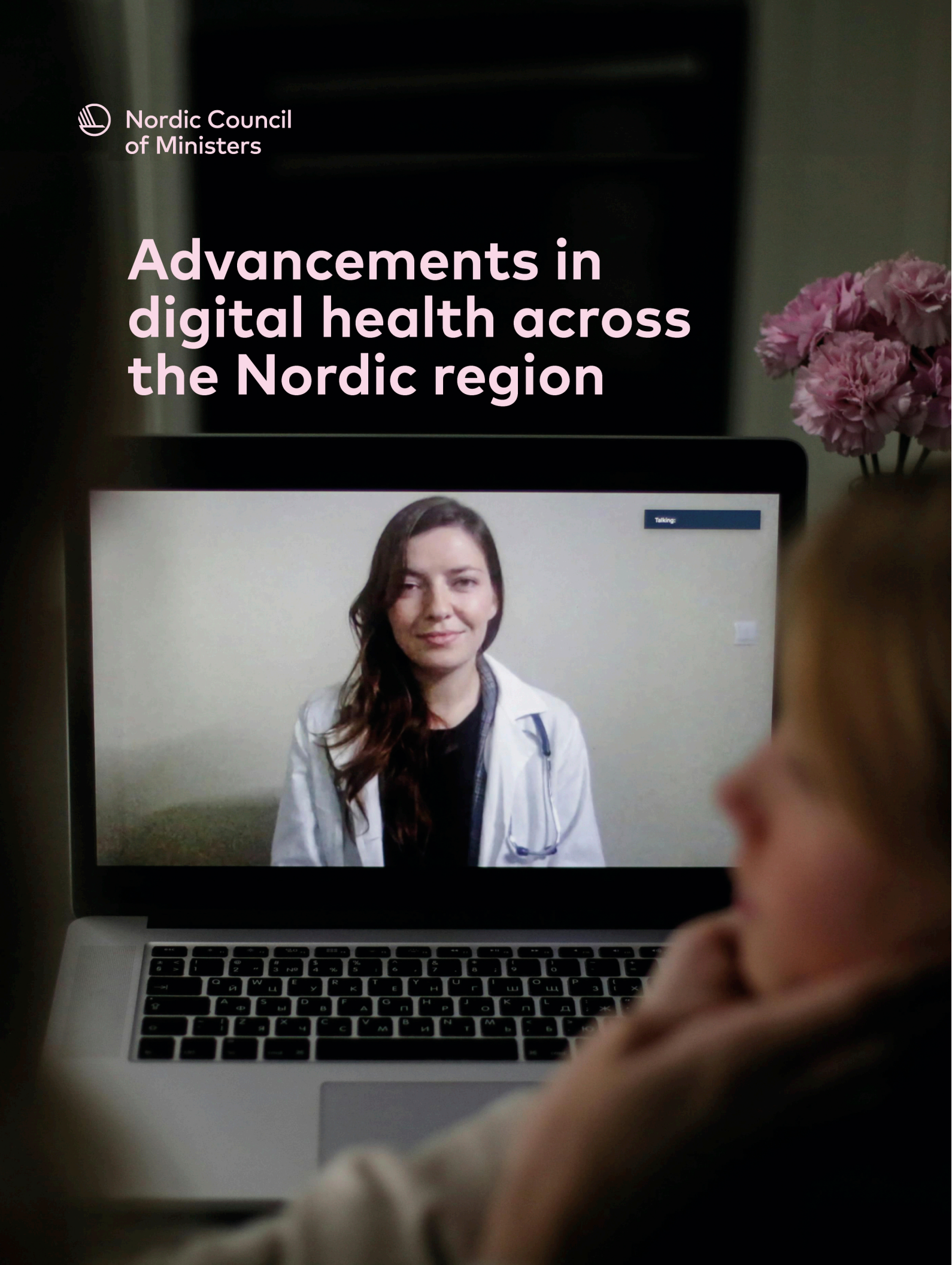
Nordic Council of Ministers

Advancements in digital health across the Nordic region



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This publication is also available online in a web-accessible version at:
https://pub.norden.org/temanord2025-573

Foreword

Finland and Åland hold the co-presidency of the Nordic Council of Ministers for 2025. The yearlong presidency period continues with efforts to deliver on the Nordic Vision 2030. Special focus areas are according to Finnish Prime Minister Orpo as follows: "The Finnish and Ålandic co-presidency seeks to address three key areas: The welfare of children and young people, the bolstering of overall security, and improving Nordic competitiveness."

Digital health is closely coupled with special focus areas as well as the Vision 2030 goals. Therefore, as a delivery related to the presidency goals, Ministry of health and social affairs Finland launched preparation of this publication on digital health as an overreaching transformation in health care services in all five Nordic countries with specific focus on current development with highlighting not only ongoing efforts in each Nordic country but also highlighting new capacities related to, for example, telehealth and remote care, and possible technology supported progress in care delivery based on, for example, artificial intelligence. The publication gives a comprehensive view on the current state of the art in Nordic digital transformation, and some key future directions in the Nordic countries as written by the Nordic experts.

This publication underscores the central role of digitalization as a transformative force in advancing the welfare, security, and competitiveness of the Nordic region. The publication, contributed by leading Nordic experts, provides a comprehensive overview of ongoing progress as well as forward-looking perspectives that will shape the next phase of health and social care delivery.

As Finland and Åland undertake the co-presidency of the Nordic Council of Ministers in 2025, this work serves as a concrete contribution to the implementation of the Nordic Vision 2030. It reaffirms our shared commitment to harnessing innovation and digital solutions to ensure high-quality, accessible, and sustainable health services for all citizens across the Nordic countries. The insights and directions outlined in this publication will support continued cooperation and provide a solid basis for strategic decision-making in the years ahead.

November 2025, Helsinki

Sari Palojoki and Riikka Vuokko

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Summary

This publication presents a comprehensive overview of the current state and future direction of digital health in the Nordic countries, with a special focus on infrastructure development, preventive digital health solutions, and inclusion in digital transformation. It supports the objectives of the Finnish and Ålandic co-presidency of the Nordic Council of Ministers 2025, aligned with the Nordic Vision 2030 emphasizing resilience, welfare, and competitiveness.

The first theme explores the foundational elements required to support digital health. It begins with semantic interoperability as a critical enabler of the European Health Data Space (EHDS), highlighting how shared standards and frameworks can enhance data exchange across borders and sectors. Nordic perspectives illustrate how integrated digital ecosystems can break down barriers between health care service delivery and wider health innovation environments.

The publication then addresses the secondary use of health data, presenting national approaches particularly from Sweden to leverage health data for research, innovation, and policy planning while ensuring trust and data protection. Cybersecurity emerges as another key component, with EU-level frameworks and the Finnish strategy providing guidance to secure health data, strengthen system resilience, and ensure continuity of care.

The second theme focuses on the shift from reactive to preventive health systems enabled by digital tools. Artificial intelligence in Finnish health care is examined not only as a technological advancement but also as a driver of new skills and competencies among professionals. Evidence from Nordic and international studies illustrate the effectiveness of digital interventions in improving health outcomes, supporting self-management, and reducing system pressures. Telehealth and remote consultations are presented as central to integrated care models, improving accessibility, and supporting continuity of care regardless of geographical distance.

Ensuring equitable access to digital health services is a key Nordic priority. This theme outlines the principles of digital inclusion and patients' rights, noting the risks of unequal access due to digital literacy gaps, socioeconomic factors, or regional disparities. Nordic country case studies from Denmark, Finland, Iceland, Norway, and Sweden provide diverse approaches to safeguarding inclusivity during the digital transition. The role of health personnel is also emphasized, particularly the importance of developing digital and AI-related competencies to ensure safe, ethical, and person-centered care.

The publication demonstrates that digital health is a strategic asset in advancing Nordic cooperation, supporting public health goals, and strengthening resilience in line with European developments such as the European Health Data Space (EHDS). By addressing infrastructure, prevention, and inclusion, the Nordic countries are laying the groundwork for a sustainable digital future. The collective insights presented here form a roadmap for policy development, cross-border collaboration, and innovation that benefits all Nordic citizens.

1. Background

Overall, the Nordic countries are well on the way towards a socially sustainable region. The Nordic countries are similar societies regarding for example health care and levels of trust. This enables striving towards more integrated Nordic region: "For the Nordic Region, integration primarily means a shared Nordic identity, cohesive societies based on the same values, and mobility and freedom of movement within the region." (NMC 2021) At the same time, demographic shift towards increasingly aging population puts pressure especially on health service delivery and sufficiency of health workforce.

Grounded on the sustainability goals by UN, according to the Nordic Vision 2030, the Nordic countries will become the most sustainable and integrated region in the world by 2030. This means working together actively to ensure sustainable progress in any specific sector. Especially in health care sector sustainability of service delivery is supported with digital transformation. Regarding the level of integration between the Nordic countries, the aim is being achieved at different levels of society, starting with smooth services for any individual person in the Nordic countries and free movement across the Nordic borders.

For the purposes of this publication on digital health in the Nordic countries, the guiding framework was derived from the three strategic goals of the Nordic Vision 2030. Building on this framework, three key thematic areas central to digital health development were identified: digital infrastructure, the role of digitalisation in prevention, and approaches to inclusion (see sections 2–4). Relevant examples were selected for each theme to illustrate current progress and emerging practices. Subject-matter experts from across the Nordic countries were engaged to contribute concise papers, ensuring that the publication reflects both national perspectives and shared regional priorities.

Goals for the Nordic Vision 2030

Goal 1: Welfare provisions in the Nordic Region must be sustainable, high quality, safe for both patients and care recipients, and accessible to all

Goal 2: The Nordic Region must promote good physical and mental health, wellbeing and quality of life for all

Goal 3: The Nordic societies must accommodate and include everyone

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2. THEME 1: Infrastructure for digital health

2.1 Semantic interoperability as a foundation for the European Health Data Space

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> **In clinical practice, interoperable EHRs enable healthcare professionals to gather, store, and communicate essential patient information securely across care settings, thus supporting coordinated and patient-centered care.**

The European Health Data Space (EHDS) Regulation emphasizes the importance of interoperability between health information systems across Member States. Ensuring that health data can be exchanged and accessed across borders, while maintaining its meaning and reliability, is central to safe and efficient care delivery. (EU COM 2025) Moreover, the Interoperable Europe regulation (EU 2024/903) entered into force in April 2024, and its goal is to promote the interoperability of Europe-wide digital public services in cross-border operations. The regulation is part of a wider European digitalization framework, which includes various data areas, such as the European Health Data Space. The European Interoperability Framework (EIF) further supports interoperability that entails four levels: legal, organizational, semantic and technical interoperability (Communication (COM(2017)134)). In this paper, main focus is on semantic interoperability.

