ADVANCING INTEROPERABILITY TOGETHER GLOBALLY

GDHP White Paper on Interoperability

GLOBAL DIGITAL HEALTH
PARTNERSHIP

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ABOUT THE GLOBAL DIGITAL HEALTH PARTNERSHIP

The Global Digital Health Partnership (GDHP) is a collaboration of governments and territories, government agencies and the World Health Organization, formed to support the effective implementation of digital health services.

Established in February 2018, the GDHP provides an opportunity for transformational engagement between its participants, who are striving to learn and share best practice and policy that can support their digital health systems. In addition, the GDHP provides an international platform for global collaboration and sharing of evidence to guide the delivery of better digital health services within participant countries.

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1 NOTE FROM THE GDHP WORK STREAM CHAIR

Every country and territory has a different healthcare system, but all understand the importance of leveraging digital health advancements to provide more efficacious care to individuals so they can live healthier and longer lives. These advancements aspire to empower individuals to fully use their electronic health information, facilitate healthcare providers and organisations to deliver better care, and promote innovation within all levels of the healthcare system.

As we discussed in the previous white paper, "Connected Health: Empowering Health through Interoperability," connected care through interoperability is the key to achieving these health IT aspirations. All nations use some health data standards, regardless of their healthcare systems. Countries and territories are at different stages of adoption and implementation of these health data standards, and the harmonisation of these standards globally is crucial to promoting the interoperability of electronic health information.

The Global Digital Health Partnership (GDHP) continues its work of advancing widespread interoperability of individuals' health data on the global scale. GDHP countries have the same goals and we work together to determine how to make connected care through interoperable systems a reality.

This white paper builds on the previous white paper's analysis of countries and territories' health system infrastructures, how they exchange health data, for what purposes that exchange happens, and what standards are employed to collect, use, and share that data. In this white paper, we collected structured and illustrative information from GDHP participants to understand the barriers to advancing interoperability, and the creative solutions they have devised to overcome those barriers. We also discuss the healthcare purposes that have the highest priorities for interoperability. Finally, we propose potential next steps for advancing interoperability globally through the adoption and use of health data standards.

Although the writing of this white paper predates the COVID-19 response, the findings and recommendations are relevant. Sharing information using health data standards for interoperability is necessary to advance public health reporting and research which are key parts of an evidence-driven response to pandemics. Now, more than ever, increasing collaboration and sharing best practices around the world, not just within countries and territories, is critical to advance interoperability together globally.

I am thankful to the GDHP Secretariat and all GDHP participants who shared their expertise and time to provide feedback that was used to develop this white paper.

Together, we *can* advance interoperability globally.

Dr Don Rucker
National Coordinator for Health IT
US Department of Health and Human Services

and
Chair, Interoperability Work Stream
Global Digital Health Partnership

2 EXECUTIVE SUMMARY

Interoperability has long been considered necessary for connected health care. It improves care quality and safety, cost-effectiveness and patient empowerment. However, despite widespread desire for interoperability, global progress has been sporadic. The Global Digital Health Partnership (GDHP) seeks to better understand interoperability challenges and to take the initiative to *advance interoperability together globally*.

This white paper focuses on barriers, solutions and drivers related to interoperability. It also shares lessons learned and best practices that GDHP participant countries and territories have used to address interoperability through standards, legislation, policies, incentives and innovative solutions. Finally, it recommends next steps for the GDHP Interoperability work stream to take to advance interoperability globally.

The previous GDHP white paper established a baseline by describing the digital health landscape of GDHP participant countries and territories as of 2018, focusing on interoperability challenges and use of health data standards. To deepen the understanding and to advance beyond description to action, in 2019, the GDHP Interoperability work stream conducted a structured survey with GDHP participants on interoperability barriers and purposes, to inform this white paper. GDHP participants were also asked to suggest collaborative efforts that the GDHP Interoperability work stream could develop and execute to deliver substantial value. Twenty-two GDHP participant countries and territories responded to the survey, resulting in key findings and recommendations.

The most significant barriers were lack of capability to take action based on exchanged data, and poor usability and negative impact on providers' workflows. Sometimes, difficulty using EHRs stems from the lack of structure and standardisation of data. Thus, many countries are trying to deal with the capability problem at its root: data quality. Few generalisable solutions to usability have been discovered, but including frontline users in system design and policy formation has helped in some cases. There are also significant economic barriers. In some locales, although interoperability can improve efficiency, it can also result in reduced payments or increased costs to providers. Costs may be direct (e.g. software licences and upgrades) or indirect (e.g. retraining, extra time spent). Governmental financial incentives have helped address economic barriers, with varying degrees of success.

Interoperability is driven by many purposes. GDHP participants noted that data exchange supporting transitions of care was the highest priority purpose, among several others that also ranked high (receiving laboratory and pathology reports, receiving diagnostic imaging reports, medication management, electronic prescribing and patient access). Most GDHP participants listed many high-priority purposes for interoperability, not just a few. Direct patient care purposes ranked higher than secondary uses such as population health and research.

We realise the need for caution when generalising across a wide variety of countries and territories because of the many differences among them. Nonetheless, we are confident in the key findings because the significant barriers all had low variability among their answers. The similarities in health care and human needs transcend the differences.

There is also general agreement on the major interoperability health data standards to be used. Still, much more specific guidance will be needed regarding appropriate standards and implementation guides for specific purposes. This leads to the recommendations for GDHP's next steps for collaboration to advance interoperability. GDHP participants recommend creating a Global Master Standards Guide (GMSG) to provide detailed implementation guidance on use of specific standards to accomplish various purposes such as those described in this white paper. Some countries and territories already have their own example of a master standards guide, which may be useful source material for a GMSG. The GMSG would be augmented if a Global Interoperability Maturity Model (GIMM) for health IT was also developed. A GIMM would take into account factors such as functionality, standards adherence, adoption levels, governance and metrics. It could be used to assess the interoperability maturity level of a product, organisation, or even a regional or national health system.

In conclusion, we understand what specific barriers must be overcome in order to achieve the highest priority purposes, and we have a new awareness of innovative standards-based solutions already in use. We are eager to share this information and collaborate on projects to *advance interoperability together globally*.

3 INTRODUCTION

3.1. BACKGROUND

The previous Global Digital Health Partnership (GDHP) interoperability white paper, *Connected Health: Empowering Health through Interoperability*, collected high-level descriptions of the current interoperability landscape in GDHP participant countries and territories, and summarised themes that were shared among most countries, such as the widespread use of Health Level Seven (HL7) and Integrating the Healthcare Enterprise (IHE) standards, the very high adoption of semantic/code system standards, and the desire for patients to be highly engaged in sharing their digital health data. The next step, as discussed in this white paper, is to go beyond description and analysis to action in order to advance interoperability together globally.

3.2. PROBLEM STATEMENT

Although every country and territory has a different healthcare system, all nations use health data standards. Countries and territories are at different stages of adoption and implementation of these standards. Thus, harmonisation is crucial for promoting the interoperability of electronic health records (EHRs) and empowering patients to use their health data across the globe.

This white paper will focus on the barriers to, solutions for, and drivers of interoperability as a transformational challenge; the legislative changes required to achieve interoperability; and the lessons learned and best practices from across the globe for advancing interoperability through the adoption and use of standards.

3.3. SIGNIFICANCE FOR POLICY MAKERS

Each country and territory has health IT policies implemented through legislation, but it is intended that this white paper's recommendations will influence future policies so participant countries and territories will adjust direction as they learn from the experiences of others, avoid duplicative efforts, and collaborate on globally harmonised efforts to deliver value for all. Many examples in this white paper show that appropriate legislation can play a major role in removing barriers and advancing interoperability.

3.4. SCOPE

This white paper is based on the analysis of results from a GDHP survey of interoperability barriers, solutions and purposes. The survey results identify areas of commonality and highest priority, leading to recommendations for GDHP collaborative action. Interoperability is necessary both *internally* within an organisation (e.g. between departments of a hospital), and *externally* between separate organisations (e.g. from one

healthcare system to another). While it is not assumed that *internal* interoperability has been completely accomplished, *external* interoperability is the primary context for this white paper.

A subset of external interoperability is *cross-border interoperability* (when patient information is exchanged from one country to another), but, unless specifically noted, the examples in this white paper focus on interoperability within a country or territory. However, *cross-border interoperability* offers an excellent opportunity to find common ground regarding coding and structuring of data.

3.5. METHODOLOGY

To produce results for systematic analysis, a structured (multiple choice) survey/questionnaire (see Appendix A) was designed to gather data. The survey choices were extracted from previous research publications (see References) and the GDHP participants' previous descriptions of interoperability approaches. In addition to answering the structured questions, respondents elaborated on their answers and offered comments about areas of interoperability beyond the structured questions. All participant countries and territories were asked to review and approve the draft survey before it was distributed on 20 June 2019. Twenty-two country and territory governments or government agencies responsible for the delivery of digital health services nationally provided data through the survey. There was only one response allowed per country or territory. These were analysed quantitatively and qualitatively. The following principles were applied to guide inclusion:

- Include examples that show the diversity of experience within each question.
- Use direct quotations to provide participants' perspectives in their own words.
- Identify recurring themes and patterns across multiple countries.
- Highlight areas of strong agreement or strong disagreement (variability of answers).
- Acknowledge well-articulated innovative ideas and solutions, even if mentioned by only one country.
- Look for practical suggestions that are widely applicable across the GDHP.

4 INTEROPERABILITY: BARRIERS AND PURPOSES

This white paper seeks to promote understanding of the global interoperability landscape from both positive and negative perspectives. On the negative side, barriers inhibit or completely block interoperability. Eliminating barriers does not necessarily produce interoperability but makes it more feasible. On the positive side, purposes are specific health-related use cases that interoperability enables or supports. High-level goals such as “improved patient care,” or “higher care quality,” or “increased efficiency” are achieved indirectly through the more specific purposes listed in this survey. For example, “patient access” is intended to lead to more engaged patients and to greater awareness of patients’ needs among providers, which should presumably improve patient care.

4.1. BARRIERS TO INTEROPERABILITY

Statistical analysis of the structured survey of barriers gave a weighted significance score for each of 25 barriers identified in the survey, plus any other barriers added by respondents. The answers for barriers ranged from 0 (not a barrier), 1 (minor barrier), 2 (moderate barrier), to 3 (major barrier). Responses were tabulated, and the mean (a number between 0.0 and 3.0) and standard deviation were calculated. The barriers were ranked from highest to lowest significance, and several were designated Tier 1 barriers to be analysed in more detail. After displaying the overall results in tabular and graphical formats, we continue with a qualitative summary of Tier 1 barrier comments, including areas of strong agreement or disagreement, and the reasons given to support the answers.

The table of results below shows the average scores and standard deviations. Appendix A, the original survey, has a full explanation of each question (column).

Perception varied regarding the significance of the barriers. At one end of the spectrum, Austria said it had already overcome most barriers, so its average barrier score was only 0.42. At the other end, Sweden considered most barriers major or moderate, so its average barrier score was 2.20.

Table 1: Barriers to interoperability showing average scores and standard deviations

Country/Territory	Average Barrier	Lack of digital health system	Lack of accurate patient ID matching	Lack of infrastructure for secure transmission	Difficulty identifying and communicating w other entities	Existing standards are not adequate	Variability in choice of standards	Inconsistent implementation or constraints	Difficulty understanding what other providers meant	Two or more incompatible versions of standard	Lack of universal adoption of standards-based EHRs	Lack of EHR capability to take action on exchanged data	Poor usability and negative impact on workflows	Too much data is exchanged, meaningful data hard to find	Exchanged data missing what providers want	Data not available at point of care	Complex privacy and security challenges	Lack of trust in data quality	Inadequate or inconsistent approaches to patient consent	Regulations or variations in regulations increase burden	Information blocking	Difficulty managing coordinated collective action	Legislation lacks clarity	Increased costs due to interoperability	Economic incentives do not encourage data exchange	Unclear definition of use cases, low user engagement
Argentina	1.19	2	1	1	1	0	0	1	0	1	3	1					2	1	0	1	3	1	0	3	2	1
Australia	1.76	2	1	1	1	1	2	2	3	2	2	3	2	2	1	2	2	2	2	2	1	2	1	1	3	1
Austria	0.44	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	2	1	2
Brazil	2.00	3	3	3	3	2	2	2	1	0	3	3	1	2	1	3	3	2	1	1	0	3	2	2	2	2
Canada	1.92	1	3	1	2	0	3	1	2	2	1	2	2	2	2	2	3	2	2	3	2	3	2	2	1	2
Estonia	0.80	0	0	0	0	1	0	2	2	0	0	2	2	2	1	2	0	0	0	0	1	3	0	1	0	1
Hong Kong SAR	0.92	0	1	0	1	1	0	1	1	0	2	2	2	1	1	1	1	1	0	1	2	2	0	1	1	0
India	1.21	2	1	1	2	0	0	1	0	1	2	2	2	2	2	2	1	1	1	1	1	1	1	2		0
Indonesia	1.46	2	1	1	2	3	2	2	1	1	1	1	1	2	0	1	2	3	1	2	1	2		1	0	2
Italy	1.92	2	0	1	0	1	1	1	2	1	2	3	3	2	2	3	2	3	1	3	3	3	3	1	3	2
Japan	1.24	2	2	1	3	1	1	1	1	1	2	2	1	0	0	0	1	1	1	0	0	2	0	3	3	2

Country/Territory	Average Barrier	Lack of digital health system	Lack of accurate patient ID matching	Lack of infrastructure for secure transmission	Difficulty identifying and communicating w other entities	Existing standards are not adequate	Variability in choice of standards	Inconsistent implementation or constraints	Difficulty understanding what other providers meant	Two or more incompatible versions of standard	Lack of universal adoption of standards-based EHRs	Lack of EHR capability to take action on exchanged data	Poor usability and negative impact on workflows	Too much data is exchanged, meaningful data hard to find	Exchanged data missing what providers want	Data not available at point of care	Complex privacy and security challenges	Lack of trust in data quality	Inadequate or inconsistent approaches to patient consent	Regulations or variations in regulations increase burden	Information blocking	Difficulty managing coordinated collective action	Legislation lacks clarity	Increased costs due to interoperability	Economic incentives do not encourage data exchange	Unclear definition of use cases, low user engagement
Kingdom of Saudi Arabia	0.68	1	0	0	0	2	0	0	0	0	2	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
The Netherlands	1.72	1	0	0	2	1	2	3	3	1	3	3	3	1	1	2	2	1	3	0	0	2	1	3	2	3
Poland	0.75	2	1	1	1	0	0	0	0	0	1						2	0	0	1	0	1	1	1	2	1
Portugal	1.96	3	2	0	2	2	3	3	3	2	2	2	2	0	0	1	3	2	3	3	0	3	3	2	0	3
Republic of Korea	0.88	1	0	0	0	1	1	1	2	0	2	2	1	1	1	0	1	1	0	0	1	1	0	2	2	1
Singapore	0.84	1	1	1	1	1	0	1	0	0	1	0	1	0	1	0	1	1	0	1	2	2	0	2	2	1
Sweden	2.20	0	0	0	3	0	3	3	3	3	2	3	3	1	2	3	2	2	3	3	3	3	3	2	3	2
Switzerland	1.24	3	2	0	2	0	1	2	1	1	2	3	2	0	0	3	0	1	1	0	1	2	0	2	1	1
United Kingdom	1.16	1	0	0	1	1	2	1	2	1	2	2	1	1	1	2	2	1	1	0	1	2	0	2	1	1
Uruguay	0.64	0	0	0	0	1	0	0	1	0	1	1	2	1	1	1	0	2	0	0	1	1	0	2	1	0
United States	2.00	0	3	1	3	1	1	2	2	1	1	3	3	3	2	3	3	2	2	3	3	2	1	2	1	2

Country/Territory	Average Barrier	Lack of digital health system	Lack of accurate patient ID matching	Lack of infrastructure for secure transmission	Difficulty identifying and communicating w other entities	Existing standards are not adequate	Variability in choice of standards	Inconsistent implementation or constraints	Difficulty understanding what other providers meant	Two or more incompatible versions of standard	Lack of universal adoption of standards-based EHRs	Lack of EHR capability to take action on exchanged data	Poor usability and negative impact on workflows	Too much data is exchanged, meaningful data hard to find	Exchanged data missing what providers want	Data not available at point of care	Complex privacy and security challenges	Lack of trust in data quality	Inadequate or inconsistent approaches to patient consent	Regulations or variations in regulations increase burden	Information blocking	Difficulty managing coordinated collective action	Legislation lacks clarity	Increased costs due to interoperability	Economic incentives do not encourage data exchange	Unclear definition of use cases, low user engagement
Average	1.32	1.32	1.00	0.59	1.36	0.91	1.09	1.36	1.36	0.82	**1.68**	**2.05**	**1.90**	1.30	1.15	1.55	1.50	1.32	1.00	1.14	1.18	**1.86**	0.86	**1.86**	**1.57**	1.36
Std Deviation		1.02	1.04	0.72	1.07	0.79	1.08	0.93	1.07	0.83	0.82	0.95	0.70	0.84	0.73	1.12	1.03	0.87	1.04	1.18	1.07	0.92	1.08	0.62	0.95	0.88

Key: Green = areas of low variability; Red = areas of high variability; Grey = no response provided; Yellow = tier 1 barriers.

