approach vis-a-vis

development of eHealth applications and their procurement processes, as well as to fragmented approaches by the private sector.

The most eagerly embraced services offered through these health information systems are **ePrescriptions and eAppointments and eConsultations**. Especially the first is widespread amongst considered countries (Bulgaria being the exception), albeit differences can be noted in their intensity of usage. For instance, in Estonia ePrescriptions are bundled in a centralised paperless system for issuing and handling medical prescriptions. It is also the most used public eService (the 2014 eService satisfaction survey found that 73% of people who have used internet within 2013-2014 have also used ePrescription) with the highest citizen satisfaction score (4.8 out of 5.0). 64% of citizens are aware of the possibility to view the prescriptions at the patient portal and 27% have also done so. ePrescriptions cover 100% of used prescriptions, whereas 98% are prescribed digitally and the remaining 2% are entered in the pharmacy. The ePrescription is also the first use case for cross-border data exchange; the service as of 2018 is progressing in its development. Similar to Estonia, the vast majority of physicians operating in Finland have EHR applications and prescriptions that are generated electronically within the nationwide KanTa system. ePrescription services also offer the patient the possibility to request prescription renewals or inquire information on dispensation. Slovenia fostered the application of ePrescriptions at a rapid speed, as they had not been introduced before 2016 on a national level. They have been mandatory for all health service providers in the country ever since. All ePrescriptions are stored in a CRPD, i.e. EHR, and by 2018 more than 92%[71] of all prescriptions issued have been digital. Physicians issue paper-based prescriptions only at special circumstances, like visits at home and some others. According to the public opinion surveys, more than 90% of all Slovenian patients are very satisfied with the service.

Estonia has established an **eConsultation** and **eAppointment** system that is primarily focused on healthcare providers. In fact, through eConsultations family physicians can consult with specialists via the health information system without sending the patient to the specialist care provider. The results of the consultation are forwarded to the health information system by the specialist doctor and may contain recommendations for continuing treatment or invite the patient to attend an appointment. In the pilot period the eConsultation was applied to limited number of specialities. After piloting it has expanded gradually and as of 2019 will be in use in 21 specialities. In the 3rd quarter of 2018, 670 family doctors had 4709 eConsultations, which is 50% more than at the same time the year before. Family doctors have stated the eConsultation as the best eHealth innovation of the last few years. Finland has pursued intensified approaches to directly link patients to their responsible medical instance instead. Finnish university hospitals jointly develop a national virtual hospital, which is intended to support present infrastructure and specifically improve quality of and access to specialist care.

[71] NIJZ (2018). Uveljavitev eRecepta in eNaročanja v slovenskem zdravstvu. Available at: http://www.nijz.si/sl/uveljavitev-erecepta-in-enarocanja-v-slovenskem-zdravstvu

Currently, the flagship project consists of multiple divisions (so-called “houses”) that have been put into place and are expected to be expanded to more than 30 by the end of 2018. Slovenia’s approach to eAppointments and eConsultation is less sophisticated and barely expands beyond technical assistance in handling physical meetings between patients and physicians. As of 2017, healthcare service providers are required to daily update central database on waiting times and free capacities. In this way, via zVem health portal, patients get information on relevant service providers, waiting times etc. They can select the hospital or clinic in which they want to be examined or treated and make an appointment via eAppointment service. In August 2018, the percentage of eReferrals exceeded 96% of all referrals issued.

All aforementioned services and infrastructural framework conditions are ultimately reflected in the effective **uptake and usage of such from the patients’ perspective**. Awareness about eHealth services and their value can be directly linked to usage. Finland stands out as a country with positive user perception and high participation rates, as about two-thirds of the entire population use eHealth services. Users repeatedly report high satisfaction with eHealth solutions and the portals through which users interact with the eHealth system is highly important. An example of this is My KanTa patient portal. Finland employed an effective communication strategy, which targeted medical professionals and healthcare providers, instead of patients themselves. This approach has the advantage of a direct, individual and reliable source through which relevant information about eHealth applications can be gathered. In addition, this approach allowed early adoption of eHealth services, as professionals have been specifically encouraged to use eHealth applications. In Estonia, the awareness of Digilugu.ee portal among Estonian citizens was at about 63% in 2016. By 2017 the portal was accessed by 244,369 unique visitors the portal (which account for roughly 15% of the citizens). In Slovenia, more than 25% of citizens used electronic health and care services between 2016-2017. Clearly, Finland’s communication strategy (using healthcare providers as disseminators for eHealth availability and opportunities presented by eHealth solutions) could also be used in Estonia and Slovenia, to further the adoption rate of certain eHealth services. It should be noted that the mandatory use of some services in Slovenia by healthcare providers (ePrescriptions, eReferrals/eAppointments) is likely to see fast adoption among users for these specific services (it is reported that hand written prescriptions in Slovenia are barely in use by 2018). Therefore, Finland’s example of dissemination through care providers is perhaps more applicable when discussing healthcare portals (for Finland it is My Kanta, for Estonia Digilugu.ee, for Slovenia it is zVem). In Bulgaria, however there is a distinct dissatisfaction with eHealth applications introduced in the country, reinforcing low adoption of services among patients. 56% of all respondents of a recent study claimed not to be familiar with the term “electronic healthcare” and 94% claimed not to have been informed about its benefits. This lack awareness about eHealth stands in contrast with Estonia, Finland and Slovenia.

Box 2 KanTa and My KanTa

In general, eHealth services and solutions have grown in popularity in Finland since 2007 when many of the current solutions were introduced. The use of the My KanTa interface, for instance, has experienced exponential and significant growth, making it one of the most commonly used public eService applications amongst Finnish residents. This progress can be documented despite the fact that KanTa or My KanTa have not been promoted to residents through any systematic campaigns, which rather focused on professionals, instead. Aforementioned security measures have furthermore contributed to a seemingly high level of trust by users in digitalised healthcare services in Finland - only about 1% of all users effectuated their right to limit access to their electronic health records. Transparency certainly plays a key role in this respect and is exemplified by the feature that patients can review whether a newly appointed doctor had accessed the concerned person's medical records prior to first contact from the My KanTa website.[72] The most eagerly embraced tool within the My KanTa system is represented by ePrescriptions, which allows for the electronical issuing and renewal of prescriptions, mental health support and remote or eAppointments. A recently conducted study concluded that about 2/3 of all respondents were familiar with the My KanTa service. ePrescriptions being one of the key features of My KanTa, about 96% of all respondents who had used this specific feature were satisfied with its performance and usability. In total figures, the use of My Kanta and its economic dimensions can be approached as follows: In July 2018 alone, more than 1.1 million log-ins were registered on My Kanta by about 530,000 people. Moreover, the patient data repository's count of documents stored exceeded 1.2 billion in July 2018. ePrescriptions issued through KanTa exceeded 61 million in 2017, and dispensing follow suit with a volume of nearly 32 million in the same year.[73]

Keywords: eAccess, remote access, efficiency, eHealth applications

Besides the patients' point of view, the **physicians' perspective** and the respective influence on their work needs to be considered as well. Several solutions have been implemented in considered countries (once more with the exception of Bulgaria) that have contributed to more efficient operations amongst physicians, healthcare institutions, nurses and all other relevant stakeholders. For instance, Estonia launched its eReferral initiative in 2009, and enabled mainly general practitioners to link their patient to the next level of care. In 2017 about 50% of referrals were digital. As of 2018, all referrals must be entered digitally via the health information system. Finland has pursued intensified operations in more technical spheres, primarily represented by Radiology and Laboratory Information Systems (RIS) and Laboratory Information Systems (LIS). For instance, RIS enables the controlling and managing of the operations of radiological units through software-based solutions. It also gives access to an overview of referral letters and appointment orders, and facilitates the management of work flow, reports or further operational activities. Hospital districts rely on this system and have entirely incorporated the according technology amongst all of its 21 representations. Healthcare centres follow suit and demonstrate a level of coverage of about 90%. In a like manner, Slovenia has implemented a similar telecommunication network (zNET; Teleradiology), as well as a patient management

[72] My KanTa serves as KanTa's online access platform

[73] Kela (2019). Significant increase in the use of Kanta services. Available at: https://www.kela.fi/web/en/news-archive/-/asset_publisher/lN08GY2nlrZo/content/significant-increase-in-the-use-of-kanta-services

system called eTriage.[74] This application assists medical personnel in cases of large numbers of incoming patients who cannot be treated simultaneously. Its aim is to help identify patients who cannot wait safely and need urgent treatment. Currently only three medical institutions are included in the system, the reason for low usage being weak integration with the back-office systems.

