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Progress on implementing and using electronic health record systems

Developments in OECD countries as of 2021

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Abstract

Electronic health records (eHR) systems are one of the most tangible manifestations of digital technology entering the healthcare sector. However, their implementation has not always been successful. The 2021 OECD survey investigated the advancement and governance of eHR systems across 27 countries. The study found a consistent increase in the use and maturity of eHRs. However, record fragmentation remains a concern, with only 15 countries adopting a unified system at a national level. 24 countries have implemented a minimum data set for core health information to improve data standardisation. The accessibility and interactivity of these electronic records for patients have also grown since 2016. While data quality and immediacy are improving, challenges persist due to resistance from providers, technical barriers, and legal issues. The importance of eHR data in managing the COVID-19 pandemic was evident, with its use in vaccine tracking and post-market surveillance. Integration with AI is emerging, yet governance challenges remain. The pandemic underscored the value of eHRs, emphasizing the need for ongoing collaboration to harness their full potential for healthcare.

Résumé

Les systèmes de dossiers de santé électroniques (eHR) sont l'une des manifestations les plus concrètes de la technologie numérique dans le secteur de la santé. Cependant, leur mise en œuvre n'a pas toujours été couronnée de succès. L'enquête de l'OCDE de 2021 a examiné l'avancement et la gouvernance des eHR dans 27 pays. L'étude a constaté une augmentation constante de l'utilisation et de la maturité des eHR. Cependant, la fragmentation des dossiers reste préoccupante, seulement 15 pays ayant adopté un système unifié au niveau national. 24 pays ont mis en œuvre un ensemble minimal de données pour l'information de santé de base afin d'améliorer la standardisation des données. L'accessibilité et l'interactivité de ces dossiers électroniques pour les patients ont également augmenté depuis 2016. Bien que la qualité et l'immédiateté des données s'améliorent, des défis subsistent en raison de la résistance des fournisseurs, des obstacles techniques et des problèmes juridiques. L'importance des données eHR dans la gestion de la pandémie de COVID-19 a été évidente, avec leur utilisation pour le suivi des vaccins et la surveillance après mise sur le marché. L'intégration avec l'IA émerge, mais des défis de gouvernance demeurent. La pandémie a souligné la valeur des eHR, mettant l'accent sur la nécessité d'une collaboration continue pour exploiter leur plein potentiel pour les soins de santé.

Executive Summary

This Working Paper reports the findings of a 2021 OECD survey on the development, use and governance of electronic health record (eHR)¹ systems. The primary focus of the survey was the readiness of eHR data to contribute to health data analytics. Twenty-seven (27) countries responded to the 2021 survey, which was based on two previous surveys conducted in 2012 (24 responding countries) and 2016 (28 responding countries).

The 2021 results suggest that eHR systems are increasingly used in OECD countries, with a consistent rise in the levels of implementation and maturity² across care settings (with the greatest improvement reported by **Japan**). If this trend continues, the ‘electronic’ prefix in eHR or eMR will soon be largely redundant. However, fragmentation of record platforms and software persists. While the degree of data exchange among providers and institutions has risen considerably since 2012, only 15 countries have implemented a unified eHR system where data are either held or linked at national level.

Twenty-four of the 27 countries surveyed report having a minimum data set to capture core health information, as a mechanism to improve standardisation and reduce friction when sharing data. These data sets comprise things such as unique patient and provider identification, patient demographic information, and medical history including procedures, medication lists, test results, allergies and relevant clinical information. Comparison with previous survey results reveals an increased use of structured elements in eMR/eHR data. The use of unique patient identifiers, smart cards and secure tokens has grown to 25 out of 27 responding countries. However, a range of terminology standards are used, and there is currently little evidence of convergence across countries.

The number of countries reporting that patients can access and interact with their electronic records is now 23, up from 19 reported in the 2016 survey. Seventeen countries also report that patients can interact with their records, compared to 14 in 2016. This is an encouraging finding from the perspective of patient engagement, safety and quality of care. The use of telemedicine with eHR systems serving as a platform is also increasing and looks likely to continue.

Data timeliness is improving, but immediate availability for secondary uses is still rare. **Iceland** is an exception, where eHR data from hospitals and primary care clinics is transferred to relevant national registries in real-time. Data quality remains a concern for most countries. The key challenges relate mainly to resistance among providers, as well as technical, financial, and legal barriers. While the reported number of eMR software vendors continues to grow, adoption of Application Programming Interfaces (APIs) and

¹ Electronic medical records (eMRs) are defined differently – see Box 1.1.

² Implementation and maturity are defined as the proportion of healthcare services using electronic as opposed to paper records, and the functionality of these records in terms of direct clinical use and secondary uses such as research.

data standards is also proliferating. Regulation of vendors to promote interoperability and terminology and messaging standards is increasing, with more auditing and mapping of clinical content reported.

The value of harnessing eHR data for analytical purposes was highlighted by the COVID-19 pandemic. Approximately half of responding countries in 2021 report using eHR data to assist with tracking people diagnosed with Sars-CoV-2 or issuing COVID-19 vaccination certificates. Eleven countries also report using eHR data for post-market surveillance of COVID-19 vaccines and to generate real-world evidence for their effectiveness.

Only five countries report systematically mapping clinical data to a common model for secondary use. The use of natural language processing technology based on artificial intelligence (AI) to convert free-text eHR data to a structured format is emerging. **Denmark, Israel** and the **Netherlands** report deploying AI on eMR data for natural language processing, automatic alerts or actions and predictive analytics based on eHR data. Six countries report having national projects to integrate eHR data with genomic, environmental, behavioural, economic or other information.

The most common secondary uses of eHR data reported in the 2021 survey were for monitoring population health, and for monitoring safety and quality of care. A minority of countries (5 out of 27) report using eHR data for retrospective clinical trials, post-market surveillance of medical technology, and/or supporting clinical decision-making. AI/machine learning is reportedly deployed in eight countries to find and extract relevant eHR data for specific uses, assist with clinical decision-making, and support administrative processes through automated alerts or managerial workflow.

While the technical and operational readiness of eHRs has improved, countries report ongoing challenges in the governance of harnessing eHR data for analytics and research. Many of these challenges have been reported since 2012. They include legal barriers, lack of resourcing, and ongoing resistance from providers. A lack of social consensus, license and trust is a key barrier to using eHR data for these purposes. However, the COVID-19 pandemic may have served as a turning point by illustrating the value of using eHR data for population health purposes. Sixteen out of 27 countries report that the pandemic has influenced their eHR system or their plans for further development and use of their eHR system.

The results highlight, once again, how important the political, social and cultural dimension of policy is in this area, and the need for continued monitoring and mutual learning. The benefits of digital technology increase exponentially through systematisation, standardisation and convergence (conversely, these benefits are diminished by fragmentation). Ongoing collaboration on the policy and technical aspects of eHR implementation and use across countries will be critical to maximise the benefits and minimise the risks of using data to advance human health and progress.

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Acronyms

AI	Artificial intelligence
AIHW	Australian Institute for Health and Welfare
AIR	Australian Immunisation Register
API	Application programming interface
ATC	Anatomical Therapeutic Chemical
EESZT	National eHealth Infrastructure (Hungary)
EHNIS	Estonian National Health Information System
EHIF	Estonian Health Insurance Fund
EHNIS	Estonian National Health Information System
eHR	Electronic Health Record
eMR	Electronic Medical Record
ePIP	Practice Incentives Program eHealth Incentive (Australia)
ePR	Electronic Patient Record
FHIR	Fast Healthcare Interoperability Resource
GDPR	General Data Protection Regulation (EU)
GTIN	Global Trade Item Number
HHS	Department of Health and Human Services (United States)
HIPAA	Health Insurance Portability and Accountability Act (United States)
HL7	Health Level Seven
ICD	International Statistical Classification of Diseases and Related Health Problems
ICPC	International Classification of Primary Care
IIS	Immunization Information Systems (United States)
MHR	My Health Record (Australia)
OMOP	Observational Medical Outcomes Partnership
ONC	Office of the National Coordinator for Health Information Technology (United States)
PKI	Public key infrastructure
RRF	Recovery and Resilience Facility
SUT	Sağlık Uygulama Tebliği (Türkiye)
WHO	World Health Organization
XDS	Cross Enterprise Document Sharing

1 Introduction

1. The introduction of electronic health and electronic medical records (eHRs and eMRs – see Box 1.1) is among the most tangible manifestations of digital technology entering the healthcare sector. However, their implementation has not always been entirely successful. While these initiatives helped create an important and powerful infrastructure, they have not always been fully informed by, and designed with, the needs of patients and health professionals in mind. Further, the broader policy, scientific and societal needs served by high quality health information have not always been considered.

2. By ensuring that important clinical information such as allergies, prescription drugs and medical history can be accessed by patients and their healthcare providers, a well-designed and implemented eHR can, first, improve the quality of care. Improved safety, efficiency and effectiveness, as well as better care coordination and patient experience, are most likely if data can be exchanged between various providers, and ‘follow the patient’ whatever healthcare setting they are in (Slawomirski and Klazinga, 2020^[1]). Second, the data held in an eHR can generate valuable information for other analytical purposes. These include healthcare quality improvement (continuous learning), informing public health policy, and enabling biomedical innovation and health systems research. Using eHR data for these purposes has several advantages over traditional methods, including the cost-effectiveness of repurposing data, enabling big data and AI applications, and the relative timeliness of eHR data (Oderkirk, 2017^[2]; OECD, 2019^[3]).

3. This Working Paper reports the findings of an OECD survey of the development, use and governance of eHRs in health systems, complementing the earlier publication of some of the survey data (OECD, 2022^[4]). The primary focus of the survey was the readiness of eHR data to contribute to health data analytics. (The primary use of data for direct patient care was also considered insofar as it is a foundation for other analytical uses). Twenty-seven countries responded to the 2021 survey, which followed similar surveys conducted in 2012 (24 responding countries) and 2016 (28 responding countries). While there is some overlap, different countries responded to the surveys (see Annex B: Country participation in OECD eHR Surveys, 2012-2021 for more information). Annexes C and D of the report offer contextual information and include supplementary tables.

4. This Working Paper contributes to the OECD’s ongoing efforts to leverage the potential to use health data while managing risks. Since the survey in 2016, OECD Health Ministers have welcomed the Recommendation of the OECD Council on Health Data Governance. This Recommendation lays out the framework conditions to encourage the availability and use of health data for health-related public interests, while promoting privacy and data security (OECD, 2016^[5]).

5. This working paper comprises three main chapters covering:

- 1) the technical and operational readiness of electronic health records
- 2) the data quality and timeliness of electronic health records, and
- 3) the governance of eHR data focusing on analytical purposes.

It concludes with a brief chapter on the outlook for the future.

Box 1.1. Key terms and definitions

Clinical terminology standards: Standard sets of terms, names and codes to be used when entering data in electronic records. For example, SNOMED-CT (Systemised Nomenclature of Medicine – Clinical Terms) provides a broad set of standardised clinical terms for software applications. These standards are needed to ensure interoperability (OECD, 2019^[6]).

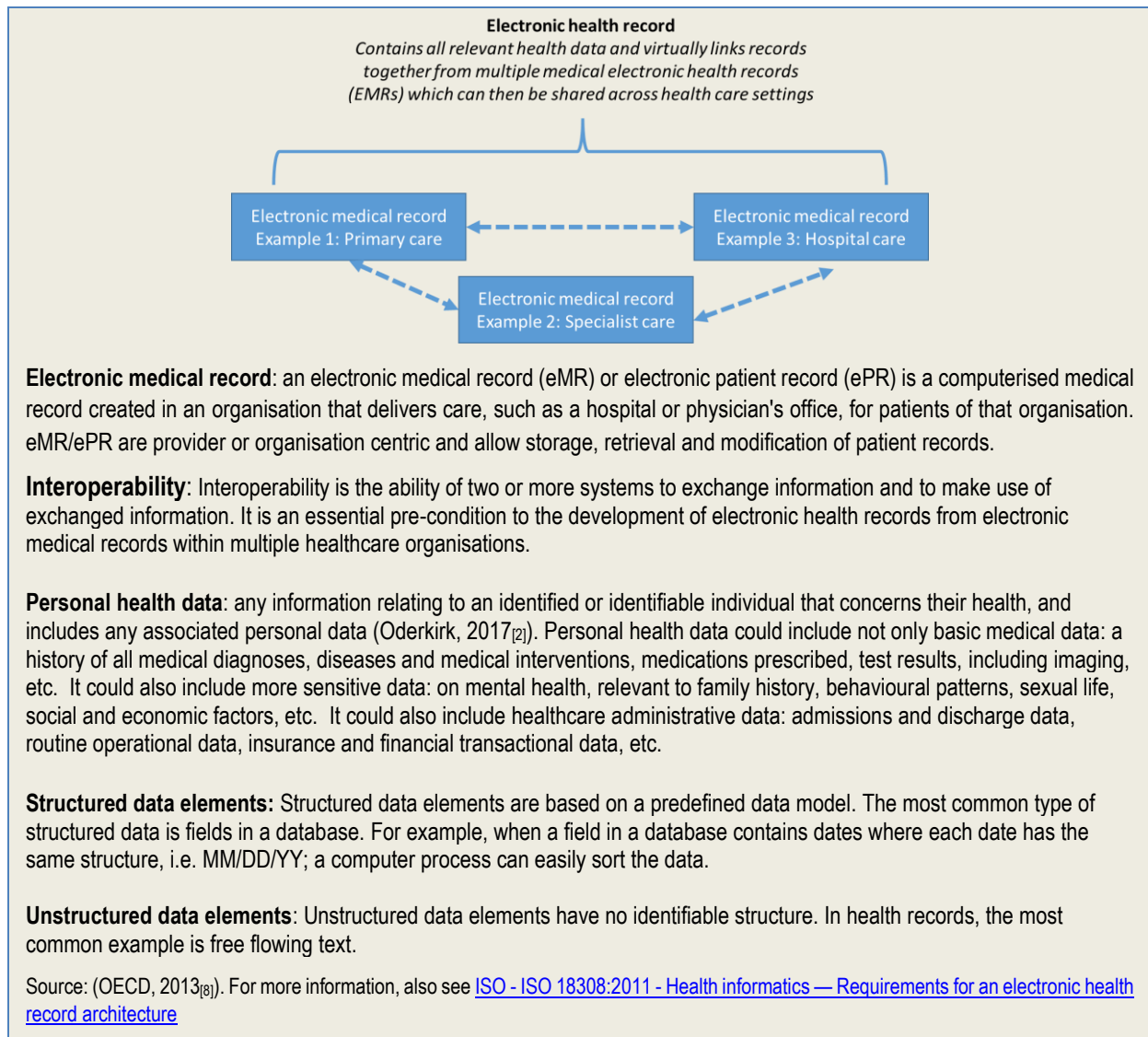
Cost-efficiency refers to the costs and provider burden relative to the output. Provider burden is a cost borne by the provider, but is a cost nevertheless. Although the OECD does not regard cost-efficiency as a dimension of quality, it is a factor that must be considered in any analysis of quality as it can affect quality in all dimensions (OECD, 2011^[7]).

Data quality: The OECD Quality Framework and Guidelines for OECD Statistical Activities defines quality as “fitness for use” (OECD, 2011^[7]). The framework is based on seven dimensions:

1. **Relevance:** measuring relevance requires the identification of user groups and their needs.
2. **Accuracy** is the degree to which the data correctly estimate or describe the quantities or characteristics that they are designed to measure.
3. **Credibility** is the confidence that users place in data products based simply on their image of the data producer. Credibility is determined in part by the integrity of the production process, which is driven by strict adherence to professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of data.
4. **Timeliness*** reflects the length of time between data becoming available and the events or phenomena they describe. The notion of timeliness is assessed on the period that permits the information to be of value and still acted upon.
5. **Accessibility** reflects how readily data products can be located and accessed by users.
6. **Interpretability** reflects the ease with which users may understand and properly use and analyse the data. The adequacy of the definitions of concepts, target populations, variables and terminology underlying the data, and information describing the limitations of the data, if any, largely determines the degree of interpretability.
7. **Coherence** reflects the degree to which the data are logically connected and mutually consistent. Coherence *within* a dataset implies that the elementary data items are based on compatible concepts, definitions and classifications and can be meaningfully combined. Coherence *across* datasets implies that the data are based on common concepts, definitions and classifications, or that any differences are explained and can be allowed for. *Temporal* coherence over time implies that the data are based on common concepts, definitions and methods over time, or that any differences are explained and can be allowed for. Coherence *across countries* implies that the data are based on common concepts, definitions, classifications and methods, or that any differences are explained and can be allowed for.

*For the purposes of this Working Paper, timeliness is considered separately to data quality, although in practice they are closely linked concepts.

Electronic health record: an electronic health record (eHR) refers to the longitudinal electronic record of an individual patient that contains or virtually links records together from multiple electronic medical records (eMRs) which can then be shared and re-used across healthcare settings (interoperable). It aims to contain a record of contact with the healthcare system for individual patients from multiple organisations that deliver care. It includes information on the provision and results of therapeutic and diagnostic interventions, including pathology and radiology.



2 eHR technical and operational readiness

6. Technical and operational readiness is a prerequisite for the successful development, implementation and utilisation of eHR systems. It refers to several aspects of eHR systems, including the type of electronic record that is used, its coverage and interoperability across and within different healthcare settings, adherence to terminology and electronic messaging standards, accessibility to patients, as well as the ways in which data are stored and processed.

The use of electronic records is growing but coverage varies across settings

7. A central prerequisite for the development of eHR systems is the use of eMRs in regular settings of care, such as doctors' practices and hospitals, where health data are generated, collected and accessed (see Box 1.1). According to the 2021 survey, the use of eMRs by medical practitioners to access and capture information on patient diagnosis and treatment varies across healthcare settings. eMR use in OECD countries is high in hospital settings, with 21 and 20 countries respectively reporting that eMRs are used in at least 90% of hospital inpatient care settings and emergency rooms. Eighteen of the 27 countries report that electronic records are used in at least 90% of primary care physician offices and 17 report that this is the case for medical specialists³.

8. At the national level, full coverage of eMRs varies. Eleven out of 27 countries (**Costa Rica, Denmark, Estonia, Finland, Germany, Hungary, Lithuania, the Netherlands, Norway, Sweden, and Türkiye**) report that 100% of providers use eMRs in all healthcare settings covered in the 2021 survey. In 2016, this was only reported to be the case in **Denmark, Sweden** and the **UK (Scotland)**. Countries reporting the lowest eMR coverage across healthcare settings were **Japan**, with around 45% of settings covered on average, and **Korea**, with around 85% of settings covered on average. **Australia, Canada, Mexico** and **Switzerland** were unable to provide data on eMR use for at least two of the four healthcare settings covered in the survey.

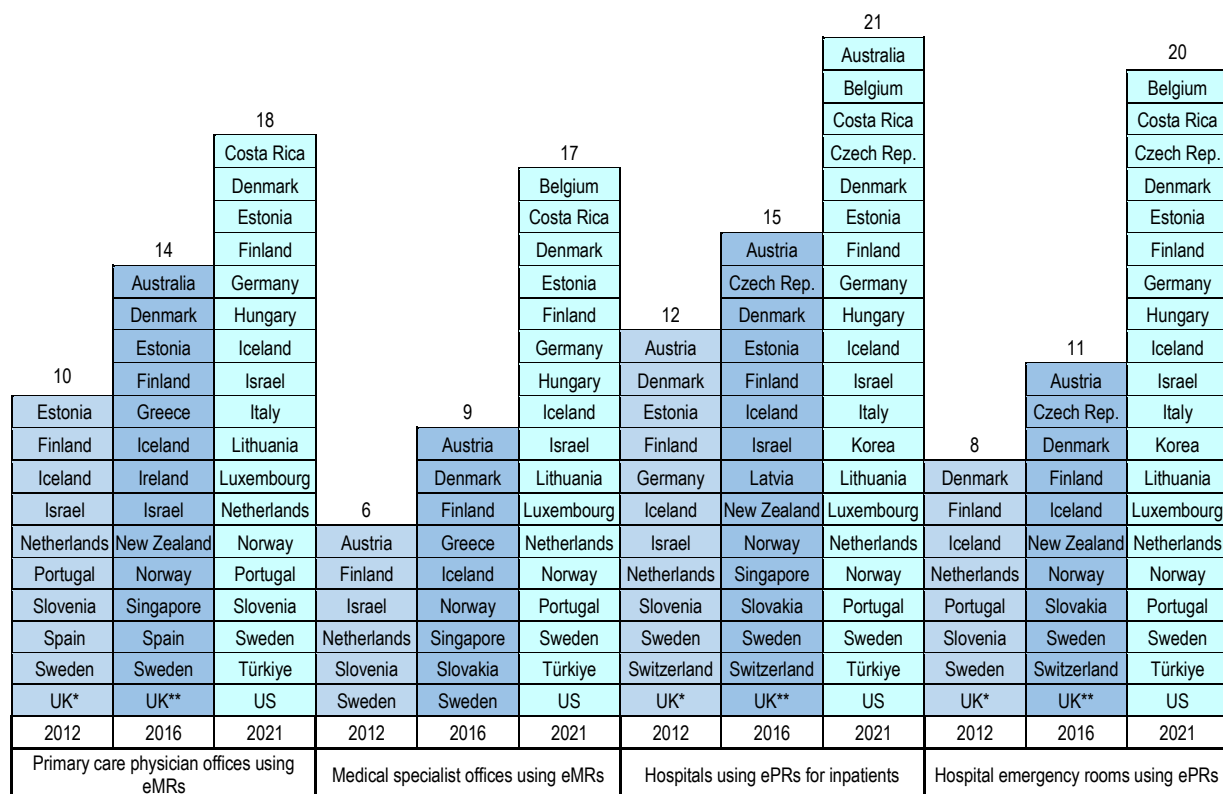
9. The overall use of electronic health or medical records has increased throughout all care settings and countries since 2012 (see Figure 2.1). The increase was greatest for medical specialist offices, where the number of countries reporting a coverage of at least 90% doubled from nine out of 28 countries in 2016 to 18 out of 27 countries in 2021. A similar development was reported in hospital emergency care, where the number of countries in which more than 90% of care settings use an eMR rose from 11 out of 28 to 20 out of 27 countries. Although these figures are not entirely comparable due to varying country survey participation in different years, they nevertheless signal a trend towards broader implementation. In 2021 this was reported by 11 countries. The greatest change from 2012 to 2021 was reported in **Denmark** for

³ Primary care physicians focus on generalist care rather than specialism and in the provision of patient-centred rather than disease-centred services. Primary care physicians can be referred to as family physicians or general practitioners. Specialist physicians primarily provide disease-centred services. In some countries medical specialist physician offices may be only outside of hospital, while in other countries medical specialist physician offices may be within hospitals.

medical specialists, where the proportion of offices using eMRs increased from 10% to 100%, and in the **United States** for inpatient hospital settings, where eMR coverage rose from 19% to 96%.