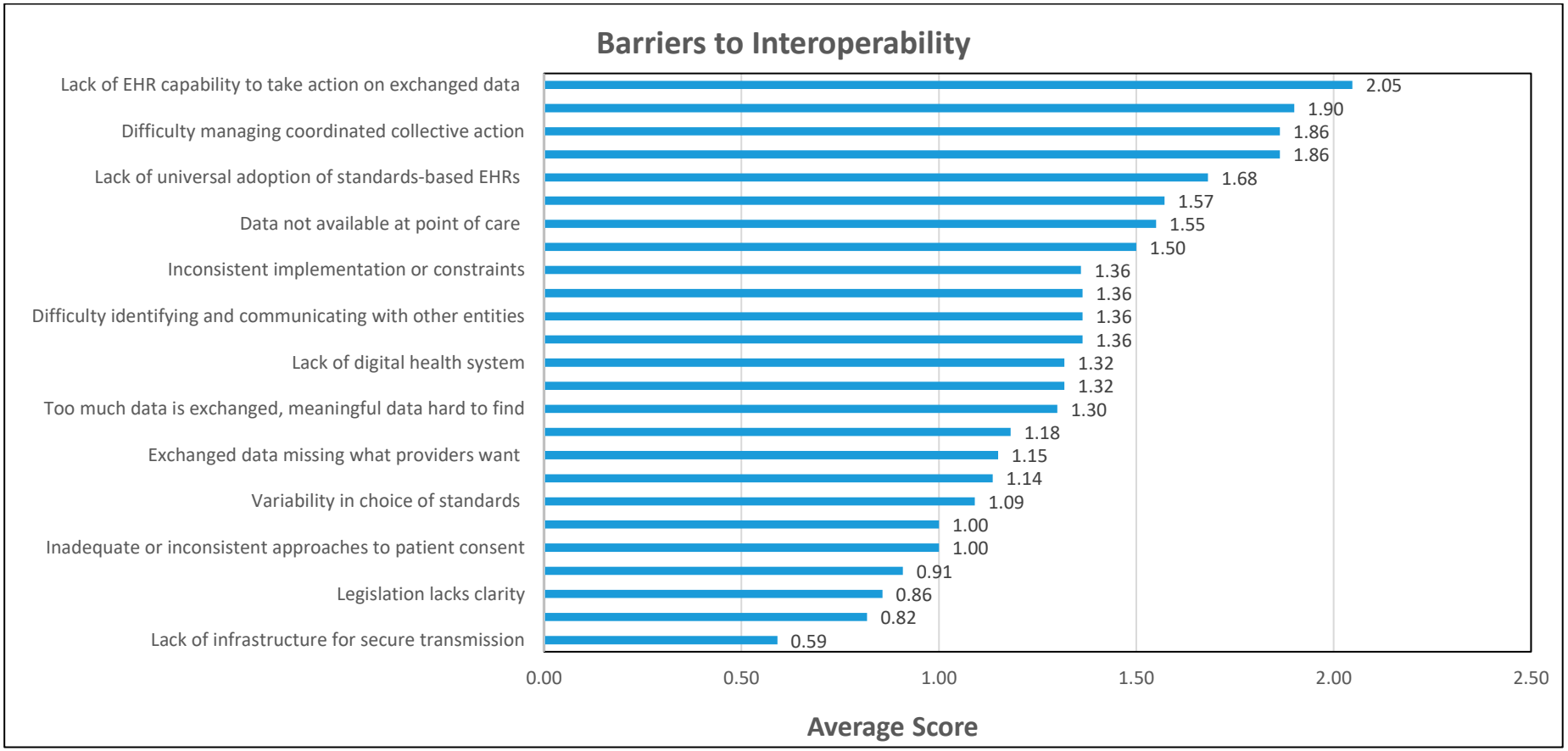


Figure 1: Barriers to interoperability, ranked by significance

4.1.1. Tier 1 Barriers

These barriers are the highest ranked (the third and fourth barriers tied at number 3):

1. *Lack of EHR capability to take action based on exchanged data*
2. *Poor usability and negative impact on providers' workflows*
3. *Difficulty managing coordinated collective action among multiple organisations*
4. *Increasing cost due to interoperability that entities cannot afford*
5. *Lack of universal adoption of standards-based EHRs*
6. *Economic incentives do not encourage data exchange*

The summarised comments mainly focus on the Tier 1 barriers, including countries' and territories' examples of their negative impacts of these barriers, and potential solutions or information that can be shared to help overcome these barriers. A few noteworthy comments on other barriers are included below. In particular, the major barriers that respondents added, which were not predefined in the survey, are acknowledged. While these are not candidates for a GDHP collaborative project, they may provide excellent opportunities for GDHP participants that have overcome those barriers to reach out and advise countries that face them.

These barriers suggested by respondents were not in the original survey:

- Number of details and issues during specification and implementation (Austria)
- Lack of drug dictionary (Canada)
- Patient control not driving interoperability (Canada)
- Lack of national exchange or trust framework (Canada)
- Interoperability driven by IT rather than clinicians (Canada)
- Unmet infrastructure needs for low-income areas (the United States)
- Lack of metrics for success (the United States)
- Market failure in interoperability (the Netherlands)
- Lack of knowledge and skills in the boardroom and providers (the Netherlands)

See Section 4.1.9 below for more discussion.

4.1.2. Barrier 1: Lack of EHR capability to take action based on exchange data

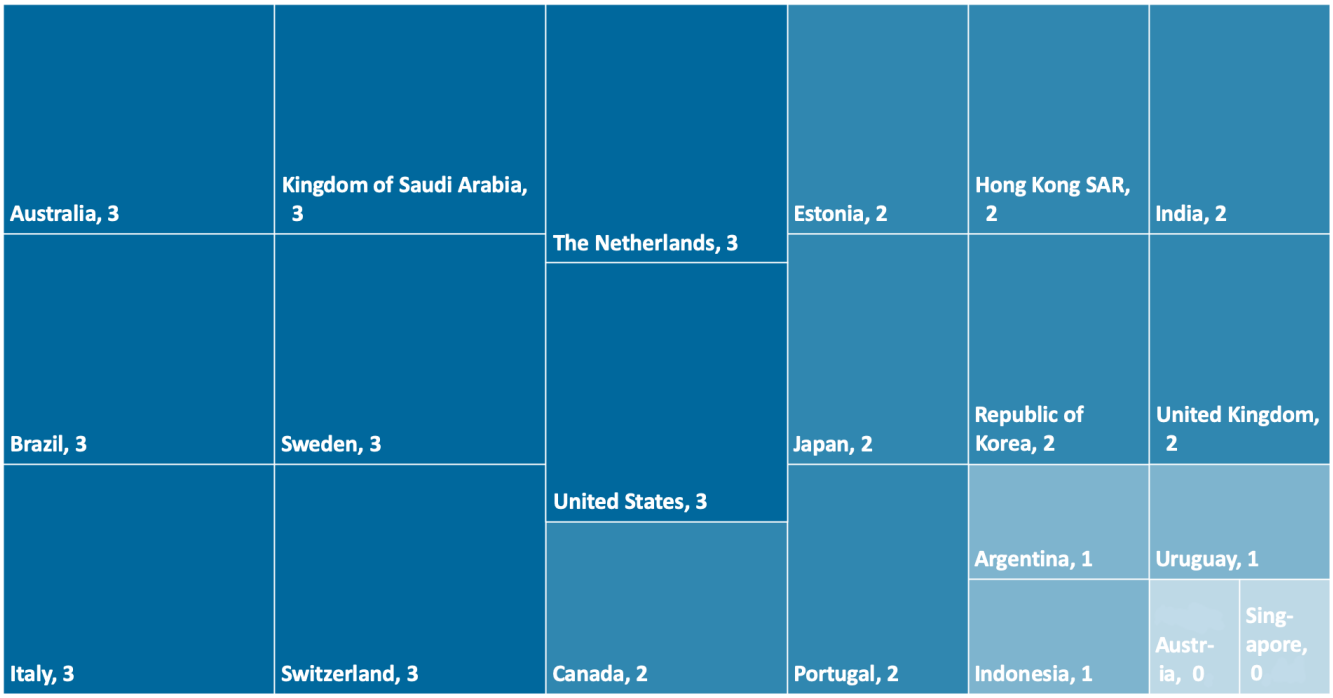


Figure 2: Barrier 1 treemap

The top-rated barrier was the lack of electronic health record (EHR) capability to take action based on exchanged data. It was considered a major barrier by more countries and territories (seven) than any other barrier. For example, the provider can view the data, but cannot import, reconcile and integrate it to update the corresponding information in the patient's record. Providers may protest, "What is the point of receiving data if I cannot *do* anything with it?"

There are two main aspects to this barrier. The first is lack of structure and/or standard terminologies in the content of exchanged data, and the second is the lack of functionality such as parsing capability in EHRs.

In Portugal and Switzerland, most exchanged data are unstructured documents that can only be viewed, not parsed. Canada said that "semantic interoperability is still immature as shared terminology (reference sets) is less common" and the Netherlands noted many providers' EHRs are "tailor-made, work with their own dialect of standards, and can't even exchange data within the same organisation." When the data are not structured, users cannot take action on exchanged data regardless of their EHRs capability.

Even if the data are structured, there is also a lack of mature or widely adopted standards and guidelines for interoperability functions such as data reconciliation. In the United States, despite 80 per cent of physicians using interoperable EHRs that generate structured documents, only 10 per cent could find, send, receive and integrate patient summary records from outside their health system. Austria said that most systems had not yet implemented parsing functionality to understand shared data, which was implemented into the systems in the course of connecting them to the national eHealth

infrastructure called ELGA.[1] Most systems prior to ELGA had simply transmitted data using proprietary standards, only for viewing. Furthermore, even the presence of such capabilities does not guarantee their usability or widespread use.

To overcome this barrier, Canada is addressing one inhibitor (lack of shared terminology), by establishing a national terminology gateway, and the Netherlands is placing high emphasis on semantic interoperability by focusing on Health and Care Information Models[2] at a national and international level. Shared terminology is necessary but not sufficient in itself for EHRs to take action. Australia provides a National Clinical Terminology Service offering easily computable formats, but "there has been no enforcement of standardised terminology within Australia." The United States went further by defining a certification requirement for EHRs to be able to reconcile and incorporate medications, medication allergies and problems from a structured HL7 Clinical Document Architecture (CDA) document, thus ensuring that the capability is present in EHR systems. Austria, when it set up ELGA, required structured data "and in its tail the ability to parse the data and take some action on it." By addressing the structure of content by law, Austria has removed lack of structure as a barrier, though actual deployment of such EHR functionality is expected to be a gradual process. India describes its emerging solution as "adoption of Fast Healthcare Interoperability Resources (FHIR) [which] ensures that the EHRs are available, discoverable, understandable, and also structured and standardised to support automated clinical decision support."

In summary, it is understandable that most countries have systems that generate and communicate data to other providers, but have not completed the steps of interoperability where the data are processed, reconciled with previous data and made useful to those receiving the data. GDHP participants recognising "lack of EHR capability" as the most important barrier to overcome is encouraging as a global health IT area to address. It is also likely that this barrier is related to the "poor usability" barrier in cases where EHRs possess capabilities that are underused because they are time-consuming. There is an opportunity to improve EHRs as well as redesign clinical processes to incorporate external as well as internal data sources.

[1] Elektronische Gesundheitsakte

[2] https://zibs.nl/wiki/HCIM_Mainpage

4.1.3. Barrier 2: Poor usability and negative impact on providers' workflows

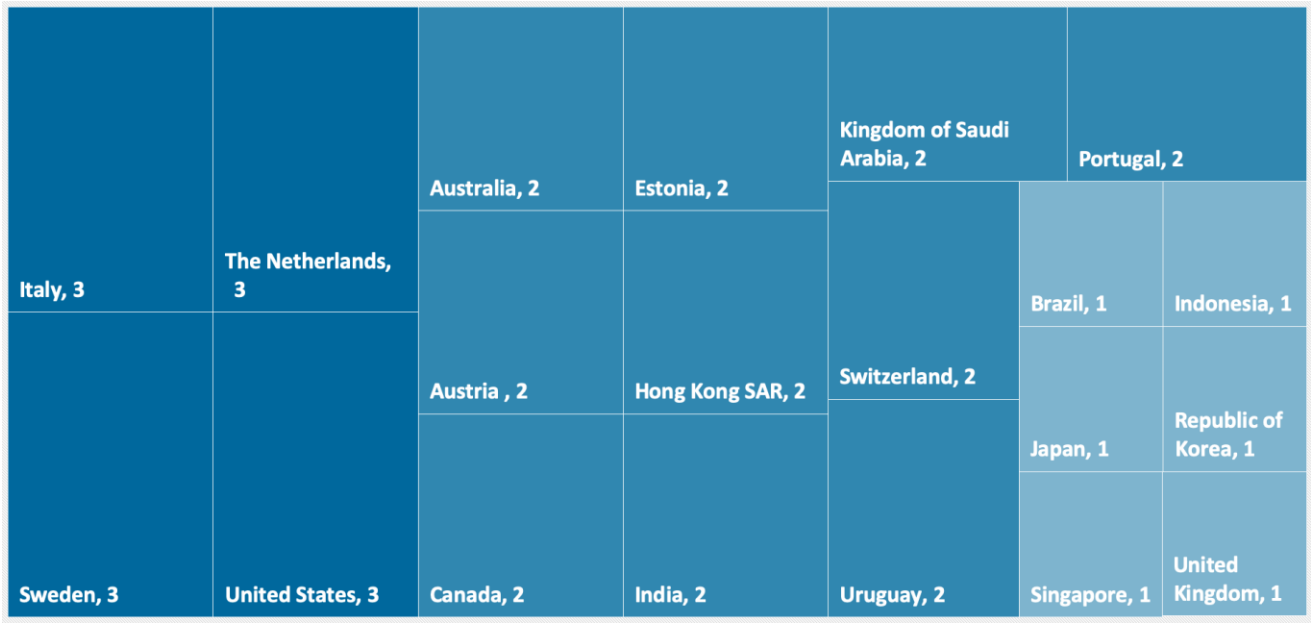


Figure 3: Barrier 2 treemap

Poor usability had a high degree of agreement among respondents (a low standard deviation). All respondents said it was a barrier. Poor usability was the first and most general among four questions about usability. It asked about the significance of the barrier of poor usability and negative impact on providers' workflows. For example, users complain that using interoperability functions are confusing, disruptive or take too much time. There are two main aspects to this barrier: poor or fragmented system design in EHRs and other health IT systems, and user attitudes and perceptions.

Poor or Fragmented System Design

"Bad" user interface (UI) design, is not necessarily the issue that leads to poor usability; sometimes this is a broader cross-system problem. Both the United States and the Kingdom of Saudi Arabia stated that interoperability sometimes requires using different applications or modules with different user interfaces from each other; even if each UI is good by itself, the aggregate UIs can be inconsistent, confusing and negative in their impact. Estonia pointed out that market fragmentation leads to many systems which may be interoperable but have different UIs. Likewise, Portugal noted "the experience still suffers from fragmentation due to the need to log on to different applications which communicate with each other in not very transparent mechanisms." Uruguay has a national strategy called "Historia Clínica Electrónica Nacional (HCEN)", which allows each healthcare provider, both public and private, to have its own information system (HIS) connected to the national platform. The HIS is the choice of the healthcare provider, whether from a vendor or in-house developer, that determines that their UIs are designed for their particular and business workflows. Australia provides a My Health Record system to all Australians unless they opt out; it contains a broad range of CDA document types accessible to patients and providers. Canada summed up the situation: "This [poor usability] is increasing as interoperability creates the onus on system providers to adapt clinical practice to enable 'just in time' interoperable workflows.

Digitising paper practice without thought to user experience has resulted in time-consuming and unfriendly user interfaces."

User Attitudes and Perceptions

Regarding non-system factors, Austria said that there is a legal uncertainty "related to the accountability of physicians in light of the sudden availability of much more clinical information, which the physician is supposed to read, but most times can't due to time constraints." Uruguay noted general resistance to change among professionals. The impact may be unevenly distributed among providers depending on size and care setting. Switzerland said that "especially the general practitioners complain that using interoperability functions would take too much time." India listed fear as a perception: "overburdening of doctors with data entry is considered to be a big fear in the community with respect to the digital health landscape." The Republic of Korea pointed out that semantic interoperability requires accurate coding of structured concepts on the part of the originating/sending provider, which results in less time for patient care, but they do not receive direct benefit for spending that extra time; it helps the next providers who receive the data. In the United Kingdom, users accentuated the positive by acknowledging that "information being available is a major step forward, and the next step will be to understand how to display this information in the most effective way."

Solutions to the Usability Barrier

Several solutions to the usability barrier were offered. Hong Kong SAR reported that usability was partially addressed because "frontline users were involved in the design of the system," which is a national EHR Sharing System (eHRSS). Similarly, the Netherlands stated that "government and providers have co-created a set of interpretations, best practices and Q&As that has been very constructive in educating and engaging the health care professionals. This set is being translated into English and can be shared with the GDHP members." The Netherlands is also building Health and Care Information Models (HCIM), a library of reusable common clinical concepts that promote common understanding, to counteract fragmentation and inconsistency. Brazil explained that flexibility of software applications "to allow many different streams without losing essential information" made usability only a minor barrier. Portugal is trying to mitigate this issue through a single authentication and authorisation application to provide a "one stop shop where healthcare professionals can login in their ecosystem and also manage all the permissions and authorizations used by other applications." For its population, Uruguay provides on the website of the Ministry of Health, an application "MiHCD" that "unifies the patient's clinical information, regardless of the healthcare provider, in a single portal, maintaining its custody in the health facilities that originated the data."

In summary, actual usability problems in IT systems plus the perception of negative impact when familiar work patterns were disrupted, plus the shortage of solutions thus far, all combine to push "poor usability" very high among the cited barriers.

4.1.4. Barrier 3: Difficulty managing coordinated collective action among multiple organisations

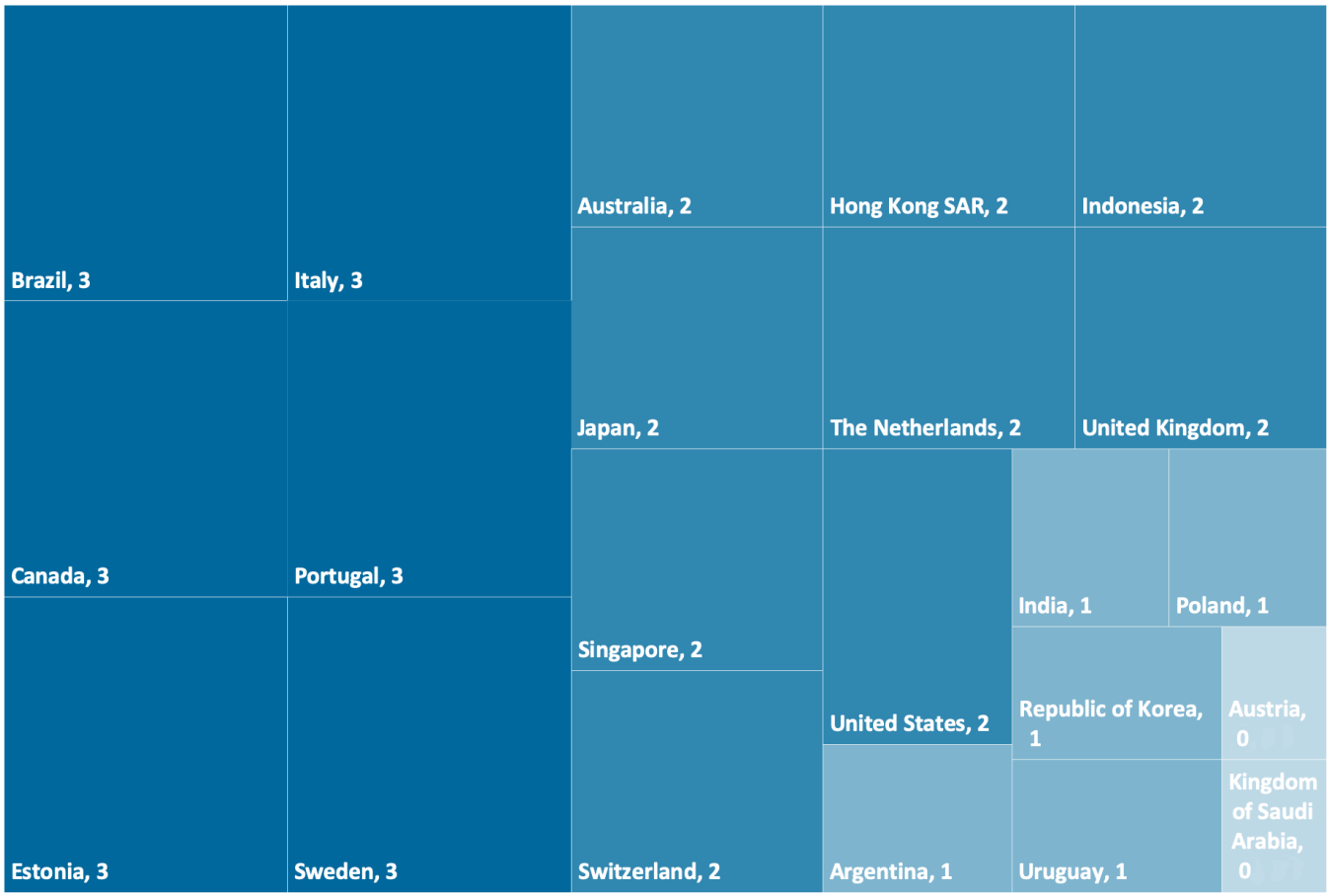


Figure 4: Barrier 3 (Tied) treemap

Even if all technical and standards issues are solved, implementing interoperability can be complex because it involves coordination among multiple entities without a single decision-making entity who can make them all work together or proceed at the same speed.