In all respects, **Bulgaria** lags behind all benchmarked countries and even finds itself at the lower end in an EU-wide comparison. Larger-scale investments with coverage and more complex functionalities like electronic patient records, remote monitoring, self-managed apps, are currently beyond reach. Instead, ad-hoc developments of private applications which rely on subscriptions or advertisements are the most progressed approaches in the Bulgarian market. As a result, most solutions do not share a common data format or information standard, with no interoperability or possible exchange of data for the future.

[74] eZdravje (2018). E-Triaža. Available at: http://www.ezdrav.si/category/projekti/etriaza/

5 Digital health services through the eyes of a diabetes patient in Estonia, Finland, Slovenia and Bulgaria

To demonstrate the practical application of eHealth in Estonia, Finland, Slovenia and Bulgaria we outline a hypothetical "patient journey" for a citizen diagnosed with diabetes, a common but high burden disease on health services in the EU MS. However, diabetes also represents a medical condition that could be better self-managed by patients through use of eHealth solutions (i.e. help in identifying symptoms that a patient might be diabetic, facilitating monitoring patients treatment without the need for physical meeting between patient and doctor). This analysis aims to demonstrate how eHealth infrastructure in the analysed countries of Estonia, Finland, Slovenia and Bulgaria offers concrete help to patients with a concrete disease. We highlight the similarities and differences in how digital healthcare is used in identification and verification of diabetes (e.g. through the availability of online self-assessment guides), diagnosis (e.g. through dedicated eHealth apps facilitating this process) and finally in treatment and long-term monitoring of the disease.

5.1 Estonia

While Estonia has a basic infrastructure and generic set of eHealth services in place, there is no evidence of condition specific eHealth tools for healthcare professionals and patients, including digital solutions aimed at people with diabetes.

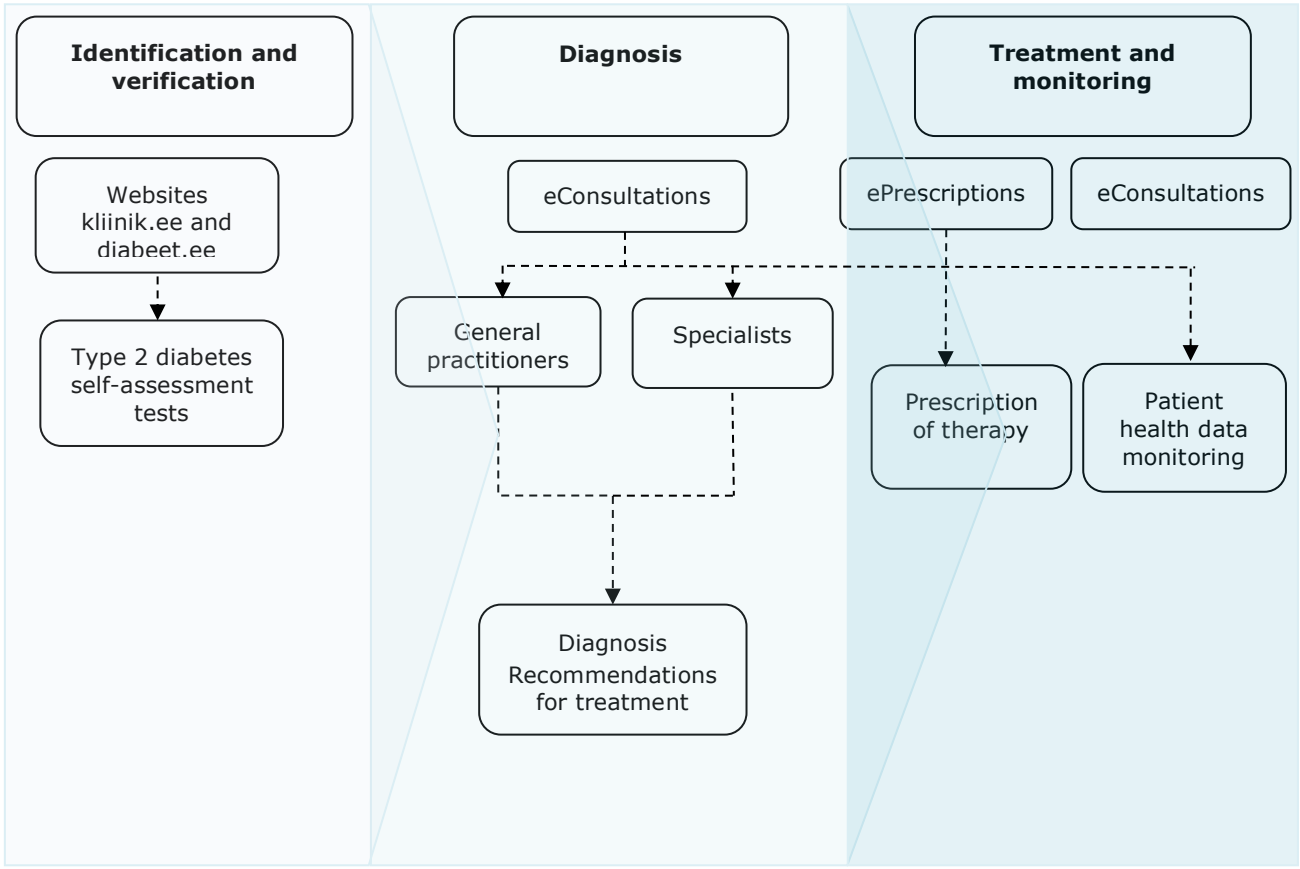
Regarding identification and verification of diabetes, people can find Type 2 diabetes self-assessment tests to find out if they are at risk from websites like kliinik.ee and diabeet.ee. In the care-focused healthcare system, there is not yet the prevention programmes to identify the risk group (using AI and machine learning based algorithms) and prescribe interventions like weight management (supported by the trackers and apps) to reduce the risk of getting ill.

In the diagnosis, treatment and monitoring stages, the main responsibility in the healthcare system relies at the primary care level, while general practitioners are equipped with the eConsultation possibility, which allows them to consult with the specialist doctors. Improving the monitoring of chronically ill patients (incl. Type 2 diabetes) at the primary care level is incentivised financially by the EHIF family physicians' quality system. However, the system is not complemented with the digital tools, which could support caregivers doing the monitoring more efficiently (incl. spending less time) and empowering patients for self-management. For example, the MoSA and the Estonian Diabetes Association commissioned a study[75] in 2016 finding out, that at doctor's appointment considerable time goes for the activities, which could be done by the patient in advance (e.g. lifestyle audit, self-assessment of diabetes management) and/or could be solved by using digital solutions (e.g. automated summaries from the patient's diabetes and nutrition e-diaries).

[75] Mõtus M., Koppel K. (2016). Kroonilise haige jälgimise teenuseprotsessi disain

People living with diabetes are free to use different apps and connected devices available in the global market (there are more than 2,000 digital services for diabetes patients available globally[76]) to manage their condition. However, there are no such solutions adopted to or developed particularly for the Estonian market (incl. available in Estonian and Russian). Even when 63% of people in Estonia would expect their doctor to prescribe them also digital tools, doctors are usually not aware of or do not trust the digital solutions and therefore do not recommend these to their patients. Moreover, the national health information system currently does not allow patients generated self-monitoring data to be sent there and that way share with the doctor. Doctors are also concerned of this new type of data source until they do not have a dashboard-like solution, which could turn the raw data to the information relevant for making better treatment decisions.