Figure 2.1. Use of electronic medical records is increasing

Countries reporting that electronic medical or patient records are used in 90% or more of physician offices, specialist offices or hospital settings



Note: *England and Scotland, **England, Northern Ireland and Scotland, countries participating in the 2012 survey: 24, countries participating in the 2016 survey: 28, countries participating in the 2021 survey: 27

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance, 2021; 2016 HCQI Survey of Electronic Health Record System Development and Use; 2012 HCQI Questionnaire on Electronic Health Record Systems and the Secondary Use of Health Data (OECD, 2013^[8]; Oderkirk, 2017^[2])

Most countries are implementing a unified eHR but fragmentation persists in others

10. The widespread use of eMRs in medical offices is an important step towards new ways of supporting patient diagnosis and treatment, as well as population health monitoring and research. To harness this potential, interoperability is critical to enable the sharing of information captured in single offices across providers and entities like research and governmental institutions. In the absence of a single, country-wide eHR platform, interoperability is necessary to develop unified information from a collection of local or settings-based eMRs.

11. While there is still considerable fragmentation and devolution in many eHR systems, 15 out of 27 countries (**Australia, Czech Republic, Estonia, Finland, Germany, Hungary, Iceland, Italy, Japan, Lithuania, Luxembourg, Portugal, Slovenia, Switzerland and Türkiye**) are implementing a “country-wide” eHR system, where data are either created, stored or linked at a national level (see Figure 2.2). Twelve countries (**Australia, Belgium, Czech Republic, Denmark, Estonia, Finland, Germany, Israel,**

Japan, Norway, Portugal and Sweden) report using a system where a minimum set of patient data (summary) is exchanged nationally and a broader exchange of patient data takes place at the subnational level (such as within regions, states or networks of healthcare organisations). Only **Canada and Korea** report exclusively using systems with subnational exchange of data only. Four countries (**Costa Rica, Mexico, the Netherlands, and the United States**) report that there are no mandated national or sub-national eHR systems currently in place.

12. Out of the seven countries that reported not implementing a national eHR system in 2016, three (the **Czech Republic, Denmark and Japan**) have since adopted systems where at least a minimum data set is exchanged nationally. Most countries participating in the 2021 survey were still using the same type of system as in 2012. Only **Switzerland** changed from a system of subnational exchange in 2012 to a country-wide eHR system.

Figure 2.2. Types of eHR systems used across OECD countries

16			
Australia			
Czech Republic			
Estonia			
Finland			
12			
Germany	Australia		
Hungary	Belgium		
Iceland	Czech Republic		
Ireland	Denmark		
Italy	Estonia		
Japan	Finland		
Lithuania	Germany		
Luxembourg	Israel		
Portugal	Japan		
Slovenia	Norway		
Switzerland	Portugal		
Türkiye	Sweden		
		2	
		Canada	
		Korea	
			4
			Mexico
			Netherlands
			Sweden
			United States
One country-wide eHR system	A system with country-wide sharing of minimum data set AND broader sub-national data exchange	A system where patient data is ONLY exchanged at the sub-national level	Another type of system

Note: Countries participating in the 2021 survey: 27

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

The capacity for data sharing across providers is improving in most countries

13. Data sharing across providers is essential to effectively use the data stored in patients’ electronic records along the care pathway. Twenty out of 27 countries (**Australia, Belgium, Canada, Denmark, Finland, Germany, Hungary, Iceland, Israel, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, Norway, Portugal, Slovenia, Sweden and Türkiye**) report that arrangements enable patient data on treatments, medications, laboratory test results and medical imaging to be shared among physician offices and between physician offices and hospital systems (see Figure 2.3).

14. One of the most established forms of health data exchange is sharing prescription data. ePrescription systems are common. Many countries, including **Australia, Canada, the Czech Republic, Hungary, Iceland, Italy, the Netherlands, Norway, Portugal, and Türkiye**, report that electronic prescribing is part of their eHR system. In **Norway**, ePrescriptions are the most widely used form of data exchange with more than 7.5 million prescriptions generated each month (almost 1.4 per inhabitant).

Figure 2.3. Data sharing of patient data across providers has increased since 2016

Countries reporting sharing of data on patient treatment, current medications, laboratory tests AND medical imaging results among physician offices or between physician offices and hospitals

			20			20
			Australia			Australia
			Belgium			Belgium
			Canada			Canada
			Denmark			Denmark
			Finland			Finland
			Germany	15		Germany
			Hungary	Belgium		Hungary
14					13	
Belgium						
	13					
Canada	Australia		Iceland	Canada	Australia	Iceland
Denmark	Austria		Israel	Denmark	Austria	Israel
Finland	Canada		Italy	Finland	Canada	Italy
France	France		Japan	France	Denmark	Japan
Indonesia	Israel		Korea	Indonesia	France	Korea
Israel	Luxembourg		Lithuania	Israel	Israel	Lithuania
Mexico	New Zealand		Luxembourg	Mexico	Luxembourg	Luxembourg
Poland	Poland		Mexico	Poland	New Zealand	Mexico
Portugal	Singapore		Norway	Portugal	Poland	Norway
Singapore	Spain		Portugal	Singapore	Singapore	Portugal
Slovakia	Sweden		Slovenia	Slovakia	Spain	Slovenia
Spain	Switzerland		Sweden	Spain	Sweden	Sweden
Switzerland	UK*		Türkiye	Switzerland	Switzerland	Türkiye
2012	2016		2021	2012	2016	2021
Sharing among physician offices			Sharing among physician offices and hospitals			

Note: *England and Northern Ireland. Countries participating in the 2012 survey: 24, countries participating in the 2016 survey: 28, countries participating in the 2021 survey: 27.

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance; 2016 HCQI Survey of Electronic Health Record System Development and Use; 2012 HCQI Questionnaire on Electronic Health Record Systems and the Secondary Use of Health Data

15. In some countries, including **Costa Rica, Finland, Hungary, Iceland, Italy, Luxembourg, Portugal and Slovenia**, data sharing is facilitated through a national system or platform. In **Costa Rica**, data sharing takes place via the eMR system of the Social Insurance Fund, which integrates several systems to record the clinical data of each patient, which can then be shared across the country. In **Finland**, the Kanta system, which most healthcare providers are connected to, allows for data sharing. In **Hungary**, the country-wide electronic health record system “EESZT”, which every healthcare provider is obliged to join and use, is used to store, share and transfer data.

16. In some countries, sharing of health data is still hindered by fragmentation, coupled with the lack of interoperability of eMRs across institutions or regions. **Australia** reported that data sharing is most established within state public health systems and private hospital networks (though not between the two) as they have implemented common systems to share information. In **Israel**, data sharing works well within

insurer and provider networks but only a minimum data set is shared across these networks. In **Sweden**, health data sharing mostly takes place within each region. **Mexico** reports that eHR coverage is fragmented as each health sector uses a different electronic platform. Private providers run their own health data systems, which are decoupled from the public sector, hindering the exchange of data across sectors and providers.

17. Many countries report considerable progress enabling health data sharing in the past years. The number of countries reporting that comprehensive patient data is shared across both physicians and hospitals increased from 12 out of 28 countries in 2016 to 20 out of 27 in 2021.

18. At the time of survey responses, several countries report plans to further develop their health data systems and policies. In the **Netherlands**, for example, legislation on electronic exchange of patient information has unanimously passed the House of Representatives, which means that the electronic sharing of health data among providers will very likely be mandatory pending ratification by the Senate. **Switzerland** reports that they are beginning to implement an eHR system for mandatory use in hospitals. This system and its modes of sharing will be refined and fully implemented in coming years.

19. Some countries note that data sharing across providers is possible in their country only with patient consent. This is the case in countries such as **Germany, Luxembourg, the Netherlands, Switzerland and Türkiye. Luxembourg** has an access matrix, which defines the viewing and writing rights for each type of healthcare provider and for each specific type of data contained in the eHR system. In the **Netherlands**, patient consent is required when information is shared, except in cases of joint treatment by a treatment team (although the patient must be informed about information sharing). While the comprehensive sharing of health data across providers supports diagnosis and treatment decisions, it is crucial to ensure that patients' perspectives are considered, and patients can access and interact with their own health records (see the next section).

In most countries, patients can access and interact with their own health records

Mechanisms for patient access to eHR data exist, but use is still developing

20. Countries are increasingly providing patients with a means to view their own eHR data. Patient access to an eHR system is usually facilitated through patient portals, which individuals can log into via a secure internet platform⁴. Twenty-three out of 27 countries (**Australia, Belgium, Canada, Costa Rica, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Iceland, Israel, Italy, Japan, Lithuania, Luxembourg, the Netherlands, Portugal, Slovenia, Sweden, Switzerland, Türkiye** and the **United States**) report that patients can view the data in their own eHR. This is an increase compared to 2016, when 19 out of 28 countries reported that patients can view their own health data. Patient access is currently not possible in **Korea** and **Mexico**. Among the countries participating in both the 2016 and 2021 survey, the **Czech Republic, Israel** and **Japan** have implemented new functions for patient access since 2016.

21. While most countries report that their eHR systems have mechanisms for patient access, there is great variety in the proportion of patients that can use this function. In 12 countries (**Denmark, Estonia, Finland, Germany, Iceland, Israel, Italy, Japan, Lithuania, Luxembourg, Sweden, and Türkiye**) all

⁴ A difference exists in patient portals and personal health environments (PHE). Patient portals are offered by individual providers. PHE are offered (as is the case in the Netherlands) by private enterprises and combine data of all providers and self-measured data (by apps). The key difference is that the portals are the responsibility of the provider, whereas the PHE is managed by the patient, who then is responsible for the data in it.

(100%) patients can view their health data. In other countries, including **Canada, Costa Rica**, the **Czech Republic, Hungary, Portugal, Slovenia**, and the **United States**, this function is available to half or less of patients - access depends on the context (for example, access may only be available for patients in hospitals or other specific settings). In the **Netherlands**, all patients can view at least an abstract of the eMR of their general practitioner, while access to hospital related data and data from other providers varies. In **Slovenia** only 5% of patients can view the data in their eHR, although the use of this function is steadily increasing.

22. A further limitation is that in some cases only data captured from specific providers is accessible to patients. Only 14 out of 27 countries (**Australia, Denmark, Estonia, Germany, Hungary, Italy, Japan, Lithuania, Luxembourg, Netherlands, Slovenia, Sweden, Switzerland** and **Türkiye**) report that patients can view health data from all providers. In **Belgium**, only some information can be viewed by patients. **Estonia** reports that specific software is needed to access medical images, which prevents patient access. This is also the case in **Finland**. In the **United States**, there is no country-wide eHR system and patients need to access multiple patient portals to view their complete medical record. In **Hungary**, patients can view an audit log, which allows them to track the publication or alteration of data in their eHR or successful and unsuccessful queries. In **Iceland**, patients can access all their medical data and reportedly can view their practitioner's notes since 2021.

In many countries, patients can now interact with their own electronic health records

23. Some eHR systems not only allow patients to view their data but also enable them to interact with their record. For instance, interaction may comprise patients uploading health or health-related information themselves, contacting healthcare providers, or specifying their preferences regarding the sharing of their data with providers or for secondary uses. Patients can interact with their record in 17 out of the 27 countries participating in the 2021 survey (**Australia, Costa Rica, Czech Republic, Denmark, Finland, Germany, Iceland, Italy, Lithuania, Luxembourg**, the **Netherlands, Portugal, Slovenia, Sweden, Switzerland, Türkiye** and the **United States**).

24. This is an improvement compared to 2016, when half (14 out of 28 countries) reported that this function was available to patients. In the 2021 survey, the most reported functions in patient portals are the booking of medical appointments (17 countries), the requesting of prescription medicine renewals (12 countries), and the uploading of data from medical devices and/or approved smartphone apps/tele-monitoring (11 countries). In many countries, patients can also directly communicate with their healthcare professionals via a patient portal, such as via video conferences (12 countries) and secure messaging (11 countries).

25. The specific modes of patient access and interaction vary across countries. The **Icelandic** patient portal allows patients to give power of attorney to their significant others to pick up their medication from the pharmacy, change donor information, upload data, book and change appointments, and answer questionnaires about their health and wellbeing. It not only allows for the storing and accessing of data but also constitutes a tool of interaction between patients and the healthcare system.

26. Such interactive or administrative functions are increasingly being implemented in other countries. In the **Czech Republic**, patients can change appointment times if their portal support e-appointments. In **Lithuania, Slovenia** and **Türkiye**, patients can also book appointments via their patient portal. In **Germany**, patients can amend, upload and delete information and see which healthcare providers accessed which data at which time. Moreover, from 2023 onwards, communication between patients and healthcare providers will be possible via video and messaging.

Telemedicine services are offered through eHR systems and infrastructure

27. As discussed in the previous section, patient portals are one way that patients can access healthcare services remotely, using the portal to directly communicate with health service providers. In **Canada, Denmark, Germany, Iceland, Israel, Japan, Lithuania, the Netherlands⁵, Sweden⁶, Türkiye** and the **United States**, patients can use portals to exchange secure messages (asynchronous communication via text message, email and/or voice message) with their healthcare provider. Patient portals in **Canada, Denmark, Germany, Hungary, Iceland, Israel, Japan, the Netherlands⁷, Portugal, Sweden⁸, Türkiye** and the **United States**, allow patients to video-conference (synchronous communication with audio and video) with their healthcare provider.

28. In some cases, e-services are available primarily for certain settings or groups of patients. In **Costa Rica**, older and chronic patients can access teleconsultations through the patient portal. In **Denmark**, e-consultations are primarily used to access primary care providers. In **Germany**, doctors and psychotherapists with their own practice can offer e-consultation hours, with the Federal Association of Statutory Health Insurance Physicians setting precise rules for this (e.g., a certified video service must be used for the consultation session via the Internet). In **Iceland**, e-consultations are mostly used by patients living in remote areas. In **Israel**, this service is used to access primary care doctors and paediatricians out-of-hours.

29. The COVID-19 pandemic has driven the adoption and normalised the use of telemedicine in routine practice. Eighteen out of 27 countries surveyed expect electronic communications for medical consultations to increase in the future. **Canada, the Czech Republic, Denmark and Sweden** expect the number of electronic communications for medical consultations to decrease compared to the peak of the COVID-19 pandemic, but still to be much higher than the pre-pandemic period.

Consistent data structure is essential for functional eHRs

In most countries, a minimum data set is defined to capture core health information and improve the standardisation and sharing of data

30. Many countries have defined a minimum data set that can be shared among medical providers treating the same patient to promote the standardisation and exchange of health data. The exact setup and content of the minimum data set varies across countries. However, it usually contains the information about patients that is considered most important when diagnosing and treating a person.

31. In 2021, twenty-four out of 27 countries report that they have defined a minimum data set. This is not yet the case in the **Czech Republic, Germany, Mexico and Switzerland**. In **Switzerland**, there are recommendations from eHealth Suisse about which documents to place in the eHR file of a patient, but there are no mandatory requirements.

32. Most countries (24) require standardised data entry for unique patient identifier, information on patient demographics and medications as part of the minimum dataset. Other commonly included elements are: patient clinically relevant diagnostic concerns (23 countries); patient clinically relevant procedures (22 countries); a healthcare provider unique identifier (21 countries); patient immunisation (20 countries), and a so-called patient problem list including active diagnoses and solved diagnoses (20 countries).

⁵ Via provider portals, not via a comprehensive personal health environment (eHR) system.

⁶ Some regions

⁷ Via provider portals, not via a comprehensive personal health environment (eHR) system.

⁸ Some regions

33. Only three countries (**Costa Rica, Denmark and Iceland**) include patient reported outcome measures (PROMs) in their minimum data set. None include patient reported experience measures (PREMs) or genetic data. The countries with the most comprehensive minimum data sets are **Denmark and Iceland**, which include 16 out of 18 verified elements, and **Costa Rica** and the **Netherlands** which cover 15 elements.

34. Implementing a minimum data set supports the standardisation and sharing of data, but only if patients have an eHR containing these data elements. In **Costa Rica, Denmark, Estonia, Finland, Iceland, Israel, Japan, Luxembourg, Norway, Sweden and Türkiye**, 100% of patients have an eHR containing this minimum data set. In **Italy**, this only applies to 5% of patients, and in **Belgium and Portugal** to about 25% of patients. **Portugal** reports that this is so because only a part of the population has access to or is registered in the Citizens Portal, where this information can be captured and accessed, although all citizens have the capacity to have a minimum data set. **Australia** notes that around 10% of patients have opted out of having a My Health Record, which is the Australian national eHR system. In many countries the coverage of eHRs with a minimum data set has increased since 2016. In **Estonia**, coverage increased from 68% to 100%, in **Israel** from 90% to 100%, and in **Sweden** from 76% to 100%. Defining a minimum data set needs to be accompanied by efforts to increase the use of eHRs in general.

The use of structured data elements in eHR is increasing

35. Countries are also increasingly requiring structured data entry to help standardise the information captured by and shared via EHR. In contrast to unstructured data, which is typically free text, structured data is standardised so that it can be easily processed, shared and understood across software platforms.

36. Since 2016, many countries have made considerable progress in adopting structured data elements to register information on crucial medical issues, like patient diagnosis, medications, laboratory test results, medical imaging results and surgical procedures. While in 2016, only 4 out of 28 countries (**Denmark, Estonia, Japan and the United Kingdom (England)**) reported using structured elements to capture and share data on all of these categories, in 2021 this number increased to 13 out of 27 countries (**Australia, Belgium, Costa Rica, Denmark, Estonia, Iceland, Israel, Italy, Japan, Mexico, Norway, Türkiye and the United States**). Standardisation is most established for patient medications, with all but one country (**Switzerland**) reporting the use of structured elements to capture medication data.

37. Only seven countries (**Costa Rica, Denmark, Iceland, Lithuania, Mexico, the Netherlands⁹, and Türkiye**) reported the use of structured elements to capture patient socio-economic data. Four countries (**Costa Rica, Iceland, Italy and Mexico**) reported the use of structured elements to capture psychosocial or cultural data. The same holds for PROMs and PREMS, metrics designed to capture and measure patients' perspective in healthcare. Only **Iceland** and **Mexico** use structured elements to capture PROMs in all cases while seven countries (**Australia, Canada, Costa Rica, Denmark, the Netherlands, Norway and the United States**) reported doing so in some cases. The use of structured data for PREMs within eMRs is less common, with only **Mexico** using structured elements in all cases and **Australia, Canada, the Netherlands and Norway** in some cases. Ongoing initiatives to develop a standardised vocabulary for patient-reported experiences and outcomes, like the OECD PaRIS project, are likely to contribute to further progress (de Boer et al., 2022^[9]).

⁹ The Netherlands has Clinical Building blocks 'Education' and 'Housing' (with the value homeless), where vendors have the possibility to include these building block in their software (eMR).

The use of international terminology standards is high but variation persists

38. When coding patient information in a structured manner, physicians and other medical professionals usually rely on terminology standards. These include the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT), Logical Observation Identifiers Names and Codes (LOINC), and Anatomical Therapeutic Chemical (ATC) Classification System.

39. Relying on such standards improves the exchange and interpretability of electronic health data. The most established clinical terminology standard is the ICD, different versions of which are used for capturing patient diagnoses in 21 out of the 27 countries participating in the survey. **Australia** and **Switzerland** use SNOMED to record this data, while **Greece**, **Hungary** and the **United States** use both systems. The survey results indicate that in many countries multiple clinical terminology standards are used next to each other, even for the same data category.

40. Another category with an established clinical terminology is patient medication, which is coded using the ATC standard in 16 out of 27 countries. While **Australia** and **Switzerland** rely on SNOMED to code patient medication, some countries use their own, locally developed clinical terminology standards. These include **Costa Rica**, which uses Lista Oficial de Medicamentos (LOM), **Korea**, which uses the KD (Korea Drug) Code, **Mexico**, which relies on a national norm from 2012, and the **United States**, which uses RxNorm and NDC (National Drug Code).

41. Patient laboratory test results are captured using the LOINC standard in 16 countries, whereas SNOMED is used for this purpose in **Iceland**, **Slovenia**, and **Sweden**. The **Czech Republic**, **Denmark** and **Sweden** also use standards based on Nomenclature for Properties and Units in Laboratory Medicine. For medical imaging results, 11 countries report relying on DICOM, while SNOMED and LOINC are used by three countries each. For surgical procedures, there is less conformity across countries with eight reporting the use of an ICD based system, five relying on SNOMED, four using NCSP, two using NOMESCO and others relying on national codes.

42. Other categories are less consistently standardised. Patient vital signs, such as body mass and blood pressure, are coded with LOINC in **Finland**, **Luxembourg** and the **United States**, with SNOMED in **Australia** and **Portugal**. The remainder of reporting countries use other terminology systems. Of the few countries capturing socio-economic data in a structured format, most use their own terminology standards. Only **Australia** uses ICD-10 and **Portugal** uses HL7. There is also little cross-country concordance in the terminology used to register clinically relevant behaviours and psychosocial or cultural issues. When capturing PROMs and PREMs in electronic records, no country uses the same terminology, with most not using a structured format at all (see above).

43. These patterns are similar to the survey results from 2016. They indicate that countries rely on mostly the same established international standards for medical categories like medications and diagnoses. There has been little progress made regarding the low level of standardisation and use of terminology for patient-reported outcomes, socio-economic data and psychosocial data categories in eHRs.

Use of unique identifiers, smart cards and secure tokens is growing

44. Unique patient identification is essential to developing a longitudinal eHR for patients that contains input from multiple healthcare providers over time. Unique patient identification supports both diagnosis and treatment of individual patients as well as research and statistical analysis of population health data. Unique identification also supports data quality checks and facilitates the linkage of eHR data to other health-related datasets for approved analytical purposes.

45. Twenty-five of the 27 respondents to the 2021 survey report that they have a unique number to identify patients. Unique identification for providers is used in all responding countries, except **Japan** and the **United States**. In the **United States**, other forms of patient identity matching are used. There has been limited change on this aspect since 2016. The **Czech Republic** has adopted a unique number to identify providers entering data into eMRs. **Japan** has introduced a unique identification number for patients.