Effective interoperability requires all participants to agree upon certain rules and policies in order to exchange information, and it costs time and money to reach and implement agreements. The Netherlands has a "consensus culture" that gathers government, payers, providers, patients and professionals to set the course together, resulting in "many projects, programs and collective activity, but results that have meaningful impact for patients' experience and quality vary." The United States itemised several areas where common agreements are needed, and decisions must be made for each participant in data exchange regarding: transaction types, purposes (acceptable uses), transport standards, format standards, vocabulary standards, patient access, security levels, patient matching and consequences for violating the rules.

Portugal emphasised that, as complex as it is to manage within a country, it is even harder across borders: "Previous experiences with lack of consensus among countries has led to defining very small work items to submit to very bureaucratic and time-consuming

change management processes, which means small steps towards interoperability taking a very long time."

One reason for the difficulty is a "mismatch in value – the organisation that is being asked to share information is not getting the most benefit" according to Canada.

Even though many GDHP participants mentioned there is difficulty in managing and coordinating collective action for interoperability, there are some countries for whom this is a not major barrier. Austria has overcome this barrier because "a collaborative approach was taken to prevent it: all three key stakeholders of the Austrian Healthcare System (Federation, Provinces, Social Insurance) are owners (and drivers) of the eHealth Infrastructure, thus there is a lot of intrinsic motivation to positively manage a coordinated collective action." In the United Kingdom, National Health Service User Experience (NHSX[3]) within England is tasked with coordinating across multiple organisations. And Poland feels that this is a minor barrier because "regulation is central and legislative, therefore binding to all stakeholders in the health sector." Switzerland notes that its inpatient institutions are obliged to take part in the system, but that outpatient institutions like general practitioners are not. In that case, coordination is only partial.

In summary, interoperability is inherently more complex than many other health or IT activities because of the multiple entities that must reach agreements. Legislation and collaborative approaches, uniting around the common good, have proven successful in some instances.

[3] NHSX brings teams from the Department of Health and Social Care, NHS (National Health Service) England and NHS Improvement together into one unit to drive digital transformation and lead policy, implementation and change. https://www.nhsx.nhs.uk/who-we-are

4.1.5. Barrier 4: Increasing costs due to interoperability that entities cannot afford

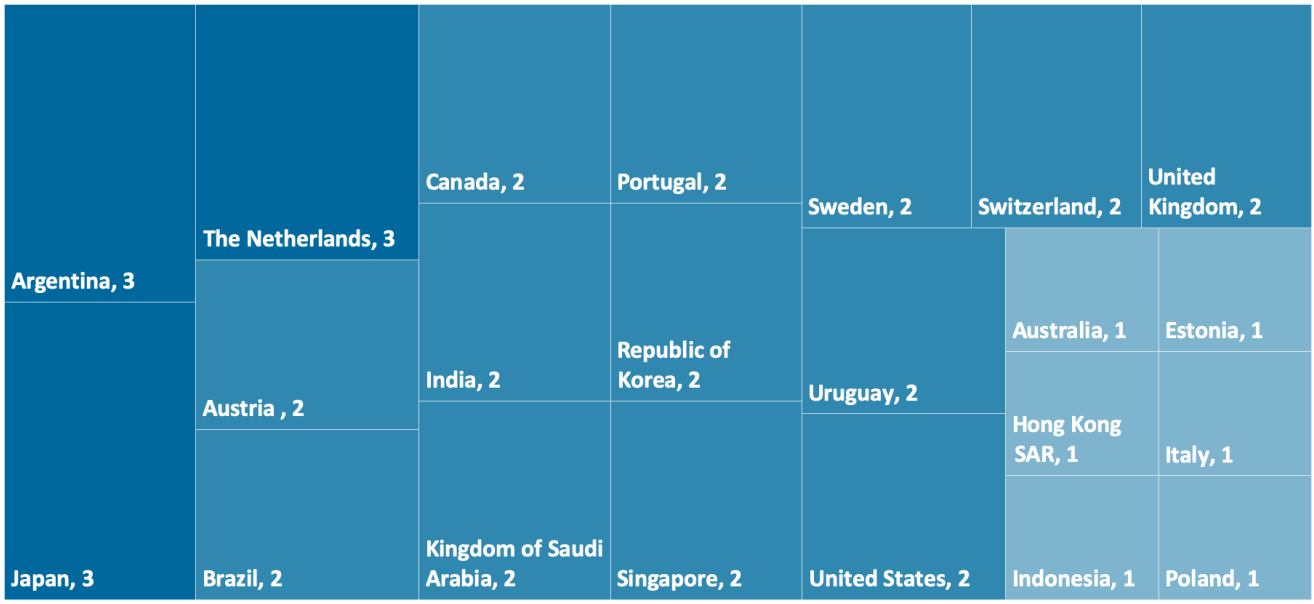


Figure 5: Barrier 4 (Tied) treemap

The increased cost barrier had high agreement among countries. Cost is a barrier to interoperability for nearly every GDHP respondent. Some comments emphasised increased direct or indirect costs of interoperability, whereas others emphasised a perceived lack of benefits.

The Republic of Korea said, "the implementation cost of standard specifications is higher for hospitals when we compare it to the conventional way, for instance, for the referral case, hospitals still can make hard copy of documents or CDs." The United Kingdom noted that suppliers charge extra to support interoperability initiatives, sometimes multiple times across organisations; these charges were a surprise to some of those organisations. Uruguay further noted "There are no economic benefits for exchange of information" within their country. Creating content and consuming content takes time (compared to not doing either), and payments are generally not higher whether or not someone exchanges data. Costs are direct and indirect. As Canada stated: "Often the long-term sustainability is not considered – cost to update APIs, maintain testing environments – many interfaces become obsolete." Portugal added that direct costs such as new software to comply with GDPR[4] security controls, cost of SNOMED CT licence, and conformance testing and certification all raise expenses. The United States and Portugal also noted indirect costs such as retraining and lost productivity. As with other barriers, the impact is unevenly distributed across the healthcare landscape: the Kingdom of Saudi Arabia and the United States singled out "small private health providers and small local vendors" as most likely to face this challenge and Austria mentioned that objections based on cost were especially used by "community care providers (GPs)."

Hong Kong SAR has lessened the economic impact because the government has developed clinical software that is free to all providers. The Netherlands acknowledged

[4] GDPR is the General Data Protection Regulation of the European Union (EU), governing processing of personal data relating to individuals in the EU.

that “In the current fee-for-service model this [increased cost] is a big issue” but their government “is investing almost half a billion Euro in supporting providers, professionals and patients in freeing up the data and digitally exchanging it using standards.”

In summary, many countries recognise the cost barrier for providers and have offered economic incentives to try to offset that cost. See the related barrier about economic incentives, below.

4.1.6. Barrier 5: Lack of universal adoption of standards-based EHR

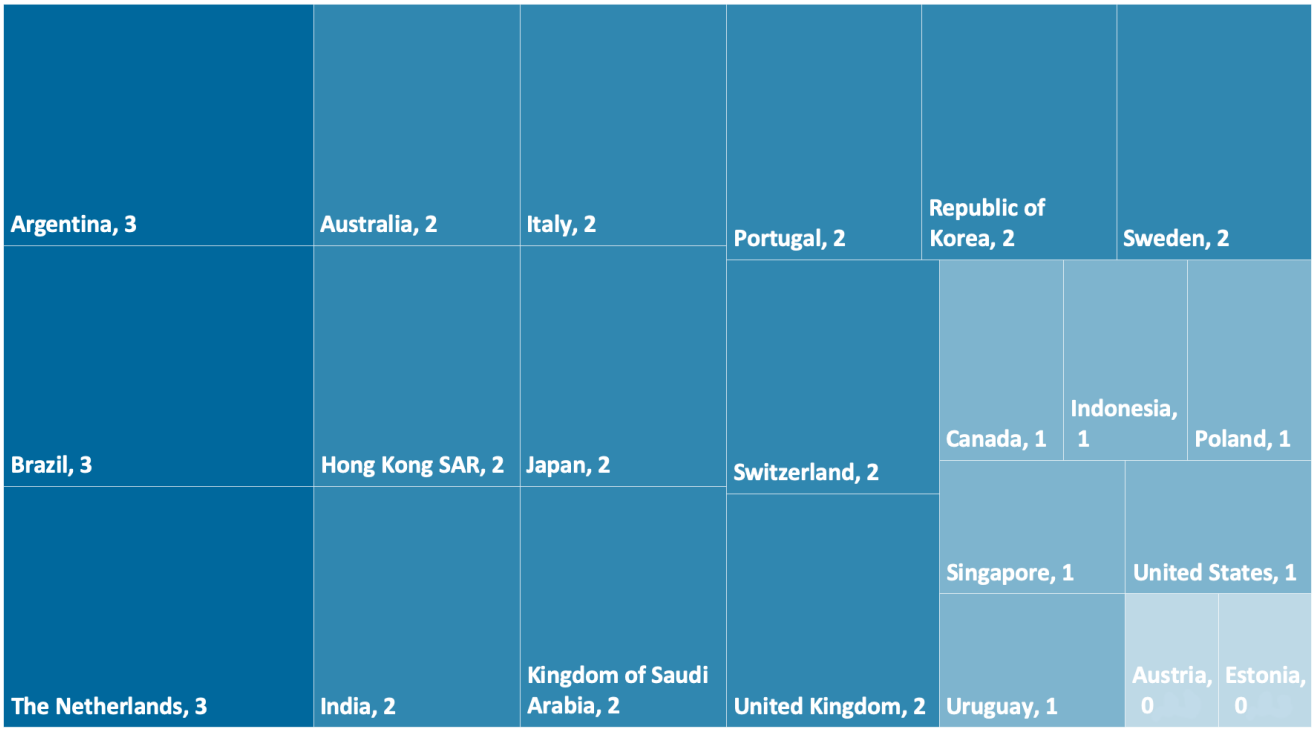


Figure 6: Barrier 5 treemap

While every GDHP country and territory has EHRs, many experience a barrier when the EHRs or other health IT software do not support interoperability standards. Sometimes, even when standards-based EHRs are required by legislation, entities may not fully use them, may not implement them in a standardised consistent manner or may struggle to stay up-to-date on the latest versions. A common theme of the survey responses was that the legacy of installed non-standardised EHRs requires a lot of effort to retrofit to become interoperable.

In the Netherlands, “even though almost all healthcare providers have EHRs, many are tailor-made, work with their own dialect of standards and can’t even exchange data within the same organisation.” Portugal noted that while there is now “a culture and a demand for standardised interoperability … usually legacy EHRs are not developed with interoperability in mind, but changes are being noticed in fresh new ones.” In Switzerland, “many software providers have not yet adopted the standards that are defined in the national electronic patient record.”

In the United States, even though most hospitals and office-based physicians use certified EHRs, there is "a gap between certified capabilities of the EHR and actual implementation of interoperability in the field, especially among smaller practices and among patients, and therefore the full goals of interoperability have not yet been achieved." In India, specific standards were prescribed beginning in 2016, but "different healthcare establishments might be using varied standards and they will have to shift to prescribed standards … For smaller facilities taking their first steps towards digitisation, some cost might be involved and the government is exploring measures to ensure a smooth transition." In the Republic of Korea, only 12 per cent of providers are participating in the national health information exchange. Sweden has "few requirements for using specific standards on a national level for exchanging information, which leads to standards being implemented in different ways. The use of standards is not comprehensive, and some standards are used very specifically in limited applications."

Austria reduced this from a major barrier to no barrier by requiring all software systems "to be updated by this functionality when the stakeholder connected to ELGA." Poland plans to make standards-based EHRs mandatory by 2021. In contrast, in Hong Kong SAR, "although government has provided free software which adopted eHRSS standards to healthcare providers, the installation rate is still low." In Italy, variations in rules among 21 independent regions prevent interoperability between EHRs.

In summary, it is difficult to quickly replace existing systems. Clinical practice already depends on existing software, for better or worse, and changes (whether upgrades or system replacements) require much planning, coordination and caution, to avoid disruption of patient care or other unintended consequences. Nevertheless, the installed base of EHRs is gradually conforming with interoperability standards. For example, the percentage of office-based physicians adopting certified EHRs in the United States has more than doubled within 10 years to 80 per cent as of 2017.

4.1.7. Barrier 6: Economic incentives do not encourage data exchange

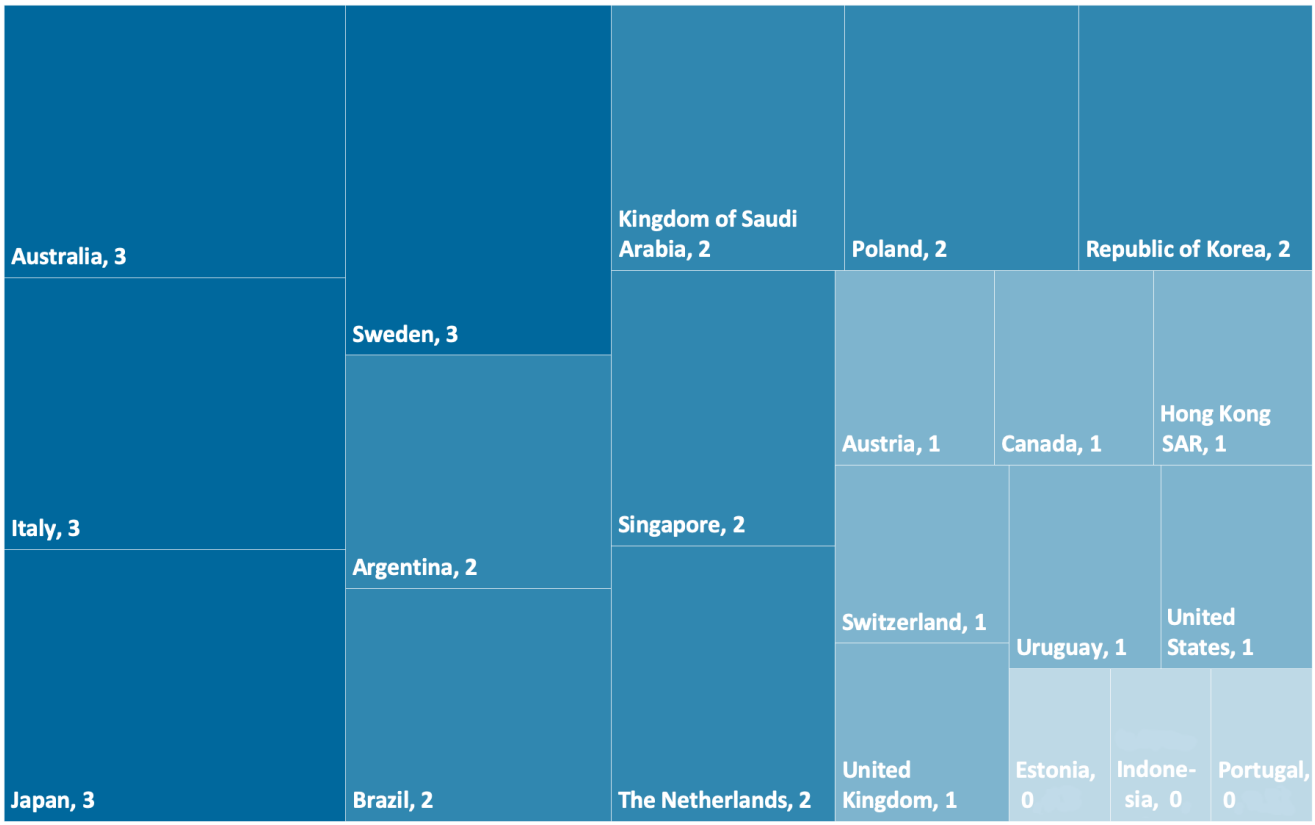


Figure 7: Barrier 6 treemap

The survey question noted it was not limited to government-provided incentives for using EHRs or exchanging data, but allowed respondents to explain how economics affected decisions: "For example, if providers are paid more money for doing repetitive work (such as collecting data or performing tests again), they lack incentive to exchange data that might prevent the repetitive work." Responses to this barrier focused either on government-supplied incentives, or economic disincentives of the current system.

The Republic of Korea said: "Financial incentive is provided for each case of information exchange, but the level of incentive is not adequate because providers are paid more when they do the repetitive tests based on a fee-for-service payment system."

Disincentives

Disincentives were often the by-products of the fee-for-service economics of the market system. The Netherlands highlighted the disincentive to be efficient when they said: "As with any fee-for-service model, this is the case in the Netherlands as well."