Figure 7. Identification, verification, diagnosis, treatment and monitoring of diabetes in Estonia using eHealth solutions



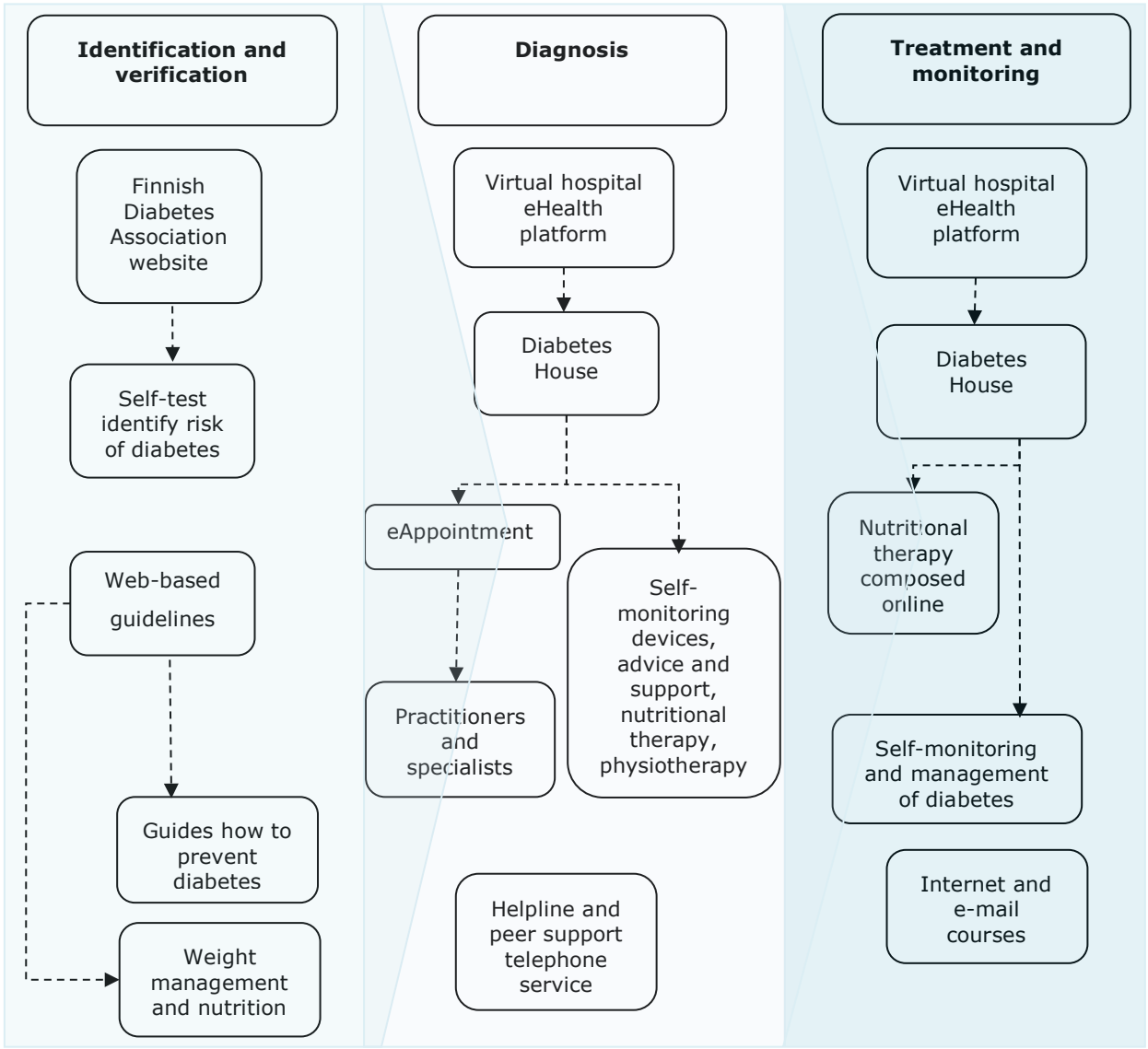
Source: ESPON (2018)

[76] Research2Guidance (2018). Digital Diabetes Care Market 2018-2022. Available at: https://research2guidance.com/wp-content/uploads/2018/08/R2G-Digital-Diabetes-Care-Market-2018-2022-Ready-To-Take-Off-Report-Preview.pdf

5.2 Finland

The availability of eHealth services in Finland for patients diagnosed with diabetes or looking to verify such suspicions is considerable. In fact, it is possible for a patient to use eHealth entirely from first identification of diabetes symptoms all the way through diagnosis and treatment. The system presents a comprehensive approach of how eHealth can be applied throughout the stages of treatment.

Figure 8. Identification, verification, diagnosis, treatment and monitoring of diabetes in Finland using eHealth solutions



Source: ESPON (2018)

Before the actual patient journey begins, people can use a web-based self-test to identify their personal risk of getting diabetes. They can access the test on the Finnish Diabetes Association

website.[77] There are also web-based guidelines and recommendations on how to prevent diabetes, particularly related to weight management and nutrition.

Once the diabetes has been diagnosed, there are several support services available. These start with helpline and peer support telephone services, social media groups, web-based and e-mail courses aimed at recently diagnosed patients.

One of the most developed eHealth platforms in Finland is the Virtual Hospital.[78] It was launched in 2018 and it covers several diseases, one of which is diabetes. The Diabetes House at the Virtual Hospital offers a wide range of services including eAppointments, ordering self-monitoring devices and materials, advice and support, nutritional therapy, physiotherapy, mouth, foot and eye health, mental health and psychotherapy, and intoxicant services. Most of these services are available via eHealth applications, and the ones that require traditional appointment, examinations or treatments are integrated through the eHealth platform. Furthermore, the Diabetes House offers a wide range of support material and services for self-monitoring and management of diabetes.

Currently, only diabetes patients from the 5 hospital districts jointly developing the Virtual Hospital platform can access the Diabetes House fully after they get a referral from their local healthcare unit. Most of the content of the Diabetes House however is openly available for anyone interested. The user can also register on the platform after which services of diabetes such as messaging, calendar, symptom diary, and permission requests become available.

The concept of the Virtual Hospital is very new, so awareness of it and its offer are still limited and closely linked to the healthcare units of the 5 hospital districts. However, it offers a shared platform where new and more extensive eHealth services and applications can be developed. Further development of the platform facilitates better and more extensive integration across healthcare units, which is currently not as seamless as it could be.

Other hospital districts offer similar eHealth services for diabetes patients, but the range and quality vary between regions and healthcare service providers across Finland. There are many web-pages and applications aimed at diabetes patients. However, their user friendliness, quality and interoperability vary a lot and diabetes patients may find it difficult to select which ones are the best for their individual purposes. This emphasises the need for support from the local healthcare provider professionals.

Replacing or complementing traditional healthcare services with eHealth services and applications often require significant changes in day-to-day practices, both among healthcare units and professionals as well as patients. However, the economic potential is high, as can be illustrated e.g. by the weight management support services for diabetes patients: the cost of

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[77] Finnish Diabetes Association (2019). Finnish Diabetes Association. Available at: https://www.diabetes.fi/en/finnish_diabetes_association