46. Smart cards typically contain an embedded microprocessor that provides for the secure identification of patients and healthcare providers. Smart cards can facilitate secure access to records and services on-line for both groups. This technology makes it possible to store within the card some essential elements from patients' medical records to assist with patient care in an emergency. Smart card technology is used to identify healthcare providers in 13 countries (**Belgium, Czech Republic, Estonia, Finland, Hungary, Israel, Italy, Lithuania, Luxembourg, the Netherlands, Portugal, Slovenia** and **Sweden**). This technology is used to identify patients by only 11 countries (**Belgium, Czech Republic, Estonia, Hungary, Israel, Italy, Japan, Lithuania, Luxembourg, Portugal** and **Slovenia**). The use of smart cards for patient identification has increased slightly since 2016, when only 8 out of 28 countries were using this identification method.

47. Secure tokens, which are external devices used to gain access to electronically restricted resources, constitute another method for identifying patients and providers. This is the least common technology for identification across the countries participating in this survey. It is used in eight countries (**Denmark, Israel, Luxembourg, the Netherlands¹⁰, Portugal, Sweden, Switzerland** and **Türkiye**) for identifying patients and in 11 countries (**Australia, the Czech Republic, Denmark, Hungary, Israel, Italy, Luxembourg, the Netherlands, Portugal, Switzerland** and **Türkiye**) for identifying providers.

Most countries store eHR data on on-site hardware but hybrid models are emerging

48. The amount of eHR data typically grows exponentially in the years following system implementation. Storage and management of data are therefore increasingly relevant concerns. Most reporting countries noted the use of on-site hardware, such as dedicated servers, to store and process eHR data. Twelve of 27 countries (**Costa Rica, Denmark, Estonia, Hungary, Iceland, Italy, Lithuania, Luxembourg, Slovenia, Sweden, Switzerland** and **Türkiye**) report that they exclusively rely on their own hardware solutions. Six countries (**Australia, Czech Republic, Israel, Korea, the Netherlands** and the **United States**) use a combination of on-site hardware and cloud storage technology. Other countries, like **Estonia**, are currently solely using on-site servers but are considering a wider use of cloud services in the future. **Israel** reports that eHR data services are increasingly using cloud technologies. Only **Japan** and **Luxembourg** report using primarily cloud services to manage, store and process eHR data.

49. In **Canada**, the use of data storage technologies varies by provincial and territorial jurisdiction due to its devolved healthcare system. In the **United States**, healthcare providers can choose the eHR system that best suits an organisation's budget, setting, practice type, and patient population and can opt for either public, private and hybrid clouds and/or premise eHR systems. **Swiss** law prohibits the use of any cloud services, as health data must be kept within the country.

50. The distinction between cloud-based services and on-site hardware is useful to track changes in health data storage. In practice, however, these two kinds of storage often overlap, especially when adopting the perspective of providers or patients. Many countries, like **Costa Rica, Hungary, Italy, Slovenia** and **Türkiye**, manage and process eHR data in national data centres, which are on-site hardware technologies from the government's perspective but are used as cloud services by physicians, researchers

¹⁰ Multi factor authentication.

or patients that access or interact with an eHR. Overall, there has been little change in practices since 2016.

Encryption, privacy-enhancing technologies and other security measures are used to protect patients' health data

51. Health data contain sensitive information and adequate safeguards are needed to protect data storage and transmission. A secure health data infrastructure is not only necessary from a legal, technical and operational perspective - it is also important for people to trust and use eHR systems.

52. The most common method used to secure eHR data in the countries participating in this survey is data encryption, which is used in 14 out of 27 reporting countries (**Australia, Canada, Czech Republic, Hungary, Iceland, Israel, Italy, Japan, Korea, Luxembourg, Portugal, Slovenia, Switzerland** and the **United States**). For example, **Switzerland** has implemented a data protection strategy that safeguards patients' data using encryption. In the **United States**, healthcare providers and eMR vendors are required to comply with the HIPAA Security Rule, which requires implementation specifications for encryption.

53. Other methods are also used to secure eHR data. In **Denmark**, access is enabled through a digital signature and data are exchanged on a secure network. In **Lithuania**, eHRs are signed by public key infrastructure (PKI) certificates. In the **Netherlands**, access to the network of the National Exchange Point is heavily restricted and, for instance, requires providers to log in with a special ID-card and password.

Key finding: technical and operational readiness is improving

54. The use of eMRs has grown over the past decade, with a consistent rise in the level of implementation. The proliferation is most pronounced in hospitals, but other settings are catching up. The greatest increase has been observed in medical specialists' offices, where the proportion of countries reporting at least 90% coverage has risen from 6 out of 24 reporting countries in 2012 to 17 out of 27 reporting countries in 2021.

55. Fragmentation persists, however, with only 15 respondent countries implementing a unified eHR system where data are either held or linked at national level. Nevertheless, the exchange of data for patient care is rising, with 20 out of 27 countries now reporting data sharing between physicians' offices and hospitals compared to 13 out of 28 countries in 2016.

56. Patients are now able to access their digital records in most countries that responded to the 2021 survey, with 17 countries reporting that patients can also interact with their record. These are very encouraging findings. Patient access is a legal obligation in many countries and also an important factor in patient-centric, safe and quality care (OECD, 2022^[4]; de Bienassis et al., 2022^[10]).

57. Telemedicine is used increasingly, whether through an eHR-enabled patient portal or a separate platform. This increase has been driven mainly by the COVID-19 pandemic. Most reporting countries expect electronic communication between patients and providers to increase, and to continue to be important (OECD, 2023^[11]).

58. Most countries have now defined a minimum data set to capture core health information, improve the standardisation and reduce friction in sharing data. Data portability is a key means to enable the transfer of health data for re-use, including for analytical purposes (OECD, 2021^[12]). Comparison with previous survey results reveals an increased use of structured elements in eMR/eHR data. The use of unique identifiers, smart cards and secure tokens is growing. However, a range of terminology standards are used, and there is little evidence of convergence across countries.

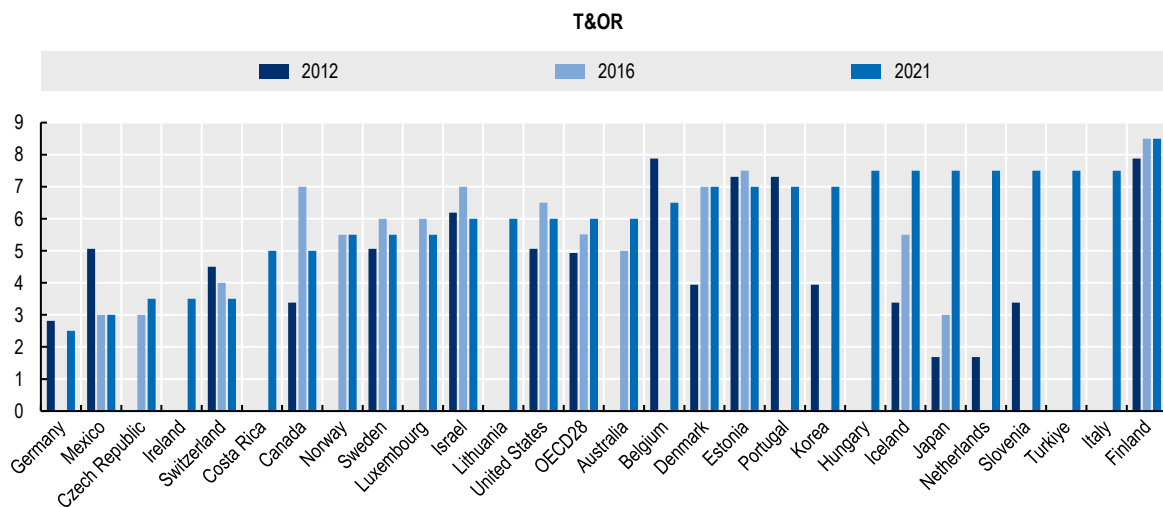
59. Most countries store eHR and eMR data on on-site hardware. Hybrid models are emerging, however, where eHR data are managed on government servers which serve as cloud facilities for patients, physicians and researchers who access or interact with eHR data. Encryption is the most common method to secure and protect eHR data in countries participating in this survey. Additional ways to protect privacy include anonymisation, digital signatures and ID cards, and secure networks (see Section 155852352). These findings are relatively consistent with those from the 2016 survey.

60. Overall, the technical and operational factors that support countries to use electronic health data to build national health information and research infrastructure data include:

- coverage
- comprehensive record sharing
- patient access
- sufficient minimum datasets
- structured data and clinical terminology standards, and
- unique IDs for patients and providers.

61. Each participating country’s responses were assessed on these factors. The resulting scores are provided in Figure 2.4. Where relevant, the scores from the 2012 and 2016 surveys are also provided. The highest 2021 score was reported by **Finland**, which also reported the highest scores in the two previous surveys. The biggest improvement was reported by **Japan**. The average score has improved in each successive survey, from 4.9 in 2012, to 5.5 in 2016, and 6.0 in 2021.

Figure 2.4. Composite score for technical and operational readiness of eHRs



Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance, 2021; 2016 HCQI Survey of Electronic Health Record System Development and Use; 2012 HCQI Survey of Electronic Health Record System Development and Use
 Notes: (1) Questions varied slightly between surveys. (2) The 2012 maximum score for Technical and Operational Readiness index was 8 and has been adjusted to be a score out of 9. (3) Only countries that participated in 2021 are shown. However, the OECD27 average reflects all countries that participated in the year specified. Additional detail is provided in the Annex.

3 eHR data quality and timeliness

Challenges in eHR quality and timeliness persist, despite their expanded use

62. Countries continue to encounter numerous technical and financial challenges in developing health information systems with data from eMRs, and in making these data available for purposes like healthcare monitoring and research. The 2016 study revealed a range of concerns reported by countries in this regard: multiple terminology standards; incomplete records; variable provider-level record keeping, checks and coding; incomplete coverage; legacy systems; lack of standard formats; inadequate patient ID; technical constraints; and financial constraints (Oderkirk, 2017^[2]). For the purposes of this Working Paper, data quality and timeliness are considered separately, although in practice they are closely linked concepts. Some definitions of data quality include the dimension of timeliness (OECD, 2011^[7])

63. Results of the 2021 survey suggest that several challenges still exist. These include financial barriers, resistance among healthcare providers, technical barriers, jurisdictional barriers and legal barriers. Eighteen countries expressed concerns about the quality of data within eHR systems. In some countries, challenges are limited and there are strategies in place to address them. In other countries, challenges are reported to be significant and will be difficult to resolve. Specific concerns raised by countries include:

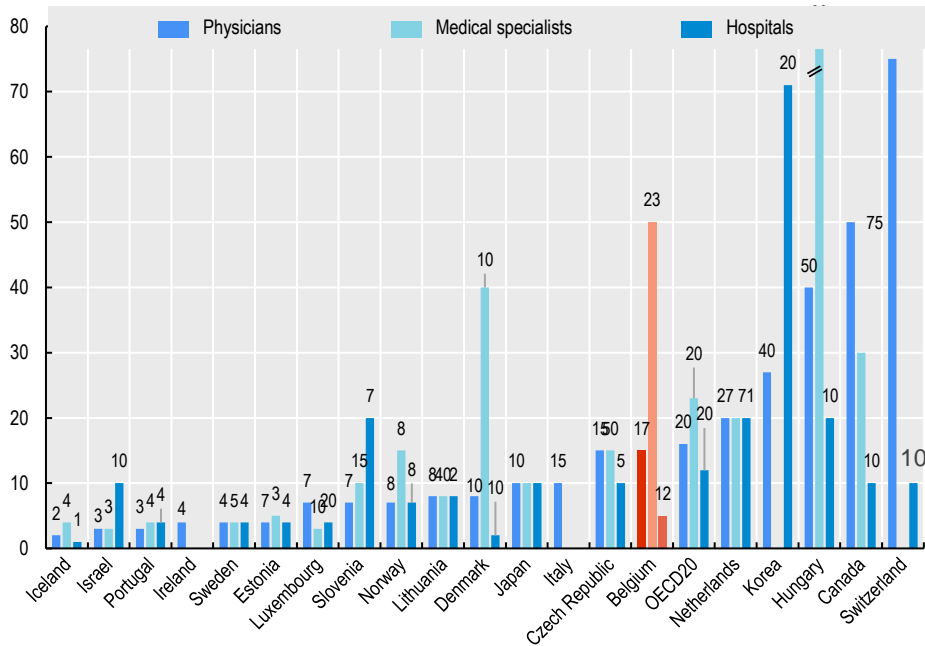
- building meaningful use and overcoming resistance from clinicians, particularly specialists, and in aged care and private hospitals
- financial/resource-based barriers and integration of point of care systems outside of primary and acute care e.g., long-term care and ambulatory care
- technical barriers related to the use and adoption of interoperability/vocabulary standards by legacy vendors and sub-nationally
- change management (e.g., compelling use-cases for the implementation of digital systems at the point-of-service) and human resources (e.g., need of education/specific training for healthcare providers)
- slower than expected introduction of some nationally specified features in systems and some legal barriers at a detailed level
- heterogeneous needs and situations in different regions and systems, as well as legacy systems
- differing levels of awareness among citizens and the digital divide between those with/without access to computers and/or the Internet
- political issues and sub-national coordination.

The number of eMR software vendors is rising

64. Tension can exist between certain dimensions of data quality (such as accessibility and coherence) and the choices of eMR software platforms. According to the 2021 survey results, the number of eMR software solutions available in countries continues to expand (see Figure 3.1). The average

number of eMR software vendors available to physicians, medical specialists, and hospitals was approximately 16, 22, and 12 respectively. Competition and choice in this regard is not inherently negative and may confer benefits. These markets, however, require strong regulation and policy oversight to ensure data quality standards are met.

Figure 3.1. Many countries have a number of eMR vendors available by setting/provider



Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Policies to improve interoperability are being developed

65. Some countries report that a plan has been developed (or is under development) for implementing policies or projects to improve eMR interoperability nationally. Plans have been developed in **Australia** (National Digital Health Strategy and an interoperability implementation plan in development), **Belgium** (national eHealthplan), **Canada**, **Denmark**, **Estonia** (Next Generation ENHIS Project), **Finland**, **Hungary** (National E-Health Strategy), **Iceland**, **Israel**, **Italy**, **Japan**, **Lithuania**, **Luxembourg** (National Interoperability Framework), the **Netherlands**, **Slovenia**, **Switzerland** and the **United States**.

66. The **Czech Republic** reports that its eHR system is not well standardised, which limits interoperability and secondary use. The secondary use of eHRs is currently limited to statistical purposes and does not provide necessary feedback for improving quality of care. In the **Czech Republic**, there is a plan to improve interoperability by: establishing and strengthening the National eHealth Center; a mandate to the Ministry of Health on selecting interoperability standards; developing and adopting national interoperability standards; establishing national terminology services; establishing a testing framework and accreditation scheme for eHR providers; and improving the interoperability of healthcare providers through publicly financed projects.

67. For more information on governance of national eHR infrastructure development, see Annex D: Supplementary tables.

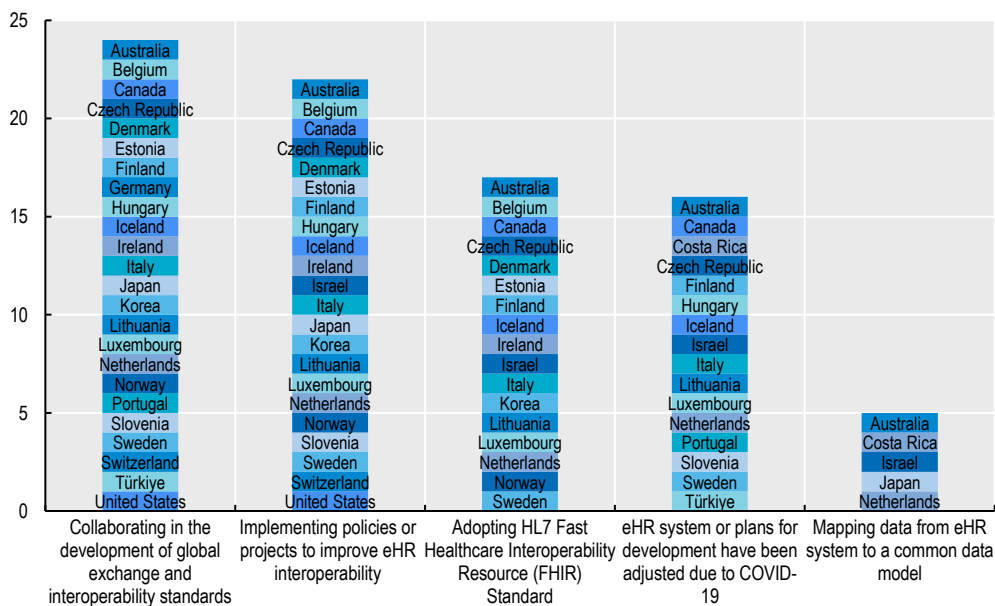
The adoption of APIs and international standards is growing

68. Application programming interfaces (APIs) allow data sharing among different eMR software and Health Information Technologies. Real-time access to datasets through APIs enables the linkage and re-use of data among healthcare stakeholders. Setting up infrastructure, processing and updating data, and other operational activities are required for functioning APIs (OECD, 2022^[13]). In the 2021 survey, fourteen countries (**Australia, Belgium, Canada, Denmark, Finland, Hungary, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Sweden and Türkiye**) report the development of public APIs.

69. In the **United States**, the 21st Century Cures Act (Section 4002), establishes a condition of certification that requires health IT developers to publish APIs that allow “health information from such technology to be accessed, exchanged, and used without special effort through the use of APIs or successor technology or standards, as provided for under applicable law” (ONC, 2021^[14]). In **Sweden** a new linked database on prescription data, enabled via the National Medicines List Act and implemented by the Swedish eHealth Agency, is creating a standardised registry accessible to healthcare providers, pharmacies and patients.

70. Fifteen countries report plans to adopt the HL7 Fast Healthcare Interoperability Resource (FHIR) standard (see Figure 3.2). The FHIR standard provides web-based applications in healthcare as they exist for other sectors such as for e-commerce, banking and travel bookings, and utilises commonly used web development tools which allow for a larger pool of developers and faster development. Finally, 11 countries (**Australia, Belgium, Czech Republic, Estonia, Finland, Korea, Lithuania, the Netherlands, Norway, Sweden, and Türkiye**) report that they are adopting or planning to adopt Substitutable Medical Applications and Reusable Technologies (SMART) on FHIR standards or another standard to support the development of mobile or smartphone apps that connect to eHRs. SMART is a standard used on top of FHIR to develop web-browser and mobile/smartphone apps that can be connected to and interact with any eMR platform. For example, an app to assist patients with managing their medications or an app for secure communication with a healthcare provider (see section 155852352 for more information on patient portals).

Figure 3.2. Country activities for improving the quality and timeliness of eHR data



Note: N=27 responding countries.
 Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

71. In **Norway**, for example, a range of activities are underway to improve the quality and timeliness of eHR data. A national document-sharing infrastructure (based on Cross Enterprise Document Sharing (XDS)) has been developed for sharing eHR-documents across organisations. It is envisaged this will be expanded to give providers and consumers access to data as well. National guidelines are under development, including policies and target architectures for open APIs and data sharing. A semantic interoperability program has been developed to establish a common data model, including the use of SNOMED CT and HL7 FHIR. Norway has also begun a national, multi-year program to further improve interoperability, e.g., by developing trust model/infrastructure, open API infrastructure, common data and national sharing of clinical test results.

Policies supporting the adoption of eHR systems are proliferating

72. One strategy to cope with multiple clinical terminologies for the same data element is to map the data to a common standard (see section 155852352 for more discussion on standardisation of terminology). This step is also needed when local code sets are permitted and there is a need to map to a single national or international terminology. Not all countries require this step because some already have consistency in the terminologies used throughout their eHR system. At the time the 2021 survey was conducted, five countries map data from eHR systems to a common data model: **Australia** (hospital specific mapping to Observational Medical Outcomes Partnership (OMOP)); **Costa Rica** (Power BI, data cubes); **Israel** (OMOP and FHIR); **Japan** (Clinical Innovation Network); and the **Netherlands** (health and care information models)¹¹. Even countries with internally consistent eHR data can boost engagement in multi-country scientific, medical and technological research and development by coding their data to an internationally recognised common data model.

73. Most countries have a national authority responsible for the eHR system that sets and maintains national standards. Often, the responsibility for eHR system implementation nationally is within an organisation that has broader responsibilities, such as a health ministry, a health information organisation, or a health insurance provider. Countries have implemented different strategies to improve consistency and interoperability where there are multiple minimum dataset specifications in use.

74. In the 2021 survey, 24 out of 27 countries reported that there was a national organisation with primary responsibility for national eHR infrastructure development (compared to 27 out of 28 countries in 2016). Of these, 87% are responsible for setting standards for clinical terminology in eHRs and 83% are responsible for setting standards for electronic messaging.

75. The engagement of stakeholders in decision-making about the development and implementation of national eHR strategies is important to the adoption and use of eHR systems, and their continuous improvement. Over 60% of countries surveyed in 2021 included multi-disciplinary advisory bodies with representation from various stakeholder groups, such as professional associations, patients, health insurers, government and healthcare providers.

76. Nineteen countries reported that there are laws or regulations within the country that require healthcare providers to adopt eHRs. Twelve countries (**Costa Rica, Estonia, Finland, Hungary, Iceland, Italy, Japan, Korea, Lithuania, the Netherlands, Slovenia, Switzerland and Türkiye**) have laws or regulations in place concerning the use of clinical terminology standards (see Annex D: Supplementary tables). All of these countries also have laws or regulations in place requiring electronic messaging standards. Seventeen countries (**Costa Rica, Denmark, Estonia, Finland, Hungary, Iceland, Italy, Japan, Korea, Lithuania, Luxembourg, the Netherlands, Norway, Portugal, Slovenia, Switzerland and Türkiye**) have laws or regulations that require healthcare providers to meet standards for national eHR interoperability.