Semantic interoperability refers to the ability of different systems and professionals to exchange and interpret information consistently, based on shared data models, standards, and clinical terminologies. It facilitates the exchange and use of health data documented in Electronic Health Records (EHRs) without loss of meaning. The EHDS regulation aims to strengthen the semantic development of health data and promote common frameworks for data exchange as well as availability and quality of data. The use of standardized terminologies, such as SNOMED CT, has shown potential to improve data quality, interoperability, and

patient safety, while also enabling the reuse of data for secondary purposes such as research and public health. (Vuokko, Vakkuri ja Palojoki 2023)

In clinical practice, interoperable EHRs enable healthcare professionals to gather, store, and communicate essential patient information securely across care settings, thus supporting coordinated and patient-centred care. (Palojoki, Lehtonen, Vuokko 2024, also Palojoki, Vakkuri, Vuokko 2021) Well-designed data models may further enhance how information is structured and utilized in EHRs. Data models ensure that patient information is comprehensive, up-to-date, and reliable, and they enable the effective use of advanced methods like clinical decision support and artificial intelligence. Approaches for enhancing clinical data availability should be carefully designed and economically sustainable to achieve long-term benefits. (STM 2025)

Semantic interoperability, therefore, forms a cornerstone for a data-driven and knowledge-based health system. By ensuring that health information can be exchanged and understood unambiguously across different systems and care settings, it enables healthcare professionals to make informed decisions, coordinate care effectively. Beyond supporting efficient care delivery, semantic interoperability also facilitates innovation in digital health, allowing new tools, artificial intelligence applications, and clinical decision support systems to operate on high-quality, standardized data. Moreover, it grounds the required foundation to further promote safe and ethical secondary use of health data, for example, for research, and public health surveillance. In this way, semantic interoperability underpins the broader objectives of the European Health Data Space, helping to create a sustainable, patient-centered, and knowledge-driven health ecosystem across Europe. (Vuokko, Vakkuri, Palojoki 2022)

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2.1.1 Leveraging Digital Health and EHDS in the Nordics: Towards breaking down the barriers between healthcare systems and health ecosystems

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Health authorities in the Nordic countries were early at exploring the use of information and communication technologies to improve upon their healthcare systems. Each nation succeeded in creating legal and financial frameworks for these systems to be developed and in organising sector-wide implementation projects for the systems to be taken into use (Table 1). Today, the Nordic countries are living proof that it is possible to build and implement digital health systems on a national level (Table 1).

Table 1 Health information systems and infrastructure in use in the Nordic countries.

	Denmark	Finland	Iceland	Norway	Sweden
Health record systems	☑	☑	☑	☑	☑
Health registries	☑	☑	☑	☑	☑
National patient portals	☑	☑	☑	☑	☑
Laboratory information systems	☑	☑	☑	☑	☑
Imaging information systems	☑	☑	☑	☑	☑
Health information exchange	☑	☑	☑	☑	☑

Leveraging e-Health investments

As of 2025, many Nordic countries have embarked on using their digital health systems and infrastructures to bring about healthcare system reforms. Citizens can now use the national-level patient portals as a digital front-door to the healthcare system. Likewise, patient portal features enable citizens to take a more active role in their own care (Eriksen et al. 2024, Faxvaag et al. 2024). Another

important component of contemporary e-health policies in the Nordic countries is to build a knowledge economy on top of the digital health data that have accumulated in the national-level health registries. The Nordic AI Center, recently established by the Nordic Council of Ministers, is the latest manifestation of this trend (Nordic Council of Ministers 2025).

Towards breaking down borders between healthcare systems and health ecosystems

With the EHDS, the EU has set the stage for health information exchange and for citizens to be provided healthcare in any European country. Furthermore, EHDS constitutes a legal framework for building a knowledge economy on top of health and healthcare data in Europe.

The defining function of a healthcare system is to provide valuable care by applying the most appropriate knowledges and skills on the health-related problems at hand. With the EHDS, Europe might finally be able to build the health ecosystem that is needed to provide healthcare systems with the knowledges, skills, medicines and tools that are needed to provide truly valuable care (Figure 1), (Faxvaag et al 2025).

Figure 1 Healthcare system and health ecosystem value chains (Faxvaag et al 2025).

The Nordic countries, with their strong track record of collaboration, knowledge exchange and standardisation are uniquely positioned to take a leading role in preparing for the EHDS. The Nordic countries should build on their profound digital health experiences to substantiate a Nordic health ecosystem that is deeply integrated with their healthcare systems and where the citizens can take an even more active and empowered part.

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2.2 Implementation of the secondary use of health data at the national level in Europe: Benefits of deployment and possible Nordic approaches

Joni Komulainen, Ministry of Social Affairs and Health Finland

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> **Nordic countries though advantage in the secondary use of health data are data quality, statistical power, public trust and shared challenges seem to be timelines, regulatory fragmentation, data restrictions. The national progress reports and the capacity building report show that the Nordics are in very different stages of implementation of both the primary use of electronic health data and the secondary use of health data. Experiences of the secondary use of health data in the Nordics can benefit the larger implementation of the secondary use in Europe though.**

The secondary use of health data has benefitted the Nordic countries for a long time. The high-quality health records, dating even from the 1950´s, structured data, electronic health records, national ID number and trust of the citizens, have been enablers and benefitted the secondary use of health data in the Nordics. On 5th March 2025, the European Health Data Space (EHDS) Regulation was officially published in the Official Journal of the European Union. (2025/327) It entered into force on 26 March 2025, marking the beginning of the transition phase towards application. The EHDS regulation will be a cornerstone of the European Health Union and it is the first common EU data space dedicated to a specific sector as part of the European strategy for data. The EHDS Regulation enables health and certain health related data to be reused for public interest, policy support, and scientific research purposes. It fosters a health-specific data environment that supports a single market for digital health services and products. Additionally, the regulation establishes a harmonised legal and technical framework for electronic health record (EHR) systems, fostering interoperability, innovation, and the smooth functioning of the internal market. (European Commission 2025a)

Finland's foundation for secondary data use rests on the Act on the Secondary Use of Health and Social Data (552/2019). (STM 2019) It modernized national legislation in line with EU General Data Protection Regulation (GDPR) and set requirements to safeguard privacy while ensuring smooth data access for research, policy, and innovation. The act aimed to reduce bureaucratic hurdles and accelerate data approvals. Central to this framework is Findata, a national data permit authority, acting as a "one-stop shop" for data access requests, streamlining the interaction between data controllers and users, and even providing secure processing environments. Finland has developed an infrastructure of technical, semantical, organisational, and regulatory framework for the secondary use of health and social data, to enable high-quality health research, but even Finland has challenges regarding the new centralized "one-stop shop" model for secondary use and thus there is governmental proposal in the Parliament to amend the current legislation in order to find a more flexible model for the secondary use of health data. (87/2025)

Regarding the experience the Nordics have in the field of the secondary use of health data, there are some lessons learned that could be benefitting the implementation of the new secondary use legislation and secondary use of health data in general in Europe and furthermore clarify the benefits of the large-scale secondary use of health data. (European Commission 2025b) One possibility is to explore Nordic model.

A recent survey conducted by the eHealth Network on the Capacity Building of Primary Use of Health Data in Member States (European Commission 2025c) may also benefit in evaluating of the readiness of the implementation of secondary use of health data in Europe. EHDS regulation is a starting point for secondary use project, VALO project that is funded by the Nordic Council of Ministers. VALO proposes a Nordic model of collaboration in the secondary use of health data (Sitra 2025).

As the Finnish and French secondary use legislation can been seen as inspiration for the modern European secondary use legislation, especial attention is paid to their experiences and plans for the implementation of the new European secondary use legislation. Benefits of the secondary use are explored from various reports and impact assessments that have been performed by the EU Commission and some of the Member States. Opinions and results in this article are also based on many stakeholder consultations and discussions in various fora in Finland, the Nordics and Europe.

Almost all the Member States are planning to build a centralized implementation of the EHDS Regulation. There are still though fragmented approaches because of the way they have been providing health care and secondary use of health data in their respective countries. There is common goal to implement the EHDS Regulation, but the challenges in each of the Member States are different and it seems very difficult to find a mutual model for the implementation.

Nordic countries' advantages in the secondary use of health data are data quality, statistical power, and public trust. Shared challenges seem to be timelines, regulatory fragmentation, and data restrictions. The national progress reports and the capacity building report show that the Nordics are in very different stages of implementation of both the primary use of electronic health data and the secondary use of health data. Experiences of the secondary use of health data in the Nordics can benefit the larger implementation of the secondary use in Europe though.

Lessons learned from Finland include for example that successful ecosystem for the secondary use involves multiple stakeholders. Health data holders and providers include public and private healthcare providers, while data users encompass for example academic researchers, businesses, innovators, and public authorities using data for various purposes including clinical research, innovation, and policymaking. Finland has been bringing these together in an emerging ecosystem. The ecosystem also benefits from high-performance computing resources like the LUMI supercomputer, which supports AI research. (STM124:00/2022)

The experiences and results from France with a similar way of providing secondary use in their national Health Data Hub resemble the Finnish experiences. There are similar triumphs but also similar challenges. (Health Data Hub 2025) French Health Data Hub for example could benefit from Findata, to make secondary use process work more efficiently, as the process for the health data users seems to take on average 18 months in France and 51 calendar days using Findata in Finland. Finland could benefit the French experiences from having the Data Protection Authority and Ethical assessment part of the permitting process. (SWD/2022)

The implementation of the secondary use is a mutual challenge of all European countries. How will European countries learn from each other and benefit from the secure and safe way of the implementation of the European secondary use health legislation and at the same time gain the competitive advantage for Europe? The Nordic model could be built on enhancing the current co-operation and providing fora for the primary and secondary use ecosystem work. Most of all, even though health care is provided and secondary of health data use is arranged in different ways in the Nordic countries, valuable co-operation could be built on common metadata work and model, that could benefit not just the Nordics, but the wider implementation of the European secondary use regulation throughout Europe.

The benefits of the fora and ecosystem is not just to make the secondary use work within one country or the Nordics or the entire Europe, but to learn from each other in order to gain from the benefits of the secondary use, which in a nutshell are: better healthcare, better medicines, more efficient and fine-tuned processes, better products, better legislation, benefits the common European market etc. The benefits of the secondary use of health data seem to be the same in all the European countries. It will benefit all EU citizens, including patients, healthcare professionals, researchers, policymakers, and industry players. Most of all everybody in one form or another will benefit from the secondary use of health and the Nordic model: you, me, everybody.

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2.2.1 Health Data for Secondary Use in Sweden – National Principles and Preparations

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Like the rest of the Nordic countries, Sweden has a long tradition of collecting data at the national level and is rich in health data. This has served us well, providing excellent conditions for register-based research and the development of a high-quality healthcare system. The National Board of Health and Welfare (Socialstyrelsen) maintains 13 national registers covering various aspects of public health, healthcare, and dental care. Other government agencies manage registers on, for example, vaccinations, infectious disease spread, care providers, or approved pharmaceuticals. In addition, Sweden has over 150 national quality registers that contain information on diagnoses and treatment outcomes for individuals. These are reported voluntarily by healthcare professionals to monitor and improve healthcare services.

Swedish healthcare is organized, financed, and governed by 21 regions, and local self-government is a strong principle within the Swedish administrative model. Currently, there is no national health data infrastructure in place that allows all regions to share necessary information. As a result, the Swedish eHealth Agency, E-hälsomyndigheten has been tasked by the Government to develop a national digital infrastructure, which will also prepare Sweden for the requirements of primary use under the European Health Data Space (EHDS).