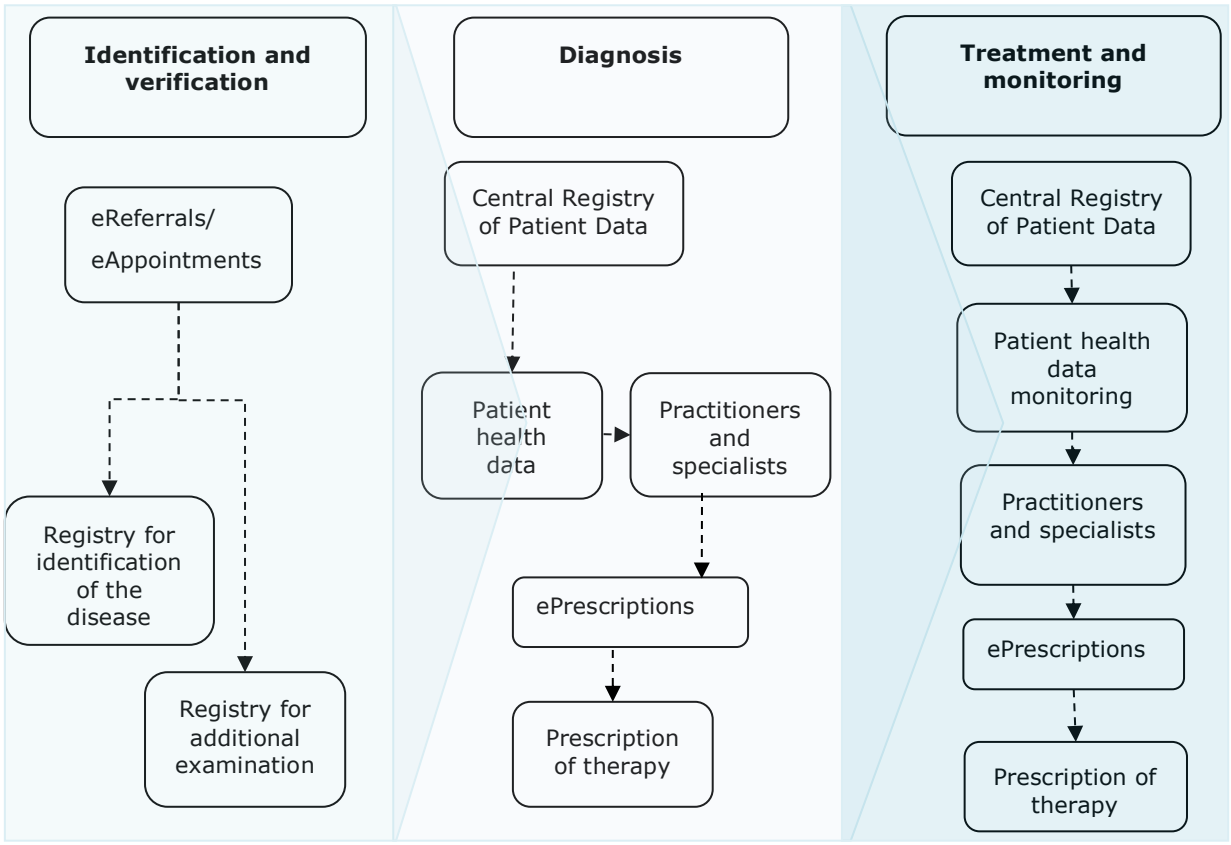
[78] Tervetuloa Terveyskylään (2019). Tervetuloa Terveyskylään. Available at: https://www.terveyskyla.fi/

delivering these services via the Virtual Hospital platform is only one third compared to traditional ways of delivering the same services.

5.3 Slovenia

From the point of view of eHealth services, diabetes patients in Slovenia do not represent a special case and they use all regular eServices available to patients (unlike Finland, where specific solutions are in place).

Figure 9. Identification, verification, diagnosis, treatment and monitoring of diabetes in Slovenia using eHealth solutions



Source: ESPON (2018)

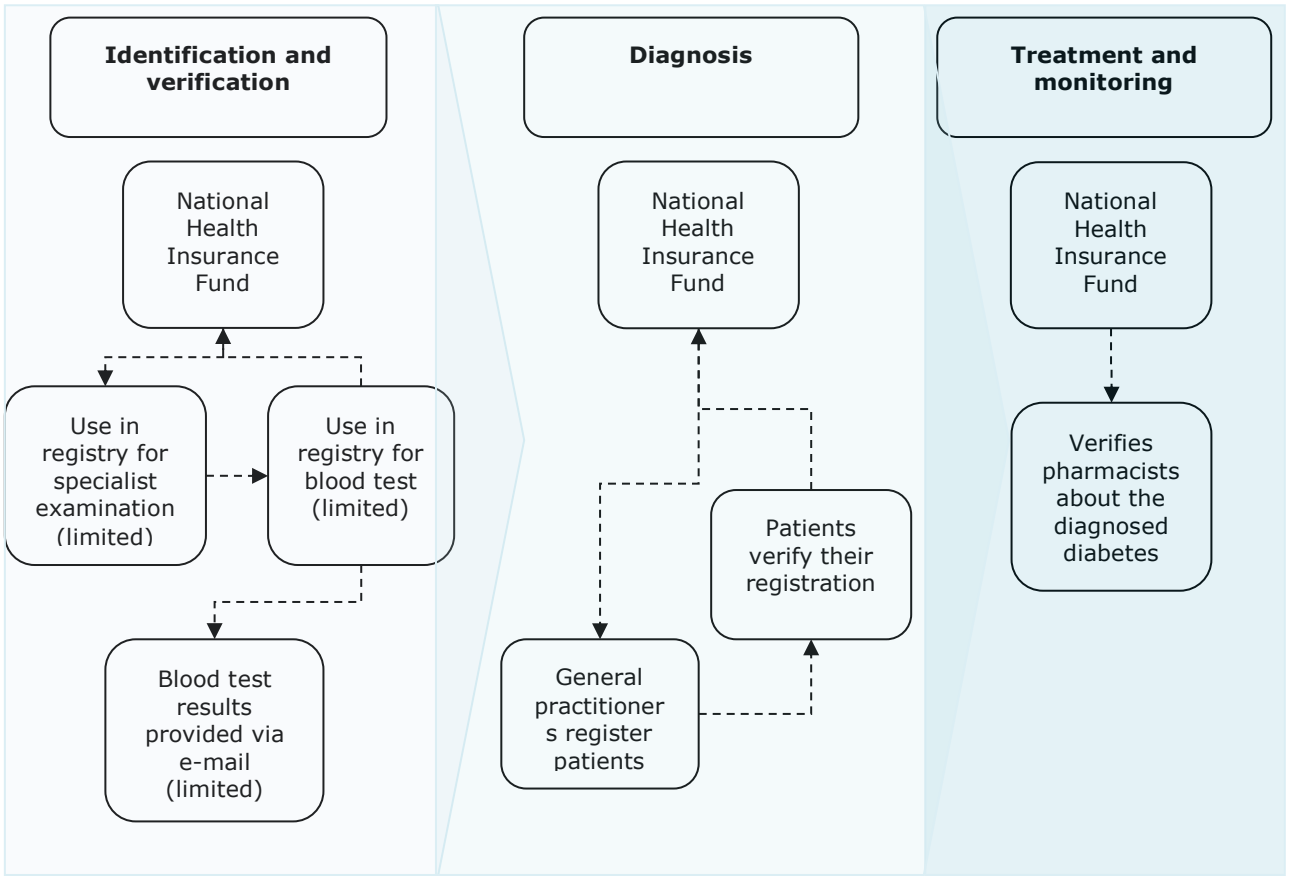
eHealth system in Slovenia has been designed at the national level as a horizontal, integral system covering the entire health care system in the country. The system integrates and links all three levels of the health care system into an integrated platform, accessible and available to all patients and all service providers in the country. This means in practice that regardless of the entry point, i.e. at the local community GP centre, specialist clinic or hospital, citizens have access to the same set of integrated services and, via platform zVem, also to the same set of electronic medical documents. The most frequently used integrated services are the eReferrals/eAppointments and the CRPD, when fully used, provide via zVem key documents and information to stakeholders in a patient pathway across the national health care system.

At the moment, the weakest points in the system are the numerous internal hospital information systems, many of which are not yet fully integrated with the national interoperability backbone and therefore not yet sending all relevant medical documents to the CRPD.

5.4 Bulgaria

Given that there is currently no integrated electronic healthcare system in Bulgaria, much of the journey of a patient with diabetes involves visiting the doctor and using of documentation largely in paper format with multiple trips to different institutions. The following figure highlights areas where digitisation is being applied in health services in Bulgaria.

Figure 10. Identification, verification, diagnosis, treatment and monitoring of diabetes in Bulgaria using eHealth solutions



Source: ESPON (2018)

If a patient is concerned about having diabetes, they have to visits their personal doctor (GP). Observing the symptoms, if the GP suspects that the patient is suffering from diabetes, s/he requests a test in the NHIF system and directs the patient to a specialist (i.e. an endocrinologist). The request is registered in the NHIF system and a printed copy is handed to the patient.

The patient then registers for an appointment to visits the hospital and presents the printed copy to the specialist. The specialist doctor then registers the test in the hospital software, which sends the information daily to the NHIF. Note that the need for two separately and independently registrations in the NHIF. The patient is examined by the specialist and receives a direction for blood tests in the laboratory. Depending on the types of tests, the chosen laboratory and on whether the laboratory has a contract with the NHIF, the request for test is either registered and later reimbursed or the patient is required to pay for the tests. The test results are provided to the patient in either paper format or via email or access to a web platform. In both cases, the patient is required to present the results to the specialist (with some exceptions when the laboratory is in the same hospital and is connected with the hospital's patient register).