¹¹ https://zibs.nl/wiki/HCIM_Mainpage

More countries are regulating adherence to agreed standards

77. Countries may institute legal or regulatory requirements for healthcare providers to adopt eHR systems that meet national standards. Certification may be used to encourage software vendors to offer eHR systems that meet national standards, and incentive payments or penalties may be launched to encourage healthcare providers to adopt or maintain high quality eHR systems. Many of the countries with the most advanced eHR systems described in this Working Paper employ several of these policy levers to achieve their success. In the 2021 survey, thirteen countries cite certification processes in place for vendors of eHR systems, increasing from 9 countries in 2012 (OECD, 2013_[8]) (see Table 3.1)

Table 3.1. eHR certification processes and functions

	Do you have a certification process for vendors of eHR systems?	Does the certification process require:		
		Use of clinical terminology standards	Adherence to health information exchange standards	Requirements for national eHR interoperability
Australia	Yes	No	Yes	No
Belgium	Yes	Yes	Yes	Yes
Canada	Yes	No	Yes	Yes ⁵
Costa Rica	No	n.r.	n.r.	n.r.
Czech Republic	No	n.r.	n.r.	n.r.
Denmark	Yes	Yes ⁴	Yes	Yes
Estonia	No	n.r.	n.r.	n.r.
Finland	Yes	Yes	Yes	Yes
Germany	Yes	n.r.	n.r.	n.r.
Hungary	Yes	Yes	Yes	Yes
Iceland	No	n.r.	n.r.	n.r.
Ireland	Yes	No	Yes	No
Israel	No	n.r.	n.r.	n.r.
Italy	No	n.r.	n.r.	n.r.
Japan	Yes	Yes	Yes	Yes
Korea	Yes	Yes	Yes	Yes
Lithuania	No	n.r.	n.r.	n.r.
Luxembourg	No ¹	No	No	No
Mexico	n.r.	n.r.	n.r.	n.r.
Netherlands	Yes	Yes	Yes	Yes
Norway	No	n.r.	n.r.	n.r.
Portugal	No	Yes	Yes	Yes
Slovenia	No ²	Yes	Yes	Yes
Sweden	Yes	No	Yes	No
Switzerland	No ³	Yes	Yes	Yes
Türkiye	Yes	Yes	Yes	Yes
United States	Yes	Yes	Yes	Yes

Notes: n.r. Not Reported // n.a. Not Applicable // d.k. Unknown 1. At present, Agence eSanté imposes external software providers to pass a labelling process before being allowed to connect their IS to eSanté platform. Agence is label owner / label provider. 2. National standards required to participate in E.H.R exchange 3. Included indirectly 4. Conformance to e.g. ICD 10 5. Optional

Source: OECD 2021 Survey of Electronic Health Record System Development, Use and Governance.

Adoption of financial incentives for maintaining high quality eHRs has not accelerated

78. Thirteen countries reported financial incentives or penalties in place to encourage healthcare providers to adopt and maintain high quality eMRs (see Figure 3.3). There has not been significant adoption of new policies using financial incentives since 2016, when thirteen countries also reported having these systems in place (Oderkirk, 2017^[2]). In 2012, eleven countries reported incentives or penalties to encourage healthcare providers to adopt eHR systems conforming to national standards and to use their eHR system and keep records up-to-date (OECD, 2013^[8]).

79. In **Belgium**, general practitioners are eligible for additional financing to support the practice and the use of e-services. In **Lithuania**, healthcare providers that introduce a standardised eHR system can receive a subsidy from the fund to support digitalisation of medical information. In addition, in the medical fee system, healthcare providers are evaluated on medical information provided using the standards. In **Slovenia**, major upgrades of hospital information systems are co-financed through external partnerships.

80. In **Australia**, the Practice Incentives Program eHealth Incentive (ePIP) aims to encourage general practices to keep up to date with the latest developments in digital health. To meet ePIP requirements, practices must adopt compliant software for secure messaging and the My Health Record (MHR) system and make use of e-prescribing and nationally-recognised disease classification or terminology system. In addition, the Australian Digital Health Agency has provided small incentive payments to vendors to accelerate adoption of standards. The Agency provided financial incentives in 2019 to accelerate the adoption of new secure messaging standards by software providers and the integration of new standards into their products. Furthermore, the Australian Institute for Health and Welfare (AIHW) is assessing the data quality of selected tranches of MHR data, to gauge its suitability for research and public health use.

81. In **Estonia**, data exchange between the Estonian National Health Information System (EHNIS) and health providers is mandatory under the health service reimbursement contract between the Estonian Health Insurance Fund and healthcare provider. To be able to exchange data, healthcare providers need to abide by eHR interoperability standards. In **Luxembourg**, there is an incentive scheme for digitalisation of general practices (a one-off payment and an annual payment). **Sweden** has targeted state subsidies from the government. In **Norway**, the Norwegian Healthnet (Norsk helsenett) has a voluntary test scheme to help vendors and healthcare companies to adopt approved solutions adhering to eHR standards.

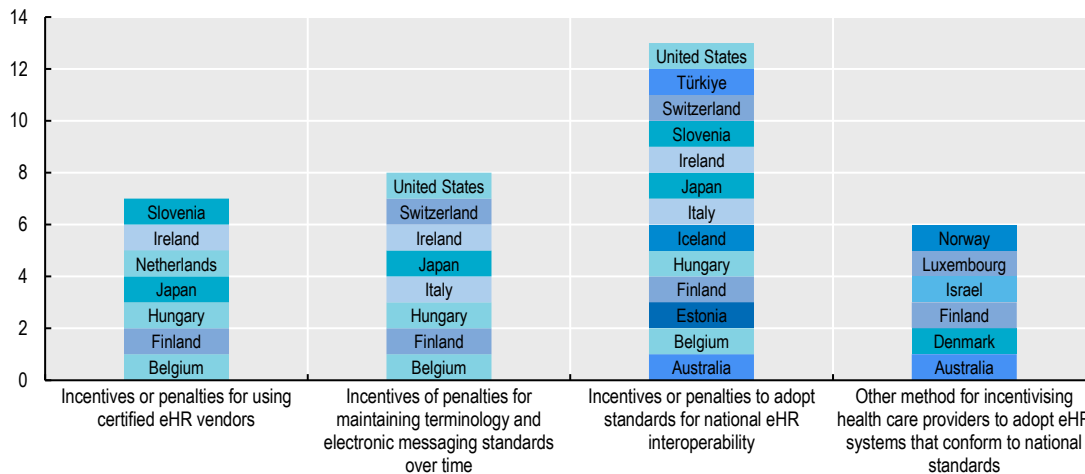
82. In **Finland**, legislation, decrees and rules (referring to more detailed specifications), and mandates for supervisory authorities (other organisations) are in place to enforce compliance with eHR standards. This is supported by active collaboration with various stakeholder groups and joint prioritisation. Financial support has been available for first implementers in the past. In **Hungary**, the National Authority can audit and investigate the adherence to rules, and in cases of non-compliance, the consequences can include a warning, a penalty or withdrawal of licence. In **Italy**, regions receive specific funds to implement the eHR system, according to defined objectives and are evaluated to verify their performance in providing healthcare services within the National Health Service, including on eHR functionality.

83. In **Denmark**, specific incentives and penalties are not in use, but yearly economic agreements regulate adherence to standards as well as the annual fiscal agreement. An executive order on eHealth standards governed by the standard catalogue provides incentives for adherence to national standards. In the **United States**, the Promoting Interoperability Program provides incentives to healthcare providers to adopt certified eHR technology. Incentives are voluntary for providers participating in the major US public health insurance programmes who benefit from payment incentives when meeting programme requirements regarding the use of certified health IT¹². Additionally, federal laws penalise vendors that

¹² <https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Basics>

engage in information blocking practices or fail to comply with certification programme requirements. Penalties may include decertification and/or civil monetary penalties¹³.

Figure 3.3. Countries using different types of financial incentives to promote high quality eHRs



Note: N=27 responding countries. 1. For Luxembourg, national terminology referential bases are put in place and maintained by Agence eSanté 2. For Iceland, there is an incentive for primary healthcare clinics to use the national patient portal. 3. For Australia, a small incentive is paid to accelerate adoption of standards 4. For Denmark, an executive order on eHealth standards governed by the standard catalogue provides incentives to comply with national standards.

Source: OECD 2021 Survey of Electronic Health Record System Development, Use and Governance.

Quality auditing and mapping of clinical record content has developed in recent years

84. Auditing of the clinical content within eHRs is another key quality improvement strategy that can help to reduce inconsistencies in record-keeping practices among providers. Over half of countries report auditing the quality of clinical record content. The **Netherlands** and **Sweden** conduct audits on samples of data. In the **United States**, HIPAA Security Rules include audit controls to be used by healthcare providers to implement hardware, software, and/or procedural mechanisms that record and examine activity in information systems that contain or use electronic health information. Most information systems provide some level of audit controls with a reporting method, such as audit reports. These controls are useful for recording and examining information system activity, especially to determine a security violation.

85. In 2021, just over half of the reporting countries (14 out of 27) audit eMR quality in hospitals, followed by physicians' offices (13) and medical specialists (12) (see Figure 3.4). This is an increase from the nine countries that reported the auditing of the clinical content of records for quality in 2016, and the six countries that had reported the same in 2012 (OECD, 2013^[8]; Oderkirk, 2017^[21]).

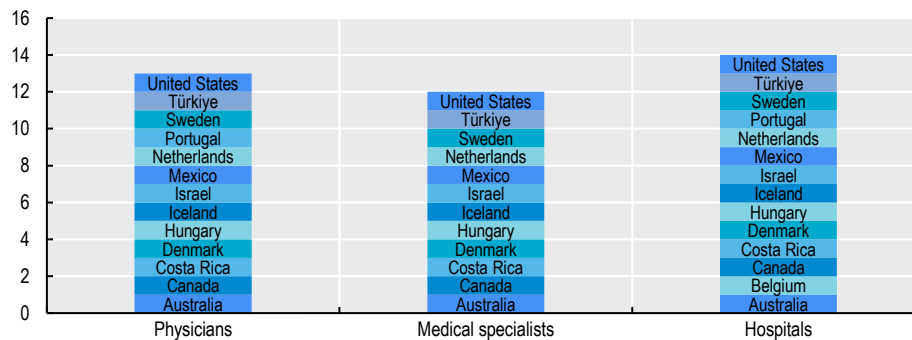
86. Audits are conducted by the Australian Digital Health Agency and AIHW (**Australia**), FPS Health (**Belgium**), Health Statistics Department of the Social Insurance Fund (**Costa Rica**), Quality at the General Practitioner (**Denmark**), Finnish Institute for Health and Welfare (**Finland**), OKFŐ and EESZT (**Hungary**), Directorate of Health (**Iceland**), Audit commission of scientific associations of physicians, the Dutch Health Care Inspectorate (IGJ) and audit agencies (the **Netherlands**), Central Authority for Health System (**Portugal**), and the Ministry of Health (**Türkiye**).

87. In **Canada** the organisations conducting the audits vary by provincial/territorial jurisdiction. In **Sweden**, regional health authorities conduct audits. In **Switzerland**, there are two firms certifying

¹³ <https://www.healthit.gov/topic/information-blocking>

communities, one of them is now formally accredited (KPMG). In the **United States**, the HIPAA Security Rule does not identify data that must be gathered by audit controls or how often the audit reports should be reviewed. A healthcare provider must consider its risk analysis and organisational factors, such as current technical infrastructure, hardware and software security capabilities, to determine reasonable and appropriate audit controls for information systems that contain or use electronic health information.

Figure 3.4. Audit of electronic records for quality by setting



Note: N=27 responding countries.

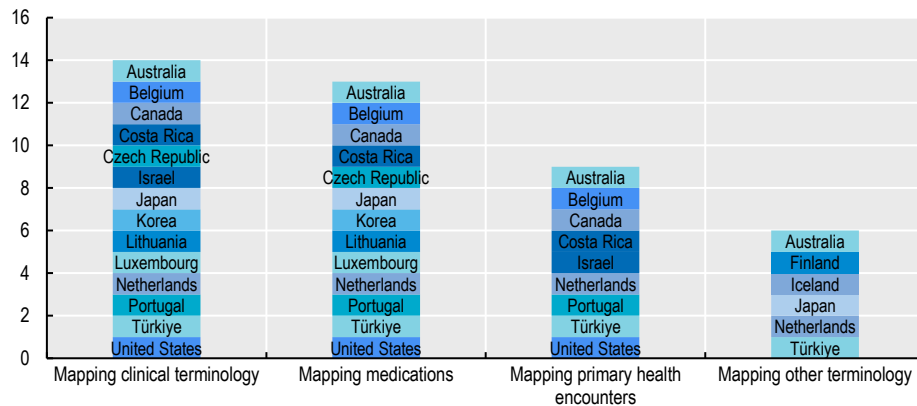
Source: OECD 2021 Survey of Electronic Health Record System Development, Use and Governance.

88. Concerns cited by countries regarding the quality of eHR data relate predominantly to the point of creation. These include limited use of national healthcare identifiers, limited use of standardised terminology (non-standardised abbreviations, narrative content, PDF documents), incompleteness, duplication, inconsistent programming, and an inadequate use of coded data within eHR workflows. Health system fragmentation and a fragmented eMR landscape are also problematic in this regard.

89. In the **United States**, for example, the ONC established The United States Core Data for Interoperability (USCDI) which is a standardised set of health data classes and constituent data elements for nationwide, interoperable health information exchange. In the **Czech Republic**, all data are now collected electronically, however not all data can be directly extracted from eHR systems due to differences of granularity of information in eHR and disease registries.

90. Mapping to common data languages can facilitate comparable national and international statistics for surveillance, monitoring and research (see Figure 3.5). Fourteen countries are mapping clinical terminology in the eHR system to a diagnostic code set (e.g., mapping to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)). Thirteen countries are mapping medications terminology in the eHR to a medications code set (e.g., the Anatomical Therapeutic Chemical (ATC) Classification System). Nine countries map primary healthcare encounters terminology in the eHR to a primary care classification (e.g., the International Classification of Primary Care version 2 (ICPC-2)). Mapping processes and formats used by countries include GTIN, Lionic, RX NORM, SNOMED CT, Standard Master for Pharmaceutical Products, Laboratory Test Code Master, ICPC-1, ICD-10, and SUT. There have been modest improvements since 2012, when less than half of countries participating had succeeded in implementing a system where all eHRs had key data elements that were structured and followed a clinical terminology standard (OECD, 2013^[8]).

Figure 3.5. eHR mapping activities by setting and context



Note: N=27 responding countries.

Source: OECD 2021 Survey of Electronic Health Record System Development, Use and Governance.

Improvements in eHR data timeliness are evident

91. Twelve countries (**Australia, Belgium, Canada, Costa Rica, Czech Republic, Denmark, Iceland, Israel, the Netherlands, Slovenia, Türkiye** and the **United States**) cite that eMRs have improved the timeliness of the creation of databases for health or healthcare monitoring and analysis. Improvements in data timeliness have led to several new features and applications (see section 155852352 for discussion of COVID-19 related advancements).

92. In **Australia**, there is a medicines information view available in the My Health Record that can reduce the time usually required to search through recent summaries or relevant documents to find information about a patient's medications. The medicines information view can also assist in the transition of care and medicines management for patients between their treating doctors and pharmacists. In **Denmark**, timeliness has improved during the COVID-19 pandemic and digitalisation has shown a significant impact. In **Iceland**, there is real-time data collection of eHR data from hospitals and primary healthcare clinics via the Icelandic HealthNet into the national registries of the Directorate of Health. In **Slovenia**, the eAppointment system allows monitoring the availability of healthcare services. In **Türkiye**, emergency care services are monitored by relevant managers through business intelligence reports providing information about the utilisation level, which is updated every 20 minutes. In the **United States**, the immunisation information systems (IIS) give providers and families access to timely immunisation information. Specifically, the data remind families when an immunisation is due or has been missed.

Key finding: data quality and timeliness are improving, but challenges remain

93. Eighteen countries report concerns with data quality, citing similar challenges to those in previous surveys. Concerns over data quality have, in fact, increased since 2012. The main issues concern resistance among health service providers as well as technical, financial, and legal barriers. Countries report various strategies to overcome these challenges - and variable degrees of success in resolving them.

94. While the number of eMR software vendors is growing overall, in some cases (such as the **Netherlands**) a decreasing number of vendors is creating vendor lock-in. This is leading to limitations in desired modifications and high switching costs. However, adoption of Application Programming Interfaces

(APIs) and internationally agreed data standards is also growing. Countries are reporting that vendors' adherence to agreed standards is increasingly regulated.

95. There appears to be mixed attitudes to financial incentives for adopting and maintaining eHR data at an agreed level of quality. More auditing and mapping of clinical record content is being reported, with several countries systematically mapping clinical data to a common data model to allow data and their meaning to be shared across different applications and facilitate use in research and monitoring. Three countries now report using natural language processing technology based on AI to convert free text eHR data to a structured format.

96. Improvements in data timeliness are evident in the 2021 survey, with 12 countries reporting that eHRs helped to quicken the creation of databases for public health or healthcare monitoring and analysis. This has enabled a set of several new features and applications, especially for harnessing eHR data for secondary purposes.

4 eHR data governance enabling data analytics

97. The governance of eHR system design and implementation impacts significantly on whether data from eHR systems are useable for national healthcare quality and health system performance monitoring. This chapter builds on previous work to assess the readiness of national health data governance frameworks to support the use of data held within eHR systems to fulfil national health information and research objectives. This includes:

- having a legal framework to allow system data to be extracted for statistical and research purposes, subject to suitable safeguards
- having a national eHR plan or policy that includes the statistical and research uses of this data
- engaging in the extraction of data from eHR systems to create national datasets, and
- analysing data extracted from eHR systems for key national monitoring and research objectives.

A good legal and policy environment enables eHR data usage for secondary purposes

98. eHR systems not only allow providers and patients to capture, access and share health data but are also used for secondary purposes. These purposes include public health monitoring, monitoring of health system performance and patient safety, and biomedical and health systems research. Countries need to have a data governance framework in place to allow for the use of eHR data for secondary purposes while protecting patients' data and identity.

99. In almost all countries, there are laws and policies in place to allow authorities to extract data from eHRs. The extraction of eHR data for secondary purposes is governed in various ways depending on the specific purpose the data is used for. In most responding countries, public authorities are permitted to extract data from eHRs for statistical and research purposes. In 22 out of 27 reporting countries, respective laws and policies are in place.

100. In **Costa Rica**, the extraction of data from eHRs for secondary purposes is not yet possible. There are ongoing discussions with progress reported on legislative change, which would allow different entities to have access to the records of the eMR system of Costa Rica's Social Insurance Fund. In **Switzerland**, there are no current plans to allow the use of eMR data for secondary purposes, but discussions are ongoing as the use of data for secondary purposes would necessitate amending the eHR law.

Data extraction and processing for creating national databases

101. A robust health data governance framework is crucial for enabling further use of eMR data. Among responding countries, 17 (**Belgium, Canada, Costa Rica, Czech Republic, Denmark, Estonia, Finland, Hungary, Iceland, Israel, Japan, the Netherlands, Portugal, Slovenia, Sweden, Türkiye** and the

United States) report that eMRs have been used to create databases for health or healthcare monitoring and analysis. In **Australia, Italy, Korea, Lithuania, Luxembourg** and **Switzerland**, this is not yet the case. **Luxembourg's** Agence eSanté is, however, setting up a Data Lake related to the data held in the *Dossier de Soins Partagé* eHR system. In **Canada**, the use of eMR data to create databases also depends on provincial and territorial jurisdiction.

102. Using eMR data has several advantages over conventional methods. These advantages include its relative timeliness and the cost-effectiveness of repurposing data. Eleven out of 27 countries (**Australia, Canada, Costa Rica, Czech Republic, Denmark, Iceland, Israel, the Netherlands, Slovenia, Türkiye** and **United States**) report that eHRs improve the timeliness of creating databases for health or healthcare monitoring and analysis.

103. **Denmark** reports that digitalisation has impacted the health sector overall and improved data timeliness was notable during the COVID-19 pandemic. In **Iceland**, eHRs are used to collect real-time data from the hospital minimum data set and the primary healthcare minimum dataset for the health registries of the Directorate of Health. **Israel** reports that the effectiveness of monitoring COVID-19 vaccinations is a good example of how eHRs can support timely health monitoring. In **Türkiye**, emergency care services are monitored by relevant managers through business intelligence reports, which provide information about the utilisation level and are updated every 20 minutes.

104. **Estonia, Finland, Hungary, Korea, Lithuania, Sweden** and **Switzerland** report that the use of eHR data did not significantly improve the timeliness of their databases. In **Sweden**, other factors are drivers of timeliness as real-time monitoring of eHRs is not commonplace and is not conducted at the national level. **Finland** and **Hungary** report that initiatives are underway to improve the real-time monitoring of eHR data.

National authorities play a limited role in preparing & processing eHR data

105. In many countries, national authorities only play a limited role in preparing and processing eHR data to inform health statistics or research at a national level.

- In eight out of 27 countries (**Denmark, Finland, Iceland, Italy, Japan, the Netherlands, Portugal** and **Türkiye**) report that national authorities create databases from electronic health records.
- In 13 out of 27 countries (**Australia, Belgium, Czech Republic, Denmark, Finland, Hungary, Iceland, Italy, Japan, the Netherlands, Portugal, Sweden** and **Türkiye**) national authorities de-identify databases created from eHRs.
- In 12 out of 27 countries (**Australia, Belgium, Czech Republic, Denmark, Finland, Iceland, Israel, Japan, the Netherlands, Portugal, Sweden** and **Türkiye**) they approve or decline requests for access to databases from eHRs.
- **Denmark, Finland, Iceland, Japan, the Netherlands, Portugal** and **Türkiye** report that national authorities perform all of these tasks.