Other major holders of health data include Sweden's 290 municipalities, which are responsible for certain health services within local government operations, private companies, some of which are major care providers contracted by the regions, and of course, numerous research institutions. The implementation of EHDS in Sweden will thus take place in a context with many large data holders, each of whom must develop the knowledge, processes, and infrastructure necessary to comply with the regulation. To varying degrees, they will need national support.

In January 2024, the Ministry of Health and Social Affairs initiated a government inquiry (S 2024:A) to, among other things, propose how the responsibilities of the Health Data Access Body (HDAB) should be organized and how Swedish legislation should be aligned with EHDS. This resulted in three preparatory government assignments related to secondary use:

- An assignment to the National Board of Health and Welfare (Socialstyrelsen) to prepare to become the responsible body for access to health data under EHDS (S2025/00977),
- An assignment to the Health and Social Care Inspectorate (Inspektionen för vård och omsorg) to prepare to supervise and monitor compliance with EHDS (S2025/00980),

- An assignment to Statistics Sweden (Statistikmyndigheten SCB) to investigate the prerequisites for providing secure processing environments under EHDS (S2025/00975).

These assignments will lay the groundwork for how EHDS will be organized, built, and ultimately managed in Sweden. The final reports are due in June 2026. In parallel, work continues on proposing legislative amendments necessary to align Swedish law with EHDS.

EHDS will establish a new legal basis for processing health data and create an opportunity for centralized data access. The scenario Swedish authorities are preparing for involves the establishment of one single HDAB, responsible for receiving and managing data access requests from users. The designated HDAB is expected to be the National Board of Health and Welfare. The aim is to make the application process significantly simpler for users, compared to today. However, this also places high demands on the HDAB to avoid becoming a bottleneck in the future system. There will also be a need to address potential conflicts of interest, as the National Board of Health and Welfare will simultaneously act as a data holder and a data user.

The assignment given to Statistics Sweden to investigate how the responsibility for providing secure processing environments should be organized includes several important issues, such as the required analytical capacity and how collaboration with data holders, data users, and other HDAB authorities should be structured. Analytical methods are continuously evolving, and the demand for large datasets is growing every day. We need to future-proof the EHDS to meet upcoming needs and opportunities.

Looking Ahead

Since Sweden currently is establishing a common national infrastructure for health data, there is a unique opportunity to incorporate the EHDS requirements from the very beginning. This would enable effective integration between primary and secondary use of health data and ensure broad availability of data for secondary use. There are several advantages to this starting point, but the national transition must proceed at a pace that ensures timely implementation of EHDS in Sweden.

In summary, several key issues must be addressed for EHDS to achieve its intended impact, and these are likely common across all Member States. It involves establishing effective governance, collaboration, enhancing competencies, and building a scalable system that accommodates future technological developments and data needs. There is strong cooperation between stakeholders in the sector, and Sweden possesses a high level of technical competence and public trust in authorities. This provides a solid foundation on which to build a well-functioning system.

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2.3 Cybersecurity for health data: EU frameworks and Finnish strategy

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> **Within the EHDS framework, only EHR systems that comply with harmonized EU cybersecurity and inter-operability standards may be placed on the market. These systems must support secure digital access for individuals, enabling them to control the sharing of their health data, including across borders.**

Cybersecurity refers to the protection of networks and information systems, their users, and associated individuals from increasingly sophisticated cyber threats, incidents, and data breaches. In the context of health data, this protection is particularly critical due to the sensitivity and societal value of the information involved.

The European Health Data Space (EHDS) builds upon the regulatory foundations established by the General Data Protection Regulation (GDPR) and the NIS2 Directive. It introduces a set of binding obligations aimed at ensuring the secure processing, access, and exchange of health data across the EU. The overarching objective is to facilitate secure cross-border healthcare services and to strengthen the resilience of the EU's digital health ecosystem.

The GDPR applies extraterritorially to any organization that offers goods or services to, or monitors the behavior of, individuals within the EU. It imposes strict data protection requirements and enforces compliance through substantial administrative penalties, thereby reinforcing accountability in data governance. Complementing this, the NIS2 Directive mandates that organizations operating in critical sectors implement comprehensive cybersecurity risk management practices, report significant incidents to national authorities, and ensure the security of their supply chains and manage vulnerabilities. It promotes cybersecurity awareness and training and establishes mechanisms for EU-wide coordination through the CSIRT network, EU-CyCLONe, and the NIS Cooperation Group.

Within the EHDS framework, only EHR systems that comply with harmonized EU cybersecurity and interoperability standards may be placed on the market. These systems must support secure digital access for individuals, enabling them to control the sharing of their health data, including across borders. Member States are required to establish national health data access bodies and to integrate with HealthData@EU, a secure EU-wide infrastructure for the secondary use of health data. Organizations must implement robust audit trails, access logging, and incident response mechanisms, and ensure that health data is minimized, pseudonymized or anonymized where appropriate, and encrypted during both transmission and storage.

Finland's Cyber Security Strategy 2024–2035 aligns with these EU-level frameworks, reinforcing the secure handling of health data in both national and cross-border contexts. The strategy identifies health data as a critical information asset and emphasizes the need to develop cybersecurity capabilities within the healthcare sector. It promotes cross-sectoral collaboration among health authorities, cybersecurity agencies, and private service providers to manage risks associated with sensitive data processing. The strategy's implementation plan outlines several concrete measures, including the creation of a national cybersecurity guidance database with sector-specific content for healthcare and social welfare, the execution of a risk assessment during EHDS implementation to ensure compliance with EU cybersecurity standards, the classification of critical systems and the adoption of a new ICT risk management model by wellbeing services counties, and the development of certification and cybersecurity requirements for healthcare systems.

2.3.1 Health Care Resilience and Cyber Security

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Digitalisation of health care has radically transformed how patient data is managed, care is delivered, and services are produced. The proliferation of Electronic Health Records (EHR), mobile health (mHealth), and various cyber-physical systems (CPS) has brought significant benefits, but also increased the vulnerability of systems to cyber threats. Cyber security is no longer merely a technical issue – it is a sociotechnical challenge where technology, people, and organisational processes form a complex, interconnected whole.

Traditional cyber security strategies have often focused on protecting individual technical components, such as firewalls, encryption, and system updates. However, these approaches are insufficient to address vulnerabilities in health care systems that arise from human error, outdated infrastructure, inadequate training, unclear policies, and poor communication. Cyberattacks like ransomware do not only target technology – they exploit human behaviour and organisational weaknesses. (Ewoh & Vartiainen 2024)

Cyber Security as a Sociotechnical Phenomenon

Sociotechnical systems (STS) theory provides a framework in which cyber security is viewed holistically, optimising technical, social, and procedural factors together. In the health care context, STS offers a lens to understand cyber security not just as a technical problem, but as a complex interaction between people, technology, and processes. Vulnerabilities often stem from a *security design reality gap*, where technical solutions fail to consider social and organisational dimensions. Therefore, cyber security solutions must be co-designed to account for all three dimensions. (Ewoh & Vartiainen 2024.)

Science of Cyber Security

When examining cyber security as a science, Edgar & Manz (2017) propose that cyber space consists of the following interconnected components:

- **Data**: Information processed, stored, and transmitted within systems. In health care, this includes patient records, diagnoses, treatment plans, and lab results.
- **Technology**: Infrastructure, systems, and devices that enable data processing. This includes EHR systems, IoMT devices, cloud services, and mobile applications.
- **People**: Users, professionals, patients, and administrators interacting with technology and data. Their actions, skills, culture, and decision-making impact system security.

In health care, Edgar & Manz's framework helps illustrate how cyber security is a sociotechnical issue. Data is particularly sensitive (PHI – Protected Health Information), and its protection is essential for patient safety and trust. Technology may be outdated or poorly integrated, increasing vulnerabilities (e.g., the Finnish health data breach, psychotherapy center Vastaamo case). People may unknowingly pose risks (phishing, negligence) or intentionally (insider threats), but they are also key to building resilience.

Building Resilience – From Control to Coordination

With digitalisation, health care systems have evolved into increasingly complex cyber-physical networks (CPS), where technology, people, and processes are tightly interconnected. This development challenges traditional cyber security thinking, which has largely relied on internal control and technical safeguards within individual organisations. As systems become more interdependent and networked, internal control alone is no longer sufficient to secure critical operations.

Traditionally, organisations have tried to protect themselves from external threats by building technical "walls" such as firewalls, closed networks, and access restrictions. Security is seen as an internal matter managed within the organisation. This model works in limited and static environments but does not address the dynamic nature and interdependencies of modern CPS networks.

Resilience thinking views cyber security as an ecosystem-level challenge, where threats can spread through networks and affect multiple actors simultaneously. Therefore, a shift from control to coordination is needed. Maintaining cyber security and resilience requires collaboration, information sharing, and a **Common Operational Picture (COP)** among various stakeholders – hospitals, technology providers, authorities, and patients. COP enables a comprehensive understanding of the situation, supporting decision-making and resource allocation.

Coordination-based resilience also emphasizes **Cognitive Situational Awareness (CSA)** – the continuous ability to observe, understand, and anticipate the system's state. COP and CSA do not emerge within a single organisation but require open information exchange and cooperation across the CPS network. Resilience is not built through isolated control but through coordinated action, flexibility, and the ability to recover from disruptions. (Rajamäki 2024.)

Digital Twins as Enablers of Resilience

With advances in AI and machine learning, Digital Twins (DT), Cognitive Digital Twins (CDT), and Virtual Human Twins (VHT) are emerging as enablers of future resilience. Digital Twins are virtual replicas of physical systems, enabling real-time monitoring, analysis, and simulation. In health care, DT technology can be used for hospital operations planning, care pathway optimisation, and immunisation strategy development. More advanced CDTs can autonomously learn, analyse, and support decision-making, making them especially valuable in managing disruptions.

VHTs model both biological and non-biological aspects of humans. They enable personalised care, ethical decision-making, and patient-centeredness. VHT research offers insights into CPS resilience development, as humans are more complex than technical systems. (Rajamäki 2024.)

Ethical Perspective on Data Utilisation

Cyber security and resilience are not only technical or operational issues but also ethical responsibilities. Rather than merely protecting health care data, it must be actively and responsibly utilised. Responsible use of patient data, ethical application of AI, and transparency in decision-making are key principles. VHTs enable ethically informed care that considers patient values and choices. DTs and VHTs support predictive care, resource optimisation, and personalised services. Sharing data across CPS systems enhances holistic resilience and promotes global well-being. By integrating these considerations, future health care professionals will be better equipped to navigate the ethical and cyber security complexities of AI, fostering responsible innovation, secure data practices, and resilient health care systems. (Rajamäki & Postolache 2024)

Conclusions

The resilience framework offers a holistic approach that integrates technological, human, and organisational dimensions. Digital Twins are not just technical innovations—they enable the health and resilience of both individuals and technical systems within the complex health care ecosystem. The framework challenges traditional control-based thinking and emphasizes collaboration, ethics, and the role of AI in the future of health care.