Governmental positive incentives for interoperability may be insufficient to overcome disincentives. Furthermore, the Republic of Korea providers complain that they lack time for patient care since "it takes too much time and effort to input the medical record accurately using required specifications." In Australia, "the classifications systems used to fund the healthcare system … do not align with desirable clinical terminologies." The situation is similar in the United States. Funding systems in Australia are largely activity-based and highly transactional, which does not support or require patients to be

considered holistically." Poland said that "eliminating economic incentives from market operations is a challenge and requires a lot of resources at each stage of a given e-service (from development to launching)." There may be initial negative perceptions to overcome: according to Switzerland, "many providers first see the time and money they have to invest to be part of the national electronic patient record (EPR) and not the benefits they can expect."

Positive Incentives

Some countries have found strong ways to encourage interoperability positively through legislation and/or payment (and to penalise the lack of interoperability).

The Kingdom of Saudi Arabia said: "For private health providers, claims will not be accepted unless they follow the standards and pass through the health information exchange (HIE) platform." Similarly, Brazil said that "in our country the exchange is legally required and may impact suspension of payments." For Austria, the barrier "has been diminished by the legal framework related to ELGA, which requires participants to share their data." However, incentives sometimes only affect part of the healthcare system. This is true in Argentina where "there are some incentives in the public system, no incentives in the private system." In Sweden, "investments are made in this area, but because of municipal autonomy they are not coordinated nationally." And Canada said that "increasing economic incentives are not sufficient as there is awareness of the other issues – regional variability, sustainability, market size etc."

The United States has nationwide financial incentives and penalties to enforce interoperability policy. As a result, "the number of providers exchanging data has been increased greatly, stimulated (since 2011) by government health IT incentive programs that financially reward providers for adopting interoperable standards-based certified EHRs and using them to exchange information with other providers, public health, and patients." Uruguay provided economic incentive by assuming "the cost of designing and maintaining a national platform for the interoperability of the sector, as well as the delivery of libraries, components and software devices as tools to facilitate the adoption of the exchange of clinical information."

4.1.8. Additional observations on barriers

Barriers in the next tier down are briefly described below, in the order of their ranking.

1. Interoperable data are not available at the point-of-care, when needed most. For example, at the time a patient sees the current provider, the information has not yet been received from the previous provider.
2. Complex privacy and security challenges associated with data exchange. For example, it may be difficult to manage levels of user authorisation and permission across organisations, or to keep mental health information separate from other health data if required by law.
3. Inconsistent implementation or constraints on standards (lack of profiling). "Profiling" means applying constraints on a standard (e.g. which data elements are required, or which code systems are used for each data element) that all organisations agree upon, so that the exchanged information is clearly understood and used by all.
4. Difficulty understanding what was meant by other providers, sometimes due to lack of standardised terminology. "Understanding" means more than a person's ability to

view and comprehend the exchanged data, but that software can understand the data's meaning and process it in a standardised way, such as for clinical decision support. While it was listed as a distinct barrier, this was clearly related to a top barrier, "Lack of EHR capability to take action on exchanged data."

5. Difficulty identifying and communicating with other entities. This includes difficulty finding electronic addresses to connect to specific entities. For example, this may be because a national provider directory or unique provider identifiers are lacking.
6. Unclear definition of the use cases and low end-user engagement and consultation. Some countries regarded this as two separate issues, but it was a single question. Insufficient engagement with both individuals and clinicians were cited.
7. For the remaining barriers in the survey, with scores ranging from 1.32 down to 0.59, see Appendix A. Their relatively low scores meant that they are a minor-to-no barrier for most respondents. Although previous studies showed that all barriers in the survey were significant in some countries, the following can be designated as least important for GDHP participants, and not issues that need to be addressed by GDHP:
    - Lack of infrastructure for secure transmission to another facility. No country or territory ranked this above being a minor barrier.
    - Two or more incompatible versions of a standard are used (although 1 country ranked it as major, 16 ranked is as minor or no barrier).
    - Legislation is subject to interpretation and the lack of clarity blocks interoperability implementation (note: 3 countries ranked it as a major barrier).
    - Existing standards are inadequate for the desired purposes (although 1 country ranked it as a major barrier, 17 ranked it as minor or no barrier).

4.1.9. Additional major barriers cited

We acknowledge additional barriers not enumerated in the survey that were volunteered by respondents as major barriers.

- The Netherlands cited a "market failure in interoperability: for many years 'the industry' was supposed and expected to solve the interoperability problem." Since the government has no procurement power to force use of standards, there is "vendor lock-in and data lock-in" and too much dependency on too few vendors … Not only vendors/industry are at fault: everyone involved is to blame for letting this situation exist for too long." They imply that government should take a stronger role in driving the industry, since the industry is not driving itself toward interoperability.
- Canada said that patient control of their health data is not driving interoperability – there is still a lot of "lip service" in that "clinicians are not ready to truly share control of health data with the patients." This seems related to Canada's comment about the information-blocking barrier: "often invoking privacy/security concerns, data custodians are concerned about implications of sharing clinical data."
- The Netherlands pointed to [lack of] "knowledge, skillset and experience in the boardroom and for healthcare providers. Technology is not the problem, nor is lack of vision or strategy. It is the ability to translate these into working solutions that scale through the country that is the problem in NL. This requires new knowledge and skills where the change is most impactful: at the professional level, as it is their work that changes (for the better!), and in

boardrooms as they have to scale." They mean that more executive support is needed to ensure interoperability at scale (widespread adoption).

4.1.10. Areas of least and most variability

The standard deviation of responses was calculated. The lower the standard deviation, the more consistency (agreement) among the responses. The highest degrees of agreement were that increased costs and poor usability are moderate-to-major barriers, and that lack of Infrastructure for secure transmission is a low-to-non-existent barrier.

The area with highest variability (most disagreement) was regulations or variations in regulations increasing burden and making interoperability difficult. This is not surprising since regulations are cultural more than technical, and can differ greatly between countries. The area with the second highest variability was that exchanged data misses what providers need.

4.2. SOLUTIONS TO BARRIERS

GDHP participants were generous in offering to share their solutions and positive experiences with other participants. Solutions to address specific barriers are discussed above within the individual sections on each barrier. A summary of non-barrier-specific solutions is given below, listed alphabetically by country. Some solutions are based on industry standards and may be transferable technically. Other solutions may not be transferable because they are locale-specific but still may be conceptually helpful.

- Argentina has a national definition of standards and federated infrastructure with decentralised repositories and indexes. The system also enforces the use of national identifiers and interoperability standards.
- Australia "is currently developing a National Health Interoperability Roadmap which will seek to address the barriers identified in this survey. Australia also participates in national and international standards development processes associated with clinical informatics and terminologies."
- Austria established a nationwide eHealth infrastructure connecting all Austrian healthcare providers and its access is strictly integrated into the edge systems. It overcame most barriers through regulations, incentives, commitment to IHE profiles since 2007, and content harmonisation "so that the content is complete and useful and can be parsed by all participants."
- Canada set-up a national drug directory (CCDD), national FHIR registry free for users, and a national terminology gateway (for pan-Canadian as well as regional Canada content).
- Estonia has had a national EHR running for 10 years, national standards, and a national "x-road" platform for health information exchange.
- India has established a "centre of excellence for EHR standards … to accelerate and promote adoption of EHR standards in India and provide assistance in developing, implementing and using EHR standards across the country." They have also recently finalised "a National Digital Health Blueprint (NDHB) proposing a federated architecture, which will allow the creation of this ecosystem to integrate all digital health applications with each other and to create longitudinal health records for patients."

- Indonesia has a program "Data Quality Self-Assessment using the WHO Data Quality Tools" and they use a "DHIS2 [District Health Information Software 2] platform to monitor and then improve the data quality."
- The Kingdom of Saudi Arabia said they had overcome many barriers through: centralised regulations, a national patient identifier, a centralised "Unified Health Record," national decisions on standards including Integrating the Healthcare Enterprise (IHE) profiles and standard terminologies, a published opt-in policy for patients, and requiring claims to follow standards and pass through the HIE [health information exchange] platform in order to be accepted.
- Poland says, "Data sharing will be mandatory as of January 1st, 2021. Standards are set centrally, eliminating variability. Almost all entities are connected. Patient ownership of data eliminates information blocking. Patient consent procedures are clear and well implemented."
- Portugal offered a specific solution to information sharing between e-Prescribing and EHRs: "We have a centralised e-Prescription system used by all medical doctors. Apart from this, there's the usual EHR system that doctors use in their points-of-care in primary care units. This EHR system makes available the SOAP [Subjective, Objective, Assessment, Plan] note, which integrated in the 'P' part the prescribed treatment plan. When preparing the 'P' part of the SOAP note, doctors had to use the e-Prescription system to prescribe medicines and this information should be instantly displayed in their EHR system to allow them to finish the appointment and save the patient record." An HL7 FHIR notification model facilitated the integration."
- The Republic of Korea stated that a national HIE exists based on IHE XDS and HL7 CDA, and that they have a unique national provider ID and patient ID.
- Switzerland described an Electronic Patient Record solution in progress: "a national law sets the rules and standards that guarantee a nationwide integration. This law not only describes the organisational policies and regulations but also the whole architecture and technical standards that have to be used. So there is not much room for interpretation." This will use IHE Profiles (XDS), Digital Imaging and Communications in Medicine (DICOM), CDA, FHIR (future), SNOMED CT and Logical Observation Identifiers Names and Codes (LOINC). This is a prospective solution, but not implemented yet.
- The Netherlands offered the following solutions:
    - Patient access and use of personal health data: MedMij is a program governed by a national coalition led by the patient federation (representing 150+ patient organisations) with payers (private health insurers), providers (academic and general hospitals, clinics, home care organisations), professionals (medical specialists, nurses, pharmacists, general practitioners) and government (local and national). "This program creates a national trust framework for safely and securely collecting, storing, exchanging and sharing personal health data with patients, citizens, and consumers. It identifies two roles: a patient-service-provider and a professional-service-provider. Each is responsible for the safe and trusted communication between the MedMij certified service providers and patients on one end and professionals on the other. For this, it has created a set of standards to exchange personal health data from professional systems to patient-facing apps and services, using standardised open APIs [application programming interfaces] based on FHIR profiles."
    - Consensus governance through a multi-stakeholder national council: The Netherlands has a decentralised, fully privately executed and publicly funded healthcare system with no central health data exchange

infrastructure. “This means that we needed to create governance that fits our consensus-building culture. Therefore, we created the National Health Information Council. The Ministry of Health chairs this council, with members representing the major stakeholders in health care: private health insurers, patients, academic and general hospitals, medical specialists, nurses, general practitioners, pharmacists, physiotherapists (for all paramedical care), long-term care, mental health care, disabled care and local government. This council meets at least five times a year and sets the common goals and course of the Dutch health information ecosystem.”

- The United Kingdom has developed resources to support interoperability which it would be happy to contribute, including:
    - Interoperability survey to understand the capability and uptake of interoperability solutions.
    - Core information set, a data model to represent components of care, aimed at both clinical and technical audiences.
    - Interoperability specifications including messaging specifications and terminology content for discharges from inpatient care, accident and emergency departments and mental health; outpatient letters; demographic services; pathology messaging and universal test catalogue.
    - National systems and services that support interoperability, including: Summary Care Record application; National Record Locator which manages pointers to records and supports retrieval; National Event Management Service to support event-based notification of updates from national and local systems; Electronic Prescribing System used across all primary care for prescribing and dispensing of medications; Electronic Referral Service; Data Processing Service; NHS Login to link citizen identity to their medical records which can be trusted by applications, and NHS Identity, a national solution to verify the identity of care professionals.
- The United States also offered several solutions which it thought could be applicable in other countries, especially those without nationally-operated healthcare systems.
    - National Guidance on Standards Suitable for Interoperability Needs. The federal government publishes and continually updates the ONC Interoperability Standards Advisory, which names specific standards and implementation specifications (e.g. Profiles) for many interoperability needs.
    - Core Data Set for Interoperability. The Common Clinical Data Set (CCDS) was required for EHR certification starting in 2015, and this is evolving into the first version of the US Core Data for Interoperability (USCDI) data set defined by ONC through regulation in 2020.
    - Reduction of Variability and Version Incompatibility. Because base standards are flexible and subject to much variability, implementation specifications, also known as Implementation Guides, (HL7) Profiles, (FHIR) and Integration Profiles (IHE) are specified in regulations to constrain the cardinality and optionality of data elements and extensions, to ensure interoperability requiring less negotiation among exchange partners.
    - Record Location and Connectivity. Several voluntary organisations, Commonwell Health Alliance, Carequality (for query exchanges) and

DirectTrust (for push exchanges), have accelerated progress through networks, services, certification, and technical and policy frameworks, to help providers exchange data on a national scale across multiple vendors and regions (states).

- **Uruguay** also provides solutions which could be applied to other country contexts.
    - **National HCEN platform**. Uruguay created the national HCEN platform which is based on based on a national definition of standards and governance of a national index and patient identification, backed by a federated infrastructure with decentralized data repositories. Their foundation uses national identifiers and interoperability standards. Its health information exchange is based on the IHE XDS profile and HL7 CDA documents along with a national master patient index
    - **Patient access for the use and control of personal health data.** MiHCD is a state portal, designed in conjunction with the community of practice, academia, patient organisations and healthcare providers (private and public). This portal creates equal access for all patients to their clinical information and a national trust framework for the unification of clinical information. In the portal, it is possible to change the access policies (in Uruguay the voluntary exclusion is regulated) for the exchange of personal health data. Currently 92% of the population has access to their digital medical history through MiHCD.

4.3. PURPOSES FOR INTEROPERABILITY

Similar to the analysis of barriers, the structured survey of purposes was analysed statistically, giving a weighted priority score for each of the purposes enumerated in the survey, plus those added by respondents. The priority score for each purpose could be 0, 1, 2, or 3. The mean and standard deviation were calculated. The purposes are rank ordered from highest to lowest priority, and the top six purposes are identified as Tier 1 purposes similar to the analysis of barriers. Some respondents differentiated purposes of high priority that have not been accomplished versus those that have already (or mostly) been accomplished, to identify areas where there is more interest in pursuing GDHP projects.

Tier 1 Purposes:

1. *Transitions of care*
2. *Receiving laboratory and pathology reports and results*
3. *Receiving diagnostic imaging reports and results*
4. *Medication management*
5. *Electronic prescribing of medication*
6. *Patient access*

The responses did not yield much differentiation. In general, most respondents tended to rank most purposes “High” so there is not much spread in the scores. The averages range from 2.80 to 1.53, but all but one are 2.0 or above.

Table 2: Purposes for interoperability showing average scores and standard deviations

Country/Territory	Average Priority	Identifying patients accurately	Clinical ordering of diagnostic tests	E-Prescribing of medications	Clinical ordering of procedures	Receiving laboratory and pathology reports and results	Receiving diagnostic imaging reports and results	Medication management	Referral management	Transitions of care	Patient access	Public health registries and reporting
Argentina	2.73	3	3	3	2	3	3	2	3	3	2	3
Australia	2.18	3	2	2	0	3	3	3	2	3	2	1
Austria	2.55	3	1	3	1	3	3	3	3	3	3	2
Brazil	2.09	1	2	3	1	3	1	3	2	3	1	3
Canada	2.36	3	2	3	1	3	3	2	2	2	2	3
Estonia	2.82	3	3	3	3	3	3	2	3	3	3	2
Hong Kong SAR	2.91	3	3	3	3	3	3	2	3	3	3	3
India	2.82	3	3	3	2	3	3	2	3	3	3	3
Indonesia	2.30	2	3	2	3	2	2	2	3	2	2	
Italy	2.36	0	2	2	3	2	2	3	3	3	3	3
Japan	2.09	3	1	3	1	2	2	3	2	3	1	2
Kingdom of Saudi Arabia	2.73	3	3	3	0	3	3	3	3	3	3	3
The Netherlands	2.18	0	2	3	1	2	3	3	2	3	3	2
Poland	2.45	0	2	3	2	3	3	3	2	3	3	3

Country/Territory	Average Priority	Identifying patients accurately	Clinical ordering of diagnostic tests	E-Prescribing of medications	Clinical ordering of procedures	Receiving laboratory and pathology reports and results	Receiving diagnostic imaging reports and results	Medication management	Referral management	Transitions of care	Patient access	Public health registries and reporting
Portugal	2.00	1	1	3	2	3	2	1	2	3	3	1
Republic of Korea	1.64	0	0	0	0	3	3	3	3	3	2	1
Singapore	2.18	3	1	1	1	3	3	3	3	3	1	2
Sweden	1.91	0	2	0	2	2	2	3	2	2	3	3
Switzerland	2.18	3	2	2	1	3	2	3	2	2	3	1
United Kingdom	2.18	2	3	3	2	3	2	3	2	2	1	1
United States	2.36	3	3	3	1	2	2	3	2	3	3	1
Uruguay	2.00	3	1	3	1	2	3	0	0	3	3	3
Average	2.33	2.05	2.05	**2.42**	1.50	**2.68**	**2.55**	**2.47**	2.36	**2.77**	**2.41**	2.19
Std Deviation		1.26	0.88	0.94	0.94	0.47	0.58	0.78	0.71	0.42	0.78	0.85

Key: Green = areas of low variability; Red = areas of high variability; Grey = no response provided; Yellow = tier 1 purposes.