After the specialist considers the results of the blood test and the earlier examination, a diagnosis is made and the patient receives their diagnosis documentation together with a protocol for 'hospitalisation', which in the case of a diabetes patient may mean the monitoring and regular checks performed by the GP. The patient has to present these documents to their GP, who in turn, registers these in the NHIF system and assigns the patient as assigned to the GP. Finally, the GP notes this procedure in a second protocol and gives it to the patient.

Following this procedure, the patient visits the local NHIF office, hands in the (second) protocol that certifies their hospitalisation and assignment to their GP. The NHIF office ratifies it and registers it in their system – the patient is now registered as a hospitalised diabetic patient in their insurance profile. After the patient returns the NHIF-ratified protocol to their GP, they also need to buy a personal prescription booklet in a stationary store. The GP then provides prescription for insulin and blood sugar testing strips, and fills in the patient information in the prescription booklet and signs it.

The patient can then proceed to visit a local pharmacy that has a contract with the NHIF, presents their prescription booklet and the GP's prescription. The pharmacist checks in the NHIF system if the patient is insured, verifies the validity of the paper documents (prescription booklet and the actual prescription) and (depending on the rate of reimbursement) either sells or provides free of charge the prescribed insulin and test strips.

It is apparent that the process is rather cumbersome and mostly relies on the patient bringing information in paper format from one provider or institution to another. The opportunity for savings and simplification appears considerable, especially if an integrated system updated in real-time could connect all key players. Such a solution would not only facilitate and shorten the process, but also provide a much-needed transparency.

6 Socio-economic benefits of eHealth

6.1 Socio-economic benefits of eHealth in Estonia, Finland, Slovenia and Bulgaria

Table 14. Socio-economic benefits of eHealth in Estonia, Finland, Slovenia and Bulgaria

Estonia	
Benefits	• Improvement of the quality of health services which translates to improvement of the quality of life for Estonian citizens – increased life expectancy, time and money saving by engaging with the healthcare system through digital services. • Improved cost-efficiency. For example, since the introduction of ePrescription the service has been increasingly used by patients and healthcare providers. As a consequence, costs of paper-based prescription by the EHIF in 2009-2013 have been noted to have decreased from €63,668 to €1,628.
Limits	• The impacts and benefits of existing and planned eHealth services are not systematically evaluated. Thus, the development of eHealth is driven more so by the perceived positive impacts of digitisation rather than empirical evidence. • Lack of well-defined evaluation approach for eHealth service impacts, especially regarding time savings and enhanced healthcare quality. A more systemic approach to impact evaluation for digital health services would benefit the country long-term.
Finland	
Benefits	• Improvement of access and quality of health services. eHealth is considered to facilitate more personalised healthcare. Provision of healthcare services to remote regions is also among the considered benefits that drive eHealth development. • Improvement of time and cost-efficiency due digital solutions streamlining healthcare processes. For example, the ePrescription system detects misuse of pharmaceuticals and monitors the overall pharmaceutical use. This allows the system to determine potential problems arising from combinations of pharmaceuticals and leads to increased patient safety while minimising expenses on pharmaceuticals. eConsultations are noted for improving time-efficiency by allowing patients to receive medical consultations despite potentially long distance between patients and healthcare providers. This results in faster consultations for a higher number of patients.
Limits	• The main obstacle is represented by lack of monitoring the actual economic and social impacts of digitised healthcare services in Finland. Focus has largely been on monitoring the introduction, distribution and use of eHealth services rather than effectively measuring and conceptualising their impact.
Slovenia	
Benefits	• While evaluations for concrete benefits are not yet available is Slovenia, the opinion among healthcare stakeholders is that digitised healthcare has improved access and quality of health services and increased transparency of health services which translates in greater trust from the patients. – In Slovenia ePrescriptions stand out for their impact towards availability and quality of health services. ePrescriptions in everyday medical practice almost completely replaced classical paper-based prescriptions. The service has enabled patients to get some prescriptions without visiting healthcare providers. For instance, in the case of patients suffering from chronic diseases, ePrescriptions have allowed to have better access to their mediation. ePrescriptions is also an archive with a large amount of data available for medical studies.

Limits	• Lack of comprehensive evaluation of the impacts of eHealth solutions on quality and availability of health services. eHealth evaluation is currently being prepared by the Ministry of Public Administration. • Need for systematic surveys and evaluations especially in light of future direction for eHealth in the country remaining undetermined.
Bulgaria	
Benefits	• Personal Information System (PIS) has significantly facilitated the process of choosing and assigning a GP.
Limits	• Very limited use of the PIS and not a satisfying electronic medical record and crowdsourced control mechanism. • PIS remains the only realised solution.

6.2 Comparative analysis of socioeconomic benefits of eHealth in Estonia, Finland, Slovenia and Bulgaria

Independent evaluations of socio-economic benefits of eHealth interventions are necessary for accountability, transparency and decision making for future strategies. This requires the development of a suitable monitoring and evaluation framework with measurable and accepted indicators to provide evidence about the impact of introducing digital health. Identifying the socioeconomic impact stemming from eHealth solutions amongst benchmarked countries, however, has proven to be a challenging task due to the widespread lack of **standards of measuring concerned impacts**. In fact, none of the analysed countries have established a suitable nationwide framework that would allow for a systematic and reliable assessment of digitisation of healthcare yet. A partial exemption is represented by the **Finnish** city of Oulu, which has established the digiHealth Hub.[79] One of the explicitly communicated goals of this initiative is to develop an evaluation framework with appropriate and measurable indicators for eHealth uptake and data governance. However, this entity and action has not entered the national mainstream yet and does therefore merely classify as an advanced and materialised strategy. In a similar vein, an independent evaluation of the ePrescription in **Estonia** performed 6 years after its launch found that there is only little empirical evidence available to confirm if the benefits originally expected of the service were achieved. Instead, policy makers have to rely almost exclusively on perceptions and potentially partial evidence, or made frameworks deemed to be suitable have been established on a regional or geographically limited scope. To partially tackle these issues and lay the foundation for an optimally fruitful analysis, an indicative (and by no means exhaustive) framework has been applied within the scope of this analysis (see **Error! Reference source not found.**), where the classification ranges from "- -" (very m inimal impact), over "-" (minimal impact), "o" (moderate impact), "+" (significant impact), to "++" (highly significant impact). These classifications are applied to the categories i) economic impact, ii) impact on quality of healthcare, iii) impact on access to healthcare, and iv) the aforementioned notion of impact evaluation. In this sense, our analysis can be regarded as one

[79] University of Oulu (2019). DigiHealth Knowledge Hub. Available at: https://www.oulu.fi/cht/node/55195

of the first steps to support the provision of a broad overview of the effects of digitisation of healthcare through desk-research and interviews.

Table 15. Socio-economic benefits of eHealth

	Economic Impact	Impact on Quality of Healthcare	Impact on Access to Healthcare	Impact Evaluation
Estonia	+	++	++	-
Finland	++	++	++	o
Slovenia	o	o	o	- -
Bulgaria	- -	- -	- -	- -

Source: ESPON (2018) (Note: "- -" (very minimal impact), over "-" (minimal impact), "o" (moderate impact), "+" (significant impact), to "++" (highly significant impact)

In **economic** terms, eHealth solutions are believed to contribute to improved cost-efficiency in all countries. Most specific and significant financial impacts can be noted in Estonia and Finland. For example, cost savings have been registered ever since ePrescriptions replaced paper-based prescriptions in Estonia; The costs of paper-based prescription forms bought by the EHIF in 2009-2013 have decreased from €63,668 to €1,628. **Finland** proliferates itself with its ePrescription system, which can detect misuse of pharmaceuticals, monitor the overall pharmaceutical use and detect potential problems arising from combinations of pharmaceuticals, etc. This is likely to not only improve patient safety, but also minimise expenses on pharmaceuticals.