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3. THEME 2: Advancing prevention through digital health

3.1 Artificial intelligence in social and health care in Finland

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> **In previous years, AI development primarily focused on various diagnostics, predictions, and partly information production support use cases, applying machine and deep learning methods. However, over the past couple of years, the focus of development has shifted to use cases related to information structuring, summary production, and decision support.**

Artificial intelligence is expected to have a significant impact on productivity and employment in various industries. However, the estimations vary on how significant the impacts will be. For example, Acemoglu (2024) estimates the impact on annual growth in total productivity at only 0.07 percentage. On the other hand, Investment bank Goldman Sachs (2024) has estimated that the percentage could be as high as 1.5.

In social and health care sector there are high expectations that AI can improve the services to the customers, support professionals in clinical as well as administrative tasks and provide possibilities for cost savings. However, at the same time many of the real-life AI solutions are still in the piloting phase and large-scale implementations are only underway. Little research evidence on the effects of artificial intelligence is available.

The Finnish national AI ecosystem for social and health services is an informal network of stakeholders in the social and healthcare sector, including authorities, businesses, and researchers (DigiFinland 2025a). The ecosystem brings together over 250 organizations with a shared mission: to responsibly harness the power of

AI to enhance health and social services nationwide for patients and the community. The ecosystem is not a rigid structure but a dynamic, voluntary network. It thrives on collaboration, shared learning, and experimentation. Key national actors support its coordination.

For the AI ecosystem, a cornerstone of the 2025 plan is a series of pilot projects (see Table 1) designed to test AI solutions in real-world settings, offering valuable insights into their effectiveness, scalability, and legal implications. Funding is provided by the Ministry and the wellbeing services counties for the pilots that are expected to pave the way for broader national adoption.

Table 1 The pilot projects in the Finnish AI ecosystem.

Finnish Health AI Ecosystem pilot projects
AI-assisted assessment of child service needs
AI-based prediction of functional capacity changes
Professional's AI assistant
AI-based compilation of client background and risk information
Automatic clinical information system documentation
LingAI real-time interpretation
AI-based real-time interpretation solution
50% productivity increase in digital obesity treatment using AI tools
AI in cancer PET imaging
Development and implementation of an AI-powered medication risk tool

A key enabler of this collaboration is the Wellbeing Counties own AI Network group. The group meets every three weeks to share updates, identify common challenges, and foster partnerships among its members. It plays a crucial role in maintaining a real-time overview of AI development across the country and ensuring that knowledge flows freely between regions. Wellbeing Counties AI Network maintains status information of AI development in the wellbeing counties. The goal is to gather information about AI-related development already carried out and ongoing to enable transparency and information sharing. The pilot goals are categorized

based on the AI applicated area and related use cases. In May 2025, almost 150 current projects related to the AI development have been documented in wellbeing services counties. Of these 25 percent have reached implementation while the rest are in a piloting or a development phase. (UNA 2025)

The content of AI development projects has been analysed in relation to the use case categories and use cases described in the Mapping of Potential AI Use Cases feasibility report (DigiFinland 2024). In previous years, AI development primarily focused on various diagnostics, predictions, and partly information production support use cases, applying machine and deep learning methods. However, over the past couple of years, the focus of development has shifted to use cases related to information structuring, summary production, and decision support.

In spring 2025, the ecosystem undertook a vision-building initiative to define a shared national direction for AI in the social affairs and health sectors. This process resulted in a white paper (DigiFinland 2025b) that focused on the most promising AI use cases but also outlines ethical principles and policy recommendations. Based on the vision, a road map for health AI development will be created.

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3.1.2 Artificial Intelligence Creates New Competency Demands in Wellbeing Services Counties

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Harnessing Artificial Intelligence for Health Care Transformation

In recent years, rapidly advancing artificial intelligence (AI) technologies have demonstrated substantial potential to transform social and health care systems. AI's capacity to process vast quantities of data and generate new content enables the automation of cognitive tasks, more efficient allocation of resources, and enhanced decision-making support (McKinsey & Company 2025, PwC 2025). In Finland, the safe adoption of AI is facilitated by unique structural advantages, including comprehensive digital patient records, extensive quality registries, and a robust research infrastructure.

Within publicly funded health care, available resources are expected to decline relative to service demand in the coming years. As a result, Wellbeing Services Counties face increasing pressure to enhance efficiency and reform their operational models, and AI is widely regarded as one possible solution. AI can reduce clinicians' documentation burden e.g., through automation (Stults et al. 2025), improve the consistency and quality of diagnostic processes (Takita et al. 2025), and support decision-making both in clinical practice and in organizational leadership. Furthermore, AI is anticipated to transform both public health prevention strategies and individualized treatment decisions (Panteli et al. 2025, Sharma et al. 2024).

From the perspective of health care professionals, the range of potential AI applications can be structured based on use purpose. In addition, there are numerous other use cases, such as facilitating multilingual communication and accelerating or optimizing radiological workflows, that may remain invisible to front-line professionals but nevertheless hold considerable significance for the broader implementation of the technology.

State of Knowledge on Workforce Competence

To date, assessments of AI-related competencies within Wellbeing Services Counties have been highly limited. To our knowledge, the first such evaluation was a survey conducted by Keusote in August–September 2025, assessing staff use of AI and their self-perceived competence (Keusote 2025). The survey received responses from 437 employees across various sectors. Among respondents, 43% had used AI at least once in their work, yet only 21% of those users rated their AI competence as good or excellent. The primary barriers to adoption were a lack of knowledge regarding available applications and insufficient training.

In spring 2024, the Western Uusimaa Wellbeing Services County examined the impact of an AI tool on the work efficiency of professional translators (Martikainen et al. 2025). The study revealed substantial variation in staff capacity to adopt and benefit from the tool: one translator improved productivity by 102%, whereas another experienced a 2% decline.

Globally, research evidence on workforce AI competencies remains scarce. A systematic review by Garquez-Garcia et al. (2025) sought to identify the key competency requirements for the adoption of AI among health care professionals. Of 1,489 articles identified, only seven were deemed relevant and included in the final analysis. The review highlighted five essential domains of competence: Fundamentals of AI, Ethical and legal considerations, Data analysis and management, Communication and teamwork, Evaluation of AI tools

Regulatory Framework for AI Competencies

Legislation imposes comprehensive obligations on Wellbeing Services Counties to ensure adequate AI-related competencies among their personnel. Under the AI Act, any organization deploying AI applications in its operations must be able to document and demonstrate that staff have received sufficient training in AI literacy, commensurate with their roles and responsibilities (European Union 2024). Moreover, national legislation in Finland, including the Occupational Safety and Health Act (738/2002) and the Act on Health Care Professionals (559/1994), requires employers to provide guidance and create the conditions necessary for learning the use of new tools.

Discussion

AI tools are expected to become substantially more prevalent in health care over the coming years, among both administrative personnel and professionals directly involved in patient care. Realizing the full potential of AI will require not only the redesign of workflows but also strong staff motivation and the capacity to competently use new technologies. However, current evidence suggests that gaps in AI-related competence persist at both the leadership level of Wellbeing Services Counties and among front-line users.

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3.2 Promising evidence on the value of eHealth interventions and digital tools

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> **"Measuring and understanding the economic value and performance of eHealth tools is essential to understanding the outcome and best uses of such technologies."**

eHealth represents one of the pillars of the modern healthcare system and a strategy involving the use of digital tools to assist an increasing number of patients and reducing healthcare costs. Measuring and understanding the economic value and performance of eHealth tools is, therefore, essential to understanding the outcome and best uses of such technologies (Biancuzzi et al. 2023). However, only few economic evaluations of eHealth technologies among elderly have been published (Sanyal et al. 2018). Despite its potential, eHealth implementations have often faced significant challenges, with high failure rates reported in both developed and developing countries (Palm et al. 2025).

Early assessments suggested promising results. In 2010–2011, published systematic reviews on eHealth interventions concluded that high-quality evidence on health and economic benefits was still lacking (Ekeland et al. 2010, Black et al. 2011). Systematic reviews on eHealth interventions in somatic diseases published in 2009–2012 concluded that eHealth is effective or cost-effective but did not significantly improve quality of life and all-cause mortality (Elbert et al. 2014). In measuring eHealth interventions, the included reviews differed substantially in terms of study populations, intervention components, comparison groups, and outcome measures.

A large-scale cluster randomized trial failed to show cost-effectiveness of telehealth compared to usual care among patients with long-term conditions. The Whole System Demonstrator trial involved 3230 patients with diabetes mellitus, COPD, and CHF in 2008–2009 in England, and showed that eHealth interventions are associated with lower mortality and emergency admission rates (Steventon et al. 2012). Net benefit analyses of costs and outcomes using quality adjusted life years (QALY) gain showed that the incremental cost per QALY (ICER) of telehealth when added to usual care was £92,000 (Henderson et al. 2013). The QALY gains by patients using telehealth in addition to usual care were similar than those by

patients receiving usual care only, and total costs associated with the telehealth intervention were higher.

A systematic review summarised the evidence on the cost-effectiveness of digital health interventions published in scientific literature in 2016–2020 (Gentili et al. 2022). Findings showed a growing body of evidence and suggested a generally favorable effect in terms of costs and health outcomes. However, due to the heterogeneity across study methods, the comparison between interventions remained difficult.

Another recent structured review on eHealth interventions published in 2019–2021 found that there is still a lack of consensus regarding the recommended models to map and report their economic outcomes and performance (Biancuzzi et al. 2023). As in earlier systematic reviews, several diseases were the object of detailed clinical trials and protocols using various eHealth tools, leading to various economic outcomes, especially in the COVID-19 post-pandemic era.

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3.2.1 Measurement and Effectiveness Evaluation of Digital Health Services – From Current Perspectives to Future Directions

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Introduction

Digital health services (DHSs) are increasingly recognized as valuable tools for improving the overall quality and efficiency of health and social care. However, DHSs encompass a broad spectrum of solutions from remote consultations and chat-based support to cutting-edge technologies like artificial intelligence and the metaverse. In addition, the aim may vary from replacing a physical contact to supporting long-term self-care of a chronic disease. This diversity poses significant challenges for assessing their effectiveness, making it difficult for policymakers to make well-informed decisions about their adoption, use, and potential replacement (Härkönen et al., 2024; Laukka et al., 2025).

In Finland, the number of digital clinics has grown rapidly, now covering over 80% of the population (www.sotedatalab.fi). Despite their expansion, it remains unclear whether these services are truly effective or whether they might even lead to increased use of care with less severe needs, although the common aim is to increase cost-effectiveness by offering digital solutions to suitable needs. DHSs operate through varying mechanisms: some aim to reduce the number of visits by offering remote alternatives, while others take a more preventive approach, encouraging early-stage consultations to avoid deterioration of health. This latter model may be particularly beneficial in managing chronic conditions.

Current Understanding of the Effectiveness of Digital Health Services in Finland

The findings of the Finnish studies have been synthesized using the Quintuple Aim framework.