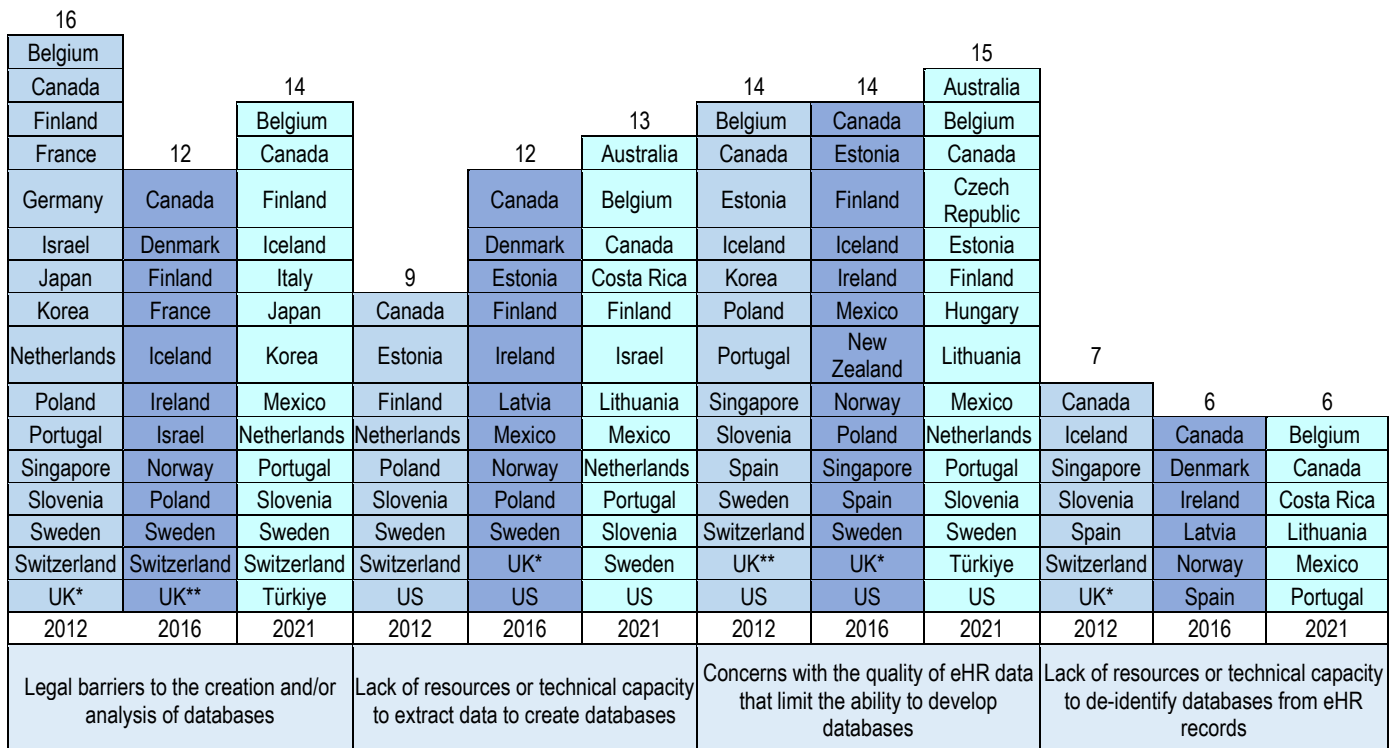
106. In **Canada**, the processing of eHR data is conducted at the provincial/territorial level and not at the national level. Similarly, in the **United States** there is no national entity responsible for this role. However, there are federal agencies that are conducting research to assess the feasibility of extracting eHR data for the purpose of creating databases that can be used for reporting and research purposes. In the **Czech Republic**, the extraction of data for the creation of databases is performed by healthcare providers. In **Israel**, this takes place through an interface between hospitals and the databases. In **Sweden**, the National Board of Health and Welfare maintains registries and databases based on eHR data but does not process eHR data itself. However, national authorities may specify regulations and protocols regarding which data elements are to be delivered (by law) to national registries from providers.

Most countries experience difficulties in creating databases from eHR data

107. In many countries, the widespread use and implementation of electronic medical and health records is a relatively recent phenomenon with governance and legislative structures still under development. Extracting data from eHRs to develop robust and reliable databases comes with further challenges (see Figure 4.1).

Figure 4.1. Difficulties developing datasets from eHRs

Countries reporting challenges in the development of datasets based on eHR data due to various factors



of databases based on eHR data, which is a prerequisite for further secondary uses in research and statistics.

110. Implementing a high level of personal data protection and data confidentiality promotes the development and acceptance of eHR use for secondary purposes. Nevertheless, legal barriers to the creation and/or analysis of databases was also cited by 14 countries in the 2021 survey. For example, **Finland** report that their legislation does not fully support quality monitoring of data. In the **United States**, new regulations regarding bulk export of data and APIs are being considered.

111. The legislative basis for eHR data use is often detailed and clearly defined to ensure data security. While a certain level of control is usually exerted over the extension of secondary uses of personal health data, this can also create (or be perceived to create) barriers to the prompt addition of new data uses. In **Iceland**, for instance, national health registries are defined by law and regulations, so both the law and regulations must be changed if the Directorate of Health wishes to add a new database for health monitoring. **Korea** and **Switzerland** report that their national eHR law does not foresee the use of the stored patient health data. **Italy** reports that their General Data Protection Regulation (GDPR) provisions are very comprehensive but not oriented to an efficient use of information.

112. High-level principles in data protection laws may also prove difficult to translate into practice by non-privacy experts. To avoid such risks, it is essential to involve personal data protection authorities in the process as early as possible, and to ensure that they provide very concrete support to the public authorities that design and deploy the eHRs. The involvement of the data protection authority in eHR legislation is thus key to finding useable and effective solutions.

113. Despite considerable investments in eHR data infrastructure and analysis, many of the difficulties reported by countries in 2012 persist and have, in some cases, become more prevalent. For example, an ongoing challenge countries report is the lack of resources or technical capacity to extract eHR data to create databases for secondary uses. In 2012, 9 out of 24 countries reported this as a challenge, whereas 13 out of 27 countries identified this as a challenge in 2021.

114. This may seem like a negative trend. It is to be expected, however, that countries encounter more difficulties with extracting eHR data as they progressively develop and implement the legal, technical, and administrative infrastructures that allow for secondary data uses. Nevertheless, overcoming these challenges in coming years will be crucial for countries to harness the potential of eHR data for statistics and research by ensuring data quality and protection.

Secondary uses of electronic medical data for statistics and research

115. Electronic health records data are highly valuable for public health and research purposes, when appropriately collected, governed and processed.

116. According to the 27 country respondents to the 2021 survey, eHR data is used for:

- public health monitoring, such as counts of patients with specific health conditions (16 countries)
- monitoring patient safety and quality of care, such as counts of hospital readmissions for adverse drug reactions (12 countries)
- monitoring of health system performance (10 countries)
- monitoring of care outcomes and treatment costs (10 countries)
- research to improve patient care, health system efficiency or population health (10 countries)
- facilitating and contributing to clinical trials (five countries - **Costa Rica, Denmark, Japan, Sweden** and **Türkiye**), and

- supporting clinical decision-making (five countries - **Denmark, Iceland, the Netherlands, Sweden and Türkiye**).

Only a few countries develop machine learning or artificial intelligence algorithms based on eHR data

117. In recent years, the use of machine learning and artificial intelligence (AI) for data analysis has become increasingly relevant. AI applications are also on the rise in the health field and are expected to significantly change biomedical research, public health monitoring and health system administration (Oliveira Hashiguchi, Slawomirski and Oderkirk, 2021^[15]).

118. Thirteen out of 27 countries (**Australia, Belgium, Canada, Czech Republic, Germany, Hungary, Italy, Korea, Lithuania, Mexico, Slovenia, Switzerland** and the **United States**) report that they are not currently using AI for the processing of analysis of eHR data.

119. In eight countries (**Costa Rica, Denmark, Finland, Israel, Luxembourg, the Netherlands, Portugal and Türkiye**), AI or machine learning is used in data mining to find or extract data from eHR systems. In **Portugal**, AI tools support the identification and reduction of antibiotic over-prescription. Eight countries reported the use of AI for automated alerts, messages and actions for patient care or managerial decision-making. In **Estonia** and **Finland**, a decision support system has been developed using eHR data for family doctors. **Iceland** reported the use of automatic alerts that are built into some parts of the national eHR; for example, if a doctor prescribes a drug which the patient is allergic to or if a patient answers a questionnaire about discomfort in cancer care beyond certain defined score limits. A similar system is in place in **Sweden**, where algorithms alert patients if they are at risk of possible harmful drug interactions or allergies. In the **Netherlands**, prescribers are legally ordered to use the EVS (Electronic Prescription System) that checks for drug-drug interactions, contra-indications and known or potential allergies against substances (de Bienassis et al., 2022^[16]).

120. **Denmark, Israel** and the **Netherlands**¹⁴ stand out in this context. They are the only countries covered by this survey where AI applications are used for data mining, natural language processing, automatic alerts or actions and predictive analytics based on eHR data. They are the only countries that use AI for natural language processing to convert text based eHR data to coded data. In **Israel**, this takes place in the framework of the TIMNA big data research platform, which also covers a wide range of other machine learning applications. **Finland** reported that pilot studies and research have been conducted on natural language processing and predictive analytics.

121. While many countries have not yet implemented machine learning tools for the analysis of eHR data, some have plans or ongoing projects to explore the feasibility of these technologies. In **Australia**, for instance, the use of AI is envisaged to occur once the framework to guide the use of My Health Record data is implemented by 2023. In **Hungary**, establishing AI processes on a regular basis is under preparation as defined by the eHealth Strategy. The **United States** reports that, while it does not have a national eHR system, a number of projects aim to identify best practices for leveraging machine learning and AI¹⁵.

122. Another recent development in health data analysis is the integration or linkage of eHR data with genomic, environmental, behavioural, economic or other data. Only six out of 27 countries (**Belgium, Estonia, Germany, Israel, Italy** and the **Netherlands**) report that there are national projects in this area. **Germany** reports that from 2023 patients can release data from the eHR to the research data centre at BfArM (Federal Institute for Drugs and Medical Devices), which holds claims data of all statutory insured

¹⁴ This option is provided some vendors, and used mainly in research.

¹⁵ <https://www.healthit.gov/topic/scientific-initiatives/pcor/machine-learning>

people in Germany. In the **Netherlands**, eHR data are linked with economic and environmental data via Statistics Netherlands (Centraal Bureau voor de Statistiek). **Türkiye** reports that the eHR technology has grown fast with the implementation of e-Nabız. In the next five years, the country plans to integrate or link genomic data with eHRs, for instance to detect certain diseases before birth.

Lack of consensus is a common barrier to the secondary use of eHR data

123. Many countries are encountering difficulties in the creation of datasets from eHRs, as outlined above. The same holds for the secondary use of data, with 23 out of 27 countries experiencing barriers to the use of eHR data for research or statistics purposes. The challenges that countries face range from legal to technical issues to a lack of resources or inadequate data quality.

124. **Australia** reports that several factors have contributed to delays in preparing for the secondary research use of data from My Health Records, including the opt-out programme for the My Health Record system and the COVID-19 pandemic. In **Canada** and **Germany**, the federated structure of the health system leads to additional complications and legal issues. Several countries further mention the difficulty of aligning secondary uses of eHR data with data protection laws like the GDPR.

125. Some countries also report resistance from, or lack of consensus among, healthcare providers as a barrier to the secondary use of eHR data. In **Finland**, there are quality challenges arising from resistance to the entry of clinical data. In **Iceland**, some private practice specialists resist sending information to the national registries of the Directorate of Health, which results in limited information about quality of care and patient outcomes within their practices. Similarly, **Korea** reports the lack of social consensus for such data uses. **Portugal** notes that there is limited trust in digital health services and secondary use of health data.

126. These examples underline that the development of data governance frameworks is not only of legal, technical or scientific concern. eHR data governance enabling data analytics requires countries to address social, political and cultural concerns and ramifications. It is thus important to involve multiple stakeholders in the process of formulating and implementing national eHR data strategies to build social and professional consensus and trust.

Many countries are not yet fully harnessing the potential of eHR data for statistics and research

127. There is a divide between countries that have policies and processes in place that allow for the secondary use of eHR data and a considerable number of countries in which eHR data are not yet harnessed for statistical or research purposes. Often, the level of secondary data analysis is closely tied to the overall maturity of the national eHR system.

128. In the 2012 and 2016 surveys, several countries reported having secondary uses of data envisaged within national plans or priorities for eHRs. While some countries, like **Belgium, Denmark, Finland, Japan** and **Iceland** made significant progress on their policy objectives, other countries like **Canada, Luxembourg, Mexico, Switzerland** or **the United States** were not (yet) able to reach their goals, on a national level.

129. In many countries, policies and plans to facilitate the secondary use of eHR data for statistics and research are currently underway. In **Australia**, the implementation of the framework to enable the efficient use of eHR data to monitor health and healthcare is underway and should be established in full within the next 5 years. **Canada** reports that the use of eHR data for analytics is planned for the provincial/territorial levels. The **United States** has projects underway to explore ways to leverage eHR data for research purposes.

130. In **Sweden**, selected eHR data are widely used for specific purposes and in restricted settings. However, problems still exist regarding comparability and interoperability across settings and jurisdictions.

Sweden notes that openness and transparency are important and serve as a driver for developing better analytics and aggregated quality measures in healthcare.

Half of responding countries report using eMR data to help manage the COVID-19 pandemic

131. Although it is not known what form the next crisis will take, data will be vital to tackle it. Better use of data and the tools to convert it into actionable information is critical to surveillance of new threats and to providing a better picture of health. The COVID-19 pandemic highlighted the value of health data for disease monitoring, the identification of risk groups, and the assessment of health system resilience (OECD, 2023^[17]).

132. In 14 out of the 27 countries participating in this survey (**Canada, Costa Rica, Czech Republic, Denmark, Estonia, Hungary, Iceland, Israel, Italy, Lithuania, the Netherlands, Portugal, Slovenia and Türkiye**), eMR data was used to facilitate the tracking and tracing of patients infected with SARS-CoV-2.

133. In **Estonia**, contact tracing and tracking data was broadly based on data from the Environment and Health Information System (ENHIS), complemented by other data sources. The **Czech Republic** reports that positive test results were sent to the central epidemiology system (ISIN) using the national health data standard DASTA¹⁶. In **Iceland**, a system developed for COVID-19 screening at the borders is now used for all COVID-19 testing. The system is highly automated and fully integrated with the national eHR system and the national patient portal, and all healthcare providers can instantly see if the patient has a positive COVID-19 test. Furthermore, the system is integrated with the Department of Civil Protection and Emergency Management to manage the national vaccination programme for COVID-19.

134. Sixteen out of 27 countries (**Australia, Belgium, Costa Rica, Denmark, Estonia, Finland, Hungary, Iceland, Israel, Italy, Lithuania, Luxembourg, the Netherlands, Portugal, Slovenia and Türkiye**) report a connection or integration between eHR records and the issuing of COVID-19 vaccination certificates. In **Iceland**, for instance, the national eHR, the COVID-19 testing system and the national patient portal are integrated. In **Lithuania**, all vaccination records (including for COVID-19) are stored in the central e-health system (ESPBI IS) and there is a plan for vaccination certificates with easy proof of validity compatible with WHO and European Commission recommendations.

135. In some countries, eHRs are not only used to store and communicate vaccination data but also for the post-market surveillance of COVID-19 vaccine effectiveness and/or adverse effects. Eleven out of 27 countries (**Denmark, Finland, Hungary, Iceland, Israel, Lithuania, Luxembourg, the Netherlands, Slovenia, Sweden and Türkiye**) report that they are using, or planning to use, eHR data for this purpose.

Country experiences of the COVID-19 pandemic are affecting the development of national eHR systems

136. Most country respondents to the 2021 survey (16 out of 27) report that the COVID-19 pandemic has changed their eHR system or plans for further development and use of the eHR system (**Australia, Canada, Costa Rica, Czech Republic, Finland, Hungary, Iceland, Israel, Italy, Lithuania, Luxembourg, the Netherlands, Portugal, Slovenia, Sweden and Türkiye**).

137. **Australia** reports that the national eHR system - My Health Record (MHR) - will play a key role for Australians as an authoritative record of COVID-19 vaccinations. MHR is connected to the Australian Immunisation Register (updated via a daily feed for AIR data) and it supports mobile app connectivity to potentially enable the generation of immunisation certificates. Based on its pandemic experience, **Canada**

¹⁶ <https://www.dastacr.cz/>

is developing a pan-Canadian health data strategy that will align public health, population health and health system data. In **Iceland**, it is under discussion whether the integrated national system for all COVID-19 testing and vaccination can be used for regular cancer screening and other vaccination programmes, such as the yearly vaccination for influenza.

138. **Italy** reports that the experience of COVID-19 increased awareness of the strategic role of eHRs for healthcare and governance, and an early warning and response system requires the linkage of eHR data with other available sources. Italy's recovery plan contains a project to enhance and accelerate eHR system functionalities and usage. **Lithuania** reports that improvements have been made to the quality of eHR data, the collection of health data and eHR systems integration, to enable the sharing and publication of COVID-19 statistics, with the possibility to create open data sets for statistics, research or healthcare planning. In **Portugal**, the COVID-19 pandemic, and the Recovery and Resilience Facility (RRF) plans that followed, accelerated the digital transformation and usage of digital tools in the context of healthcare and treatment. In **Slovenia**, the pandemic increased awareness of the benefits of eHR exchange on a national level. As a result, the use of the national eHR platform has increased significantly, dedicated financial resources have been provided, and new services and programmes have been implemented.

eHR data is likely to be important to the future national monitoring of health and healthcare

139. Ten out of 27 countries (**Australia, Belgium, Finland, Hungary, Israel, Italy, Japan, Luxembourg, Slovenia** and the **United States**) reported that it is likely that eHR data will be used for national health monitoring in the next five years.

140. In **Australia** this will occur once the framework to guide the use of My Health Record data is implemented in full. **Belgium** report that it is working towards more integration and interoperability between the different eHRs. **Finland** also notes that major initiatives are underway. In **Israel**, health organisations and the ministry are investing in data infrastructure and data interoperability, including the potential adoption of standards like SNOMED and FHIR.

141. In the **United States**, eHRs are widely used in physician practices, hospitals and health systems. As a result, the federal government and the private sector have increased their focus on improving interoperability. The federal government promotes interoperability of electronic health information through several programmes and policies. Also, in 2020, the U.S. Department of Health and Human Services (HHS) finalised a regulation designed to drive interoperability of electronic health information by supporting the use of HL7's FHIR standard for APIs. This regulation addresses information blocking, which is generally described as a practice that is likely to interfere with the access, exchange or use of electronic health information. The private sector recognises the value of interoperability. Spurred by HHS regulations, private entities are increasingly using standards-based APIs to develop tools that provide patients, caregivers, and providers with data to promote information sharing.

142. **Mexico** and **Switzerland** report that they are unsure whether eHR data will be used for health monitoring in the coming years. **Switzerland** notes that enough patients would first need to participate in the system, which is not mandatory (opt-in), to have a critical mass of data. Once achieved, the eHR system would then become interesting for secondary data analysis but this will take time.

143. **Canada** is the only country that considers it *unlikely* that eHR data will regularly be used in national health monitoring in the coming five years, even though Canada's development of a pan-Canadian health data strategy will target many of the barriers that hinder the national use of eHR data.

Key finding: data governance for enabling analytics continues to be challenging

144. The 2021 survey examined four factors of eHR system governance to enable and promote the use of data for monitoring, research and other purposes that are in the public interest. These four factors are:

- 1) legal frameworks for allowing system data to be extracted for these purposes, subject to necessary safeguards
- 2) national strategies or policies to address secondary use of eHR data
- 3) national datasets created from eHR data, and
- 4) analysis of data extracted from eHR systems for key national monitoring and research objectives.¹⁷

145. Almost every respondent country reports laws and policies that allow relevant authorities to extract data from eHRs for secondary purposes. In most cases, these are public authorities. After data quality challenges, countries report legal barriers and a shortage of resources (including technical capacity and expertise) as other challenges to harnessing eHR data. These difficulties appear persistent, having been raised since the 2012 survey. In some cases, these challenges have become more prevalent.

146. This is not necessarily a sign of failure. This is a new field where technical and technological capacity is developing apace. Countries may be ‘discovering’ previously unknown difficulties as they develop and implement the legal, technical, and policy infrastructures to enable secondary data uses. However, a divide is becoming evident between countries that permit secondary use of eHR data and those where these data are not yet harnessed in this way. This tends to be associated to the overall maturity of national eHR systems.

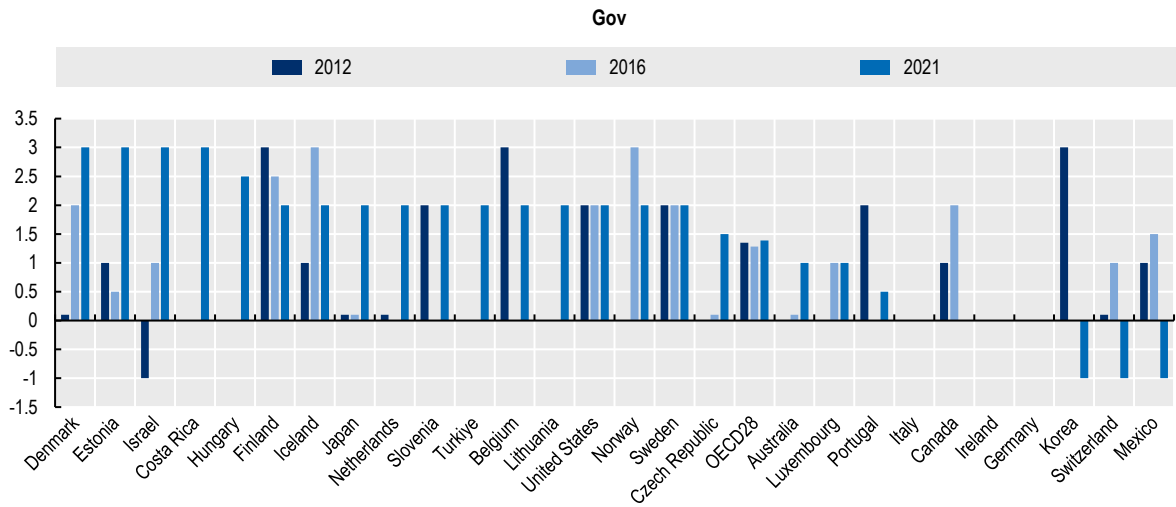
147. The value of putting eHR data to work for secondary purposes was highlighted by the COVID-19 pandemic. Most of the countries participating in the 2021 survey report using eHR data to assist with tracking people diagnosed with SARS-CoV-2 and/or issuing COVID-19 vaccination certificates. Some countries report using eHR data for post-market surveillance of COVID-19 vaccines and to generate real-world evidence for their effectiveness. The majority report that the pandemic influenced their eHR system, whether directly or by informing their plans for its further development and use.

148. The 2021 survey results highlight the importance of the political, social and cultural dimension of health data governance, as with previous surveys. Some countries report resistance from some providers as a key barrier to the secondary use of eHR data. These range from difficulties with entering data into the record to unwillingness to share information with centralised databases such as clinical registries. Several countries report a lack of social consensus and trust as a barrier to better integration and use of eHR data.