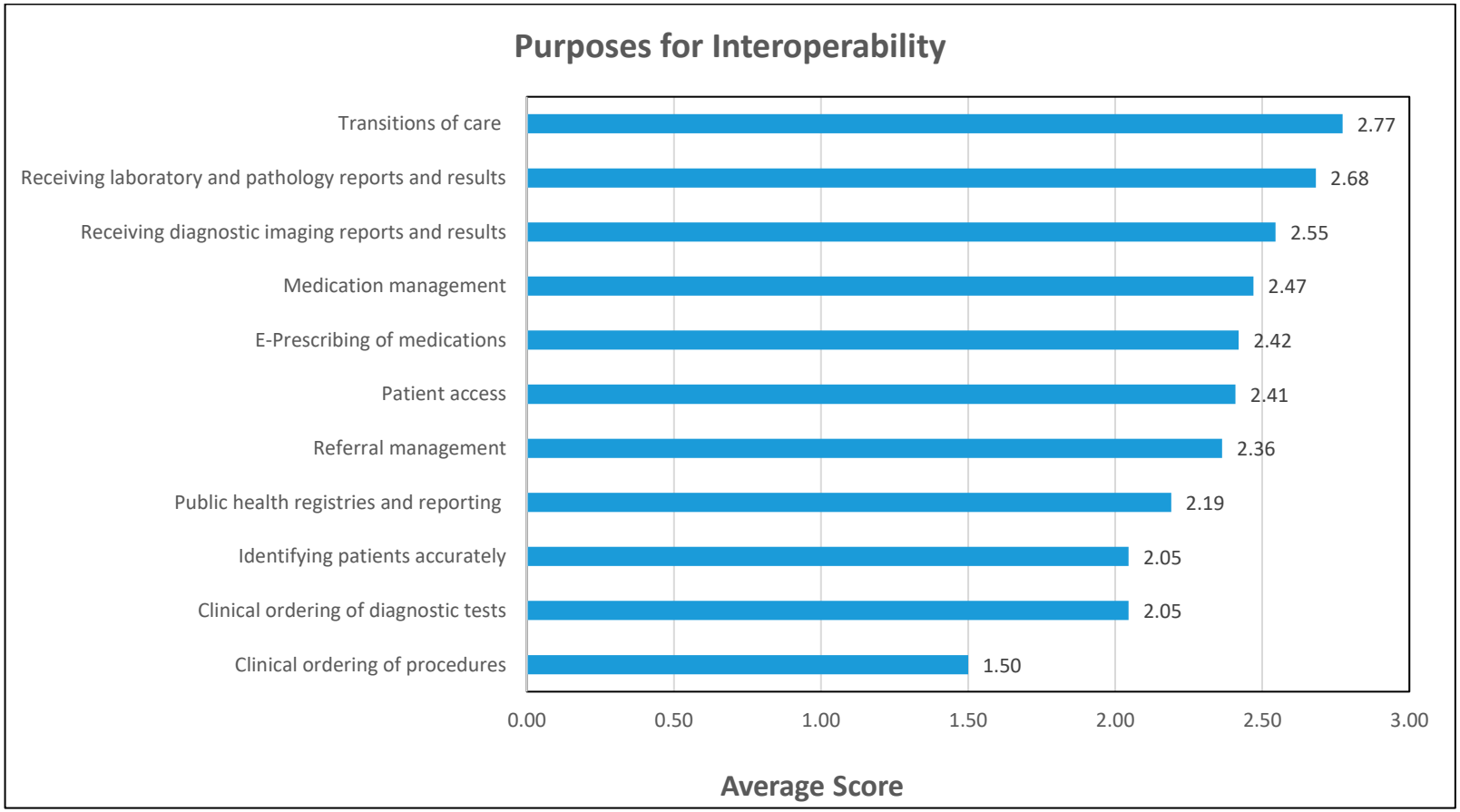
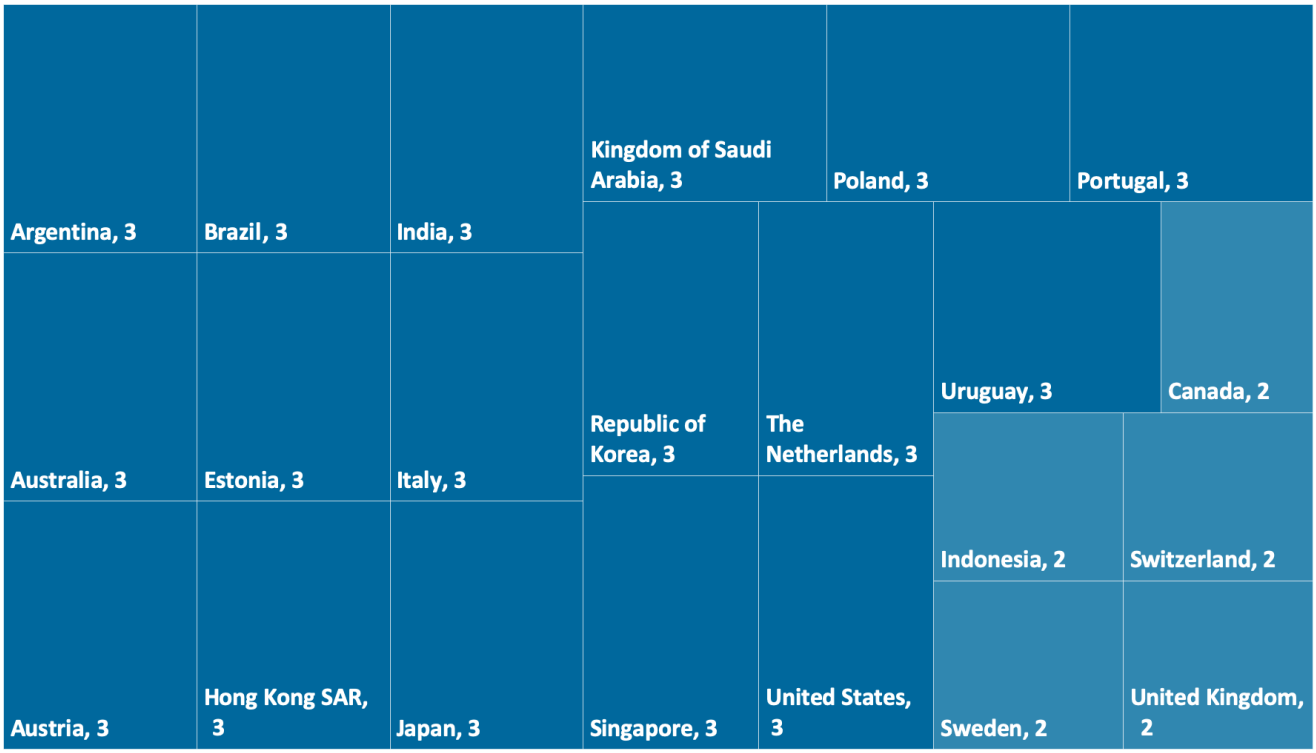


Figure 8: Purposes for interoperability, ranked by significance

The summarised comments focus mainly on the Tier 1 purposes. In addition to Tier 1, some noteworthy comments on other purposes are included, especially because there was not much range in the results, and 10 of the 11 purposes scored 2.00 or higher.

4.3.1. Purpose 1: Transitions of Care



The highest ranked purpose was transitions of care, the movement of a patient from one setting of care (hospital, ambulatory physician practice, long-term care, home health, rehabilitation facility) to another. Most respondents ranked transitions of care as a high priority, and none ranked transitions of care lower than medium priority. Transitions have the highest need for interoperability.

Transitions of care most often involves sharing a clinical document such as a discharge summary (Austria) in CDA format, at varying levels of structure (including embedded PDF). Because many countries and territories have not standardised on a fully structured CDA using standard terminologies, they experience the barrier of EHRs not being able to take action upon the data. Some countries share only partial transitions-of-care information. For example, Portugal shares allergies, chronic medications and vaccines. Portugal recommends alignment with the EHDSI Patient Summary. [5] In contrast, some countries like the United States require specific types of structured documents (such as Continuity of Care Document, Consultation Note, or Referral Note) which must contain a "common clinical data set" with a broad range of data including standard terminologies).

The United Kingdom is rolling out transfer-of-care messaging for discharges from inpatient care, mental health and emergency departments as well as outpatient letters,

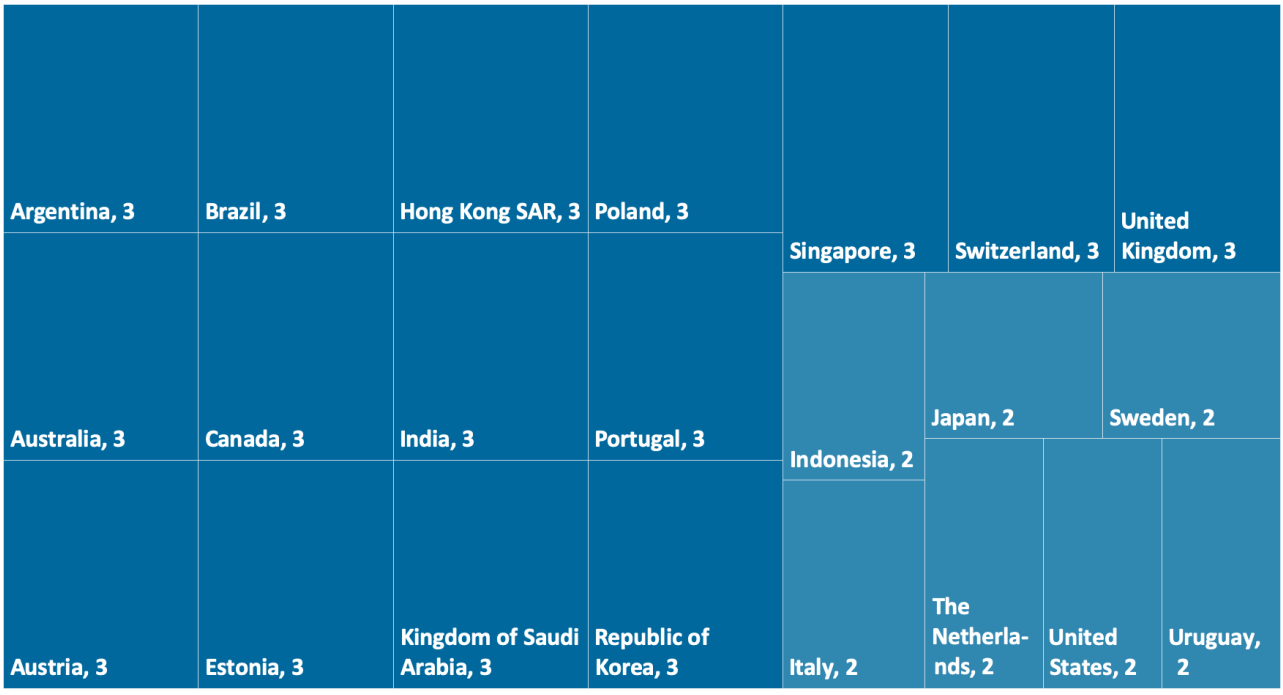
[5] eHealth Digital Service Infrastructure, the initial deployment and operation of services for cross-border health data exchange under the Connecting Europe Facility (CEF). https://ec.europa.eu/cefdigital/wiki/display/EHOPERATIONS/eHDSI+Mission

and are working on ambulance handover as well. They are also working to ensure that their unique NHS number is accessible across social care. Estonia was the only country to explicitly emphasise "ensuring continuity of care between health and social care.[6] Currently, this continuity is very dependent upon the particular doctor or patient and a more systematic approach is needed." Social determinants of health are increasingly being recognised in some countries, but they usually are a lower priority than clinical considerations.

While continuity of care for patients is implicitly the main motivator for this purpose, Poland said that transition-of-care summaries are a "vital element of continuity of care, essential for reducing overspending on procedures."

In summary, transitions of care represent the highest priority among all purposes, to improve continuity of care for patients and efficiency for providers. While most countries exchange clinical documents, the full potential is often not achieved due to the documents not being structured, lacking standard terminology or EHRs not being able to take action upon exchanged data.

4.3.2. Purpose 2: Receiving Laboratory and Pathology Reports and Results



This purpose involves receiving results (imaging, laboratory, pathology) to help in diagnosis and improve efficiency by helping avoid duplicate tests. Poland says that this provides "significant value added at the stage of diagnosing the patient."

[6] "Social care" includes community living support, housing assistance, transportation, financial aid or provision of a caretaker, food, etc.

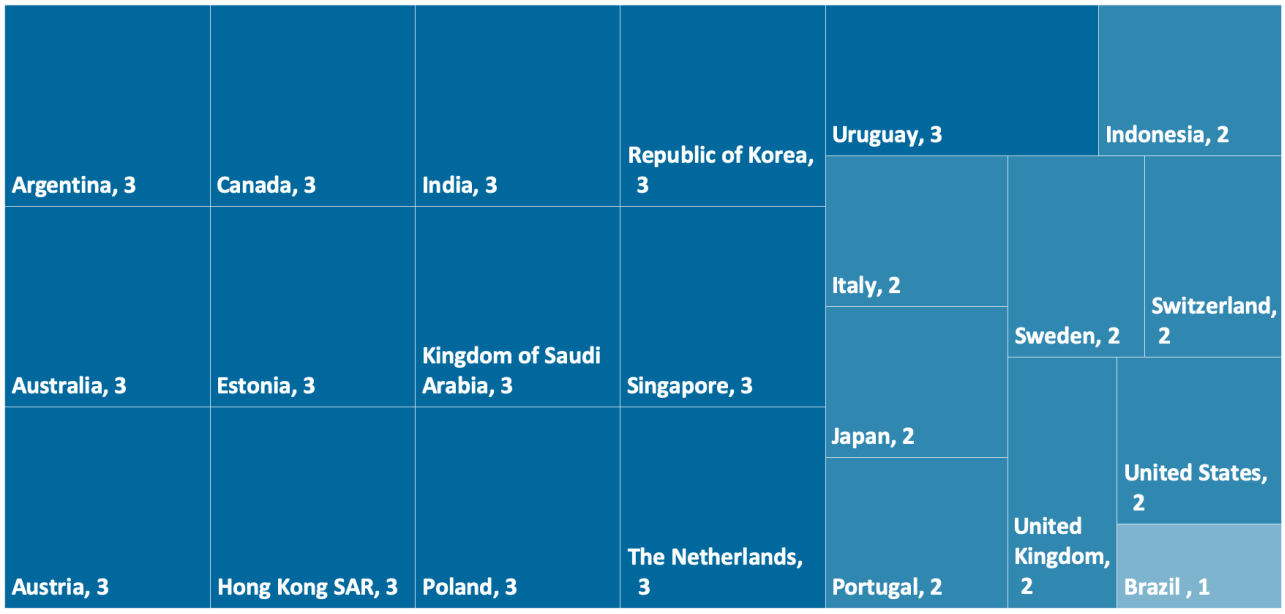
Most hospital users can receive results from tests performed within their organisation, but it is more challenging to receive results from facilities outside the provider organisation. For example, Italy says that results can only be received "in the same local health unit." Portugal recommends alignment with the European Commission's roadmap announcing a recommendation to set-up an electronic health record exchange format (EHRxF).

The purpose of receiving lab/pathology reports electronically is "for improving the workflow efficiency on the report/result part of that common ordering use-case" (Austria), and "important for record review and also closed loop result screening" (Hong Kong SAR). While the survey did not ask about the specific format of the results, the answers showed that some results were received as reports (e.g. HL7 CDA) and sometimes as HL7 v2.x messages.

Many respondents indicated that receiving lab/pathology reports has already been implemented to some degree. But there is still opportunity to do more. In the United States, receiving HL7 v2 laboratory messages from external labs is "already required for certification. Timeliness and opportunities for action on exchanged data (clinical decision support) are key goals." The United Kingdom is "looking at the creation of a unified test list" and "bringing together information for a single view point."

In summary, the benefits of receiving laboratory and pathology reports are clearly understood and mature standards exist. Unlike imaging results, many laboratory results are numeric with reference ranges, and could trigger actions if they are structured and codified in standard ways, but not otherwise. Lack of capability to take action on results is a subset of the top-ranked barrier identified in this white paper.

4.3.3. Purpose 3: Receiving Diagnostic Imaging Reports and Results



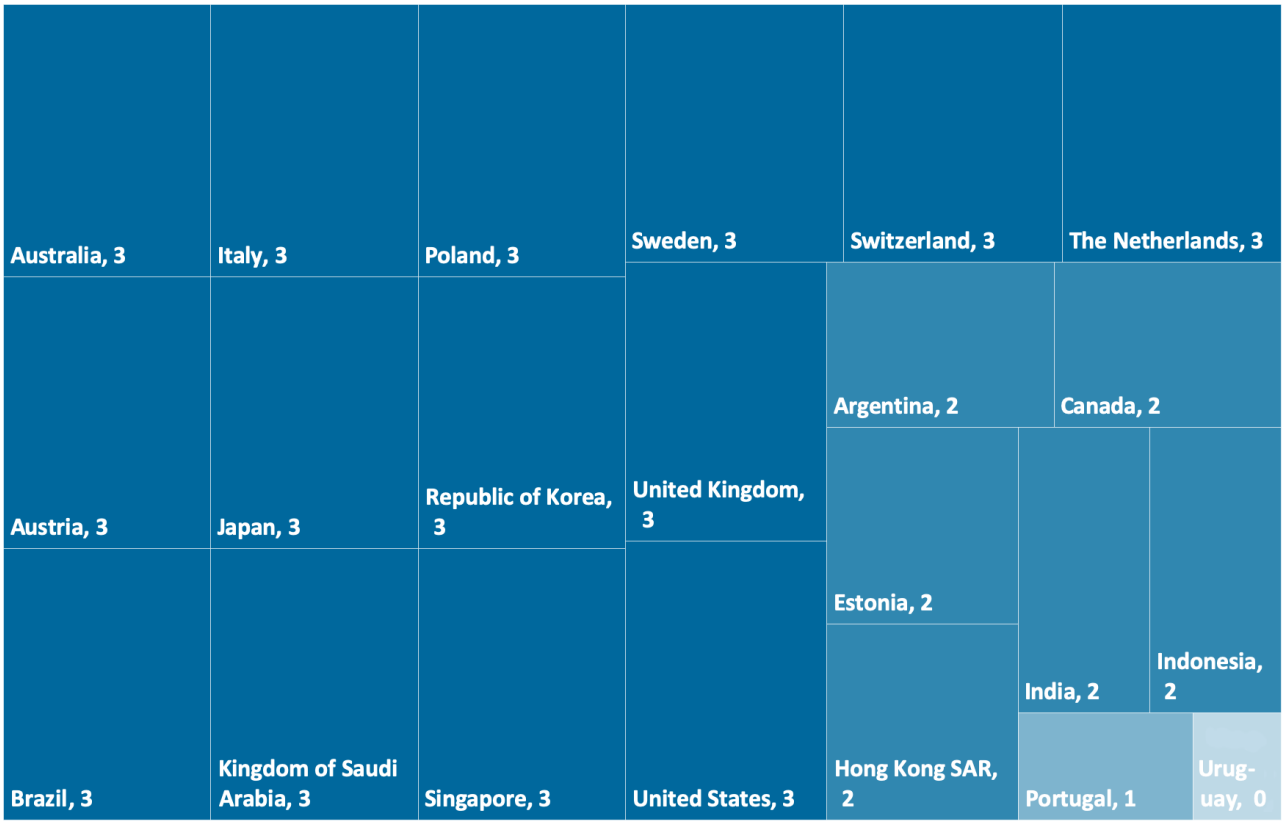
The benefit of receiving recent imaging reports is especially important given the higher impact on a patient (compared to laboratory tests) if an imaging procedure is unnecessarily repeated: increased radiation exposure, increased cost, and wasted time. Also, imaging reports, and images themselves, are less susceptible to the terminology barriers that can hinder other types of data exchange.