Improving Population Health

Users of digital clinics are typically younger, more highly educated, and predominantly female compared to health centre users, and the digital divide has to be considered also when assessing the impacts on population health. Digital clinics are well-suited for the treatment of uncomplicated infections, whereas health centre visits are more often associated with chronic conditions. Approximately 70–85% of health problems addressed in digital clinics have reportedly been successfully resolved (Lakoma et al., 2024; Dahlberg et al., 2025).

Hakanen et al. (2023) found no difference in outcomes between patients using digital care pathways compared to physical visits among tonsillectomy patients. In Finland, early experiences of digital care pathways for chronic patients seem

promising in terms of improving outcomes, supporting the evidence from the literature (Lakka et a., 2023; Kokkonen et al., 2024; Turkkila et al., 2025).

Enhancing Patient Experiences

One of the most reported benefits of DHS in literature has been improved patient experience. In Finland, both the population survey by Finnish Institute for Health and Welfare as well as many studies have reported high patient satisfaction or experience towards DHS (Parikka et al., 2020; Pennanen et al., 2023). The most frequently reported benefit is that digital services facilitate the use of healthcare services independent of time and location. In addition, the improved access has been reported both in primary and in secondary care.

Advancing Health Equity

The digital divide is a real topic in terms of equity. Many studies report increased use among young, well-educated people and limitations or concerns towards use of DHS among e.g., older or handicapped populations (Pennanen et al., 2023; Heponiemi et al., 2023). On the other hand, the improved access may reduce the equity. As the DHS are still shaping the healthcare system, the development of health equity should be carefully monitored and considered.

Improving Provider Wellbeing

Evidence on professional experiences with DHS in Finland remains limited. It is also known that there is a divide among professionals: a relatively small group is responsible for a large share of digital clinic visits.

Reducing Care Costs

Digital care appears to improve cost-efficiency. Studies have reported 20–50% cost savings, depending on the patient group and context (Hakanen et al., 2023; Kokkonen et al., 2024; Lakoma et al., 2024; Dahlberg et al., 2025). Replacing physical visits with digital contacts enhances cost-efficiency, although in primary care this may sometimes lead to additional physical visits. In specialized care, both preoperative and follow-up visits have successfully been replaced by digital consultations. In some patient groups (e.g., heart failure), improved continuity of care has also reduced the need for emergency visits and even hospitalizations.

Conclusions and recommendations

Future research should place greater emphasis on evaluating the cost-effectiveness of DHSs. A holistic understanding of their overall impact requires the integration of clinical outcomes, patient experiences, and economic evaluations. Additionally, incorporating the perspectives of equity and professionals' experience would broaden the analysis in line with the Quintuple Aim framework. To support this, healthcare policymakers must enable systematic data collection that facilitates

robust analysis and empowers researchers to produce high-quality, actionable evidence. This evidence should then guide the strategic development and continuous improvement of DHSs.

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3.3 Telehealth supporting health care delivery towards integrated care

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> **Integrating telehealth into existing care processes can be challenging. It is crucial that the transition to telehealth applications is managed carefully to maximize the benefits for all stakeholders, including patients, health care providers, and the broader health care system.**

Telehealth has potential to promote healthcare service delivery. The World Health Organization (WHO) describes telehealth as "the delivery of health-care services, where distance is a critical factor, by all health-care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health-care providers, all in the interests of advancing the health of individuals and their communities" (WHO 2022). Therefore, telehealth can be deployed for different use purposes, for example, to enhance access to services and to increase communication between the person and care professional or for consultation amongst the health care professionals. Drivers for introducing telehealth solutions may be manifold, such as the increase of the service need caused by the aging population or the simultaneous challenge of not having enough care personnel. Especially, during Covid 19 pandemic telehealth solutions were widely implemented to increase access to health services. Typically, telehealth solutions are expected to increase efficiency of the services. (OECD 2023; WHO 2022)

In Nordic context, telehealth solutions have been successfully piloted and assessed in Swedish priority project Healthcare and Care Through Distance Spanning Solution (VOPD) 2018–2021 and its continuation until 2025, the Integrated Health and Care Project iHAC. In the projects, a number of common challenges and experiences have been documented. Integrated health and social care with the citizens perspective in focus is prevailing in all Nordic countries. Focusing on citizen perspective means services at home and flexibility to access services across distances. One key point is to refine a comprehensive service model, especially so that a telehealth solution will be integrated as part of the health services. (Nordic Welfare Center 2020 & 2022) These initiatives illustrate a shared Nordic

commitment to ensuring that digital solutions serve as enablers of person-centred, equitable, and efficient care. The systematic development of telehealth services contributes not only to improved access but also to strengthened continuity of care and more resilient health systems. The lessons learned form a valuable foundation for scaling solutions regionally and provide strategic directions for future collaboration in building sustainable, digitally enhanced health and social care across the Nordic countries.

However, evidence on telehealth outcomes is still somewhat limited. Telehealth outcomes, such as, clinical efficacy, patient and provider satisfaction, and cost-effectiveness as well as patient safety are all equally vital in assessing the overall success of telehealth initiatives. Telehealth outcomes are not always consistent or well-integrated in health services, with factors such as device stability and reliability, patient education, accountability, and reimbursement issues impacting the effectiveness of remote patient monitoring. While the cost-effectiveness of various telehealth interventions has been studied, there is limited data on their long-term efficiency compared to conventional medical practices. Additionally, the cost of investment and ongoing maintenance, particularly when multiple stakeholders are involved, may pose significant challenges. Ensuring sustainable implementation requires addressing these financial and logistical barriers while optimizing resource allocation. (Palojoki, Lehtonen, Vuokko 2025)

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3.3.1 Advancing Remote Consultations in Finland

Paula Veikkolainen, Kaisa Kujansivu and Aino Rubini, The Remote Consultation Working Group of the Finnish Society of Telemedicine and eHealth, Finland

Remote consultations refer to patient-professional interactions conducted via electronic or other non-face-to-face means (MeSH 2024). Remote practices have become increasingly common in Finland and across the Europe, especially accelerated by the COVID-19 pandemic (Kyytsönen et al. 2021, Knudsen et al. 2024). Despite their growing use, variation in practices and lack of unified guidelines create challenges for organisations, clinicians, and patients alike. While remote care can offer significant benefits in terms of accessibility and efficiency, its success depends on thoughtful implementation, clinical safety, and appropriate use. (WHO 2022)

The Remote Consultation Working Group of the Finnish Society of Telemedicine and eHealth (FSTeH) was established in spring 2024 to support the development and dissemination of best practices for remote consultations in Finnish healthcare. Its multidisciplinary membership includes professionals from public and private healthcare providers, occupational health services, and academia. The group's key objectives include:

1. Developing national-level practical guidelines for remote consultations
2. Supporting education and training through webinars, statements, and courses
3. Promoting multidisciplinary collaboration and knowledge exchange

In January 2025, the group held its first educational event – the course "Everything a Doctor Needs to Know About Telemedicine" – at the Finnish Medical Convention in Helsinki, the largest professional healthcare event in Finland and the year's main continuing education forum for physicians. The course drew a strong turnout, with 171 participants, and received positive feedback. Building on this success, the group's proposal for a follow-up session focusing on remote consultations in primary health care, aimed at deepening the discussion and showcasing practical examples, was accepted for inclusion in the 2026 Convention program.

The working group is committed to identifying and promoting emerging best practices that support safe, effective, and equitable remote care. While detailed national guidelines are still under development, the group has outlined key thematic areas that are central to high-quality remote consultations. These include clinical appropriateness, digital competence among professionals, patient-centred communication and interaction in digital environments, privacy and data security, and standardized protocols for, for example, documentation, follow-up, and escalation - such as ordering laboratory or imaging examinations, initiating an

in-person consultation, referring a patient to a specialist, or alerting emergency services. To ensure these practices are grounded in evidence and remain responsive to real-world needs, the group closely follows developments in the field, including clinical outcomes, technological advances, and research, as well as feedback from professionals and patients.

The remote consultations should complement, not replace, traditional care, and that digitalization must bring added value to clinical workflows and patient outcomes. To ensure safe, effective, and equitable remote care, it is essential to train clinicians in both communication and digital competencies (Carrillo de Albornoz et al. 2022). At the same time, ongoing discussion is needed among professionals, policymakers, and patients on how remote practices can be integrated meaningfully and sustainably into healthcare systems. The Remote Consultation Working Group remains open to new members and actively contributes to both national and Nordic-level dialogues on digital health policy, education, and service design.

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4. THEME 3: Inclusion approaches in digital health

4.1 Brief introduction to digital inclusion and patient's rights

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> **Digital inclusion should be seen as a broad foundation for patients' rights. It is important to acknowledge that digital inclusion is linked to both the societal acceptability of technology use and the boundaries of that acceptability.**

Technology in healthcare is not a new topic, but it is one that continues to raise pressing questions. Healthcare and medicine are progressive fields where technological innovations and advancements are often visible and concrete to all of us; Longer life expectancy, increased well-being, and more effective treatments are evident in our everyday life – not merely as statistical indicators. At the same time, technology in healthcare holds a double role. It offers great opportunities but also brings risks. Patients have an equal right to benefit from technological progress, including new treatment methods or assistive technologies. Yet regulation must ensure that fundamental rights – such as privacy and patient's autonomy – are safeguarded.

Digital inclusion provides a strong foundation for patient's rights. Here digital inclusion must be understood broadly, and It is useful to recall the widely used UN-backed definition: *"Digital inclusion is defined as 'equitable, meaningful, and safe access to use, lead, and design of digital technologies, services, and associated opportunities for everyone, everywhere'".* (UN Digital Inclusion) This broad definition is also supported by the European union's objectives, which encompass several aspects such as digital skills, connectivity, accessibility, linguistic barriers and access. For patients, this means that inclusion is not just about having access to a computer or an app, but about being able to use healthcare technologies and healthcare services supported by technology in ways that are safe, understandable, and respectful of individual needs.

Universal Foundations, Individual Adaptations

Healthcare is inherently rights-sensitive field, closely tied to human dignity, right to life and equality. This underlines the importance of the perspective of the service user – that is, the patient – at every level of decision-making. The first step is to adopt the approach of universal design (or 'design for all') which today also has a solid legal base, emphasized by the UN Convention on the Rights of the Persons with Disabilities. (UN CRPD Art. 4.1(f) and Art. 9) This universal approach includes accessibility standards, the goal of user-awareness and everything that is vital for the foundation of inclusivity. In healthcare, this means designing patient portals, telemedicine services, and eHealth applications so that they are accessible to older persons, persons with disabilities, and people with different levels of digital literacy and digital skills. Even when the end-user is a healthcare professional rather than a patient, universal design provides a framework to ensure broad usability.