The latter notion naturally ties into the impacts on the **quality of healthcare** stemming from digitalised approaches to healthcare. eHealth comes along with the benefit of a central management of medical provision (more centralised in some countries, such as Estonia, than others, namely Finland). This notion is directly linked to targeted and personal approaches and enhanced quality of healthcare. The vast majority of stakeholders interviewed within focus countries, and in particular those having direct ties to **Slovenia**, believed that digitisation of health improves the standard of healthcare services (Bulgaria being an exception due to its limited progress to date). In **Estonia**, the introduction of eHealth strategies is expected to improve the quality of health services and the quality of life of people, ensuring more healthy life years, and save time and money.[80] Similarly, **Finland's** authorities identify increased improved time-efficiency as a major benefit. In addition, a crucial element in the social response to and effectiveness of eHealth is bundled in people-related and communication factors of these solutions: the user must understand the benefits and receive training to adopt the new tools and routines. If these preconditions have been met, studies show that eHealth supports the sufficient and timely provision many services, such as child psychiatric services in remote and sparsely populated areas of Finland for instance.

[80] Ministry of Social Affairs (2015). Estonian eHealth Strategic Development Plan 2020. Available at: https://www.sm.ee/sites/default/files/content-editors/sisekomm/e-tervise_strateegia_2020_15_en1.pdf

In a like manner, **access to healthcare** qualifies as a major point of consideration against which concerned countries inevitably need to be compared against. While according digitalised services are widely used in Estonia and Finland, their uptake and thereby access to such is less pronounced in Slovenia and Bulgaria. For instance, in Estonia eHealth services are commonly employed by citizens, healthcare providers and administrators alike and from a public administration viewpoint and the implementation has led to potential efficiency gains. Finland mostly benefits from its vast coverage of eConsultations, which reduce relative distances and thereby enable faster consultations for a higher number of patients. In general, access to healthcare can be noted as a distinct and definite benefit created by digital services, as remote consultations can be conducted, or less frequent physical meetings are necessary.

The verdict for **Slovenia** and **Bulgaria** is less evident. In Slovenia's case the implementation of eHealth solutions is still a fairly new, with many only being implemented in 2017. However, impacts, attitudes among users regarding the implemented solutions are being gathered. This evident in the fact that some mid-term action plans exist for individual areas in Slovenia, which were prepared on the basis of previous experiences, user suggestions and developmental needs identified in the specific fields. Digitisation of public sector activities and services is generally regarded as the key instrument for improving the quality of public services, accessibility and transparency on one hand and reducing the costs on the other. General consensus is that the introduction of eHealth has somewhat led to easier access to public healthcare services and better quality of services in terms of less paper work for the doctors, reduced administrative costs, less unnecessary work for healthcare institutions. Yet, socio-economic benefits in Slovenia have by no means materialised to the degree they have in Estonia or Finland and are instead more often than not anticipated rather than measurable. Bulgaria's record of socio-economic benefits certainly is the most limited in this direct comparison. In fact, the Personal Information System (PIS), apart from being the only realised solution, remains widely unknown and unused and, where adopted by users, perceived as marginally valuable or lack value altogether. Potential benefits such as facilitating the process of choosing and assigning a GP to their patients remain uncommunicated and unused.

Besides the primary categorical elements covered by **Error! Reference source not found.**, f urther impacts can be noted, too. For instance, the introduction of eHealth services is commonly considered to result in a higher degree of transparency, which ultimately reinforces trust in eHealth solutions as well as in healthcare in general. Finally, it is stressed that a suitable evaluation framework should consider intended and unintended positive and negative costs and benefits of digitisation of healthcare in their respective contexts, against business plans and targets. This optimally allows for a comparison with such situations in which eHealth interventions did not take place and account for the real opportunity cost of digitisation.

7 Recommendations

7.1 Estonia

eHealth in Estonia has a sound legal, infrastructural and technical framework, where the basic set of services is built on. In this regard, Estonia is considered being well ahead of most of the EU countries.

Table 16. Recommendations for Estonia

Recommendations for Estonia	
Recommendations for further developing and delivering eHealth solutions	• Strengthen leadership and ensure implementation of existing eHealth strategy. Despite the recent dynamics in eHealth governance in Estonia, there is lack of strategic leadership by MoSA, implementation of the eHealth strategy is stagnated, adequate funding is not ensured, stakeholder engagement and co-ordination are even weakened. As a result, the pace of development of eHealth is slowed down.
	• Include end-users to eHealth development. eHealth systems and services are often developed centrally by the state without understanding the real needs of the end-users – citizens, patients, healthcare professionals. For example, this concerns the untapped potential of the national patient portal to serve as an open platform for eHealth services and applications for the preventive, predictive and personalised care and patients' empowerment.
	• Unlock the data for improvement of existing and development of new eHealth services. This includes system for granting access to third-parties as well as providing platform for patient's consent management. Today, there is no possibility for a person to share his/her data from the health information system with entities outside the healthcare system (third parties like app developers or research institutions). However, with patient's consent, the data should be able to move securely between the various sources of data outside of healthcare and the health information system.
	• Make health information system available to exchange patient-generated data. As people increasingly use digital tools and technologies in managing their health, a large amount of health data that could be relevant to health professionals and healthcare system is being recorded outside of healthcare services. Despite 74% of citizens willing to share the information from their wearables or mobile apps with their doctor, the health information system does not yet enable this.
	• Continue to invest in developing and deploying AI in eHealth. The performed evaluation showed that Estonia has been increasing efforts in AI development for its eGovernment and eHealth is no exception to this (with a specific project under MoEAC to analyse and prepare the implementation of AI). With efforts in evaluating how AI could be deployed it is necessary to prepare the legal landscape to govern AI usage in healthcare. One area where Estonia could see long-term benefits is collaborating with neighbouring Finland which itself is also investigating AI usage. With both countries already ramping up their cross-border eHealth collaboration.

Recommendations for deploying funds more effectively	• Provide innovation funding and financial incentives for the development and faster deployment of new eHealth services. To develop new eHealth solutions and create evidence of the possible benefits, piloting has become a widely used practice both in Estonia and across the EU. The challenge is that in most cases these small-scale experiments/research projects, even with promising results, end without further implementation. For example, this is what has happened with most of the telemedicine pilot projects in Estonia. To avoid the "death by the pilot" it is crucial to have a funding and process in place to support the whole innovation process from an idea to the market. As eHealth usually changes existing processes in healthcare, the development should not be limited to technology aspects, but include elaboration of new services, organisation as well as funding models.
	• Build eHealth evaluation capability. Better understanding of the potential benefits and impact of eHealth solutions is needed to justify the investments and facilitate uptake. However, there is limited experience and expertise to perform such evaluations in a systemic manner. This concerns both the eHealth services developed centrally by the state as well as those originating from other market players (e.g. service providers, medical societies, health IT companies, digital health start-ups, etc) and seeking for the reimbursement. In order to make evaluation a routine in eHealth planning, development and implementation, the respective methodologies should be agreed on and the capacity to perform the analyses be strengthened.
Recommendations for digitalising health services	• Strengthen healthcare professionals' demand for digital health solutions, encourage their cooperation with start-ups and promote 'doctorpreneurship'. Motivation of health professionals to uptake digital solutions needs to be targeted as 63% of citizens would expect doctors and nurses to accompany the prescription of medical treatments with the supportive digital interventions. Key problems here are awareness and trust, whereas the use of validation systems like ORCHA in the UK could help to reduce the uncertainty associated with digital health solutions (i.e. safety, clinical evidence, ease of use). At the same time, healthcare professionals are in the best position to identify the needs or even come up with and/or co-create digital health solutions in co-operation with start-ups.

The challenge for Estonia is on how to move to the next phase of eHealth, where the focus is on the better use of data for citizen-centred and user-friendly services rather than on data collection. This requires a much better understanding of users' needs to improve the usability of the data collected, add functionalities to the existing services and considerably increase the pace of development, adoption and deployment of new digital health solutions.

7.2 Finland

Finland, like other Nordic countries, is continuously placed on the top of any international report on competitiveness, innovation capacity, low corruption, safety and even happiness. Finland is especially recognised for its efficient healthcare, highly educated and digi/tech savvy citizens and government that supports renewing of the society. It is expected that the Law on the Secondary Use of Social and Health data will come in force in spring 2019 that will also set the legal frame for the Data Permit Authority and the national Digital Data Service Operator

(Isaacus –project).[81] In parallel, preparation of the act on the National Genome Centre and the use of genome data in health care and scientific research as well as renewing the Biobank law are in the process. Several centres of excellences that generate, manage and use health data like Cancer Centre Finland, National Neurocentre and Finnish Biobank Cooperative have been established recently.