Canada points out that imaging, laboratory and pathology reports should be available to both clinicians and citizens (e.g. patients): while clinician access is largely complete, citizen access is a work-in-progress. In Estonia, receiving results is now well-established so that "it is hard to imagine life without it at this stage." Austria is already sharing radiology results reports, excluding the images themselves, with a goal of using structured CDA reports, though embedded PDFs are allowed for a transition phase. Similarly, the Republic of Korea exchanges imaging results using a CDA imaging report.

Australia added this caveat: "for many, access to the reports is insufficient. Access to the underlying images, either to view or download DICOM objects has been identified as a key priority." While the survey asked about receiving imaging reports rather than viewable images, most countries (18 out of 21) said they used DICOM standards, which enable sharing of images, but it is not clear whether DICOM is used for external interoperability or mainly within an organisation.

In summary, the benefits of receiving diagnostic imaging reports are clearly understood, mature standards exist, and terminology barriers are not daunting, so this purpose offers high reward and low risk for organisations who have not yet implemented it.

4.3.4. Purpose 4: Medication Management



Medication management includes managing and reconciling the history of medications ordered, dispensed and administered, to help maintain a current patient-centred medication list, which is critically important for patient safety. Electronic prescribing (e-Prescribing) can complement medication management to the extent that it facilitates a comprehensive view of a person's medications, and standardised medication terminology can enhance the value by enabling interaction checking and other clinical decision support. Australia said that medication management received "significant emphasis in the business case for national infrastructure."

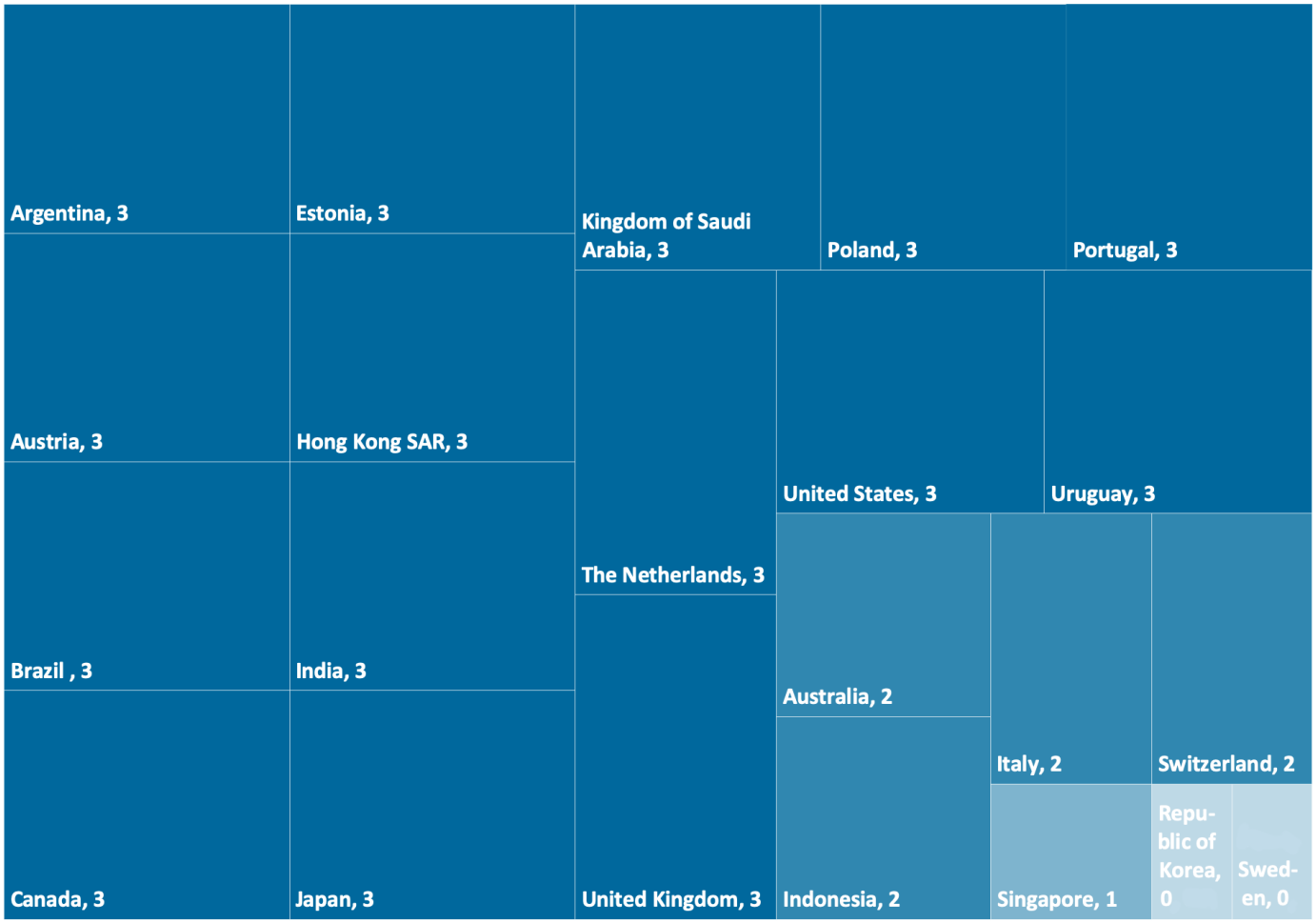
For Singapore, medication management is a top priority because "errors may cause patient harm, delays will hinder timely patient care." Switzerland seconded that idea, saying, "This is probably the most common use case. It is also one of the most dangerous to the patient because most critical incidents happen due to wrong medication." Austria's e-Medication application running on national eHealth infrastructure ELGA is considered the clinically most accepted and most valuable application of ELGA.

Regarding actual progress, with a few exceptions, medication management is not as far along as e-Prescribing. Sweden approved a National Medicines List (NLL) Act in 2018, such that "on June 1, 2022, all health and pharmacy providers will be connected to the new register with functionality for prescribing and dispensing based on information from a common source." Portugal noted that "most of our medication information is still unstructured, thus hindering appropriate interoperability implementation." In Estonia, they "already track medications prescribed and purchased, and believe there is room to improve even further by sending automated reminders when a prescribed medication hasn't been purchased on time (to improve adherence)." Monitoring of effectiveness and

abuse is another potential benefit not often realised as yet. In the United States, "coordination and reconciliation of medications across multiple providers is required, including knowledge of previous meds, effectiveness, reasons for discontinuing, and adverse reactions. Prescription Drug Monitoring Programs (PDMPs) seek to identify potential misuse and risk for overdosing (e.g. opioids), but vary from state to state, and are typically not integrated with EHRs."

In summary, medication management is a highly ranked purpose for reasons of safety, efficiency and ability to monitor effectiveness. Realisation of these benefits depends on semantic interoperability, which has only been accomplished to a small extent in most countries. This too is related to the barrier "lack of EHR capability to take action."

4.3.5. Purpose 5: Electronic Prescribing of Medication



Electronic prescribing (e-Prescribing) is a high priority and a success in many countries. The intended benefits of e-Prescribing are both improved efficiency for administrative and billing purposes, but also patient safety through allergy and drug-interaction checking (Hong Kong SAR).

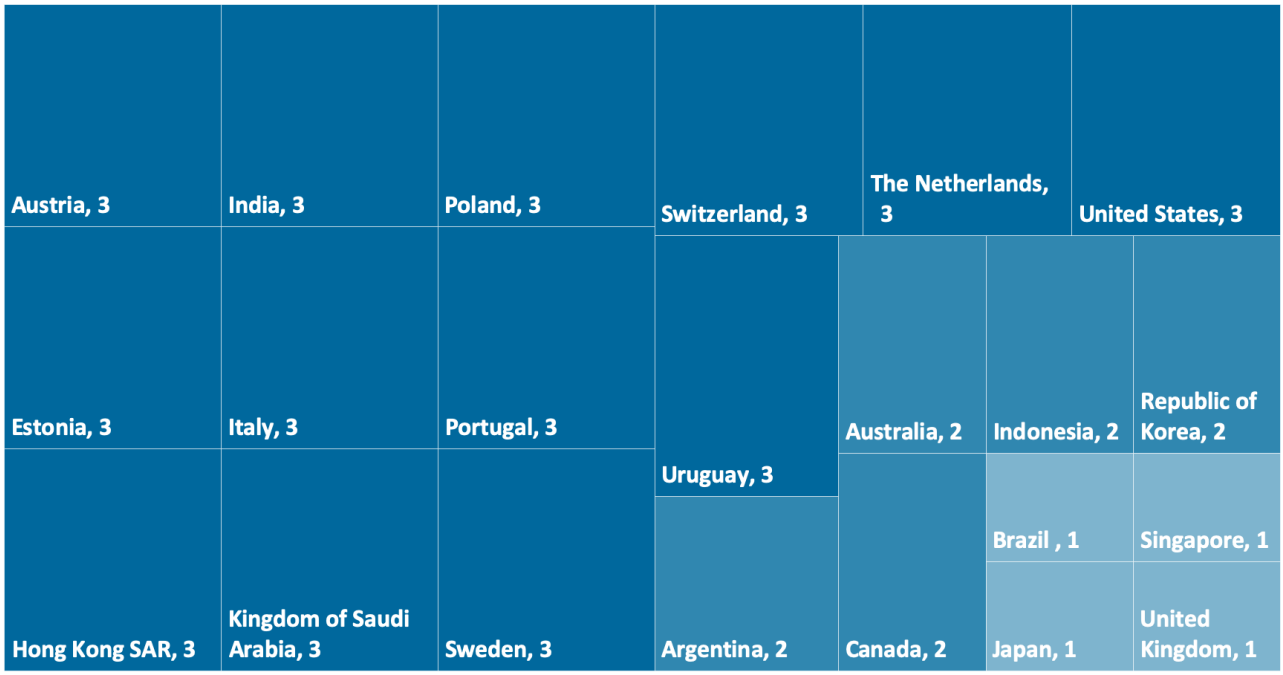
In Estonia, the penetration is so widespread and mature at a national level that "it is hard to imagine life without it" and in Poland it "is one of the most commonly used e-health services" though it was only developed in the past year. For Canada, its national service called PrescribeIT "is the first national data exchange service, with FHIR-based integration to prescriber EMRs, pharmacy management systems, as well as interoperability with registries and databases managed by the provinces and territories." Portugal "already achieved this with great success (almost 100% paperless prescriptions), with one of the latest biggest successes being a mobile e-Prescription app. No international standard is used (national specifications), apart from the correlation between our national medicinal products catalogue and the ATC."[7] Nevertheless, Portugal recommends alignment with the eHDSI e-Prescription specification.[8] The United Kingdom has "a national system in place which supports prescriptions for general practice and national reimbursement" but uptake of "solutions within secondary care is currently a key focus." In the United States, nearly all prescribers and pharmacies are connected using US-specific standards for messages (NCPDP Script), medication codes (RxNorm), and private sector networks.

In summary, e-prescribing is successful in many countries, but it is difficult to find a standardised solution that seamlessly transfers across countries due to the lack of international consensus standards for medication terminology and prescription transactions. Nevertheless, there is potential for learning from the mature systems that have been implemented.

[7] Anatomical Therapeutic Chemical (ATC) Classification is an internationally accepted classification system for medicines that is maintained by the World Health Organisation (WHO).

[8] https://ec.europa.eu/cefdigital/wiki/download/attachments/65973625/%28Adopted%29%20ePrescription%20Guideline%20crossborder%20exchange%20of%20health%20data%20%28release%202%29.pdf?version=1&modificationDate=1531928291947&api=v2

4.3.6. Purpose 6: Patient Access



Patient access, at a minimum, means that a patient can view some of the information in their record. However, in the context of interoperability, a more stringent definition was proposed for this white paper. The survey defined it as "patients participating in exchange" such as allowing patients to download copies of their health information or send their patient-generated health data (PGHD) to an organisation. It is about more than what information is exchanged; it is about the patient having a level of control. Despite the survey definition, some respondents spoke as if patient access were private messaging only, though the content of the patient messages, albeit unstructured, is still important information for the provider to receive and comprehend.

Patient access was ranked a medium or high priority by all but two respondents, earning it sixth place ranking among purposes. To Estonia, patient access was such a high priority that "this was one of the first things we developed (the Patient Portal) and it has proven invaluable." Similarly, Austria's patient portal "was mandated by law to be implemented in phase 1, because of satisfying transparency/privacy/security issues of patient organisations." Switzerland launched the electronic patient record, "a major step in the direction of patient empowerment." In Switzerland, patients will be in full control of their records and decide who has access to them. Argentina said that patients can opt out of their system. While the United States places a high priority on patient access, it has found a lack of widespread patient engagement. The United States also found that patient-reported outcomes (PROs) can play a critical role in improving healthcare delivery and patient experience, but are not widely collected or used.

Portugal's experience shows they have made substantial progress in mobile apps for patients using HL7's FHIR. Also regarding PGHD, Portugal has "a national eHealth platform available to citizens, where they can submit information on blood pressure measurements or perform a diabetes type II pre-diagnosis, and this information is shared with health professionals for the purpose of following-up the patient in case some abnormal values are detected." Hong Kong SAR cited patient empowerment as a means

to improve hospital efficiency by using a mobile app to facilitate entry of their own monitoring data. Hong Kong SAR seeks development and promotion of standards to facilitate capturing/sharing PGHD including interfaces with Internet-of-Things (IoT) devices.

In summary, many GDHP participant countries have a common goal of empowering patients to access their information as health IT advances. Patient access is sometimes one of their first initiatives. Several countries encourage patients to send their own data to providers.

4.3.7. Additional High-Priority Purposes Cited

Additional purposes each mentioned by a single country were added as high priority and are noted here:

- Austria recognises that some use cases require the transmission of Computable Care Guidelines to edge systems. For example, "the e-Immunisation project foresees computed vaccination recommendations and reminder functions for the patient on pending vaccinations, based on the national vaccination plans" which are presented to physicians to be accepted or overridden. "To achieve this, the national vaccination plans have to be shared with the GP systems in an electronic form, which can be accomplished by computable care guidelines."
- The survey asked about electronic referrals (e-Referrals) and patient access. Canada considers secure messaging "a building block for e-Referrals, patient access and other interoperable services." Thus, although messaging by itself may not be considered interoperability, it is an important complement to other services.
- Australia considered discovery of information a high-priority purpose that is not currently being fulfilled. Their My Health Record system is only a fraction of potentially relevant information, and there is no indexing system to allow discovery of other information. Discovery in the United States is sometimes called record location.

4.3.8. Areas of Least and Most Variability

It is not meaningful to talk about the areas of most agreement among purposes. Because the scores were skewed heavily toward "high" there was not much variability: all but one purpose had a standard deviation below 1.00.

The one exception, where there was much variability, is identifying patients accurately. This had a score of 2.05 but a standard deviation of 1.26.

Most countries have assigned a unique patient/citizen identifier (e.g. Australia, Austria, Estonia, Hong Kong SAR, Indonesia, Italy, the Kingdom of Saudi Arabia, the Netherlands, Poland, Portugal, the Republic of Korea, Sweden, the United Kingdom and India [planned]), and many of these ranked it as not a priority (0). Other countries rely upon other patient-matching techniques and rank identifying patients accurately it as a high priority (3). There were no answers in the middle (1 or 2).

The related barrier question about "lack of accurate patient identification (matching) across organisations" yielded a low score (1.00), with only the United States and Canada rating it as a major barrier. Thus, although accurate patient identification is essential for interoperability, it is not a high-priority candidate for GDHP collaboration.

As with other questions about EHRs, despite the provision of a technical solution (such as a national person/patient/citizen ID), systems implemented prior to that solution cannot take advantage of it until they are upgraded or replaced. For example, Australia "has strong legislative and technology support for a unique patient identifier, however not all systems resolve local identifiers to national ones. There is no current requirement for all inter-organisational connections to include the national identifier."

5 KEY FINDINGS

The key findings from the survey are summarised here and discussed in the next sections.

Highly significant (Tier 1) barriers faced by GDHP participants have been identified. While many barriers have been cited in interoperability literature, and previously by GDHP participants, they are far from equal. Tier 1 barriers remain persistent and nearly universal.

- The most significant barriers are lack of EHR capability to take action and make effective use of exchanged data, and poor usability: these are the weakest links in the interoperability chain.
- Economics remains an obstacle, as costs can inhibit organisations from implementing interoperability. Sometimes there may be more incentive to not exchange data because of how health care is reimbursed.
- Countries and territories that have not yet overcome barriers can learn from the experiences of those who have overcome them by using standards, legislation, policies and best practices. Several respondents offered to share their solutions with other countries.

Transitions of care is the most significant purpose, followed by receiving of laboratory and imaging reports, though there is not much of a distinction in priority between several interoperability purposes.

International standards are supported by most GDHP participants, most notably those from ICD, SNOMED CT, HL7 v2, IHE, DICOM, LOINC, HL7 CDA and FHIR. FHIR is touted as a key to several of the solutions described. International Standards Organisation (ISO) and OpenEHR standards are much less used. All countries are committed to the importance of standards for interoperability, though some use "national" (not international) standards where necessary for some use cases.

5.1. HIGHLY SIGNIFICANT (TIER 1) BARRIERS

The highest ranked barriers, taken discretely from the survey, are the following (Tier 1). Not only did these have the highest scores, but they all had a stronger than average degree of agreement (standard deviation <1.0) among respondents, rather than polarisation in the responses. Poor usability and increasing cost had the highest degree of agreement among these Tier 1 barriers.

1. Lack of EHR capability to take action based on exchanged data
2. Poor usability and negative impact on providers' workflows
3. Increasing cost due to interoperability that entities cannot afford
4. Difficulty managing coordinated collective action among multiple organisations
5. Lack of universal adoption of standards-based EHRs
6. Economic incentives do not encourage data exchange

However, some of these barriers reinforce each other and can be considered together.

There is opportunity to address the weak link in interoperability: taking action and making effective use of exchanged data. This finding is based on the two top ranked barriers in combination. It is no longer enough merely to move data from one entity to another. More attention must be paid to developing usable functionality to allow end users to easily create, find, consume and take action upon exchanged data, to receive benefits that outweigh any extra time or cost.

The top two barriers also pose a challenge to EHR developers to enhance their systems' functionality and usability. They also should motivate GDHP and its healthcare organisations to demand these capabilities and to train their stakeholders to use them. They also are a call to standards-development organisations, and organisations focused on user experience, to create and promote standards, implementation guidance and best practices for the use of exchanged data (e.g. reconciliation, incorporation, decision support) – not just the content, format and transport of data.