149. The aggregate scores for eHR governance based on the 2021, 2016 and 2012 surveys are presented in Figure 4.2. More variability was observed with this metric compared to technical and operational Readiness. In fact, the average score for governance was only slightly higher in 2021 than in 2012. Again, this should not, however, be interpreted as a negative finding. Countries are on a steep learning curve regarding the governance of eHR data and are discovering new, previously unknown challenges since the first survey almost ten years ago. For example, the *OECD Council Recommendation on Health Data Governance* was released in 2017 -- after the completion of the first and second surveys. (In any case, these metrics are intended to guide countries in their development, not rank them.) The results should be seen as reassuring. They suggest that countries are providing an honest appraisal of their situation (and using the survey the way it is intended – for sharing knowledge and mutual learning).

¹⁷ Performance of countries in implementing health data governance is reported in OECD (2022), *Health Data Governance for the Digital Age: Implementing the OECD Recommendation on Health Data Governance*.

Figure 4.2. Composite score of eHR governance enabling data analytics



Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance, 2021; 2016 HCQI Survey of Electronic Health Record System Development and Use; 2012 HCQI Survey of Electronic Health Record System Development and Use
 Notes: (1) Questions varied slightly between surveys. (2) Only countries that participated in 2021 are shown. However, the OECD27 average reflects all countries that participated in the year specified. Additional detail is available in the Annex.

5 Outlook for the future

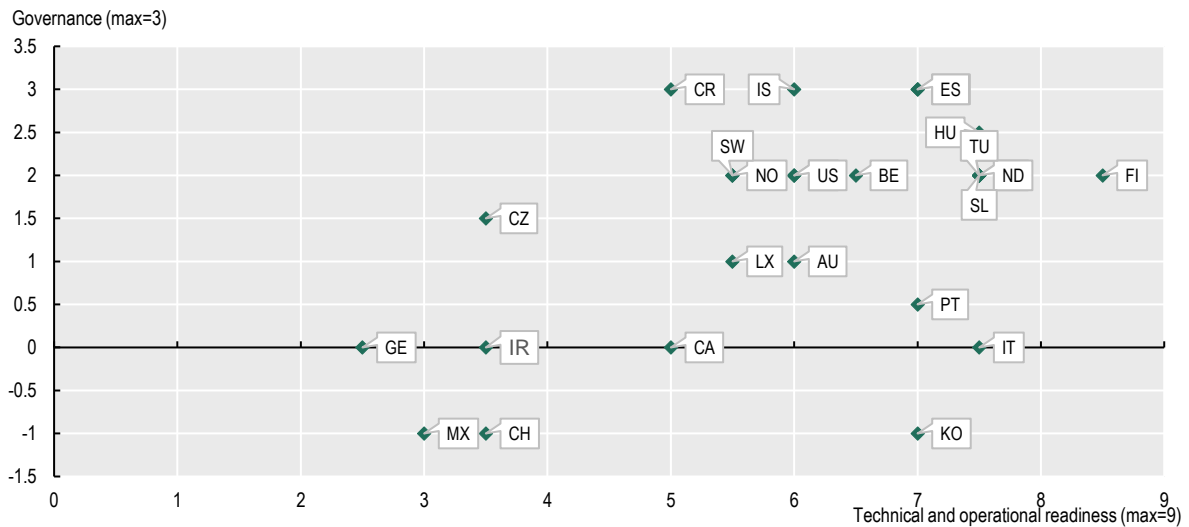
150. This Working Paper reports the findings of a 2021 OECD survey of the development, use and governance of electronic health and medical records. This survey was designed to explore the technical, operational and governance factors that support the use of eHR data for analysis and research in the public interest. Twenty-seven countries responded to the 2021 survey request, following similar surveys in 2012 and 2016, which had 24 and 28 responding countries respectively.

151. The value of using eHR data for secondary analytical purposes was highlighted by the COVID-19 pandemic. Eighteen out of 27 countries that participated in the 2021 survey report using eHR data to assist with tracking people diagnosed with SARS-CoV-2 and/or to issue COVID-19 vaccination certificates. Some countries report using eHR data for post-market surveillance of COVID-19 vaccines and to generate real-world evidence for their effectiveness.

152. Overall, the results indicate progress across OECD countries regarding the implementation, dissemination and use of eHRs. Almost all countries were at the beginning of a journey to harness these data systems for public benefit in 2012 (OECD, 2013). These more recent results suggest that the journey continues. While progress is evident, many challenges observed in previous surveys are still present and new ones are emerging. This is pronounced in the domain of governance enabling data analytics. Countries continue to be at different points on their journey towards integrated, national eHR systems where data follow the patient, thus enabling integrated, high-quality health services, and where data generates valuable information for public health, health system performance and biomedical innovation (see Figure 5.1).

153. It is encouraging, though, to observe more reports of patients now able to access and interact with their electronic records than what was reported in previous surveys, and the use of telemedicine has increased. The latter has been largely driven by the COVID-19 pandemic. The use of unique identifiers, smart cards and secure tokens is growing. The collaboration of patients in the own records can lead to for greater co-production of health and ensure that the information contained is accurate.

Figure 5.1. eHR data governance, and technical and operational readiness



Note: T&OR Max=9

1. A score of 0.5 indicates that some aspects of data sharing among physicians and hospitals were reported.
2. A score of 1 indicates that at least 7 of 12 key elements are structured in all or most records. 0.5 indicates that this is the case for some regions/jurisdictions.
3. A score of 0.5 indicates that there is a unique ID for only one group (patients or providers).
4. A score of 0.5 indicates that there is a national organisation responsible for either clinical terminology or electronic messaging standards (not both).
5. A score of 0.5 indicates that there is a legal requirement for electronic messaging standards only.
6. A score of 0.5 indicates that there is certification for electronic messaging standards only.
7. A score of 0.5 indicates that there are incentives-penalties for 1 or 2 of the three areas specified in the survey.

Gov, Max=3

8. A score of -1 indicates that legal issues impeding dataset creation or data analysis were reported.
9. A score of 0.5 indicates 1-2 key statistical or research programs were reported

154. The average composite score for technical and operational readiness by survey participants has consistently improved since the 2012 survey. The number of countries reporting that at least 70% of health services have implemented an electronic medical or health record has risen substantially. More countries now also report having defined a minimum data set to capture core health data, although a range of terminology standards are used, and there is little evidence of convergence across countries. While fragmentation persists, the number of countries reporting that patients’ health data are accessible across various settings in the healthcare system has grown.

155. The 2021 survey results also suggest improvements in data timeliness. However, data quality - particularly at point of creation - is still a concern for most countries. Concerns regarding data quality have, in fact, increased since 2012 and relate mainly to challenges getting sufficient buy in from health service providers as well as reported technical, financial, and legal barriers. While the reported number of eMR software vendors continues to grow, adoption of Application Programming Interfaces (APIs) and internationally agreed data standards is also proliferating, and vendors’ adherence to agreed standards is increasingly regulated. More auditing and mapping of clinical record content is being reported. Care, especially unplanned care, across borders can be enhanced by international standards, such as the International Patient Summary (Kay, 2021^[18]).

156. Several countries now systematically map clinical data to a common model for secondary use. The use of natural language processing technology based on artificial intelligence (AI) to convert free text eHR data to a structured format is emerging. The most common secondary uses of eHR data reported were monitoring population health and monitoring safety and quality of care.

157. While only five countries report using 'real-world' eHR data for clinical trials, post-market surveillance of medical technology, and/or supporting clinical decision-making, the use of machine learning to find and extract relevant eHR data for specific uses and to inform clinical and administrative decisions is on the rise. Countries are also beginning to integrate eHR data with genomic, environmental, behavioural, economic or other data.

158. The most challenging domain of eHR implementation and use continues to be governance enabling data analytics. The composite score for this dimension has, in fact, reduced since 2012. Some of the reported challenges, such as legal barriers, lack of resourcing and resistance from providers, were reported in the first survey more than 10 years ago. Several countries report a lack of social consensus, license, and trust as a key barrier to using eHR data.

159. Reports of ongoing challenges in this domain, reflected in a lower composite score, are not necessarily a sign of failure. Rather, this reflects how complex and sensitive the proactive use of health data can be. The OECD Council Recommendation on Health Data Governance was released only in 2017, after the 2016 survey was completed. The fact that countries are 'discovering' previously unknown difficulties as they progressively develop and implement the legal, technical, and policy infrastructures to enable secondary data uses is a positive sign. It suggests that countries are forging ahead in this complex area where the challenges and rewards are equally substantial.

160. The 2021 survey has provided an honest appraisal of the readiness of eHRs in OECD countries to contribute data for analytical purposes. The results again highlight the importance of the political, social and cultural dimension of healthcare policy and practice. Continued monitoring and mutual learning in these areas is needed. The benefits of digital technology are amplified by systematisation, standardisation and convergence. Many of the challenges reported can therefore be overcome more effectively if countries collaborate on solutions, especially policy solutions. Continued collaboration is the only way to fulfil the promise of digital technology in health.

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Annex A: Country participation in the 2021 eHR survey

161. Twenty-seven countries responded to the 2021 OECD survey exploring the development, governance and use of data from electronic health record systems (Table A1). Norway is only included for some of the questions included in the survey.

162. This study follows up upon results published in 2013 and 2017 to monitor progress toward improving national health information infrastructure so it better supports health and healthcare in OECD countries (OECD, 2013^[8]; Oderkirk, 2017^[2])

Table A.1. Respondents to the 2021 OECD survey

COUNTRY	NAME	POSITION	ORGANISATION
Australia	Dr Chris Mount	Director, Policy and Privacy	Australian Digital Health Agency
Belgium	Erik Vertommen	Program Manager	FPS Health
Canada	Mario Voltolina	Chief Technology Officer and Executive VP Innovative Technologies	Canada Health Infoway
Costa Rica	Msc. Ana Lorena Solís Guevara	Jefa Área de Estadística en Salud	CCSS
Czech Republic	Martin Zeman	Director of the IT and electronic health department	Ministry of Health
Denmark	Kenneth B. Ahrensberg	Senior Advisor	Danish Health Data Authority
Estonia	Kertti Merimaa	Adviser, Health System Development Department	Ministry of Social Affairs
Finland	Juha Mykkänen Jutta Järvelin	Leading expert	Finnish Institute for Health and Welfare
Germany	n.r.	n.r.	n.r.
Hungary	Dr. Ildikó Lelkes	Head of the Sector Finance, Performance Improvement and Analysis Department	Ministry of Human Capacities

Iceland	Gudrun Audur Hardardottir	Project Manager, National eHealth solutions	Directorate of Health
Ireland	n.r	n.r	n.r
Israel	Mali Shapira, Esti Shelley, Yeal Applbaum	Tech/ Regulation/ Informatics (respectively)	Israel Ministry of Health
Italy	Serena Battilomo	Head of Unit 3 - Directorate General for the digitalization, health information system and statistics	Italian Ministry of Health
Japan	Chika Murakami	Section Chief, International Affairs Division	Ministry of Health, Labour and Welfare
Korea	Lee Gilwon	Deputy Director	MoHW, Division of Healthcare Information Policy
Lithuania	Linas Kavolius	Advisor for e-health information technology coordination and implementation	Ministry of Health of Lithuania
Luxembourg	Daisy Smet	Administration and communication officer / EU projects	Agence eSanté G.I.E.
Mexico	Dr. Javier Mancilla Ramírez	Director General de Calidad y Educación en Salud	Secretaría de Salud
Netherlands	Ron Roozendaal	Deputy Director General on Digitalisation	Ministry of the Interior and Kingdom Relations
Norway	Lars Rønningen & Olav Isak Sjøflot	Department managers	Directorate of Health
Portugal	Filipe Mealha	IT Coordinator	SPMS
Slovenia	Please contact Ministry of Health	(the inquiry will be forwarded to authorized persons)	Ministry of Health
Sweden	Kristina B Persson	Programme Officer	National Board of Health and Welfare
Switzerland	Stefan Wyss		Federal Office of Public Health, eHealth Suisse - Swiss Competence and Coordination Centre of the Confederation and the Cantons
Türkiye	Gülay Doğan Ermiş	E-nabız Unit Supervisor	Ministry of Health
United States	Robert Anthony	Director of Certification and Testing	Office of the National Coordinator for Health IT

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Annex B: Country participation in OECD eHR Surveys, 2012-2021

Table B.1. Country participation in OECD eHR surveys 2012-2021

Country	2012 Survey	2016 Survey	2021 Survey
Australia		X	X
Austria	X	X	
Belgium	X		X
Canada	X	X	X
Chile		X	
Costa Rica			X
Croatia		X	
Czech Republic		X	X
Denmark	X	X	X
Estonia	X	X	X
Finland	X	X	X
France	X	X	
Germany	X		X
Greece		X	
Hungary			X
Iceland	X	X	X
Indonesia*	X		
Ireland			X
Israel	X	X	X
Italy			X
Japan	X	X	X
Korea	X		X
Latvia		X	
Lithuania			X
Luxembourg		X	X
Mexico	X	X	X
Netherlands	X		X
New Zealand		X	
Norway		X	X**
Poland	X	X	
Portugal	X		X
Singapore	X	X	
Slovakia	X	X	
Slovenia	X		X
Spain	X	X	
Sweden	X	X	X
Switzerland	X	X	X
Türkiye			X

UK (England)	X	X	
UK (Northern Ireland)		X	
UK (Scotland)	x	X	
United States	x	X	X

Note: * Non-OECD country, for the purposes of previous survey country totals, the UK is counted as a one country. **does not include a response to the governance section of the survey.

Annex C: Contextual information on national eHR systems

163. In **Australia**, the national electronic health record - My Health Record - is a secure online summary of an individual's health information generated through contact with health services managed by the Commonwealth Government (this excludes public hospital services, which are managed by the states and territories). My Health Record is available to all Australians. Healthcare providers authorised by their healthcare organisation can access My Health Record to view and add patient health information. My Health Record further allows practitioners to complete a Shared Health Summary containing key demographic and health information accessible by registered health practitioners. (These practitioners will operate their own local eMR for everyday patient care in parallel to the My Health Record summary for the same patients.)

164. In **Belgium**, the federal platform "eHealth" is used as a metahub that connects various networks so that healthcare providers can consult available documents about a patient, regardless of where they are stored. This platform connects the four regional exchange networks, so-called hubs, where general practitioners and specialists can electronically share health data with each other and in a secure manner with hospitals and private practices. Physicians can access all data stored on all hubs by consulting one hub via a login with their eID card.

165. **Canada** has a series of distinct health systems in each province and territory, which share some data only as needed. The provincial and territorial governments have their own digital health infrastructure, including eHRs providing access to key elements of the patient health record. Primary care physicians and specialists capture data using eHRs but not through a system-wide implementation of the same eHR.

166. The national electronic health record in **Costa Rica** only covers care provided by public services under the Social Insurance Fund.

167. In the **Czech Republic**, only the e-prescription system and the central e-booking for Covid-19 vaccinations are country-wide. Digital patient summaries are in the process of being implemented in hospitals and planned to be gradually introduced to all healthcare settings. A variety of systems are used at the same time, including two PACS exchange platforms, regional patient portals and a regional exchange of lab orders and results using national data exchange format (DASTA). Private eHR systems are also used.

168. In **Denmark**, different electronic medical record platforms and standards are used depending on the region. The eastern part of the country uses EPIC software, while the western part is implementing a Danish system called Columna.

169. Since 2008, **Estonia** has had a country-wide central Estonian National Health Information System (ENHIS), by which patient summaries and other important health documents are shared. ENHIS consists of more than 10 central e-services and more than 20 different datasets are exchanged through the system. Other healthcare data like prescription data is exchanged through a separate national system, while some national quality registries, such as the Estonian Cancer Registry, are exchanging data directly with healthcare providers.

170. In **Finland**, there is no system for all health-related purposes but a single infrastructure for the sharing of health records, which is part of the Kanta services that include the national Patient Data Repository. This repository allows the centralised archiving, active use and storage of electronic patient data and plays a key role in enabling the exchange of data sharing between healthcare service providers. Finland therefore has, for all intents and purposes, a national eHR.

171. In **Germany**, patients' basic data are stored on their electronic health card (eGK) issued to any legally insured person. Since 1 January 2021, all legally insured persons further have the right to obtain an electronic patient file (ePA) from their health insurance fund, to which they can upload their data from their card. This file allows the storage and exchange of medical findings and information from previous examinations and treatments across office and hospital boundaries. The Digital Modernisation of Supply and Care Act (DVPMG), expected to come into force in mid-2021, enables online updating of basic data from 2023 onwards as well as the inclusion of emergency data and information on personal statements in the electronic patient summary.

172. **Hungary** reports that there is a country-wide electronic health record system called "EESZT", which is used to store, share and transfer medical documents, prescriptions, images, etc. between providers. Currently, documents are primarily shared as unstructured data elements in PDF, with the transformation of into structured elements constituting an ongoing process.

173. In **Iceland**, all publicly funded healthcare organisations use a common eHR and share patient information on the Icelandic HealthNet. Nursing homes and most private practice doctors also use the interconnected eHR, so that a patient's information "travels" with them across different healthcare institutions and levels of healthcare.

174. **Ireland** is at a very early stage of implementing an eHR. Development is overseen by the eHealth Ireland and the Office of the Chief Information Officer, Health Service Executive (the largest public provider of healthcare in Ireland). While the majority of physicians' offices have eMRs, few hospitals do and the existing ones are using different systems. Further roll-out will work on ensuring interoperability. eMRs are only funded if they comply with national standards, support interoperability, are kept up to date and are from a certified vendor.

175. In **Israel**, different eMRs are used by providers and health funds. A national health information exchange system is under development to connect these local platforms. Networks using the same software can already exchange data. Data sharing also takes places within the four health funds and there is a defined dataset that is shared between the health funds and a hospital in which a patient is treated.

176. The **Italian** system is a federated one, where each region has their own electronic medical record. There are some common specifications of mandatory documents and standards defined at a national level to help with the interoperability and exchange of data across the regions.

177. **Japan** reports that it is developing a country-wide system that enables healthcare organisations and pharmacies to access a minimum data set, including information on medicine, surgery, transplantation and dialysis. This infrastructure is based on systems like the Online Confirmation System for Health Insurance Qualification and uses data from itemised billing statement of medical fees. There are also networks established on the subnational level to share medical information, depending on the needs of each region.

178. In **Korea**, the minimum data set can be exchanged electronically at the subnational level amongst providers participating in the Health Information Exchange Program, which accounts for about 20% of all providers.

179. In **Lithuania**, ESPBI IS is used as the central national eHR system. All information systems used by hospitals must be compatible with ESPBI IS to enable the sharing of compulsory data with the national

system. The ESPBI IS also has interface functionality that can be used by healthcare providers who do not have their own electronic medical record platform.

180. In **Luxembourg**, a country-wide eHR is used, which is called Dossier de Soins Partagé (DSP).

181. The **Netherlands** is implementing Personal Health Environments (PHE or PGOs), where each citizen can gather health information from different healthcare providers in one online space and add data themselves. It is intended that the data of PGOs can be shared with (other) healthcare providers and caregivers. In addition to the PGO, healthcare infrastructures exist (like the LSP; National Exchange Point) to which healthcare providers can connect. When connected, providers are able to see medical information stored in the eMRs of other healthcare providers, only after consent of the patient. Physicians (GPs and medical specialists) and pharmacists are able to see dispensed medication and an abstract of the eMRs. New legislation will foster the electronic exchange of data.

182. The eHR system used in **Norway** is called the National Core Journal which enables data exchange at all levels.

183. **Portugal** reports that its eHR aims to gather essential information on each citizen based on the clinical data that is electronically collected by primary healthcare providers and hospitals. The system allows sharing clinical data between the patient, health professionals and healthcare institutions in accordance with the requirements of the National Commission on data protection. It offers both a citizens' area and a professional portal, which are both integrated with the electronic health record. A Patient Summary is available to all Portuguese citizens, and can be used at cross-border, national, regional and local levels for planned and unplanned care, in all public health entities. This summary is created based on structured and coded data, aligned with the eHealth Network guidelines. Several projects complement the eHR, including paperless prescription nationwide and digital vaccination records.

184. **Slovenia** has a Central Registry of Patient data, which is based on IHE XDS and OpenEHR standards and available to both public and private entities. Healthcare providers are connected to this registry via standardised API.

185. In **Sweden**, the eHR implementation is decentralised according to the governance of the healthcare system, with 21 regional health authorities and 290 municipal authorities as principals and care providers. The regions and municipal councils have the responsibility for their own electronic medical record and in most cases the use of a common national terminology standard is voluntary. While the national patient summary is implemented in all regions, there are different amounts of information shared.

186. **Switzerland** is establishing a federated system with so-called "communities" as system participants. A community is a federation of service providers, like hospitals, which can cover one cantonal region or several ones. About 10 communities are undergoing the certification process foreseen at the legal level, two communities are definitively certified and commenced operating in 2021. The national system is expected to be operational by the end of 2021.

187. In **Türkiye**, the eHR system is called e-Nabız, which is established and managed by the Ministry of Health. It allows users to manage their health information and records, and access personal medical background via their browser or mobile applications.

188. The **United States** does not have a country-wide eHR. The US system is decentralised and consists of a network of various eMR vendors and users. The network also includes health information exchange organisations that are designed to facilitate electronic health information exchange at the local, state, and national level. The US federal government regulates the certification of health IT products which ensures the capability for users to exchange data. The US government also has programmes designed to incentivise the use of these technologies as well as exchange data at the local, regional, and ultimately the national level.

