

**GLOBAL DIGITAL HEALTH
PARTNERSHIP**

MEASURING BENEFITS

An international overview of approaches for evaluating digital health technologies and services

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We hope that this report provides both member and non-member countries with valuable insights into the approaches countries use for evaluating the benefits of digital health technologies and services.

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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NOTE FROM THE GDHP WORK STREAM CHAIR

Evidence and evaluation are critical inputs required to support governments in making wise investments in digital health products and services on behalf of their citizens. Understanding how to recognise high quality evidence in making those decisions, and how it should be generated through rigorous evaluation techniques, requires careful consideration of the methods and measures used to determine whether benefits have been realised and at what cost.

Defining and measuring benefits within a complex health ecosystem is a common challenge faced by countries around the world. In addition, we have the difficult task of choosing which new technologies or services among an ever-growing number of innovative developments in this field will provide the greatest impact in terms of improving the health and wellbeing of our citizens.

To address this common challenge, the Evidence and Evaluation work stream of the GDHP embarked upon an international overview of approaches for evaluating the benefits of digital health technologies and services, drawing from the experiences of GDHP participating countries.

Sharing what works, and what doesn't, allows countries to learn from each other's experiences so that successes can be leveraged and poor investment decisions can be avoided. Although local context and funding models may vary, there are still many common aspects of the way benefits evaluation models have been established in different countries. There are also a number of key themes presented that can be drawn upon by countries as they refine their approach to benefits evaluation, or applied by those who may be embarking upon this journey at an early stage.

The collaboration and efforts of many individuals from our GDHP participant countries have gone into creating this overview, drawing together international case studies and lessons learnt from participating GDHP countries around the world.

We hope that these findings, key themes and suggested next steps present an opportunity for GDHP participants and others to learn from one another – as we consider how to support the creation of high quality evidence relating to digital health benefits evaluations within our local health economies, and apply it to our decision-making processes as we choose how to allocate finite health resources – to meet the ever-growing challenge of improving the health of our populations around the world.

Clinical Professor Meredith Makeham
Chief Medical Adviser,
Australian Digital Health Agency



1 EXECUTIVE SUMMARY

1.1 BACKGROUND

Countries around the world are faced with the challenge of choosing how to spend their health resources on products and services that will provide the greatest benefits to their citizens at the best price. In order to make these decisions, high quality evidence is required that evaluates digital health services and technologies – a particularly complex task in this emerging and fast-moving sector.

It is critical that those in governments who are tasked with making these investment decisions are doing so armed with high quality evidence. In addition, they need to understand how this evidence has been generated and what it represents in relation to the realisation of better health and wellbeing for their citizens (1), and more efficient use of valuable digital health funding.

In 2018, on behalf of the Global Digital Health Partnership (GDHP), the Australian Digital Health Agency (the Agency) issued a current state “Evidence and Evaluation” review of GDHP member countries and territories. This analysis sought to inform the GDHP of current evaluation and benefits measurement approaches within its membership, to share common findings and learn from the successes or otherwise of countries around the world in this field.

Fifteen countries responded to the survey: Argentina, Australia, Austria, Brazil, Canada, Estonia, Italy, Japan, Portugal, Republic of Korea, Saudi Arabia, Sweden, United Kingdom, Uruguay and the United States. These countries provided an overview of their current approach with case studies as examples and overall lessons learnt. The international literature on digital health benefits evaluation methods was also considered and incorporated into the key findings and suggested next steps of this report.

The purpose of this overview is to guide countries as they consider how to support the creation of high quality evidence relating to digital health benefits evaluations within local health economies, and apply it to their decision-making processes as they choose how to allocate finite health resources. The lessons learnt and key themes have also been used to develop a series of next steps in the Evidence and Evaluation work stream of the GDHP.

Making evidence-based investments in digital health services and technologies will also help countries implement the health-related Sustainable Development Goals (SDGs) – in particular SDG three, which aims to ‘Ensure healthy lives and promote wellbeing for all at all ages’. Nations who are embarking upon benefits evaluation of their services may be able to leverage the lessons of others presented in this overview and ensure that the evidence being presented to them on digital technologies has been appropriately developed and is applicable to their local health systems. Of particular importance is supporting countries through greater standardisation of evaluation approaches, and the reuse and application of existing benefits measurement frameworks and methodologies where appropriate.