Economics remains an obstacle so incentives are helpful. This finding is based on a combination of the barriers ranked 3 to 6. In some cases, even though interoperability can improve efficiency, it can actually reduce payments (e.g. repeated tests). And for some entities, it increases direct costs (e.g. software upgrades, licensing of standards, interoperability implementation) as well as indirect costs (retraining, time to review exchanged data). Because of the effort and cost to upgrade to a standards-compliant EHR, not all entities have implemented interoperable software, even where it is generally available. While interoperability provides benefits to patients and the overall healthcare system, some entities may not experience the benefits themselves (e.g. the content consumer and the patient, not the creator of shared data, are the beneficiaries). Government ministries of health recognise this problem and are taking steps to educate stakeholders about the return on investment (not just the costs), to encourage information exchange as a societal benefit and to assist those who are currently giving more (in time and cost) than they are receiving.

5.2. HIGH-PRIORITY PURPOSES

Transitions of care is the highest-priority purpose, followed by receiving laboratory/pathology reports, receiving diagnostic imaging reports, medication management, electronic prescribing, and patient access. However, there was not much differentiation in their scores.

The fact that so many were considered high priority shows that interoperability has diverse and important benefits to offer clinicians, patients and society. Because interoperability requires effort and expenses to implement, it is understandable that countries want to achieve benefits throughout the patient care life cycle, from intake to diagnosis, treatment, referral, transitions of care, and the time in between when a patient is not receiving treatment but remains engaged in care (patient access). Interoperability also extends beyond direct patient care to population health and research, though direct patient care purposes were ranked higher.

Ordering of procedures was the lowest ranked, and ordering of diagnostic tests was tied for the second lowest. Purposes that supply information to the provider (e.g. receiving results or records from prior providers for continuity of care), were ranked higher than purposes that send requests to other providers. Identifying patients accurately is essential, but it tied for second lowest: many respondents did not consider it a high priority because they have solved the issue, usually with some form of national unique person identifier.

5.3. UPDATED STANDARDS CROSSWALK

The following health data standards crosswalk table is an updated version that was published in the initial GDHP interoperability white paper. It shows a high-level, aggregated view of the use of key standards areas by GDHP participants. Clearly, the extent of usage of the full set of standards is more complex and nuanced than reflected below, and some survey responses omitted to note the use of specific standards. However, this representation should help in making initial, high-level comparisons about areas of standards usage. New Zealand's response, noted in grey, is based on their 2018 response.

Table 3: Health data standards crosswalk

Country/Territory	Standard										
	HL7® v2	HL7® v3	HL7 CDA®	HL7 FHIR®	IHE	OpenEHR	ISO	ICD (9 / 10 / 11)	SNOMED CT	LOINC	DICOM
Argentina				✓	✓			✓	✓		
Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Austria	✓	✓	✓		✓			✓	✓	✓	✓
Brazil	✓	✓		✓	✓	✓		✓			
Canada	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Estonia		✓	✓		✓			✓	✓	✓	✓
Hong Kong SAR	✓		✓					✓	✓	✓	✓
India	✓		✓	✓		✓	✓	✓	✓	✓	✓
Italy	✓	✓					✓	✓	✓	✓	✓
Japan	✓		✓		✓		✓	✓			✓
Kingdom of Saudi Arabia	✓	✓	✓	✓	✓		✓		✓	✓	✓
The Netherlands	✓	✓	✓	✓	✓			✓	✓	✓	✓
New Zealand	✓		✓	✓				✓	✓	✓	✓
Poland	✓	✓	✓	✓	✓			✓	✓		✓
Portugal	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Republic of Korea	✓	✓	✓	✓	✓		✓	✓		✓	✓
Singapore		✓		✓				✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Switzerland	✓	✓	✓	✓	✓			✓	✓	✓	✓
United Kingdom	✓	✓		✓	✓			✓	✓		✓
United States	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Uruguay	✓	✓	✓	✓	✓			✓	✓	✓	
Total Countries and Territories	**19**	**17**	**17**	**17**	**17**	**4**	**10**	**21**	**19**	**16**	**18**

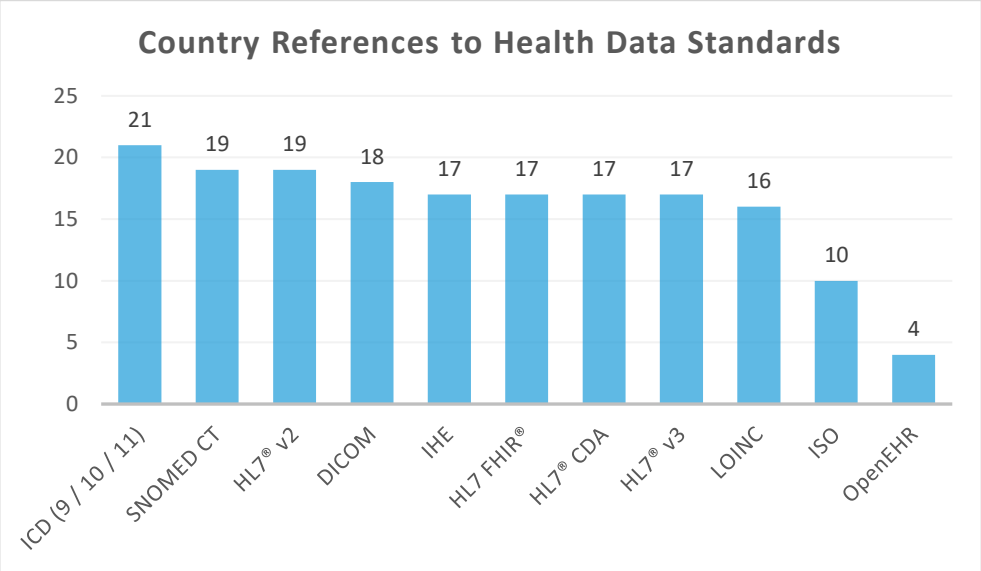


Figure 9: Health Data Standards Reference

The table is encouraging in that it shows a high degree of acceptance of many of the same standards: HL7 v2, CDA and FHIR; IHE, ICD, SNOMED CT, DICOM and LOINC. Only OpenEHR and ISO standards are used by 50 per cent or fewer of the respondents. The table is at a very coarse level of granularity – it does not list specific HL7 messages or document types, IHE Integration Profiles, ICD revision number, etc. There are subtle differences in detail that were not asked in the survey such as specific versions of a standard or different profiling of the same standard. Also, just because a country or territory indicates a standard, it is unknown what percentages of organisations or systems in the country is actually using that standard. For example, the Republic of Korea said, "National HIE adopted (announced) LOINC-based local standard terminology for laboratory tests and measurements but actual utilisation is not clear."

In summary, responses to the standards survey indicate that GDHP participants generally agree on the major standards that are in use. Much more specific guidance will be needed to recommend appropriate standards and implementation guides for specific purposes.

6 DISCUSSION

The strength of the key findings is their foundation in a structured survey that included clear definitions and examples, promoting a consistent understanding of the questions. By quantifying the results, we can assess significance systematically, rather than having to interpret narrative testimony. Relying on selective expert witnesses or public comments in meetings can skew conclusions based on the persuasiveness, credentials, fame or vehemence of individuals. In contrast, we trust that the respondents from ministries of health worldwide have made a good-faith effort to represent the status of their countries, rather than their own personal opinions.

Nonetheless, we must exercise caution when making generalisations across countries because of the variations in health system, government, culture, economics, climate and population demographics (e.g. age distribution, specific morbidities). That is why it is important to consider not just the average scores but the variability (extent of disagreement) among respondents, and the narrative comments that explain the nuances of the answers. We allow each respondent to tell their story in their own words via many direct quotes. We do not draw strong conclusions or make recommendations where high polarisation (standard deviation >1) exists. We also do not make recommendations based on only a few respondents' suggestions.

We find reason for confidence in the key findings and recommendations by observing that the Tier 1 barriers all have lower variability than the overall barriers. Thus, despite the need for cautious interpretation, we believe that similarities in health care and human needs transcend the differences among countries.

Finally, we recognise that while the Global Digital Health Partnership (GDHP) represents 31 countries from six continents and the World Health Organization, it does not necessarily represent the majority of countries or people in the world. GDHP participant countries' and territories' total population is about 2.925 billion, about 38 per cent of the world population. However, finding areas for collaboration among GDHP can have positive impacts not only among its participant countries and territories but indirectly on other countries and territories which work with GDHP participants.

7 RECOMMENDATIONS AND NEXT STEPS

As stated in the introduction, the next step is to go beyond *description* to *analysis and action* to *advance interoperability together globally*. The white paper is intended as a catalyst for positive change in Global Digital Health Partnership (GDHP) participant countries and territories. After analysing the survey responses on barriers to interoperability, purposes for interoperability and suggestions for GDHP collaboration, participating countries identified the top two candidates for the GDHP Interoperability work stream to collaborate on to advance global interoperability.

7.1. TOP TWO CANDIDATES: GLOBAL MASTER STANDARDS GUIDE AND GLOBAL INTEROPERABILITY MATURITY MODEL

The most common recommendation is for GDHP to create a Global Master Standards Guide (GMSG) on use of specific standards for various interoperability needs. While there is already alignment on baseline standards, consistent and detailed guidance on implementation is needed. The second common recommendation is for the GDHP to develop a Global Interoperability Maturity Model (GIMM) to demonstrate the interoperability adoption level of countries.

Respondents described the Global Master Standards Guide (GMSG) in different terms that are similar in meaning, for example: "master reference list," "guidance document," "creation of a common methodology and set of standards to ensure that each country is adhering to the same basic common core" or "interoperability standards advisory." Some responses suggested a broad scope (all types of standards for many uses cases or needs), whereas other responses suggested narrower scope (limited to particular use cases, or only to certain types of standards such as terminology).

As an example of broad scope, the Netherlands recommended "a global roadmap for interoperability (standards) development, including a master reference list of interoperability standards to which GDHP participants can individually sign on to." Some GDHP participants already have a country-specific Master Standards Guide artefact, (e.g. the United States government maintains the national Interoperability Standards Advisory [ISA])[9] , and some of these artefacts may be useful source material to start creating a GMSG.

As an example of narrow scope (but more in-depth), Austria said: "We would propose that the GDHP engages, triggers and fosters the creation of such aligned and harmonised standards by identifying one or a few particular eHealth use cases which are of common interest for the (or a majority of) GDHP participant states." The United Kingdom similarly

[9] https://www.healthit.gov/isa/ ISA is divided into major sections, e.g. "Vocabulary/Code Set/Terminology Standards and Implementation Specification" and then subdivided based on "Interoperability Need" (similar to "Purpose" in this white paper), e.g. "Representing patient allergic reactions." For each need, standards and implementation specifications are listed, along with indicators such as standards process maturity, implementation maturity and level of adoption.

suggested that "a set of core use cases are brought together through a common interest" and recommended initial focus on four use cases. Additionally, Hong Kong SAR suggested developing and promoting standards for patient-contributed data. As another example of narrower scope, some respondents such as Italy and Japan asked for standardisation of codes (terminologies), without mentioning other types of standards such as APIs, documents or messages. Other respondents, such as Argentina, the Kingdom of Saudi Arabia, Switzerland and Uruguay, asked for some variant of this idea.

GDHP participants cited a Global Interoperability Maturity Model (GIMM) as another potential project that could integrate or reference the GMSG. To undertake a GIMM, the GDHP would increase its chances of success by aligning with an internationally-focused organisation that is pursuing the same topic. Countries that already have maturity models would also be encouraged to contribute them for consideration. For example, the Inter-American Development Bank has created and validated a Maturity Model for National Level EHR Systems that has been tested in five countries in Latin America. The GIMM would be a health-IT-specific maturity model.

HIMSS Analytics has published a global eight-stage (0–7) Electronic Medical Record Adoption Model (EMRAM)[10] which can be considered a model to assess the maturity (adoption and use) of EHR functionality. However, it says little about interoperability, mentioning "internal interoperability" as part of Stage 2 and "external HIE" as part of Stage 7. A GIMM could similarly describe a path for countries and EHRs to evolve from lower to higher levels of interoperability. There can be many technical and human factors determining the interoperability maturity level, such as:

- Functionality to address priority purposes (use cases)
- Standards adherence (e.g. measured according to a GMSG)
- Adoption level (scale of deployment into real-world usage)
- Barriers (the extent to which they have been overcome)
- Governance process (e.g. policies, and common agreements that are clearly documented, accepted, monitored and continually improved)[11]
- Metrics for interoperability activities (e.g. number of exchanges) and outcomes (e.g. safety, quality, affordability, efficiency, clinician productivity, patient satisfaction)

While the "broad scope" GIMM would encompass the "narrower scope" suggestions, there needs to be a balance between unwieldy comprehensiveness versus simplicity and practicality. If such a GIMM were developed, it could be applied in different contexts (e.g. to a specific healthcare organisation like a hospital, to a country's healthcare ecosystem, or to products such as EHRs). The GIMM should be designed to be neutral to the political or health system structures (centralised, federated, decentralised, democratic, etc.), and flexible to accommodate differing priorities within a country.

[10] https://www.himssanalytics.org/emram

[11] https://cmmiinstitute.com/cmmi/intro – CMMI (Capability Maturity Model Integration) is one example of a maturity model to help organisations build, improve, and measure their capabilities and improve performance.

A GMSG could be created without a GIMM, and a GIMM could be created without a GMSG, though there would be strong synergy if they were integrated. The GDHP may choose to control scope by undertaking one option or both options.

7.2. OTHER SUGGESTED NEXT STEPS

Survey responses suggested several collaborative projects other than the two described above. We acknowledge them here although they were each mentioned by only one respondent. Even though they are not candidates for the GDHP "one thing," they may stimulate progress through more localised efforts.

- "Finding the right balance between centralised and distributed systems." (Estonia)
- "Develop and promote standards to facilitate capturing and sharing of patient contributed data (including interface with IOT devices)." (Hong Kong SAR)
- "A comprehensive implementation framework to create a Global Digital Health Eco-system that supports Universal Health Coverage in an efficient, accessible, inclusive, affordable, timely and safe manner." (India)
- "Digital health regulatory framework" (Indonesia)
- "A top focus area for GDHP collaboration might be patient data management in course of interaction with the healthcare system." (Poland)
- "In accordance with the recently adopted Commission Recommendation on a European EHR Exchange Format, the top focus area should be the exchange of image reports, laboratory results and discharge letters" (Portugal)
- "The GDHP should engage all member countries to define one or more particular eHealth Use Cases that would be of a common interest (remote Medical Device monitoring, Registries, etc.), and then commission the standards community to come up with a complete Interoperability Specification/Profile." (The Kingdom of Saudi Arabia)
- "What has the success factor been in countries where the information is created and used at levels other than the national one?" (Sweden)

The GDHP Interoperability work stream is poised to take action on one of the aforementioned collaborative efforts, or a variation of the efforts, to advance interoperability together globally.

8 RELEVANT DOCUMENTS

This section includes websites as well as documents, further explaining some countries' digital health strategies and programs. Not all GDHP participants submitted document names.

- Argentina
  - National eHealth Strategy 2018–2024: https://www.argentina.gob.ar/noticias/se-aprobo-la-estrategia-nacional-de-salud-digital-2018-2024
- Australia
  - Safe, Seamless, and Secure: Evolving health and care to meeting needs of modern Australia: https://frameworkforaction.digitalhealth.gov.au/australias-national-digital-health-strategy
  - Framework for Action: https://frameworkforaction.digitalhealth.gov.au/framework-for-action
- Austria
  - ELGA Law: http://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008120
  - Digital Austria Agenda: https://www.digitales.oesterreich.gv.at/
  - Europe 2020 Digital Single Market: https://ec.europa.eu/digital-single-market/
  - Patient Portal to ELGA: https://www.gesundheit.gv.at/elga/inhalt
- Canada
  - Connected Health Information in Canada: A Benefits Evaluation Study https://www.infoway-inforoute.ca/en/component/edocman/resources/reports/benefits-evaluation/3510-connected-health-information-in-canada-a-benefits-evaluation-study-document?Itemid=101
- Italy
  - Strategy for Digital Growth 2014–2020 https://www.agid.gov.it/sites/default/files/repository_files/documentazione/strat_crescita_digit_3marzo_0.pdf
- The Netherlands
  - Health and Care Information Models main page https://zibs.nl/wiki/HCIM_Mainpage
  - MedMij: https://protect2.fireeye.com/url?k=f7d551c3-ab8058d0-f7d560fc-0cc47adb5650-b25ab2139d90408c&u=https://www.medmij.nl/en/

- Portugal
    - Commission Recommendation on a European Electronic Health Record exchange format https://ec.europa.eu/digital-single-market/en/news/recommendation-european-electronic-health-record-exchange-format
- Switzerland
    - Federal Act on the electronic patient record www.ehealth.admin.ch, www.patientrecord.ch
- The United States
    - The Office of the National Coordinator for Health Information Technology Interoperability Standards Advisory https://www.healthit.gov/isa/
- Uruguay
    - The eHealth initiative Salud.uy https://www.gub.uy/agencia-gobierno-electronico-sociedad-informacion-conocimiento/saluduy
    - MiHCD https://www.gub.uy/agencia-gobierno-electronico-sociedad-informacion-conocimiento/node/4001

9 REFERENCES

This section contains references to documents that contained research identifying progress and challenges in interoperability, or other research and information about interoperability. These were instrumental in the creation of the survey, such as itemising the multiple choices for barriers or purposes. The GDHP white paper provided a global perspective and demonstrated that most countries identified a very similar set of challenges.

European Commission. eHealth Stakeholder Group report: perspectives and recommendations on interoperability. 2014. http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5168
(Provides comprehensive stakeholder input to the European Commission with key recommendations in order to accelerate scalable implementation at the country level.)

GDHP. Connected Health: Empowering health through interoperability. 2019. https://s3-ap-southeast-2.amazonaws.com/ehq-production-australia/57f9a51462d5e3f07569d55232fcc11290b99cd6/documents/attachments/000/102/278/original/GDHP_Interop_2.05.pdf
(Predecessor to this current GDHP white paper.)

Health Information Technology Advisory Committee. HITAC annual report FY2018. 2019. https://www.healthit.gov/sites/default/files/page/2019-05/HITAC%20Annual%20Report%20for%20FY18_508.pdf
(Includes discussion of priority target areas in interoperability.)

Health Information Technology Policy Committee. Report to Congress (December 2015): challenges and barriers to interoperability. 2015. https://www.healthit.gov/sites/default/files/facas/HITPC_Final_ITF_Report_2015-12-16v3.pdf
(A source of barriers used in the GDHP survey.)