Annex D: Supplementary tables

Table D.1. Summary Table of Technical and Operational Readiness to Generate Health Information from eHRs

Country	At least 70% of primary care physicians and hospitals are using eMR/ePR ¹	National system includes information sharing among physicians and hospitals about treatment, medications, laboratory tests and images ²	Minimum data set has been defined ³	Key data elements in all or most records are structured (coded to a terminology standard) ⁴	Unique patient and provider identifiers in eHRs ⁵	National organisation is responsible for clinical terminology and electronic messaging standards ⁶	Legal requirement to adopt eHR systems that conform to clinical terminology and electronic messaging standards ^{7,8}	Certification requires vendors to adopt standards and use structured data ⁷	Financial incentives or penalties to adopt and maintain high quality eHRs ⁷	Total (max=9)
Australia	1	1	1	1	0.5	0.5	0	0.5	0.5	6
Belgium	1	1	1	0.5	0	1	0	1	1	6.5
Canada	0.5	1	1	1	0	1	0	0.5	0	5
Costa Rica	0.5	0.5	1	1	1	0	1	0	0	5
Czech Republic	1	0.5	0	1	0	1	nr	nr	0	3.5
Denmark	1	1	1	1	1	1	0	1	0	7
Estonia	1	0.5	1	1	1	1	1	nr	0.5	7
Finland	1	1	1	1	0.5	1	1	1	1	8.5
Germany	1	1	0	0.5	0	0	0	nr	nr	2.5
Hungary	1	1	1	1	0.5	0	1	1	1	7.5
Iceland	1	1	1	1	1	1	1	0	0.5	7.5
Ireland	nr	nr	1	1	0	0	0	0.5	1	3.5

Israel	1	1	1	1	0.5	1	0.5	0	0	6
Italy	1	1	1	1	1	1	1	0	0.5	7.5
Japan	0	1	1	0.5	1	1	1	1	1	7.5
Korea	1	1	1	1	0	1	1	1	0	7
Lithuania	1	1	1	1	0	1	1	0	0	6
Luxembourg	1	1	1	1	0	1	0.5	nr	0	5.5
Mexico	0	1	0	1	1	nr	nr	nr	nr	3
Netherlands	1	0.5	1	1	1	1	1	1	0.5	7.5
Norway	1	1	1	0.5	1	0	1	nr	0	5.5
Portugal	1	1	1	1	1	1	0	1	0	7
Slovenia	1	1	1	1	0	1	1	1	0.5	7.5
Sweden	1	1	1	1	0	1	0	0.5	0	5.5
Switzerland	nr	0	0	0	0	1	1	1	0.5	3.5
Türkiye	1	1	1	1	0	1	1	1	0.5	7.5
United States	1	0	1	1	1	0	0	1	1	6

Note:

*1 for primary care and specialists/ n.r. for hospitals

N.B. Yes is 1 point, a Partial Yes is 0.5 points and No is 0 points

¹See Table 2.

²See Table 3. A score of 0.5 indicates that some aspects of data sharing among physicians and hospitals were reported.

³See Table 5.

⁴See Table 6. A score of 1 indicates that at least 3 of 5 key elements are structured in all or most records.

⁵See Table 8. A score of 0.5 indicates that there is a unique ID for only one group (patients or providers).

⁶See Table 9. A score of 0.5 indicates that there is a national organisation responsible for either clinical terminology or electronic messaging standards (not both).

⁷See Table 10.

⁸A score of 0.5 indicates that there is a legal requirement for electronic messaging standards only.

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.2. Use of electronic clinical records by physicians and hospitals

Country	Primary care physician offices using eMRs %	Medical specialist offices using eMRs %	Hospitals using ePRs for inpatients %	Hospital emergency rooms using ePRs %
Australia	87%	n.a.	95%	n.a.
Belgium	80%	95%	100%	90%
Canada	86%	74%	n.a.	n.a.
Costa Rica	100%	100%	100%	100%
Czech Republic	80%	80%	100%	100%
Denmark	100%	100%	100%	100%
Estonia	100%	100%	100%	100%
Finland	100%	100%	100%	100%
Germany	100%	100%	100%	100%
Hungary	100%	100%	100%	100%
Iceland	100%	97%	100%	100%
Ireland	n.a.	n.a.	n.a.	n.a.
Israel	100%	95%	95%	100%
Italy	90%	60%	100%	100%
Japan	41,6%	41,6%	46,7%	46,7%
Korea	77%	77%	93,9%	93,9%
Lithuania	100%	100%	100%	100%
Luxembourg	95%	95%	100%	100%
Mexico	n.a.	n.a.	n.a.	n.a.
Netherlands	100%	100%	100%	100%
Norway	100%	100%	100%	100%
Portugal	100%	95%	95%	100%
Slovenia	100%	70%	80%	n.a.
Sweden	100%	100%	100%	100%
Switzerland	n.r.	n.r.	n.r.	n.r.
Türkiye	100%	100%	100%	100%
United States	90,7%	93,4%	96%	96%

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.3. National electronic health record systems

Country	National system includes information sharing among:												
	Type of national system:				Physician offices about:				Physician offices and hospitals about:				
	A country-wide electronic health record system (one system)	A system with country-wide exchange of a minimum data set and comprehensive data sharing on a sub-national level	A system of exchange of patient data at the subnational level only	Another type of system	Patient treatment	Current medications	Laboratory tests	Medical imaging results	Patient treatment	Current medications	Laboratory test results	Medical imaging results	
Australia	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Belgium	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Canada	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Costa Rica	No	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	
Czech Republic	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	
Denmark	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Estonia	Yes	Yes	n.a.	n.a.	No	Yes	Yes	Yes	No	Yes	Yes	Yes	
Finland	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Germany	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Hungary	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Iceland	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Ireland	Yes	No	No	No	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Israel	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Italy	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Japan	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Korea	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Lithuania	Yes	n.a.	n.a.	n.a.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Luxembourg	Yes	No	No	n.a.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Mexico	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Netherlands	No	No	No	Yes	Yes	Yes	Yes	No	Yes	yes	Yes	No	
Norway	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Portugal	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Slovenia	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Sweden	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Switzerland	Yes	No	No	No	No	No	No	No	No	No	No	No	
Türkiye	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
United States	No	No	No	Yes	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.4. Patients can view or interact with their own electronic health record

Country	Patients can view information contained in their own record	Patients can interact with their own record
Australia	Yes	Yes
Belgium	Yes	No
Canada	Yes	d.k.
Costa Rica	Yes	Yes
Czech Republic	Yes	Yes
Denmark	Yes	Yes
Estonia	Yes	No
Finland	Yes	Yes
Germany	Yes	Yes
Hungary	Yes	No
Iceland	Yes	Yes
Ireland	n.a.	n.a.
Israel	Yes	No
Italy	Yes	Yes
Japan	Yes	No
Korea	No	n.a.
Lithuania	Yes	Yes
Luxembourg	Yes	Yes
Mexico	No	n.a.
Netherlands	Yes	Yes ¹⁸
Norway	No	n.a.
Portugal	Yes	Yes
Slovenia	Yes	Yes
Sweden	Yes	Yes
Switzerland	Yes	Yes
Türkiye	Yes	Yes
United States	Yes	Yes

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

¹⁸ Patients can add data to their personal health environment from devices or apps or by scanning bar codes of medication boxes. The possibility to communicate with their healthcare providers (in first instance GPs) is currently limited.

Table D.5. National minimum dataset

ELEMENTS OF THE MINIMUM DATA SET:											
Country	Minimum data set has been defined	Patient unique identifier	Healthcare provider unique identifier	Patient demographics	Patient socioeconomic data	Patient current medications	Patient clinically relevant diagnostic concerns	Patient clinically relevant procedures	Patient vital signs	Patient clinically relevant behaviors	Patient clinically relevant psychosocial or cultural issues
Australia	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No
Belgium	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No
Canada	Yes	Yes	Yes	Yes	d.k	Yes	Yes	Yes	d.k	d.k	d.k
Costa Rica	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Czech Republic	No	Yes	Yes	Yes	d.k	Yes	Yes	Yes	Yes	Yes	d.k
Denmark	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estonia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Finland	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Germany	No	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Hungary	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ireland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Israel	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Partial	No
Italy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Japan	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	No
Korea	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Lithuania	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Luxembourg	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Mexico	No	No	No	No	No	No	No	No	No	No	No
Netherlands	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Norway	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No
Portugal	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Slovenia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Sweden	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No
Switzerland	No	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Türkiye	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
United States	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.6. Use of structured elements in electronic medical records

DATA ELEMENTS:							
Country	Patient diagnosis	Patient medications	Patient laboratory test results	Patient medical imaging results	Patient surgical procedures	Count of TA	Count of TA 2016
Australia	TA	TA	TA	TA	TA	5	0
Belgium	TA	TA	TA	TA	TA	5	
Canada	TS	TS	TS	TS	TS	0	0
Costa Rica	TA	TA	TA	TA	TA	5	
Czech Republic	TA	TA	TA	TS	TA	4	0
Denmark	TA	TA	TA	TA	TA	5	5
Estonia	TA	TA	TA	TA	TA	5	5
Finland	TA	TA	TS	TS	TA	3	3
Germany						0	
Hungary	TA	TA	TS	TS	TS	2	
Iceland	TA	TA	TA	TA	TA	5	3
Ireland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Israel	TA	TA	TA	TA	TA	5	0
Italy	TA	TA	TA	TA	TA	5	
Japan	TA	TA	TA	TA	TA	5	5
Korea	TS	TS	TS	TS	TS	0	
Lithuania	TA	TA	TS	F	F	2	
Luxembourg	TS	TS	TS	F	TS	0	0
Mexico	TA	TA	TA	TA	TA	5	3
Netherlands	TA	TA	TA	F	TA	4	
Norway	TA	TA	TA	TA	TA	5	3
Portugal	TS	TA	TA	TA	TA	4	
Slovenia	TA	TA	TS	TS	TA	3	
Sweden	TS	TS	TS	TS	TS	0	0
Switzerland	F	F	F	F	F	0	0
Türkiye	TA	TA	TA	TA	TA	5	
United States	TA	TA	TA	TA	TA	5	2

Note:

TA-True All

TS-True Some

F-False

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance; HCQI Survey of Electronic Health Record System Development and Use, 2016

Table D.7. Clinical terminology standards

DATA ELEMENTS											
Country	Patient socioeconomic data	Patient medications	Patient diagnosis	Patient laboratory test results	Patient medical imaging results	Patient surgical procedures	Patient vital signs	Patient clinically relevant behaviours	Patient clinically relevant psychosocial or cultural issues	Patient reported outcomes (PROMs)	Patient experiences measures (PREMS)
Australia	ICD-10	SNOMED-CT-AU	SNOMED-CT-AU	Loinc	SNOMED-CT-AU, DICOM	ICD-10, SNOMED-CT-AU	SNOMED-CT-AU	SNOMED-CT-AU			
Belgium		ATC	ICD-10	Loinc	Dicom	ICD-10					
Canada		Drug Identification Number (DIN); ATC; CCD	ICD-10-CA, DSM-IV, SNOMED CT	LOINC	DICOM / SNOMED CT	Canadian Classification of Health Intervention (CCI) / SNOMED CT					
Costa Rica	Catálogo utilizado por el Instituto Nacional de Estadística y Censos (INEC), según las buenas prácticas estadísticas	Lista Oficial de Medicamentos (LOM)	Clasificación Internacional de Enfermedades (CIE-10)								
Czech Republic		ATC, National registry of Drugs	ICD-10-CZ 2021	NCLP, national laboratory test coding system derived from NPU	DICOM standard	National list of medical procedures for reimbursement	NCLP, national laboratory test coding system derived from NPU				

Denmark	Specific Danish standard applied	ATC	ICD-10, with Danish extensions	Nomenclature for Properties and Units in Laboratory Medicine (NPU)	There is no standard	NOMESCO Classification of Surgical Procedures (NCSP), Danish modification	Metric values	We are currently working on a Danish terminology for health relevant factors	There is no useful standard	We use a number of validated questionnaires and are currently working on a Danish terminology for health relevant factors	Not a clearly defined question is it measures ? in that case we use NPU or is it experiences n that case we do not know any useful standard
Estonia	Socio economic information is not commonly collected in eHR, but where relevant, national code lists are used.	Anatomical Therapeutic Chemical (ATC) Classification System	International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)	Logical Observation Identifiers Names and Codes (LOINC)	Dicom	Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT); NOMESCO	National and international classifications	National codelist	National codelist	Not included in the electronic health records	Not included in the electronic health records
Finland		ATC	ICD-10	National code set	National code set	National code set	subset of LOINC			None yet	None yet
Germany											
Hungary		ATC	ICD-10, SNOMED-CT (on some special area), ORPHA	LOINC (implementation in progress)	ICD-10, SNOMED-CT (on some special area)	local terminology using ICPM (International Classification of Procedures Inmedicine)					
Iceland	National coding system	Anatomical-Therapeutical-Chemical Classification (ATC)	International Classifications of Diseases (ICD-10) and International Classification of Nursing Practice (ICNP)	SNOMED-CT for pathogens and LOINC for some lab results	DICOM for digital imaging	Classification of Surgical Procedures (NCSP) and NCSP-IS extended version	International Classification of Nursing Practice (ICNP) and Classification of Functioning, Disability and	International Classifications of Diseases (ICD-10) and International Classification of Nursing Practice (ICNP)	International Classification of Nursing Practice (ICNP) and International Classifications of Diseases (ICD-10)	Scientificallly tested questionnaires	Questionnaires , under consideration of being implemented

							Health (ICF)				
Ireland		ATC (for reimbursable drugs only)	ICD10AM / ICPC2	LOINC	DICOM	Australian Classification of Health Interventions (ACHI)					
Israel			ICD9	LOINC		ICD9					
Italy	N.A.	Marketing Authorization Number/ATC	ICD9-CM	LOINC	LOINC	ICD9-CM and national nomenclature for outpatient procedures	mm Hg	Ad hoc classification	N.A.	N.A.	N.A.
Japan		Standard Master for Pharmaceutical Products	Japanese standard disease code master based on ICD10	Laboratory Test Code Master	DICOM	Standard surgical and treatment procedures code master	Specific Health Checkups information file specification	Specific Health Checkups information file specification			
Korea		KD (Korea Drug) Code	KOSTOM (Korean standard terminology of medicine), KCD-7 (Korean version based on icd-10)	Test items: KOSTOM, EDI (electronic data interchange, glossary of test and medical intervention for benefit claim) Test results: digit string or character string	Test items: KOSTOM, EDI Test results: character string Medical imaging: DICOM	KOSTOM, ICD-9-CM	KOSTOM	Smoking-KOSTOM, Drinking-LOINC			
Lithuania		ATC	ICD-10-AM								
Luxembourg	n.a.	ATC - Local	ICD-10 CM	LOINC	n.a.	ICD-10 PCS - SNOMED CT	LOINC	n.a.	n.a.	n.a.	n.a.

Mexico	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO	NORMA OFICIAL MEXICANA NOM 004-SSA3.2012, DEL EXPEDIENTE CLÍNICO
Netherlands *	Marital status (nominal values)	ATC	ICD10, ICPC1, DBC (list of diagnoses), DSM-5	Dutch Labcodeset, which links to LOINC, SNOMED CT, NHG diagnostic tests	DICOM (disease specific like, BI-RADS, PI-RADS, RECIST)	ZA (list of healthcare activities)	Metric values	ICD10, ICPC1, DSM-5, text	ICD10, ICPC1, DSM-5, text			
Norway		ATC	ICD10, ICPC2	NKKKL	DICOM	NCSP				EQ5D ...		
Portugal	HL7 Profiles	ATC/EDQM and National Coding System (CNPEM)	ICD-10-CM & ICPC-2	LOINC	DICOM	ICD-10-CM-PCS	SNOMED	ICPC-2	ICPC-2	N/D	N/D	
Slovenia		ATC, national medication database	ICD 10 AM	National/proprietary coding standard, SNOMED-CT (only for a few elements)		ACHI						
Sweden		ATC	ICD-10-SE	C-NPU, Snomed, and others	different	KVÅ (Swedish version of NCSP + medical procedures)						
Switzerland	See https://www.ech.ch/de/standards/39485 and https://share.ech.ch/xmlns/Backup/eCH-0010-f/indexF.html - national eGov standards used	SNOMED CT	SNOMED CT	LOINC	DICOM	use case not covered	unstructured application	unstructured application	use case not covered	use case not covered	use case not covered	use case not covered
Türkiye	-	ATC	ICD-10	LOINC	LOINC	SUT (National Standard)	-	-	-			

United States	Industry/Occupation section w/ interoperability needs and standards listed here: https://www.healthit.gov/isa/section/industry-and-occupation	RxNorm, national Drug Code (NDC),	SNOMED-CT, ICD-10	LOINC	LOINC	SNOMED-CT, ICD-10-PCS 2020, HCPCS, CPT-4	LOINC, the Unified Code of Units for Measure, Revision 2.1	LOINC, SNOMED, SNOMED CT	No standard yet adopted	No standard yet adopted	No standard yet adopted
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Note: * In the Netherlands the healthcare sector (in first instance the medical specialist healthcare) is working to the incorporation of clinical information models to define data elements in electronic health records;
https://zibs.nl/wiki/HCIM_Mainpage

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.8. Unique identification of patients and providers in eHR systems

Country	Unique number to ID patients in eHRs	Unique number to ID providers entering data into eHRs	Secure token for patients	Secure token for healthcare providers	Smart cards for patients	Smart cards for healthcare providers
Australia	Yes	Yes	No	Yes	No	No
Belgium	Yes	Yes			Yes	Yes
Canada	Yes	Yes	No	No	No	No
Costa Rica	Yes	Yes	No	No	No	No
Czech Republic	Yes	Yes	No	Yes	Yes	Yes
Denmark	Yes	Yes	Yes	Yes	No	No
Estonia	Yes	Yes			Yes	Yes
Finland	Yes	Yes				Yes
Germany	Yes					
Hungary	Yes	Yes	No	Yes	Yes	Yes
Iceland	Yes	Yes	No	No	No	No
Ireland	Yes	Yes	No	No	No	No
Israel	Yes	Yes	Yes	Yes	Yes	Yes
Italy	Yes	Yes	No	Yes	Yes	Yes
Japan	Yes	No			Yes	No
Korea	Yes	Yes	No	No	No	No
Lithuania	Yes	Yes	No	No	Yes	Yes
Luxembourg	Yes	Yes	Yes	Yes	Yes	Yes
Mexico	Yes	Yes	No	No	No	No
Netherlands	Yes	Yes	Yes	Yes	No	Yes
Norway						
Portugal	Yes	Yes	Yes	Yes	Yes	Yes
Slovenia	Yes	Yes			Yes	Yes
Sweden	Yes	Yes	Yes	No	No	Yes
Switzerland	Yes	Yes	Yes	Yes	possible option	possible option
Türkiye	Yes	Yes	Yes	Yes		
United States	No	Yes				

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.9. National organisation responsible for eHR system infrastructure and standards

Country	Is there a national organisation in your country with primary responsibility for national eHR infrastructure development?	National organisation is responsible for eHR system infrastructure	National organisation sets standards for clinical terminology	National organisation sets standards for electronic messaging
Australia	Yes	Australian Digital Health Agency (ADHA)	Yes	No
Belgium	Yes	eHealth Platform & FPS Health	Yes	Yes
Canada	Yes	Canada Health Infoway	Yes	Yes
Costa Rica	No		n.a	n.a
Czech Republic	Yes	Ministry of Health, Department of Informatics and Electronic Healthcare (ITEZ)	Yes	Yes
Denmark	Yes	Danish Health Data Authority	Yes	Yes
Estonia	Yes	Centre of Health and Welfare Information Systems	Yes	Yes
Finland	Yes	Social Insurance Institution (Kela)	Yes	Yes
Germany	Yes	Gematik GmbH	n.r.	n.r.
Hungary	Yes	Ministry of Health and Director General of National Hospitals (OKFO)	n.r.	n.r.
Iceland	Yes	Directorate of Health, National Centre for eHealth Unit	Yes	Yes
Ireland	Yes	eHealth Ireland/Office of the Chief Information Officer, Health Service Executive	No	No
Israel	No	Ministry of Health	Yes	Yes
Italy	Yes	Ministry of Economy, SOGEI (in-house system integrator)	Yes	Yes
Japan	Yes	Health Insurance Claims Review and Reimbursement Services and All-Japan Federation of National Health Insurance Organisations	Yes	Yes
Korea	Yes	Korea Health Information Service	Yes	Yes
Lithuania	Yes	Ministry of Health and State Enterprise Centre of Registers	Yes	Yes
Luxembourg	Yes	Agence eSanté	Yes	Yes
Mexico	n.r.		n.r.	n.r.
Netherlands	Yes	National Health Information Council (Informatieberaad zorg)	Yes	Yes
Norway	Yes	Norsk Helsenet	No	No
Portugal	Yes	SPMS (Shared Services for the Ministry of Health) and EPE (Public Hospitals...check text)	Yes	Yes
Slovenia	Yes	Yes, NIJZ - National Institute of Public Health	Yes	Yes
Sweden	Yes	Yes and No. Some aspects of national eHR infrastructure development are coordinated and responsibilities shared between a few authorities. This is based in some parts on agreements between regional authorities and the government, in other parts tasks assigned to a few agencies by the government.	Yes	Yes
Switzerland	Yes		Yes	Yes
Türkiye	Yes	Republic of Türkiye, Ministry of Health	Yes	Yes
United States	No		n.a.	n.a.