According to the UN CRPD Art. 2, Universal Design is defined as "the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. "Universal design" shall not exclude assistive devices for particular groups of persons with disabilities where this is needed." (UN CRPD Art. 4.1(f) and Art. 9 on accessibility)

However, rights are most tangible at the individual level. Moving from universality to individuality, technology in healthcare often requires adaptation to specific circumstances. Depending on the patient, the condition, and the technology, different levels of support may be necessary. A child, a person with a cognitive disability, or someone who is skeptical of digital tools will all need to be approached differently. For example, in the context of the right to privacy, European data protection regulation provides concrete guidance. EU GDPR Article 12 requires that information be given in clear and plain language, and Recital 60 encourages the use of icons to make data practices visible and intelligible. The European Data Protection Board's Guidelines on Transparency further emphasize that information must be tailored to the average member of the intended audience (European Data Protection Board 2018). In practice, this means healthcare organisations should use multiple formats to ensure that patients really understand how their data and technology are being used. All in all, in healthcare, one should not assume by default that every patient possesses average technological capabilities.

Trust, Autonomy, and Professional Expertise

At the same time, healthcare is a domain with a unique relationship of trust between the patient and the healthcare professional. This is not just *any* relationship between professional and service user. Especially in the public sector healthcare there is usually a need for balance between professional, clinical decision-making and patient autonomy. The healthcare professional brings professional expertise and responsibility for treatment, while the patients have the right to make informed choices about their own care and treatment. Hence, there exists a constant dialogue involving balance in medical decisions.

Although this is a very traditional topic of health care, modern technology seems to introduce new nuances to it as technology is no longer perceived solely as a tool for professionals in the traditional sense. Instead, today technology – such as Artificial Intelligence – can be a strong supporter of the professional decision-making process or treatment, which brings about questions how we should consider this change from the perspective of patient's autonomy. Respect for patient autonomy requires that the introduction of new technologies also considers differences not only between patient groups, but also within them. Patients in the same category – for example older persons or cancer patients – may have very different preferences and abilities.

For this reason, the competence of healthcare professionals is crucial. Future generations may be more naturally "technology-native," but today we all need to be more and more prepared to use different technologies. Professionals are the ones who bring technology to the patient. Unlike everyday consumer technologies, healthcare tools are highly specialised. The professional must have the knowledge to integrate these tools responsibly, to explain their use clearly, and to adapt their use to the individual patient's needs. Training and digital literacy for healthcare staff is therefore a key element of inclusion. This competence also means knowing when not to use digital tools—sometimes a face-to-face explanation or a paper form may better respect the patient's situation. From the patient's perspective, the safeguarding of rights mainly depends on healthcare professionals, with the patient–professional relationship remaining the fundamental basis of those rights, no matter how the organization providing for it is built.

Digital inclusion should be seen as a broad foundation for patients' rights. It is important to acknowledge that digital inclusion is linked to both the societal acceptability of technology use and the boundaries of that acceptability. Also, emphasizing the relationship between the healthcare professional and the patient is also a key component in implementing technology in a human-centered manner – one that respects human dignity and promotes humanity and compassion. And this is actually the place to underline that inclusive development requires cross-border and interdisciplinary dialogue; it is vital as we need to reconsider some old questions and maybe some new ones as well.

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UN CRPD Art. 4.1(f) and Art. 9 on accessibility.

4.1.1 Users' perspectives on digital services and the risk of reinforcing inequalities

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In recent years, digital health and social care services have rapidly expanded, partly replacing face-to-face interactions – particularly in Nordic countries. While this offers new opportunities, it also increases the risk for digital exclusion. Not everyone has equal possibility or ability to use digital services and take responsibility for their own wellbeing. Those with the greatest need for health and social care are often the ones facing the most challenges in adopting and adapting to digital services, potentially deepening existing social and health inequalities.

There are inequalities in access to and use of digital services

Individuals who are economically, socially, or health-wise disadvantaged tend to use digital services less frequently than their more advantaged peers. Poor health, functional limitations, cognitive difficulties, loneliness, and psychological distress are all associated with reduced access to healthcare services. Importantly, poor digital competence partly explains these associations. Specifically, we found that poor digital competence accounted for approximately 12% of the association of cognitive impairments with poor healthcare access, 9% of long-term functional limitations, and 8% of loneliness. (Heponiemi et al., 2023)

Impairments in vision (both near and distance), limited upper limb mobility, and poor cognitive and physical performance – as measured by tests such as memory assessments and the chair rise test – are significant predictors of internet non-use and low digital competence over time. Notably, we found that older individuals who perform poorly on the word list memory test had a 3.8-fold higher risk of not using the internet compared to those with better performance. (Heponiemi et al., 2023)

Not all users benefit equally from digital health and social care services

Digital services are often seen as less useful by those experiencing socioeconomic or health-related challenges. Financial hardship – such as needing to compromise on food, medications, or medical visits – is particularly linked to low perceived usefulness. Poor self-rated health and limited social contacts are also associated with reduced perceived value. Additionally, older adults, individuals with lower educational attainment, and rural residents report fewer benefits, partly due to disparities in access, digital skills, and service use. (Heponiemi et al., 2020)

Further analyses show that individuals with lower personal, economic, and social offline resources perceive digital services as less beneficial, largely due to poor access, limited digital skills, and negative attitudes toward digital services. These

findings highlight the need to address both structural and attitudinal barriers to improve the perceived value and usability of digital services among disadvantaged groups. (Heponiemi et al., 2021)

Among older adults, the most commonly perceived benefit of digital services is their ease of use regardless of time and location. Perceived usefulness is greater among those with convenient access to local services, good functional ability, good vision, the ability to learn new things, and those living with someone. Internet access and the ability to use it independently are also strongly linked to higher perceived benefits. (Kainiemi et al., 2023)

Especially vulnerable groups face digital inclusion challenges

Vulnerable groups – including older adults, migrants, mental health service users, frequent users of health services, and the unemployed – often face barriers in accessing digital services. These barriers include limited digital and/or local language skills, lack of support and training, poor health, absence of secure e-identification, and unsuitable devices. Digital services are frequently perceived as inadequate substitutes for face-to-face care, due to challenges in communication and limited applicability across diverse situations. Concerns about data security and mistrust toward digital platforms are also common. Contact with healthcare professionals in digital settings is often experienced as less personal and more prone to misunderstandings. In addition, digital alternatives are not always available when needed, and some individuals in vulnerable groups remain unaware of existing services or their potential benefits. (Kaihlanen et al., 2022)

Among mental health service users improved access to care, support for mental well-being, and the convenience of receiving services from home may support the use of remote mental health services. Whereas, the lack of non-verbal communication, difficulties in expressing and interpreting emotions, technical problems, issues related to service organization and usability, varying levels of professional readiness to deliver remote care, and concerns about safety and data security may hinder the use. (Coomans et al., 2024)

Individuals with mental health problems express heightened concern about the safety of web-based services. Poor mental health is independently associated with negative attitudes toward digital platforms, beyond the influence of socio-demographic factors. These negative perceptions are especially pronounced among older adults and men. (Rantanen et al., 2021)

Conclusions

Previous research shows that the risk of digital exclusion from services and deterioration in well-being is particularly high among already vulnerable groups. Thus, the high increase of digital services may exacerbate existing social and health-related inequalities. However, it is important to keep in mind that situation

is more complex than it seems, as individuals in these groups vulnerable to digital exclusion are highly diverse. Our recent review shows four perspectives which reflect suitability to digital services in health and social care: (1) skill-based suitability, (2) suitability based on general ability to maintain health, (3) suitability based on attitude and experience, and (4) suitability based on practical matters. (Kaihlanen et al., 2023)

It is essential that governments and service providers take proactive steps to enhance digital inclusion. Based on findings from the DigiIN project ("Towards socially inclusive digital society – transforming service culture"), several recommendations have been proposed to support this goal. To ensure that digital health and social services are inclusive and effective, it is important to guarantee the clarity and accessibility of service content. Continuous and accessible support should be provided to help users navigate digital services. Efforts are needed to promote digital inclusion among older adults and other vulnerable groups. The impact of digitalization on the work of health and social care professionals should be recognized and managed. Education and professional development must be strengthened to meet the evolving needs of a digitalized health and social care. Furthermore, successful implementation of new digital technologies in health and social care requires efforts. (Kaihlanen et al., 2025)

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4.2 Nordic perspectives on digital inclusion

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> **Digital inclusion extends beyond technical access: it requires trust, clear communication, and the ability to benefit from services in practice.**

The European Health Data Space (EHDS), which entered into force in 2025, marks a milestone in Europe's digital health development. By creating a common framework for secure use and exchange of health data, the EHDS aims to empower citizens with greater control over their personal health information, strengthen patient rights, and facilitate cross-border access to healthcare.

To deliver on this promise, inclusiveness is essential. Digital health should be usable and accessible for everyone irrespective of age, location, socioeconomic background, language, or digital skills. Digital inclusion extends beyond technical access: it requires trust, clear communication, and the ability to benefit from services in practice. Without these, digital transformation may risk reinforcing existing inequalities and excluding vulnerable groups.

The Nordic countries are well positioned to lead by example. Their universal welfare systems, advanced digital infrastructures, and high levels of public trust create strong foundations for inclusive digital health. Yet gaps exist. Older adults, rural residents, persons with disabilities, and those with limited language or technology skills continue to face barriers to participation.

Coordinated Nordic action under the Council of Ministers offers an opportunity to exchange best practices, test innovative solutions, and ensure that inclusiveness remains central in the implementation of the EHDS. This chapter highlights how each Nordic country is promoting equitable participation in the digital health transition.

4.2.1 Danish Joint Government Principles for Digital Inclusion

Kenneth Bøgelund Ahrensberg, Danish Health Data Authority, Denmark

The Danish welfare state is among the most digital in the world, and with that comes responsibility

Denmark is one of the most digitalized societies globally. Early on, central, regional and local government decided to take joint responsibility for an ambitious digital transformation in the public sector, and today, communication between citizens and authorities is primarily digital. However, for some citizens, the increasing digitalization poses a challenge. Approximately one-fifth of Danish adults experience some degree of difficulty in interacting digitally with public authorities. It is a democratic problem if the digital transformation becomes a barrier to participating in the welfare society.

As a society, we have a responsibility to harness the potentials of the digital development, contributing to improved welfare, growth and the green transition. It is our ambition that Denmark remains a digital forerunner. With that comes an obligation to create good conditions for citizens challenged by digitalization. There will always be those who find it difficult to be digitally self-reliant or who have special needs as digital users. Therefore, digital inclusion is an imperative, which we must continuously focus on when digitalizing, and a key priority across the public sector. We aim to be a forerunner in user-friendly and inclusive digitalization, empowering individuals and adding value for all citizens.

With six principles for digital inclusion, the Agency for Digital Government, Local Government Denmark and Danish Regions collectively set the direction for public digitalization with thought and consideration for all citizens. Inclusive digitalization begins in each project and within each organization. This is how we digitalize responsibly and inclusively.

Six Principles for Digital Inclusion

The joint government principles for digital inclusion aim to promote responsible and inclusive digitalisation. However, the principles only add value when they are reflected in decisions, projects and in the interaction between citizens and public authorities. The principles are advisory and meant to assist authorities in their efforts towards inclusive digitalisation.

Making the Principles a Reality

The principles are relevant for anyone involved in public digitalisation or public service in areas where the interaction with citizens is digital.