Health Level Seven International. HL7 CDA R2 implementation guide: clinical summary relevant and pertinent data, release 1. April, 2017. https://www.hl7.org/implement/standards/product_brief.cfm?product_id=453
(Information on physician perceptions about usability of clinical documents.)

Health Level Seven International. Argonaut FHIR implementation guides. http://www.fhir.org/guides/argonaut/ .
(The Argonaut Data Query Implementation Guide (FHIR IG) was published December, 2016, as a joint project of major EHR vendors to advance industry adoption of modern, open interoperability standards.)

India Ministry of Health & Family Welfare. Final report on National Digital Health Blueprint (NDHB). 2019. https://mohfw.gov.in/newshighlights/final-report-national-digital-health-blueprint-ndhb

(Provides a common national architectural framework for digital health in India, with principles and building blocks required for a standard based on interoperable digital health solutions.)

National Academy of Medicine. Procuring interoperability: achieving high-quality, connected, and person-centered care. 2018. https://nam.edu/procuring-interoperability-achieving-high-quality-connected-and-person-centered-care/
(A multi-stakeholder exploration of the path towards achieving large-scale interoperability through strategic acquisition of health IT solutions and devices.)

The Office of the National Coordinator for Health Information Technology. 2018 Report to Congress. https://www.healthit.gov/sites/default/files/page/2018-12/2018-HITECH-report-to-congress.pdf
(Current and future state of a nationwide system for electronic use and exchange of health information, including discussion of barriers and recommendations.)

10 ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Meaning
API	application programming interface
app	mobile application
ATC	Anatomical Therapeutic Chemical Classification
CCDD	Canadian Clinical Drug Data Set (Canada)
CCDS	Common Clinical Data Set (United States)
CCM	Chronic Care Model
CDA	HL7 Clinical Document Architecture
DHIS2	District Health Information Software 2
DICOM	Digital Imaging and Communications in Medicine
dm+d	dictionary of medicines and devices
EHDSI	eHealth Digital Service Infrastructure (European Union)
EHR	electronic health record
eHRSS	EHR Sharing System (Hong Kong SAR)
EHRxF	electronic health record exchange format

Acronym/Abbreviation	Meaning
ELGA	elektronische gesundheitsakte (electronic health records) (Austria)
EMR	electronic medical record
EMRAM	HIMSS Electronic Medical Record Adoption Model
FHIR®	HL7 Fast Healthcare Interoperability Resources
GDHP	Global Digital Health Partnership
GDPR	General Data Protection Regulation (EU)
GIMM	Global Interoperability Maturity Model
GMSG	Global Master Standards Guide
GP	general practitioner
HCIM	Health and Care Information Models
HIE	health information exchange
HIMSS	Healthcare Information and Management Systems Society
HL7	Health Level Seven
ICD	World Health Organization International Classification of Diseases
IHE	Integrating the Healthcare Enterprise

Acronym/Abbreviation	Meaning
IoT	Internet-of-Things
ISA	Interoperability Standards Advisory (United States)
ISO	International Organization for Standardization
IT	Information technology
LOINC	Logical Observation Identifiers, Names and Codes
MHD	Mobile access to Health Documents
NDHB	National Digital Health Blueprint (India)
NHS	National Health Service (United Kingdom)
ONC	Office of the National Coordinator for Health Information Technology (United States)
PCD	Patient Care Device
PCHA	Personal Connected Health Alliance
PDMP	Prescription Drug Monitoring Programs (United States)
PGHD	patient-generated health data
PROs	patient-reported outcomes
REST	Representational State Transfer
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms

Acronym/Abbreviation	Meaning
SOAP	SOAP (Simple Object Access Protocol) (a way of organizing medical records)
SS-MIX2	Standardized Structured Medical record Information eXchange
XCA	IHE Cross-Community Access
XDR	IHE Cross-Enterprise Document Reliable Exchange
XDS	IHE Cross-Enterprise Document Sharing
WHO	World Health Organization
WHO-FIC	WHO Family of International Classifications
UI	User interface
USCDI	US Core Data for Interoperability

11 APPENDIX A: SURVEY QUESTIONS

GDHP survey of interoperability: barriers, purposes, and priorities

Interoperability barriers

The previous GDHP Interoperability Work Stream white paper identified barriers to health IT interoperability within participant countries. Other research has identified additional barriers. Each country and territory will need to overcome these barriers to achieve effective interoperability. This survey seeks to identify the most significant barriers to interoperability within participant countries and territories, and to suggest possible solutions and best practices that can be shared among GDHP participants.

Most significant barriers

INSTRUCTIONS

- For each of the potential barriers in the table below, please mark an "X" in the column that most accurately describes how significant that barrier is in your country.
    - Please enter relevant comments about these barriers in the far right column entitled "Comments."
- If there are barriers in your country that are not listed, please add them in the blank lines at the bottom of the table, and indicate their significance level (not a barrier, minor barrier, moderate barrier, or major barrier).
- Please reference the attached standards cross-walk table from the first GDHP Interoperability White Paper when you see "interoperability standards" referenced in this survey. That cross-walk table summarises the interoperability standards currently being used by one or more countries. There are many standards for different purposes (interoperability needs).

TERMS

- Electronic Health Record (EHR): the systematised collection of patient and population electronically-stored health data in a digital format. These records can be shared across different health care settings. Records are shared through network-connected, enterprise-wide information systems or other information networks and exchanges. Some countries use terms like "Electronic Patient Record," "Electronic Medical Record" (EMR), "Digital Health Record," "eHealth" etc., to describe this concept. EHR can mean not only the electronic records themselves, but the systems (e.g., software, technology) that create and maintain these records.
- Interoperability: The ability of a system or product to transfer meaning of information within and between systems or products without special effort on the part of the user. Interoperability is made possible by the implementation of standards.
- Provider: an entity (person or organisation) that delivers health care, such as a physician, clinic, or hospital.

EXAMPLE

Here is an example of how a country might answer this part of the survey:

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Existing standards are not adequate for the desired purposes		X			There is a lack of universally adopted standard terminology for medications, but there are standardised terminologies for most other concepts. We use our own country-specific standard for medication.
Variability in choice of standards to solve specific interoperability problems				X	For Purpose XYZ, there are two competing standards and most software supports one or the other, but not both.
Inconsistent implementation or constraints on standards (lack of profiling)			X		Standard ABC is being used, but not all organisations use the same profiling specifications for required fields and allowable values. Some developers have trouble finding and reusing existing profiles.
Etc.					

SURVEY OF BARRIERS: Please fill out the table (3 pages) according to the instructions above

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Category: technical or infrastructure barriers					
Lack of a digital health system [12]					
Lack of accurate patient identification (matching) across organisations					
Lack of infrastructure for secure transmission to another entity[13]					
Difficulty identifying and communicating with the other entities in a data exchange [14]					
Category: standards barriers					
Existing standards are not adequate for the desired purposes[15]					

[12] Data are not collected or shared electronically; health records are kept on paper.

[13] This may mean lack of networking to connect providers, or lack of technical capability to ensure secure transmission.

[14] This includes difficulty finding electronic addresses to connect to specific entities.

[15] This means that a standard does not exist for the desired purpose, or the standard is not mature or satisfactory yet.

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Variability in choice of standards to solve specific interoperability problems[16]					
Inconsistent implementation or constraints on standards (lack of profiling) [17]					
Difficulty understanding what was meant by other providers; sometimes due to lack of standardised terminology[18]					
Two or more incompatible versions of a standard are used[19]					
Category: functionality barriers					
Lack of universal adoption of standards-based EHRs[20]					

[16] More than one standard is being used for the same purpose, resulting in different systems not being able to communicate, e.g. some use HL7, others use CDISC.

[17] "Profiling" means applying constraints on a standard (e.g. which data elements are required, or which code systems are used for each data element) that all organisations agree upon, so that the exchanged information is clearly understood and used by all.

[18] "Understanding" means more than a person's ability to view and understand the exchanged data, but that **software** can understand the data's meaning and process it in a standardised way, such as for clinical decision support.

[19] Even though the "same" standard is used across organisations, versions are different, resulting in incompatibilities, e.g. some use HL7 v2.2, others use HL7 v2.7.

[20] The EHRs or other health IT software that is currently used within the country do not support interoperability standards.

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Lack of EHR capability to take action based on exchanged data[21]					
Category: usability barriers					
Poor usability and negative impact on providers' workflows[22]					
Too much data is exchanged and meaningful data are hard to quickly find[23]					
Exchanged data are missing what providers are interested in, making the exchanges unhelpful[24]					
Interoperable data are not available at the point-of-care when it is needed most[25]					
Category: trust and security barriers					

[21] For example, exchanged data can only be viewed, but cannot be imported and reconciled with the data a provider already has (e.g. to update a list of allergies or medications with data from an exchange).

[22] For example, users complain that using interoperability functions is confusing, disruptive or takes too much time.

[23] For example, providers complain that they receive so much irrelevant data that they cannot find what they want.

[24] For example, exchanged data lacks a concise summary to explain the most important findings about the patient

[25] For example, at the time a patient sees a provider, the information from the previous provider has not been sent or received yet.

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Complex privacy and security challenges associated with data exchange[26]					
Lack of trust in data quality[27]					
Inadequate or inconsistent approaches to patient consent[28]					
Category: policy or regulatory barriers					
Regional, national, or state level regulations, or variations in policies or regulations, increase burden and make interoperability difficult[29]					
Information blocking: organisations choose not to share information[30]					

[26] For example, it may be difficult to manage levels of user authorisation and permission across organisations, or to keep mental health information separate from other health data if required by law.

[27] Providers may not know where exchanged data originated (provenance), and how reliable it is, and therefore may not trust it or use it.

[28] For example, it is unclear how patient consent is collected, and how that consent is shared, understood, and enforced across organisations).

[29] For example, different regions require different data elements or standards, so that developers of EHRs must provide many different versions of software to support these variations.

[30] This may occur because an organisation considers patient health information their own asset that they can control for their own benefit by making it difficult for other organisations to obtain data or for patients to transfer their health care and their records to a competing organisation.

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	
Difficulty managing coordinated collective action among multiple organisations[31]					
Legislation is subject to interpretations and the lack of clarity blocks and delays interoperability implementation					
Category: financial barriers					
Increased costs due to interoperability that entities cannot afford[32]					
Economic incentives do not encourage, and sometimes even discourage, data exchange[33]					
Category: other barriers					
Unclear definition of the use cases and low end-user engagement and consultation					
Please provide additional barriers that are significant in your country, if they are not listed above.					

[31] Effective interoperability requires all participants to agree upon certain rules and policies in order to exchange information, and it can cost time and money to reach agreement and implement the agreements.

[32] For example, there may be additional costs to acquire or upgrade software to connect to other organisations or to support the latest standards.

[33] For example, if providers are paid more money for doing repetitive work (such as collecting data or performing tests again), they lack incentive to exchange data that might prevent the repetitive work.

Potential barrier	Significance				Comments
	Not a barrier	Minor Barrier	Moderate Barrier	Major Barrier	

Solutions to barriers

For the Potential Barriers in the table above that are of "Minor" significance or "Not a barrier" in your country, you may have overcome these barriers through technical solutions, policies, legislation, financial incentives, or other ways. GDHP encourages collaboration to learn from other countries, so please answer the following question **if you have overcome one or more barriers in a way that might benefit other countries.**

How has your country overcome some of these barriers?

Please describe the solution(s) in 1-3 paragraphs, and list the barriers that it overcame. You can describe as many solutions as you wish.

EXAMPLE

Suppose a country says that "Lack of accurate patient identification (matching) across organisations" is not a barrier, and offers to describe how they overcame that barrier. They might write something like the following:

> *"In our country, the government provides a service that allows the assignment, management, and lookup of a Unique Healthcare Identifier (UHI) for each person. Each person is given a card that includes this UHI. Regional governments and private providers use health IT software with the capability to link their internal patient identifiers to this UHI. The UHI is a foundational element enabler to associate accurately the health care events and records from all providers to a specific person."*

RESPONSE

Purposes for interoperability

As barriers to interoperability are eliminated or overcome, it becomes possible to exchange data for various health care purposes. In the first GDHP Interoperability Work Stream White Paper, countries described their interoperability approaches and answered the question: "For what purposes are health data being exchanged?" In other words, "once we overcome barriers to interoperability, what do we hope to accomplish in data exchange?" Now as a next step, countries are asked to rate the priority of each purpose. The most frequently mentioned purposes from the first GDHP Interoperability Work Stream White Paper are summarised into major categories below: see the footnotes at the bottom of the page for explanation of what is included in each category.

For each purpose below, please indicate its PRIORITY for health care in your country regardless of how much progress your country has made toward that purpose.

EXAMPLE

Here is how a country might answer some survey questions:

Purpose for Interoperability	Priority				Comments
	None	Low	Medium	High	
Clinical ordering of diagnostic tests		X			This would increase efficiency, but is less important to patient care than electronically receiving the **results** and reports from the tests that were ordered.
Transitions of Care, Continuity of Care through shared health summaries				X	High priority, though we are making much progress; many providers are starting to send and receive a standardised summary record.

PURPOSE FOR INTEROPERABILITY: Please fill out the table according to the instructions above

Purpose for Interoperability	Priority				Comments
	None	Low	Medium	High	
Identifying patients accurately					
Clinical ordering of diagnostic tests[34]					
E-Prescribing of medications					
Clinical ordering of procedures[35]					
Receiving Laboratory Reports/Results and Pathology Reports and Results[36]					
Receiving diagnostic imaging reports and results[37]					
Medication Management[38]					
Referral Management[39]					
Transitions of Care, Continuity of Care through shared documents or dynamic messaging[40]					

[34] Ordering diagnostic services from another organisation or department, such as a laboratory, imaging center, clinic, or hospital.

[35] Ordering of non-diagnostic procedures, such surgical and therapeutic procedures.

[36] Receiving laboratory (including pathology) reports/results back from an external lab or a previous provider.

[37] Receiving reports and results back from an external imaging center or a previous provider.

[38] Includes managing and reconciling history of medications ordered, dispensed, and administered, to assist in maintaining a current and appropriate patient-centred medication list.

[39] Includes recommending another provider, and administrative actions to authorise and arrange the visit.

[40] Receiving clinical summaries can help providers to be well informed to help them give good care to patients during transitions of care (when the patient visits a different provider). Summaries may take the form of clinical documents (e.g. various HL7 CDA documents, IHE medical summary documents) or data accessed through Application Programming Interfaces (APIs – e.g. HL7 FHIR, IHE, or other APIs).

Purpose for Interoperability	Priority				Comments
	None	Low	Medium	High	
Patient Access (Patients participating in exchange) [41]					
Public Health Registries and Reporting, Surveillance[42]					
Other important Purposes not included above (add rows below and indicate importance)					

The one thing (top focus area for collaboration)

In the first GDHP Interoperability White Paper, the following question was proposed as a next step.

What do you recommend as the best initial area where GDHP participants should work together to deliver value through increased collaboration and standardisation of approach?

Please state your answer in 1-3 paragraphs. Your answer can propose anything that you think is a top focus area for collaboration, for example, overcoming certain Barriers, achieving specific Purposes, or any other recommendation for GDHP countries taking action together.

[41] Patient Access, in the context of interoperability, means exchanging information with patients, such as allowing patients to download copies of their health information or send their patient-generated health data to an organisation. It is *more* than allowing patients to view their data, but involves data exchange.

[42] Includes submitting data for public health, surveillance, epidemiology and research purposes, and may include retrieval of such information from public health registries (for example, history of immunisations/vaccinations).

Review information from white paper 1[43]

Your nation previously submitted a response to the GDHP Interoperability Work Stream's first survey in 2018. Part of the process for our second survey, leading to the drafting of a second white paper, is to verify the information you previously provided to ensure it is accurate and still relevant to your nation's digital health system.

This process will involve reviewing and updating your narrative submissions and verifying the standards crosswalk table below.

The previously submitted description of your nation's digital health program:

The previously submitted description of your nation's health information and communication technology or digital health infrastructure:

[43] Only included for those countries who participated in the previous GDHP Interoperability white paper. The Standards Crosswalk table is shown under Key Findings, and is not repeated here.

12 APPENDIX B: LIST OF GDHP PARTICIPANT RESPONDENTS

GDHP Participant Country	Name and Title	Organisation
Argentina	**Alejandro Lopez Osornio** National Director of Health Information Systems	Ministry of Health
Australia	**Mr Brad McCulloch** Program Manager – Interoperability – Government & Industry Collaboration, & Adoption	Australian Digital Health Agency
Austria	**Jürgen Brandstätter** Representative to the GDHP **Oliver Kuttin** Department of Architecture and Operations	Federal Ministry of Labour, Social Affairs, Health and Consumer Protection ELGA GmbH
Brazil	**Michael Luiz Diana de Oliveira** Coordinator of Prospecting and Innovation on IT, General-Coordination of Innovation in Digital Health	Informatics Department of the National Health System, Brazilian Ministry of Health
Canada	**Lynne Zucker** Executive Vice President, ACCESS Health	Canada Health Infoway
Estonia	**Dr Priit Tohver, MD** Advisor	Development and Innovation Policy, Estonian Ministry of Social Affairs
Hong Kong SAR	**Ms Vicky Fung** Senior Health Informatician **Dr Clement Cheung** Senior Health Informatician **Mr Eric Wong** Senior System Manager **Mr Michael Cheung** System Manager	Hospital Authority Hong Kong
India	**Mr Lav Agarwal** Joint Secretary, eHealth; Focal Point. GDHP Secretariat	Ministry of Health and Family Welfare

GDHP Participant Country	Name and Title	Organisation
Indonesia	**Rudy Kurniawan** Deputy Director for Data and Information, Center for Data and Information	Ministry of Health
Italy	**Dr Chiara Cadeddu** Researcher **Paolo Roazzi** Technical Scientist **Dr Marco Marchetti** Director **Dr Alessandro Campana** President **Professor Walter Ricciardi** Professor of Hygiene and Public Health, Director of the Department of Public Health and Deputy Head of the Faculty of Medicine	National Centre for Health Technology Assessment National Centre for Health Technology Assessment National Centre for Health Technology Assessment, Istituto Superiore di Sanità Value in Health Technology and Academy for Leadership and Innovation Università Cattolica del Sacro Cuore in Rome
Japan	**Kei Mori** Director, Medical Information Technology Promotion Office	Ministry of Health, Labour and Welfare
The Kingdom of Saudi Arabia	**Tarek Ahmed Hakeem** Director General of Interoperability Standards	Ministry of Health
The Netherlands	**Herko Coomans** International Digital Health Coordinator	Ministry of Health, Welfare and Sport
Poland	**Hubert Życiński** Head of Unit	Department for e-Health
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