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D10. Policy levers to encourage the adoption and maintenance of high quality eHRs

Country	Laws or regulations require healthcare providers to:			Incentives or penalties for providers to		There is a certification process for vendors	Certification requires vendors to		
	Adopt electronic health records	Adopt eHR systems that conform to clinical terminology standards	Adopt eHR systems that conform to electronic messaging standards	Install electronic record systems from a certified vendor	Adopt standards or other requirements for national e-HR interoperability		Adopt terminology standards terminology or messaging standards	Adopt electronic messaging standards	Conform to requirements for national e-HR interoperability
Australia	Yes	No	No	No	Yes	Yes	No	Yes	No
Belgium	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Canada	No	n.r.	n.r.	No	No	Yes	No	Yes	Yes
Costa Rica	Yes	Yes	Yes	No	No	No	n.r.	n.r.	n.r.
Czech Republic	n.r.	n.r.	n.r.	No	No	No	n.r.	n.r.	n.r.
Denmark	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Estonia	Yes	Yes	Yes	No	Yes	No	n.r.	n.r.	n.r.
Finland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Yes	n.r.	n.r.	n.r.	n.r.	Yes	n.r.	n.r.	n.r.
Hungary	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	No	Yes*	No	n.r.	n.r.	n.r.
Ireland	No	No	No	Yes	Yes	Yes	No	Yes	No
Israel	Yes	Yes	No	No	No	No	n.r.	n.r.	n.r.
Italy	Yes	Yes	Yes	No	Yes	No	n.r.	n.r.	n.r.
Japan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Korea	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Lithuania	Yes	Yes	Yes	No	No	No	n.r.	n.r.	n.r.
Luxembourg	Yes	No	Yes	No	No	No	No	No	No
Mexico	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Netherlands	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Norway	Yes	n.r.	n.r.	No	No	No	n.r.	n.r.	n.r.
Portugal	No	No	Yes	No	No	No	Yes	Yes	Yes
Slovenia	Yes	Yes	Yes	Yes	n.r.	Yes	Yes	Yes	Yes
Sweden	No	n.r.	n.r.	No	No	Yes	No	Yes	No
Switzerland	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes
Türkiye	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
United States	No	n.a.	n.a.	Yes	Yes	Yes	Yes	Yes	Yes

Note: * Primary healthcare clinics receive a refund based on the usage of the national patient portal

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.11. Data set creation progress and challenges

Country	Concerns with the quality of eHR data	Do you audit electronic records for quality?			Creating datasets from eHR records	Difficulties developing datasets from eHRs:			
		Physicians	Medical specialists	Hospitals		Legal barriers to the creation and/or analysis of databases	Lack of resources or technical capacity to extract data to create databases	Concerns with the quality of eHR data that limit the ability to develop databases	Lack of resources or technical capacity to de-identify databases from eHR records
Australia	Yes	Yes	Yes	Yes	No		Yes	Yes	n.r.
Belgium		No	No	Yes	Yes	Yes	Yes	Yes	Yes
Canada	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Costa Rica	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Czech Republic	Yes	No	No	No	Yes	No	No	Yes	No
Denmark	No	Yes	Yes		Yes	No	No	No	No
Estonia	Yes	No	No	No	Yes	No	No	Yes	No
Finland	No				Yes	Yes	Yes	Yes	No
Germany	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Hungary	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Iceland	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Ireland	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Israel	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Italy	Yes	n.r.	n.r.	n.r.	No	Yes	No	No	No
Japan	n.r.	n.r.	n.r.	n.r.	Yes	Yes	n.r.	n.r.	n.r.
Korea	Yes	n.a	n.a	n.a	n.a.	Yes	No	No	No
Lithuania	Yes	No	No	No	No	No	Yes	Yes	Yes
Luxembourg		No	No	No	No (*)	No (*)	No (*)	N.a.	N.a.
Mexico	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Netherlands	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Norway	Yes	No	No	Yes	Yes	Yes	No	No	No
Portugal		Yes		Yes	Yes	Yes	Yes	Yes	Yes
Slovenia	Yes	No	No	No	Yes	Yes	Yes	Yes	No
Sweden	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Switzerland	Yes	**	**	**	No	Yes	No	No	No
Türkiye		Yes	Yes	Yes	Yes	Yes	No	Yes	No
United States	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No

Note: (*): Agence eSanté is setting up a Data Lake related to the data held in DSP. The replies to below questions must be considered in this context. (**) The quality of the Swiss eHR services are assured by the legally foreseen certification process.

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.12. Summary Table of eHR Governance Enabling Data Analytics

Country	Legal issues impeding the creation of datasets and/or analysis of data from eHRs ¹	Creating datasets from eHR records ²	eHR data contributes to 3 or more key monitoring or research domains ³	Three or more key secondary data uses included in national plans or priorities	Total (max=3)
Australia	nr	0	1	0	1
Belgium	-1	1	1	1	2
Canada	-1	1	0	0	0
Costa Rica	0	1	1	1	3
Czech Republic	0	1	0	0.5	1.5
Denmark	0	1	1	1	3
Estonia	0	1	1	1	3
Finland	-1	1	1	1	2
Germany	nr	nr	nr	0	0
Hungary	0	1	1	0.5	2.5
Iceland	-1	1	1	1	2
Ireland	nr	nr	nr	nr	0
Israel	0	1	1	1	3
Italy	-1	0	1	0	0
Japan	-1	1	1	1	2
Korea	-1	0	0	0	-1
Lithuania	0	0	1	1	2
Luxembourg	0	0	1	0	1
Mexico	-1	0	0	0	-1
Netherlands	-1	1	1	1	2
Norway	-1	1	1	1	2
Portugal	-1	1	nr	0.5	0.5
Slovenia	-1	1	1	1	2
Sweden	-1	1	1	1	2
Switzerland	-1	0	0	0	-1
Türkiye	-1	1	1	1	2
United States	0	1	1	0	2

Note: N.B. Yes is 1 point, a Partial Yes is 0.5 points and No is 0 points ¹ See Table 11. A score of -1 indicates that legal issues impeding dataset creation or data analysis were reported (no reported barriers produce a score of 0). ² See Table 1113. ³ See Table 1314. A score of 0.5 indicates 1-2 key statistical or research programs were reported.

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.13. Secondary uses of data extracted from electronic health records on a national level

Country	Public health monitoring	Health system performance monitoring	Patient safety monitoring	Facilitating and contributing to clinical trials	Supporting physician treatment decisions	Research
Australia	No	No	No	No	No	No
Belgium	Yes	Yes	Yes	d.k.	No	Yes
Canada	No	No	No	No	No	No
Costa Rica	Yes	Yes	Yes	Yes	No	Yes
Czech Republic	Yes	Yes	No	No	No	No
Denmark	Yes	Yes	Yes	Yes	Yes	Yes
Estonia	Yes	No	Yes	No	No	No
Finland	Yes	Yes	Yes	No	No	Yes
Germany	n.r.	n.r.	n.r.	n.r.	n.r.	Yes
Hungary	Yes	No	No	No	No	No
Iceland	Yes	No	Yes	No	Yes	Yes
Ireland	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Israel	Yes	No	Yes	No	No	Yes
Italy	No	No	No	No	No	No
Japan	Yes		Yes	Yes		
Korea	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	Yes	Yes	Yes	No	No	No
Luxembourg	No	No	No	No	No	No
Mexico	No	No	No	No	No	No
Netherlands	Yes	Yes	Yes	No	Yes	Yes
Norway	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Portugal	Yes	Yes	d.k.	No	No	No
Slovenia	Yes	n.r.	n.r.	n.r.	n.r.	n.r.
Sweden	Yes	Yes	Yes	Yes	Yes	Yes
Switzerland	No	No	No	No	No	No
Türkiye	Yes	Yes	Yes	Yes	Yes	Yes
United States	No	No	No	No	No	No

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

Table D.14. Projects where data from electronic health records are used to regularly monitor and report on healthcare quality at the health system level

Country	Project	
Australia	Title	Program to implement the framework for use of My Health Record data for research and public health purposes.
	Purpose	To enable effective and ethical use of data from the national electronic health record in Australia (i.e. My Health Record) while preserving privacy of individuals and security of the system.
	Description	The implementation program involves establishing the potential research and public health uses of data, the governance and legislative arrangements, policies, procedures and processes and national infrastructure to enable for the secure, efficient and effective use of My Health Record data for research and public health purposes.
	Publications	
Belgium	Title	#dataforbetterhealth
	Purpose	identify the existing impediments for a FAIR data policy in public health and to formulate, test and implement solutions for these impediments in order to achieve an integrated data access policy.
	Description	https://dataforbetterhealth.be/nl/
	Title	Healthstat
	Publications	
	Purpose	Healthstat.be is the data visualization platform of the Healthdata.be project, which is part of the national Action Plan eHealth 2013-2018. Here, the researchers publish tables, figures and maps they made based on the data they have collected among Belgian hospitals, laboratories, physicians, and patients. With these reports, researchers want to give health professionals, healthcare institutions, patients, governments and the general public an up-to-date insight into the prevalence of certain diseases, their causes and impact, and the effectiveness of their treatment.
Canada	Description	https://www.healthstat.be/
	Title	2020 National survey of Canadian Nurses: Use of Digital health Technol
	Purpose	Identify Canadian nurses' access to and use of digital health in nursing practice
	Description	The National Survey of Canadian Nurses constitutes a series of surveys on the use and the impact of digital health technologies on nursing practice commissioned by Canada Health Infoway (Infoway) in partnership with the Canadian Nurses Association (CNA) and the Canadian Nursing Informatics Association (CNIA).
	Publications	2020 National Survey of Canadian Nurses: Use of Digital Health Technology in Practice, April 29 2020
	Title	MySaskHealthRecord: Benefits Evaluation
	Purpose	Identify impacts and benefits demonstrated during the first year of operations
	Description	When studying the benefits of MySaskHealthRecord, the evaluation was separated into three main pillars: benefits to citizens, benefits to healthcare providers, and benefits to the overall healthcare system. To measure the impact of the program on those areas, eHealth conducted a number of surveys that were sent to MySaskHealthRecord users and healthcare providers.
Costa Rica	Publications	MySaskHealthRecord: Benefits Evaluation, December 2020
	Title	HIV
	Purpose	Provide data for information request of PAHO-WHO and the Global Fund
	Description	
	Title	Health Surveillance
	Purpose	Tracking health events of national concern.
Czech Republic	Description	
	Publications	
Denmark	Title	LPR
	Purpose	Part of regular monitoring and not a project
	Description	The National Patient Registry (LPR in Danish), monitors every service delivered in Danish healthcare and can be accessed digitally.
	Publications	esundhed.dk and Statistics Denmark is the entrance to publicly available analysis performed on the data
	Title	RKKP
	Purpose	Part of regular monitoring and not a project
Denmark	Description	The regional clinical quality program (RKKP in Danish) monitors quality in healthcare by means of a vast number of quality databases.

	Publications	
Estonia	Title	Stroke pathway
	Purpose	Establish a comprehensive treatment pathway and a patient centered approach for stroke patients
	Description	Arranging treatment of care for stroke patients on a patient-based approach. Implementing appropriate health outcome measures. Making rehabilitation more available for stroke patients. Combining health and social care in a sustainable way.
	Publications	
	Title	Clinical indicators
	Purpose	Establish a system of indicators to assess the quality of care
Finland	Description	Developing national healthcare quality indicators to assess the quality of care mainly in hospital level.
	Publications	Eesti Haigekassa, 2020. Kliiniliste indikaatorite levaade, 2019. aasta tulemused
	Title	Data lake pilot study of the national diabetes quality register
	Purpose	To assess the quality and feasibility of data on diabetic patients in the data repository compiled from the national eHR
	Description	Data on diabetic patients, their medication, laboratory tests, and other aspects of their care are retrieved from the data repository compiled from the national eHR (data are not yet routinely used to measure healthcare quality)
	Publications	
Germany	Title	Data lake pilot study of the national vaccination register
	Purpose	To validate the coverage, correctness and deficiencies in the data repository compiled from the national eHR
	Description	Data on all vaccinations are retrieved from the data repository compiled from the national eHR and compared to the current national vaccination registry
	Publications	
	Title	Pulzus
	Purpose	Depersonalised national research database
Hungary	Description	Collecting and combining depersonalized data from operation, financing and other non-health domain for analysis
	Publications	
	Title	Out-patient traffic control system
	Purpose	Develop methodology and central services for institute- and system-level out-patient traffic control, scheduling and monitoring
	Description	- Effective organisation, scheduling and monitoring of out-patient traffic based on the availability of local human, material and location resources. - Measuring pre-defined KPIs to enhance the work of the system to gain higher efficiency and better patient satisfaction.
	Publications	
Iceland	Title	
	Purpose	
	Description	Continuous quality management of patient safety and quality of care by the Directorate of Health
	Publications	
	Title	
	Purpose	
Israel	Description	Continuous monitoring of quality of care to the elderly (RAI)
	Publications	
	Title	Covid 19 vaccination follow-up
	Purpose	To monitor and follow up the decrease of covid19 infection among vaccinated population and to analyze characteristics and mutations causing vaccination failure
	Description	Israel has a national database of all vaccinated citizens and we link this database to the national COVID-19 laboratory database and the hospitalization database in order to capture people infected, hospitalized or deceased after being vaccinated.
	Publications	
Italy	Title	General hospitalizations of psychiatric inpatients with severe mental illness
	Purpose	To monitor general and chronic diseases and outcomes among psychiatric inpatients
	Description	Patients with severe mental illness in psychiatric hospitals need special attention to prevent and treat chronic and infectious diseases that may necessitate hospitalization in acute care hospitals. We study and compare the hospitalization rates and diagnoses of psychiatric patients as compared to the general population, using the eHR and linking to the national hospitalization database at the ministry of health.
	Publications	
	Title	1.3.2 Ministry of health technological infrastructure and data analysis & predictive model to guarantee the Italian Essential Levels of Assistance (LEA) and health surveillance and vigilance -part of the Italian Recovery and Resilience Plan (Mission 6, Component 2, Investment 1, Sub-measure 1.3 "Strengthening of technological infrastructure and of the tools for data collection, data processing, data analysis and simulation")
	Publications	

	Purpose	Strengthen the infrastructure and the technological and analytics instruments of the Ministry of Health to monitor the Essential Levels of Assistance (i.e. the services guaranteed by the NHS nationwide) and plan healthcare assistance and services in line with population needs and evolution on demographic, innovation and epidemiology trends
	Description	This key and primary objective of the Italian Ministry of health is accomplished through the achievement of the following and integrating 4 sub-objectives: (i) strengthening of the infrastructure of the Italian Ministry of Health, integrating eHR clinical data with the already existing New Health Information System (NSIS) clinical, administrative and costs data and with the other information and data related to health in One-Health approach (animals, food, ..) to monitor the ""LEA and ensure health surveillance and vigilance activities; (ii) enhancement of the collection, processing and generation of NSIS data by local level, reengineering and standardizing the data generation regional and local process, in order to improve and speed the NSIS tool for the measurement of quality, efficiency and appropriateness of the NHS; (iii) development of advanced analysis tools to assess complex phenomena and scenario prediction to realize a predictive modelling due to improvement the central capacity to plan healthcare service and detect emerging diseases; (iv) creation of a national platform where supply and demand of telemedicine services from the accredited providers can meet. Among the objectives, (i) and (iii) are focused in using data from eHR to regularly monitor and report on healthcare quality at the health system level.
	Publications	
Japan		
Korea		
	Title	Open COVID-19 data sets.
	Purpose	To produce and announce the most important information and data sets about COVID-19
Lithuania	Description	The latest indicators related to the COVID-19 pandemic have been published and constantly updated in the Database of Indicators. These indicators are available in the section General statistics COVID-19 statistics. The section covers population and health statistics, weekly and monthly mortality rates, as well as statistics on crime and accidents reported to the police, employment, stoppage of work, dismissed and hired employees, GDP, general government finance, business trends, domestic and foreign trade, business activity.
	Publications	
Luxembourg		
	Title	MODELO DE EVALUACION DEL EXPEDIENTE CLINICO INTEGRADO Y DE CALIDAD/ QUALITY AND INTEGRATED CLINICAL RECORD ASSESSMENT MODEL
	Purpose	Evaluate the quality of medical documentation records and adherence to regulatory compliance, through an evaluation model available on an online platform for the health sector
	Description	The clinical record is defined as the unique set of information and personal data of a patient, which is integrated into all types of healthcare establishment, whether public, social or private, which consists of written documents, graphics, imaging, electronic, magnetic, electromagnetic, optical, magneto-optical and of any other nature, in which health personnel must make the records, annotations, where appropriate, certificates and certifications corresponding to their intervention in the medical care of the patient, with adherence to the applicable legal provisions. In order to propose a methodology that evaluates the adherence of the clinical record to the regulations, the Quality and Integrated Clinical Record Evaluation Model (MECIC) was created as a useful tool to periodically evaluate the clinical record aimed at all patients. healthcare establishments of the National Health System, the analysis of the results obtained from its application guides health personnel to implement actions aimed at raising the quality of the documentation that makes it up.
	Publications	
Mexico	Title	EVALUACION DE ALGORITMOS DE ATENCION BASADOS EN GPC ATRAVS DEL MODELO DE EVALUACION DEL EXPEDIENTE CLINICO INTEGRADO Y DE CALIDAD/GPC-BASED CARE ALGORITHMS ASSESSMENT THROUGH THE INTEGRATED CLINICAL RECORD AND QUALITY ASSESSMENT MODEL
	Purpose	Evaluate the application of algorithms for the care of priority conditions according to national mortality, through the evaluation of the clinical record.
	Description	The purpose of this Strategic Plan is to guide the standardization of medical care processes, through the implementation of specific actions, recommendations that allow improving the effectiveness of health personnel interventions, as well as the efficiency of clinical processes, through the Clinical Care Algorithms: It is expected that the improvement actions resulting from the experience in the use of CPGs through clinical care algorithms will contribute to the standardization of medical care in priority conditions at the national level, and this in turn to improve the technical quality of care and the safety of patients in healthcare establishments (EAM). In this way, with the implementation of CPGs, through clinical care algorithms It contributes, among other aspects, to strengthening the service networks between the different levels of care, improve the effectiveness of the referral and counter-referral system, as well as strengthen the multidisciplinary work in care processes; for this it is vitally important that public institutions of the sector participate in the execution of this Strategic Plan, in the short term. Through the evaluation of the clinical record, it is sought to know the level of adherence to the recommendations issued by these algorithms during healthcare."
	Publications	
Netherlands	Title	Bundled payments in Dutch maternity care
	Purpose	Measuring the healthcare utilization, spending and health outcomes after the introduction of a new and experimental bundled payment model in maternity care.
	Description	Claim data were linked to data of Perined (perinatal data of obstetricians, gynecologists and paediatricians) and population

		information (like education, ethnicity, income).
	Publications	Struijs JN, Vries EF de, Scheefhals ZTM, Molenaar JM, Baan CA. Integrale bekostiging van de geboortezorg: ervaringen na drie jaar en de eerste zichtbare effecten. Bilthoven: RIVM, 2020.
	Title	Referring between primary care and secondary care
	Purpose	Monitoring if the healthcare is performed at the right place (primary care if effective and safe).
	Description	Data of GPs were analysed to give a picture of the number and the variance among GPs in referrals to secondary care. Also data of hospitals were analysed to give a picture of referrals from GPs and referrals between medical specialists.
	Publications	Verberne L, Prins A, Veen P ten, Verheij R. Verwijzingen van eerste lijn naarspecialistische zorg en binnen de specialistisch zorg. Utrecht: Nivel, 2021.
Norway		
	Title	VACINAS
	Purpose	Monitor, record and access vaccination record & IIs Systems
	Description	An successful project is the central vaccination project has also been a roaring success. Despite starting recently, in May 2017, today everyone can see their vaccination record online, can carry it on their mobile phones with an app developed by SPMS. It means that when getting a vaccine in a pharmacy, in a hospital, or in the private sector, all of them will be immediately registered in the central database. The team knows exactly how many people did not get the vaccine and can create a letter, email or call to warn them. Vacinas (National Immunisation Information System - IIs) is a centralized and integrated management of the citizen's immunisation records inside and outside of NHS, by giving more information to the professionals for a better provision of healthcare, while making available to the citizens their clinical information. In terms of benefits for citizens, health professionals, service providers and NHS in general, through simplification of procedure. It is possible to highlight the dematerialization of the booklet and ensure cost reduction. This application allows the centralized and integrated management of the citizen's immunisation record. Health professionals can access the electronic register of vaccines in any unit of the National Health Services and, in case of an emergency. Its possible to monitor the overall, country-wide inoculation per county, municipality, district for a specific timeframe & vaccines.
Portugal	Publications	
	Title	TRACE COVID-19
	Purpose	Contact tracing and clinical follow up in COVID-19 pandemic
	Description	During the outbreak of COVID-19 in Portugal, SPMS spotted an opportunity to support the Citizens, the Portuguese-NHS (PTNHS) and Health Authorities fighting Covid-19. Gathering its expertise on ICT/telehealth Self-report&TraceCOVID-19 was designed to provide (1) digital means for the self-report of symptoms of Covid-19 by positive or in risk citizens while (2) supporting Health Provisionals with means for their telemonitorization and (3) supporting Health Authorities with intelligence on a 360 vision of Covid-19s national spread for decision-making. Rapidly the tool was implemented in the PTNHS and soon it became the digital backbone for treatment and decision-making of Covid-19 as through this integrated system Portugal become able to digitally monitor the vigilance cycle of both suspect and confirmed cases of COVID-19, diminishing the need for physical presence at hospitals for non-critical cases as their symptoms can be self-reported from home and telemonitorized by health professionals through the tool.
	Publications	
Slovenia		
	Title	IT-tool for healthcare-associated infections
	Purpose	To prevent healthcare-associated infections
	Description	When antibiotics are prescribed the cause is recorded in the eHR for follow up etc.
	Publications	
Sweden	Title	Quality Registries in Sweden
	Purpose	Vision: National Quality Registries are used in an integrated and active way for continuous learning, improvement, research and management to create the best possible health and care together with the individual More: https://kvalitetsregister.se/englishpages/aboutqualityregistries.2422.html
	Description	A system of National Quality Registries has been established in the Swedish health and medical services. The databases are held by different regional authorities.
	Publications	
Switzerland	Title	As far as we know there are no such projects in Switzerland
	Purpose	
	Description	
	Publications	MonDossierMdicale is a long-term eHR project driven by the Canton of Geneva. Its services were the basis for the Swiss participation in European projects such as Cross-Border eHealth Information Services (CBEHIS). The Canton of Geneva created an eHealth-law for the MonDossierMedical activities. Therein the secondary use of health data for public health purposes is permitted if the data are anonymized. According to the project responsables the canton never used this option until now. MonDossierMedical is currently running through the national eHR certification process in order to become a regular system participant in the now taking off national health data exchange. This future certified community called Cara contains five French speaking Swiss cantons, see. https://www.cara.ch/fr/index.html .

Türkiye		
United States	Title	AHRQ Quality and Safety Review System (QSRS)
	Purpose	Patient Safety Surveillance (Inpatient)
	Description	AHRQ has developed and tested an improved patient safety surveillance system to replace MPSMS that is known as the Quality and Safety Review System (QSRS). The QSRS relies on clinical information recorded in medical records, and the system has been designed to make use of structured data where it is or may become available. The use of reliable structured data, such as medication prescriptions and laboratory test results that are relevant to patient safety events, offers opportunities to further enhance the efficiency of the QSRS by automatically drawing this information from an electronic health record. Overall, the QSRS will generate adverse event rates and trend performance over time. Unlike MPSMS, the QSRS was designed to serve as a local hospital and health system tool to identify and measure adverse events.
	Publications	Austin JM, Kirley EM, Rosen MA, Winters BD. A comparison of two structured taxonomic strategies in capturing adverse events in U.S. hospitals. Health Serv Res. 2019 Jun;54(3):613-622. doi: 10.1111/1475-6773.13090. Epub 2018 Nov 25. PMID: 30474108; PMCID: PMC6505417.
	Title	CDCs National Healthcare Safety Network
	Purpose	Track healthcare associated infections (HAI)
	Description	CDCs National Healthcare Safety Network is the nations most widely used healthcare-associated infection (HAI) tracking system. NHSN provides facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate healthcare-associated infections.
	Publications	2019 National and State Healthcare-Associated Infections Progress Report

Source: OECD 2021 Survey of Electronic Health Record System Development, Data Use and Governance

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