[81] Sitra (2018). One-stop shop for well-being data – Isaacus laid the foundations for the future. Available at: https://www.sitra.fi/en/articles/one-stop-shop-well-data-isaacus-laid-foundations-future/

Table 17. Recommendations for Finland

Recommendations for Finland	
Recommendations for further developing and delivering eHealth solutions	• The coming and aforementioned healthcare system reform is likely to use a scoring system based on which cost predictions and calculations for different population groups can be performed. This scoring has raised a lot of active discussion in media. Especially private healthcare service providers appear to already have developed rather advanced systems that allow them to identify most profitable customer groups and potentially give less favourable ones a disadvantage. At the same time, some frustration has been expressed with the speed at which eHealth infrastructure is developing, as stakeholders seem to be willing to use more advanced systems and technical solutions. Harmonising technical innovations and their implementation with ethical and socioeconomic concerns has to be at the very core of any further discussion.
	• The objective for future eHealth should be citizen centric approach that offers ubiquitous, personalised and intelligent services having emphases in the prevention of diseases and social problems and engaging/empowering people to take care of their wellbeing.
	• Communication strategies that involve healthcare providers have been a success factor in disseminating eHealth related information across patients. Hence, future promotional campaigns should continue to strongly rely on professionals and service provider staff, supported by more technically detailed and holistic information campaigns on one hand, and more directed campaign for special user groups such as elderly or disabled people on the other.
	• As a concluding and inevitable recommendation, the establishment of a more suitable monitoring and evaluation system for the impacts of eHealth or the general digitisation of healthcare needs to be a core ambition. This could be done in the form of guidelines, which should cover metrics, KPIs and evaluation approaches most suitable for individual eHealth services and applications, specific types of eHealth systems, and eHealth platforms. Concerned evaluation and monitoring systems should capture economic as well as social (incl. quality) benefits with respect to all stakeholder groups, while understanding the wider context in which they materialise (e.g. wider ICT infrastructure, healthcare governance, service digitisation in general etc.). Establishing evaluation and monitoring systems for the KanTa platform is strongly recommended. The establishment of such interfaces on a regional scale could rather be based on voluntary action (i.e. guidelines) or integrated into the current evaluation and monitoring system regarding healthcare services and their provision.
	• Currently AI and big data analytics in Finnish healthcare sees limited use. The current legislation on secondary use of generated data foresees the granting of permissions on a case-by-case basis which limits AI deployment. However, Finland is also notable for the growing development of AI in general. Finnish legislators should work towards evaluating how to expand the use of AI deployed in healthcare which would benefit both users (i.e. increased efficiency of eHealth solutions through AI-driven management) and healthcare providers (i.e. use of big data analytics in researching new way to combat diseases). In this Finland could also look

	towards collaborating with Estonia – a neighbour which itself is also looking into AI in healthcare.
Recommendations for deploying funds more effectively	• In order to avoid fragmentation of services and loss of resources Finland should now invest in the development of well-operating ecosystem and service platform around the National Data Permit Authority and the Services Operator to facilitate the easy, safe and scalable usage of the data by companies, academia and government. Implementation of these incremental changes will need structured process and dedicated resources for maximizing the outcome and impact. In addition to transforming current social and healthcare to be more citizen centric, data-driven and cost efficient this would boost the high-level academic research, innovations, new businesses and investments to Finland.
Recommendations for digitalising health services	• Finland is well known to be a forerunner in technological development and engineering expertise. Going forward attention should be given towards establishing Finland as the leading country for the testing and implementation of exponential technologies and services like artificial intelligence, robotics and AR/VR also in health and wellbeing of citizens. This requires well-functioning real-life testbed environments, efficient use of innovative public procurement procedures and investments of public funding on research and pilots. Finland should also take a lead in setting the policies and standards in EU level for the application of new data driven solutions and infrastructure.

With the planned healthcare reform, Finland faces the challenges of redesigning the healthcare infrastructure, aggregating regional managing bodies and initiatives into larger organisational structures. In this environment a more integrated and inclusive approach should be considered. Fostering cross-regional and cross-border exchange and interoperability (standards) is a goal commonly formulated in Finland.

7.3 Slovenia

Development of eHealth services is complementary to provision of other public eServices in every country, yet in many ways it has its bespoke elements. Well designed, user-centred eHealth services can significantly improve the quality of life of citizens in every country. Since the beginning of the global financial crisis in 2008, which severely affected Slovenia, the country has been facing a period of political instability (five governments in 10 years), which influenced in many ways the implementation of most public policies including the field of eHealth. Recent dynamics of eHealth development in Slovenia resulted in visible progress and, according to the available surveys also in general in high satisfaction level with eHealth services among the citizens. Despite these early positive signs, the future of eHealth development is still unclear. This stems from up to date weak implementation of healthcare policy reforms, including eHealth policy, as well as the lack of clear strategy to continue beyond 2018. The sole strategic document currently in place i.e. 'Resolution on National Plan of Health Care between 2016 - 2025' touches this area only marginally. Over the last few years, Slovenian health care system has been facing serious problems. The gap between growing demand for health services

among aging population and the capacity of existing healthcare system and quality of its services is getting bigger every year.

On the basis of the past experiences, approaches and good practices in other countries as well as the expressed opinions and proposals of the key stakeholders, we can outline some of the important eHealth public policy points and recommendations for Slovenia in the future:

Table 18. Recommendations for Slovenia

Recommendations for Slovenia	
Recommendations for further developing and delivering eHealth solutions	• Monitoring and evaluation. So far, there is very scarce evidence that the government has been doing any systematic or even improvised monitoring and evaluation of the impacts of eHealth services. Regular monitoring, ex-ante and ex-post evaluation of the eHealth programmes and projects is the key instrument for efficient and effective development of eHealth solutions and rational use of resources. Evaluation should cover economic, administrative, quality/accessibility of services and social dimensions.
	• Better communication among the key stakeholders. It seems that communication and cooperation among the key stakeholders, is not as efficient as it should be in order to make further development of eHealth services more effective and faster.
	• Ensure compliance with the sectoral legislation requiring compulsory use of eHealth services (both in terms of integrating to zVem, as well as using eHealth applications, sending documents to the Central Registry of Patient Data, reporting accurate data to individual applications (eAppointment), reporting to registries, etc.).
	• Encourage the constructive participation of healthcare professionals (professional associations) as well as civic society associations in open issues concerning the eHealth services and boost their unity in defining professional content standards for clinical treatment (code lists, access policies, working procedures, data security, etc.).
Recommendations for deploying funds more effectively	• Stable financing. A solid financial plan with clearly defined sources of funding, monitoring and auditing should be made. Many service providers and in particular IT solution developers are uncertain as they don't know how to deploy their resources and how to invest in the field since there is neither clear strategy nor clear financial scheme how much money the government is planning to invest into this field in the future.
	• Direct funding aimed at eHealth development towards positive promotional campaigns for nationwide use of eHealth services. This campaign should target both healthcare professionals and citizens.
Recommendations for digitalising health services	• Slovenia needs to develop a new strategy for eHealth development. Actions towards supporting a new strategy should include the preparation and adoption of the novel medium-term strategic framework in the field of healthcare informatics (i.e. eHealth services) and outline the main development directions. Almost all activities which were carried out over the last three years in Slovenia in order to implement most important eHealth services like ePrescriptions, eReferrals/eAppointments, CRPD etc., were defined in distant year 2005 when the National eHealth Project was launched. Since then, there were no updated or new strategic documents, which would adjust all planned activities to the current demand of healthcare system in Slovenia and new technological development. Lack of clear strategy aims and objectives as well as coordination of the activities at the national level caused that many health care service providers, in particular bigger hospitals, went their own way and developed their own solutions, which are now difficult to integrate, maintenance costs are very high and further fate is unclear. In order to avoid these problems in the future, government would need to prepare regular strategic