As management or a decision-maker, you have a particular responsibility to ensure that citizen-oriented digitalisation considers all citizens. For this purpose, you can

use the principles for digital inclusion as strategic landmarks and as a guide when balancing relevant considerations. The principles can also help you support your employees in their work. As an employee or specialist, you can use the principles in your work with citizen-oriented digitalisation, service design, citizen contact, or procurement of digital solutions. For example, the principles can form the basis for dialogue with suppliers of digital solutions.

Principperforinklusion.digst.dk, a Danish platform, provides specific tools, materials, cases and examples for each principle to support the work with inclusive digitalisation in a public organisation.

- **Be Aware of the Consequences of Digitalisation.** Decisions about digitalisation should support the rights of all citizens and minimise risks of exclusion.
- **Design Solutions for All Citizens.** Citizen-oriented digital solutions should be developed with diverse involvement of citizens, be based on citizens' needs and be usable for as many as possible.
- **Communicate so Everyone Understands.** Authorities should use easy-to-understand language and employ supporting tools and measures.
- **Assist Citizens with Their Digital Tasks.** Citizens should have easy access to help and guidance in their digital interaction with the public sector.
- **Help the Helpers.** It should be easy, secure, and safe for helpers to assist digitally.
- **Provide Usable Alternatives.** When citizens cannot be digital, alternative options should be available.

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4.2.2 Ensuring Digital Inclusion in Finnish Health Services

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Finland is internationally recognized as a pioneer in digital health services. The national digital health infrastructure, including MyKanta-portal and electronic prescription deployment, have set benchmarks for gradual integration into regional and local health information systems (Palojoki, Vuokko 2024). Building on this foundation, the forthcoming European Health Data Space (EHDS) implementation creates opportunities for more efficient health service delivery based on health data but also may raise challenges for accessibility and equity (European Commission 2025). Without explicit inclusiveness, digitalization may risk reinforcing, rather than reducing, health inequalities. Accessible digital services strengthen both population health and public trust in the healthcare system.

Despite Finland's advanced digitalization, gaps in participation in digital society remain. Nearly 40% of Finns frequently need support with online services (DVV 2023), and around one in five report requiring guidance with digital health tools (THL 2023). Vulnerable groups include older adults, people with lower education, migrants, and those in poorer health (see e.g., Hörhammer et al. 2025, Leppiman et al. 2021). Barriers relate to language, complex interfaces, and the lack of secure electronic identification, essential for accessing public services. As digital channels increasingly replace face-to-face encounters, risk of a widening digital divide may arise. Managing personal health information through platforms such as MyKanta also presupposes skills and capacities not yet universal.

As an example of recent development, as a part of Finland's Recovery and resilience plan actions (Valtionkonttori 2025), digital inclusion perspectives were included in projects that supported access to care in digital processes. One of the examples is digital mentoring that strengthens the digital skills of social and health care professionals. In the Central Ostrobothnia welfare region, the digitally advanced employees were allocated, at first, two hours per week to provide low-threshold support to their colleagues. In addition, it was possible to exchange experiences via a chat channel. In January 2024, there were 37 mentors, and by the end of May 2025, the number had increased to 42. The mentors' superiors were not always aware of their staff's digital skills. The increase in superior support for mentoring activities was a positive development. (RRP, PIL4 INV4 tp 2, 2024)

Currently, at the Ministry, based on the recent digitalization strategy (STM 2023) it was recognized to focus on digital inclusion. Looking ahead, following focus areas are central. First, user-centred design should involve groups most at risk of exclusion. Second, multi-channel provision should remain so digital tools do not fully replace telephone or in-person services. Third, accessibility and language support must be embedded by default, including e.g., multilingual options, and compliance

with accessibility standards. Fourth, targeted investment in digital skills is needed, especially for older citizens and vulnerable groups, delivered through low-threshold training and partnerships with civil society. Finally, systematic monitoring and evaluation should ensure that inclusion targets are met and guide service improvement. (DVV 2023, Ghorbanian Zolbin et al. 2025) For example, the regional service providers and various third-party organizations provide support for digital skills and peer support (e.g., SeniorSurf 2025).

Digital inclusion is both ethical and practical. Inclusive digital services have potential to support prevention, enable earlier interventions, and ease pressure on specialized care. Especially, universal access underpins social justice and trust in healthcare (Paccoud et al., 2023). Equity in digital access is therefore not only a fairness issue but also a question of sustainability. Thus, this area deserves attention.

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4.2.3 Icelandic Perspectives on Ongoing Digital Transformation and Digital Inclusion

Guðrún Auður Harðardóttir, Directory of Health Iceland

Digital transformation in healthcare has accelerated globally, with the Nordic countries at the forefront. Leveraging a strong digital infrastructure and a commitment to innovation, Iceland has made significant progress in modernizing its healthcare system. At the same time, the European Union has introduced the European Health Data Space (EHDS) regulation, aiming to harmonize access to and use of health data across EU and EEA member states.

Key initiatives are the *island.is* portal and the national patient portal, heilsuvera.is. The island.is portal provides centralized access to hundreds of government services —and currently, there is work in process to move the national patient portal under the island.is environment.

Citizens access their personal- and health information using an electronic ID (eID), which is compliant with eIDAS regulations (Island.is 2025). Iceland has introduced numerous strategic plans to strengthen digital transformation and digital inclusion. In July 2021, a national digital strategy was published to promote inclusive digital public services for all citizens. Furthermore, Iceland has developed strategies for cloud computing, cybersecurity, artificial intelligence, and data governance, all of which support the digital transformation of public institutions (Government of Iceland 2025).

The Ministry of Health´s Health Strategy to 2030 and the Digital Healthcare Policy promote the use of interoperable digital solutions and collaboration among healthcare entities to improve health outcomes. The emphasize is on patient-centered care and secure data accessibility with interoperable EHR´s and empowered citizens who can access and manage their health digitally via the national patient portal. The strategies outlines three main objectives:

- Empower individuals to actively participate in their own treatment
- Improve interoperability and coordination between systems
- Support innovation and research, including AI and personalized medicine (Ministry of health 2021)

Iceland's digital health infrastructure features interconnected electronic health records (EHRs), including maternal- and birth records, and interactive questionnaires, enabling healthcare professionals to securely share patient data across institutions and geographic regions, ensuring timely access to clinical information and supporting coordinated care. The centralized national patient portal is interoperable with the national EHR system and accessible to all citizens through a

single access point: *island.is.* Parents have access to their childrens´ health data up to the age of 16. Moreover, an Act was recently passed that allows proxys to act on behalf of marginalized populations. Last year, 86% of citizens 16 yrs. and older used the patient portal at some point in time.

An electronic prescription system (ePrescription) was implemented in 2010, and all pharmacies in Iceland participate. Furthermore, data from hospitals and primary care centers is transmitted in real time from the EHRs to the national registries at the Directorate of Health.

However, despite notable progress, challenges and gaps remain. Existing systems require modernization, and international standards must replace locally developed standards to ensure interoperability and enable meaningful cross-border health data exchange that supports continuity of care.

Iceland is currently in the process of implementing EU4Health digital services, which will facilitate the sharing of patient data across borders. This transformation demands the adoption of international standards and a fundamental shift in how health data is managed in Iceland.

Digital transformation depends on the inclusion of all citizens. Digital inclusion is central to ensuring equitable access for all citizens, regardless of location, age, or ability. The approach of the Icelandic government is holistic, integrating digital transformation across public services, health systems, and infrastructures by aligning policies to ensure equal access to health services and patient data, to promote digital literacy and support remote care and telehealth.

Conclusion

Digital transformation in Iceland's healthcare system is rapidly progressing, and the EHDS regulation presents an opportunity to harmonize and strengthen this development through the implementation of common standards for meaningful sharing of health data across borders, better decision making, empowered citizens and improved health outcomes.

Digital transformation needs to benefit all. It is not merely a technological shift – it is a societal transformation. With a clear policy and aligned digital policies, robust infrastructure, and innovation in healthcare services, Iceland is building a system that is more efficient and serves both individuals and society as a whole, ensuring that no one is left behind.

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4.2.4 Norwegian Perspectives on ongoing digital transformation and digital Inclusion

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Digital transformation

Along with the other Nordic countries, Norway is among the most digitalized countries in the world. Digitalization is not the goal in itself. Rather, it is the tool we need to realize the new data opportunities (like AI) and to solve many of the major societal challenges we are facing.

Norway already had a long journey with digitalization of health services and building e-health infrastructure. The implementation of EHR-systems started early and was built up nation-wide. The focus is now on modernizing and improving the EHR-systems, increase digital sharing of information (data and documents) and improve the use and utilization of data (i.e., automatic data harvesting, aggregated analysis, monitoring, data mining). Norway also has developed national e-health solutions like our national health portal helsenorge.no, summary care record, e-prescription solutions and a secure digital network foundation. The goals of the EHDS are very much in line with the goals of our national e-health strategy (Helsedirektoratet 2025), and we are working in the same direction. The ambition is that the EHDS regulation can become an accelerator to implement much of what we are already doing and have planned in the e-health area (EHDS konsekvensvurdering – Gapanalyse).

Digital inclusion

Digital inclusion is a central political and societal concern in Norway. Our national digitalization strategy 2024 – 2030 (Digital Norway of the Future 2024) emphasizes that all people regardless of age, ability, income, language must be included and have equal access. It is about trust, and it is about fairness. It is about ensuring that digitalization benefits us all.

Norway has a digitally mature population. Most are online and have experience using digital services. However, some are unable to use digital services or do not want to use digital services, for various reasons. Based on existing figures, it is estimated that around 20 per cent of the adult population is vulnerable when using public digital services (Digdir 2023).

A lack of digital competence, administrative skills, trust, and confidence are among the individual challenges that create barriers to the use of digital solutions.
In addition, factors related to the solutions themselves, such as a lack of universal design, poor user interface, complexity, or a lack of cohesion, can hinder citizens from using them.

Towards 2030, the Government will ensure that everyone can take part in digitalization. We will strengthen our efforts to increase the digital competence of those groups experiencing digital barriers and digital exclusion. We shall make sure that everyone is offered an electronic identity. We shall strengthen the population's resilience to digital disinformation. Children and young people shall be ensured a safe digital upbringing. We shall ensure a good digital-analogue balance in kindergartens, schools and in the leisure time of children and young people.

Specific goals 2030 are following:

- The number of persons over the age of 12 in Norway who have a high security eID shall be 5 million. Currently, this figure is 4.5 million.
- 95 per cent of the population should have basic digital skills, and everyone should be offered the opportunity to develop such skills. Currently, 86 per cent of the population has digital skills.

In June 2023, the Government launched an Action plan for increased inclusion in a digital society (Handlingsplan for auka inkludering i eit digitalt samfunn 2023). The action plan aims to ensure that all citizens receive equal public services, regardless of background, language skills or age. The action plan primarily targets those groups that experience digital barriers and digital exclusion

Users must be included to a greater extent in the development of digital services. This also applies to services aimed at children and young people. A collaborative forum for digital inclusion has been established and is managed by the Norwegian Digitalization Agency. The forum consists of representatives from the public sector, voluntary organizations and the business sector and works to facilitate equal public services, irrespective of digital skills. The Norwegian Digitalization Agency also published a national Index on Digital Inclusion (Uutilsynet 2025). The Index shows where we have come the furthest and where we need to strengthen our efforts.