Progress in developing national evaluation and benefits measurement approaches across GDHP countries and territories is highly varied. While a small number of countries have existing national evaluation approaches, many are still in the early stages of working on relevant methodologies, and would benefit significantly from greater international collaboration.

1.2 KEY FINDINGS

Common themes identified among the participating countries include:

1. Significant variation exists in current evaluation approaches;
2. Defining the purpose of evaluation is a critical first step;
3. Key stakeholders must be identified and their context understood;
4. Evaluation approaches should be context-dependent;
5. Evaluation should focus on benefits measurement models where possible; and
6. Workforce capability requires significant development.

1.2.1 RECOMMENDED NEXT STEPS

The Evidence and Evaluation work stream of the GDHP aims to develop resources for countries and territories to use as they undertake evaluation of digital health technologies and services, understanding that the health system in each country is at a different stage of digital maturity.

In order to facilitate progress within the GDHP Evidence and Evaluation work stream, the following next steps are recommended:

1. **Develop standard benefits categories**
In order to drive greater consistency between international evaluation approaches, work to drive greater standardisation of benefits categories (for digital health technology and service evaluations) is required, drawing from established methodologies where appropriate. These categories will underpin quantitative, qualitative and health economic evaluations.
2. **Develop standard benefits and outcomes measures**
There are a range of benefits and outcomes measures discussed in this initial report. Standardising the use of these across digital health evaluations will assist with the comparison of evaluation results between participating GDHP countries, and will allow more direct comparison across the growing research and evidence base.
3. **Assist developing countries with evaluation and health economic approaches**
Countries with established evaluation approaches and benefits measurement models should seek to assist developing countries by, where appropriate, sharing existing frameworks and models. This collaboration should be undertaken through the GDHP Evidence and Evaluation work stream.
4. **Continue to develop the research and evidence base**
Despite the ongoing interest in digital health benefits evaluation frameworks, there are limited published examples of their use in the evaluation of digital health services internationally. Countries should continue to work collaboratively, with academia where relevant, to contribute new methodologies and key findings in order to bolster the available evidence base for digital health technology and service evaluation.



2 INTERNATIONAL OVERVIEW OF THE APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Measuring the effectiveness and efficiency of digital health technologies and services is a challenge faced by governments around the world. Determining whether or not a digital health innovation has delivered improvements for populations in the form of better, safer and more efficient care is critical to ongoing decisions about future investment in digital health technologies and services (1).

This is critical as digital health technologies and services are a significant contributor to the transformation of healthcare delivery (2). It has been estimated that a possible 80 per cent of technology projects fail (3), due to uncertainty, abandonment, and organisational willingness to adopt (4).

In response to the high failure rate, the discipline of benefits management has emerged and aims to measure and optimise the value of digital health initiatives. The development and application of benefits management has received attention in the literature (5)(6)(7), but due to the general infancy of the discipline there has been limited assessment of methodological frameworks and their application.

There are a number of 'lessons learnt' relating to the application of digital health research and evaluation frameworks that have been described in the literature. There is a large variation in key measures (8)(9) and an overall lack of consensus as to 'who, why, how, when and what' should be part of an evaluation (10). The impact of this has been a failure to capture the complete range of players involved in the successful delivery of a system who do not necessarily share identical perspectives. A recent systematic review recommends future frameworks present better methods for stakeholder identification and have a greater focus on understanding the context in which the system is delivered. From a systems perspective, this includes usability and organisational impact (10).

Specifically, Greenhalgh *et al.* have recently proposed an evidence-based, theory-informed, and pragmatic framework to help predict and evaluate the success of technology-supported health or social care programs (3) and to guide researchers and policy-makers in answering the question of why new health technologies succeed or fail. The Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies (NASSS) framework uses seven domains to measure different aspects of the technology or service. These domains are the condition or illness, technology, value proposition, adopter system, organisation, wider system, and the interaction and adoption over time. The domains and questions to be considered under each are outlined in Appendix A.