	and action plans for the periods of 3-5 years ahead with concrete aims and objectives, expected results, milestones, indicators, reporting and clear responsibilities.
	• Organisational transformation and innovation. Effective implementation of eHealth services requires and triggers adaptation of internal processes and procedures, documents, work and data flows. There is very little evidence that digitisation of health care system in Slovenia has been used as an important lever for in-depth reorganisation of obsolete organisational structures within the entire health care system in Slovenia and implementation of new innovative business models and processes.
	• Incentives and promotion. Health care public policy should put more stress on 'motivation' factors for all stakeholders, so that implementation and use of eHealth services represent win-win solution for all stakeholders. Health care service providers should have tangible benefits and financial incentives for use of eHealth services, while the patients should be rewarded by easier access, better quality of services, less paperwork and better transparency of the whole system.
	• Implementation of eHealth consultation services. One of the weakest points of the Slovenian health care system is communication/consultation between the patients and health care providers, in particular different doctor specialists, when patients need advice in non-urgent medical conditions. There is a number of internet forums trying to fill the gap in some most frequent specialities, like cardiology, urology, diabetes etc. Systemic eSolution, as part of the health care system, would make consultation between patients and relevant medical consultant much easier, more efficient and timely. Innovative eConsultation solution using modern AI solutions (i.e. managing the digital consultations by cross-referencing similar health ailments that were registered in the system), available 24/7 via different communication channels including mobile apps could significantly reduce currently extreme pressure on urgency medical centres in Slovenia.
	• Better data analytics. In the current health care databases, although still often fragmented, is wealth of information and data about the functioning of the health care system in Slovenia. This source of information could be much better used, comparing to the practice today, for planning, monitoring and evaluation of the efficiency, expenses etc. of the health care system as whole as well as individual health care providers and services.
	• Resolution of structural and governance problems in the healthcare system. In many individual public healthcare providers, in particular bigger hospitals, it is evident 'management crisis' (for instance frequent changes of management). Consequently, this lead also to neglecting the importance of healthcare informatics, i.e. eHealth services.

The new Slovenian government is in office since September 2018 and seems to be aware of the need to take actions for future of Slovenian eHealth. The healthcare system reform is on the top of its priorities. In this context, further comprehensive digitisation of the healthcare sector should have been seen as an important area for development.

7.4 Bulgaria

As for Bulgaria, concrete policy recommendations are hard to produce since the country has demonstrated a lack of cohesive approach in developing an effective approach towards digitisation of healthcare (with notable instances where entire government organisations were excluded from participating in planning phases where they were required to be involved in).

Paradoxically, the area where Bulgaria showed value (and could perhaps be an example to other stakeholder regions) is monitoring of implemented activities, with the government's audit office being one of the few organisations that assessed efficiency of implementing eHealth.

The current approach of taking incremental steps in developing eHealth may be adequate, especially if the reduced scope would allow stakeholders to concentrate on a better management structure and more efficient implementation of digitalising healthcare. This is also perhaps the right course of action on how eHealth should be implemented as Bulgaria's current lack of ability to develop and implement eHealth strategic plans may indicate larger institutional issues in the healthcare system.

In this regard, a more specific set of recommendations could be drawn from comparing the country to the other EU MS – while the country is obviously lagging behind in digitisation of health services, Bulgaria has the advantage of being able to learn from others – to acquire best practices from the systems in Finland and Estonia and learn from the challenges and obstacles encountered by Slovenia when the country experience a long interruption hen implementing its own strategy. In brief, Bulgaria must immediately create a simple but stable base of minimal services on which to build further eHealth solutions.

Table 19. Recommendations for Bulgaria

Recommendations for Bulgaria	
Recommendations for further developing and delivering eHealth solutions	• Keeping a centralised approach to eHealth initiative – digitalizing initiative is currently in the hands of central institutions and should stay so despite the lack of results so far. The private efforts in the sector are fragmented, partial and insufficient.
	• Potentially moving away from the larger initiative of eGovernance and eGovernment – while common and integrated State approach to digitisation is more than welcome, the lack of results and plenty of unimplemented strategies indicate that an all-in-one approach may be a challenge too complex to handle in the circumstance of a questionable political continuity. Pursuing eHealth implementation separately might be a valid way to bring implementation, results and satisfaction faster.
Recommendations for deploying funds more effectively	• Funding should remain public but should rely more on national expenditure – funding national eHealth programs through EU funding cannot guarantee continuity, is fragmented and inconsistent at best and communicates a lack of commitment by central government.
	• Standardisation – Bulgaria must establish national standards for data and IT infrastructure - there is a strong need of common standards for data format, terminology, and data protection. In

Recommendations for digitalising health services	the best-case scenario, the standards would be coherent with latest cross-border developments (eStandards project) and thus allow easier implementation of EU-wide health services in the near future.
	• A centralised regulatory effort is also in order – Bulgaria is still missing its legal framework related to health data governance and protection. The opportunity here is to tackle GDPR requirements and patient-centred control over data and health data with a single stroke of legislation – a health data management act or similar.
	• Create the base of the health information system, EPR & EHR – an electronic record that covers all interventions and pharmaceuticals for all citizens. Possibly the EHR is an extension of the existing PIS to all patients. For simplicity, ease of use and less workload for medical professionals, it can simply acquire all epicrises in XML format, similar to the practice in Estonia.
	• Further steps – ePrescription, eRegistrations and eConsultation, in that order – as seen from the report, these three eHealth solutions are widely implemented across the studied countries and are also expected to bring the most visible results in terms of cost reduction, time-saving and access to services. ePrescriptions are a logical extension of the EHR that covers a larger part of the patient's journey and keeps a better track on patient history, as well as financial flows. eRegistrations builds further on the system and alleviates GP and other medical professionals from some of the administrational burdens. As seen in the diabetic patient's journey, record, registration and prescription are the predominant part of the effort for the patient and digitalizing them will help the entire system deliver better results. eConsultations require a good and working infrastructure, as well as a more educated patient-user, but should alleviate the physical flow of patients. It is however a more complex services and should be implemented last of the set.
	• Monitor and communicate better – the national audit proved instrumental in assessing the (lack of) progress in eHealth in Bulgaria. Making it a regular occurrence or establishing a scheduled monitoring practices should provide policy makers with better data to make decisions on, as well as a solid base for the measurement and communication of the benefits and savings brought by the digitisation. Expected benefits should also be communicated before and during launch of the solutions, in order to ensure wider adoption and coverage. Furthermore, a national program for educating patients and professionals on using the eHealth applications should be put into place.

In short, Bulgaria must establish the base of its eHealth, government-funded programme. It should first concentrate towards creating common standards and regulation and then proceeding with the EHR and then ePrescription, eRegistration and eConsultation solutions. Each module should follow the best practice and learning from the other EU MS, be communicated appropriately in advance and preceded by an educational and communication campaign, while the entire process should be monitored on an annual basis.

8 Further research direction

- As made evident from the report, evaluation of eHealth impacts, particularly evaluations of socio-economic benefits of eHealth, were an issue consistent across Estonia, Finland, Slovenia and Bulgaria. Such evaluations are necessary for accountability, transparency and decision making for future strategies. This requires the development of a suitable monitoring and evaluation framework with measurable and accepted indicators to provide evidence about the impact of introducing digital health.
- Labour movement was cited to play at least some part in the development of cross-border cooperation for eHealth in Slovenia (with the migrant workforce direction corresponding to the country's cooperation partners of Italy and Austria). The Estonian-Finish collaboration was also noted as a case where labour movement between the countries acted in favour of increasing cooperation in healthcare. However, further research into labour movement's effect on eHealth development and especially cross-border eHealth would be necessary to draw any substantial conclusions on the degree of importance it plays in facilitating collaboration. It is also an interesting research dimension because if cross-border eHealth could facilitate positive impacts for labour movement, such evidence could incentivise the other neighbouring EU MS to follow the example of Estonia and Finland.
- Considering cross-border interoperability of eHealth solutions, the study was conducted at a time when promising initiatives are being developed; however, not yet launched and lacking evidence for the effectiveness, efficiency, impacts, etc. The ePrescription exchange between Finland and Estonia as well as their participation in EU programmes (cross-border eHealth data based on the European eHealth Digital Service Infrastructure (eHDSI); European Reference Networks) or Slovenia's progress on the National Contact Point which should serve as the platform for international exchange of digital health data. These efforts (among others) should in the future provide more evidence for cross-border cooperation and EU MS looking towards initiating similar partnerships would benefit from future research on the progress made in Estonia, Finland, Slovenia and Bulgaria in their cross-border efforts.

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