In order to secure full digital inclusion, it is also important to secure analogue alternatives for the non-digital citizens, i.e., extra services via telephone or mail, and to have good and effective consent mechanisms for next of kin to act on behalf of the non-digital citizens.

AI may pose challenges for equality and non-discrimination, but can also be used to promote inclusion, for example through text reading, speech-to-text and audio description of images, and in programs that support persons with dyslexia with writing. AI will also be able to assist persons who do not speak Norwegian through written and oral translations from other languages

Conclusion

Digital inclusion in Norway is about creating a society where no one is left behind due to lack of digital competence or inaccessible solutions. Norway has made significant progress through legislation, national strategies, and collaborative initiatives, but continued efforts are needed to ensure equal participation for all.

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4.2.5 Swedish Digital Transformation in Health Care: The Perspective of Inclusion

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Swedish society is founded on democratic values that emphasize equal worth, participation, and equality for all. The right to inclusion and the opportunity for independence are fundamental principles. As stated in the Swedish Constitution, "the public sector shall work to ensure that all people can achieve participation and equality in society".

The overarching goal of Sweden's digitalization policy is to become the world leader in harnessing the opportunities of digital transformation. The national strategy highlights that everyone should be familiar with digital tools and services and have the opportunity to engage in digital development based on their individual circumstances (Regeringskansliet).

Digital accessibility and usability in Sweden are primarily governed by two key laws that set clear standards for how digital environments should be designed and operated. While these laws apply to different sectors and actors, they share a common goal: to create a more accessible society for all. The Law on Accessibility to Digital Public Services mandates that all public sector websites meet legislative accessibility requirements, aiming to improve digital access for all users, including those with disabilities. The Discrimination Act prohibits both direct and indirect discrimination and requires proactive measures to prevent exclusion and promote equality (Sveriges Riksdag). Additional legislation relevant to digital accessibility includes the Electronic Communications Act and the Public Procurement Act (Digital inkludering, PTS).

From an international perspective, Sweden is a frontrunner in the use of digital services. According to the EU's statistical office, over 98% of Swedes used the internet daily in 2024 for various purposes. While the population generally demonstrates high digital competence, some groups still lack basic digital skills (European Commission).

The Swedish government envisions a sustainable, digital society where every individual can participate and benefit. To ensure digital inclusion, access, usability, and consideration of individual conditions are essential. Sweden's national digitalization strategy prioritizes digital competence to simplify the use of digital services. Digital solutions hold great potential to create more inclusive services, but true inclusion requires actively addressing digital exclusion by ensuring access, promoting digital literacy, and designing user-friendly systems for all (Sweden's digitalization strategy 2025–2030).

Accessibility and inclusion depend on understanding the end-users – their identities, needs, and contexts. Although definitions and monitoring frameworks are still evolving, there is growing recognition of the need for inclusive, accessible, and equitable digital services (Nordregio Report).

Healthcare professionals have varying requirements depending on their roles, while patients present diverse conditions, preferences, and expectations. Many patients interact with multiple healthcare providers, and existing bottlenecks in the Swedish healthcare system further complicate accessibility.

The government has emphasized that digitalization and the development of a national digital infrastructure will enhance healthcare quality, improve patient safety, empower patients, and reduce administrative burdens for healthcare professionals.

To achieve these goals, several initiatives are underway. One example, led by the Swedish eHealth Agency, is the development of a shared National Digital Infrastructure (NDI) for healthcare. This infrastructure enables secure and efficient information sharing across systems and stakeholders. A key component of the NDI is the National Interoperability Function, which focuses on standardization to ensure seamless data exchange. When information is shared securely, health data becomes accessible to authorized individuals.

The new EU framework for the European Health Data Space (EHDS) promotes equal access and safe secondary use of health data. However, successful implementation requires capacity-building, clear public communication, and measurable inclusion across care pathways. For the EHDS system to function effectively, digital health data must be shared – whether it involves patients accessing their own records, healthcare professionals collaborating across borders, or researchers utilizing anonymized data for scientific purposes.

Conclusion

Digital maturity does not automatically lead to digital inclusion. Sweden is actively working to bridge the digital divide through targeted initiatives, particularly for vulnerable populations. Despite facing challenges in establishing a unified national digital infrastructure and standardized systems across regions, municipalities, and care providers, Sweden's commitment to innovation has yielded significant progress. Digital services such as e-prescriptions, online medical records, and virtual care appointments are now standard, giving all residents the opportunity to manage their health digitally.

The next critical step is the development of robust, interoperable systems for health data exchange – ensuring that digital transformation in healthcare is not only advanced, but truly inclusive.

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4.3 Digital capabilities of health personnel during work transformation

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> **Workplaces need digital mentors with both technological expertise and expertise on key focus areas. Personnel are expected to take bold initiatives and maintain their own skills.**

Digitalization has led to major work transformation and changes working conditions of all professional groups in health care. It is important to recognize digital capabilities of the personnel and support not only capacity building at individual level but also in overall development of workplace culture.

The Ministry of Social Affairs and Health in Finland has published a handbook on the best practices for competence development in digital health services that could be used to promote digital capabilities and continuous improvement approach at the level of individuals and work communities. The handbook is grounded on material collected in 2024 consisting of descriptions of previously identified best practices, a statistical survey, professionals' interviews, and workshops.

The digital capabilities of healthcare personnel vary not only between individual care professionals and organizations but also between different regions due to, for example, organizational history and structure. Most of the care personnel felt that their digital competence was good, but particularly artificial intelligence literacy was considered weaker compared to what the perceived importance of the topic would deserve. Some of the care personnel regarded their basic digital skills insufficient. The handbook presents recommendations for each target group amongst the care personnel to support work practices: networking to develop competence with providers of education, and digital competence management as change to support capacity building, and work ability management. A need to actively involve care personnel in, for example, digitalization development and decision-making at different stages of digital transformation. A possibility with digitalization was recognized as transition from legacy processes to renew work processes with more modern approaches. Health care organizations may encourage use of digital mentors, who have both technological expertise and

sufficient health care knowledge. Care personnel are offered possibilities to maintain their own skills. It is suggested that remuneration schemes will be created for the best digital capacity building initiatives.

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4.3.1 Strengthening digital competencies for AI-enabled health care

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In the European Digital Decade aim, is deepen European resilience to digital society. The four key pillars are defined: digitalisation of public services, digital transformation of businesses, secure and performant sustainable digital infrastructures and a digitally skilled population and highly skilled digital professionals (European Comission 2021). To make effective use of digital health and social care processes in public services, there needs to be strong infrastructure, capable and flexible enterprises, professionals need to be competent, and citizens must also have the skills to use eHealth and welfare services.

In Finland, a national report commissioned by the Ministry of Social Affairs and Health has examined the current situation, experiences, and needs of healthcare organizations in developing the digital skills of healthcare personnel and the digital capacity of work communities. The report also highlighted variations in digital competence across regions, individuals, and organisations, identified best practices, and supported the development of networks to strengthen professionals' digital competencies. In addition, it defined the roles of different professionals in supporting competence development in Finnish health and social care (Tepponen, Ahonen & Turja 2024).

Internationally the health informatics competencies have been framed and largely accepted (Mantas et al. 2010) and then updated (Bichel-Findlay et al. 2023). Finland has developed a national digital competence framework for health and social care professionals at the bachelor's level (Tiainen et al. 2021) and professional specialisation education (Ahonen at al. 2024) as well as a competence framework for medical doctors (Tuovinen et al. 2021). However, the rapid development of Artificial Intelligence (AI) highlights the need to revisit and update these frameworks through literature reviews and national discussions (e.g., Ministry of Social Affairs and Health project, reference pending). In the national self-assessment, health and social care professionals' digital competence was described through six themes: informatics competencies, knowledge management competencies, competence to monitor health and well-being in digital environments, person-centred guidance in digital environments, ethical competencies, and AI-related competencies.

Social and healthcare professionals reported that digitalisation supports the meaningfulness of their work and helps balance traditional and digital practices. They felt the current level of digitalisation was suitable, with a functional balance between remote and in-person services. Professionals also expressed a predominantly positive view of their work community's digital readiness, reflecting Finland's success in advancing digitalisation in the sector. At the same time, variation in

competence levels was observed: interviewees estimated that about one-third of staff had deficiencies in digital skills. While gaps existed in basic skills, there was also expertise in more advanced areas. Overall, capabilities were seen to have improved compared to earlier assessments. (Tepponen et al. 2024.) To address these competence gaps, it is important to strengthen national and regional collaboration with educational institutions and to provide both formal and informal learning opportunities for health and social care professionals (Turja & Ahonen 2024).

Harnessing the opportunities of digitalisation in the social and health care sector requires multidisciplinary and robust expertise. The DigiNet network (2025) was established to promote competence development and research in welfare technology and the digitalisation of the welfare sector. Expanding the network to include wellbeing services counties strengthens regional expertise and supports the adoption of digital solutions in service delivery. Experts from universities, universities of applied sciences, and vocational institutions work together in DigiNet to link academic expertise with the practical needs of working life, ensuring that competence development genuinely supports digital transformation.

Against this background, DigiNet now aims to update the definition of AI competence for social and health care professionals and to coordinate the development and delivery of related training. With dedicated funding, the network will revise the national digital competence definition, originally created several years ago, to account for changes brought by artificial intelligence. This will be achieved through expert engagement, national networks, research-based knowledge, and co-creation methods. The project will also produce curriculum content in the form of a micro-credential module to support competence development in wellbeing services counties and within health and social care degree programmes. There are results that also short learning courses are increasing students' competencies in continues education (Sanerma et al. 2025).

In its next phase, DigiNet will coordinate curriculum development into training modules through collaboration between educational institutions. This work can be resourced either through core funding or with the support of additional external funding, depending on the interests of the institutions involved. Looking ahead, the work must support change management by defining professionals' competencies and future educational needs. Planning for this requires project funding for continuing education at both national and regional levels, as well as negotiation between educational institutions and wellbeing services counties. Strong cooperation with working-life partners is essential to create effective education solutions that strengthen professionals' ability to work in an increasingly digitalised health and social care sector.

As AI continues to reshape working life processes at an accelerating pace, only strong and trust-based networks can ensure the sector adapts effectively. DigiNet plays a central role in coordinating educational efforts across degree programmes and continuing education, and Nordic and wider international collaboration is needed to secure the best solutions for all partners.

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About this publication

Advancements in digital health across the Nordic region

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TemaNord 2025:573

ISBN 978-92-893-8423-0 (PDF)
ISBN 978-92-893-8424-7 (ONLINE)
http://dx.doi.org/10.6027/temanord2025-573

Cover photo: Cottonbro/Pexels
Published: December 2025

Disclaimer

This publication was funded by the Nordic Council of Ministers. However, the content does not necessarily reflect the Nordic Council of Ministers' views, opinions, attitudes or recommendations.

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