Each domain measure was classified as simple (straightforward, predictable, few components), complicated (multiple interacting components or issues), or complex (dynamic, unpredictable, not easily disaggregated into constituent components). The authors suggest that a key factor of success in health technology implementation is 'simplicity'. That is, if all domains are in the 'simple' zone, the technology program has a high chance of success. Programs with a larger measure of 'complicatedness' prove difficult but not impossible to implement, and those characterised by complexity in multiple NASSS domains rarely, if ever, become mainstreamed. The authors recommend further testing and application of the framework to guide researchers and policy-makers in planning the implementation, scale-up, or rollout of a technology program, and to explain and learn from program failures.

The World Health Organization (WHO) has also described an approach, which is largely based on population health evaluation frameworks, focusing on improving the quality and value of monitoring and evaluation of digital health interventions (1). Their guide, WHO Monitoring and Evaluating Digital Health Interventions: A practical guide to conducting research and assessment, acknowledges that digital health interventions are dynamic and evolve through several stages of maturity (i.e. from prototype to national implementation) and therefore steers users towards what is of value to evaluate at different stages of maturity (see also WHO National eHealth Strategy Toolkit). For example, in a prototype stage, functionality and usability are critical to success. For national implementation, the priorities shift to implementation research to monitor quality and fidelity. The WHO guide suggests that monitoring should be iterative and in real time to allow course corrections to be made.

The key strength of this approach is that the range of stakeholders relevant to digital health interventions as well as the evidence relevant to each stakeholder, is clearly defined. However, given the broad nature of the framework, there is limited focus on specific benefits measurement and benefits approaches that can be applied locally, nationally and internationally.

Despite the ongoing interest in digital health benefits evaluation frameworks, there are limited published examples of their use in the evaluation of digital health services internationally. The recent literature recommends incorporating a broader range of methodological approaches that consider factors such as the organisational and policy context, the use of process measures, and the consideration of scalability in order to better understand the reasons for success when evaluating new health technologies. This report provides an overview of digital health evaluation and benefits measurement approaches from GDHP participant countries, with case studies and lessons learnt, to support countries in decisions about national approaches to digital health evaluation and benefits measurement.



3 SCOPE AND METHODS

3.1 PURPOSE

The aim of this report is to present an international overview of approaches to the evaluation and benefits measurement of digital health technologies and services among GDHP participant countries.

International examples of approaches to digital health evaluation and benefits measurement, case studies and lessons learnt were provided by GDHP participant countries, with additional information sourced from a rapid review of the international peer-reviewed literature on theoretical approaches to evaluation and benefits measurement for digital health services.

GDHP participant countries are at varying levels of maturity with respect to their approach to digital health evaluation and benefits measurement. Where possible, countries have provided an overview of their evaluation approach, case studies and lessons learnt from their approaches to this topic.

The Evidence and Evaluation work stream of the GDHP has commenced a program of work to develop resources to support such digital health evaluation and benefits measurement. This is intended to support GDHP participants in understanding and applying digital health evaluation and benefits measurement approaches in their countries.

This report was developed by the GDHP Evidence and Evaluation work stream subcommittee. Participating countries are Argentina, Australia, Austria, Canada, Estonia, Italy, Japan, Portugal, Republic of Korea, Saudi Arabia, Sweden, United Kingdom, the United States of America and Uruguay. The work stream subcommittee is chaired by Australia and co-chaired by the United Kingdom.

3.2 KEY CONCEPTS

Definitions from the World Health Organization 2016 report *Monitoring and Evaluating Digital Health Interventions: A practical guide to conducting research and assessment* are used to describe the different types of digital health evaluation. In this report, evaluation is defined as “the systematic and objective assessment of an ongoing or completed project, program or policy, its design, implementation and results” (1). The aim of evaluation is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability. Examples of digital health evaluation include usability, feasibility, efficacy, effectiveness, economic and financial evaluation, and implementation research (1).

Benefits measurement has been defined considering the definitions used by Australia, the United Kingdom and Canada being as a measurable improvement or change resulting from an outcome perceived as important by one or more stakeholders which may include quality, access and productivity outcomes. Measurement of benefits may be used to justify both initial and ongoing investment in digital health technologies and services by government (11)(12)(13).



3.3 DEFINITIONS

In order to evaluate and measure the benefits of digital health services and technologies, it is important to clarify some broad definitions:

Evaluation: the systematic and objective assessment of an ongoing or completed project, program or policy, its design, implementation and results. The aim is to determine the relevance and fulfilment of objectives, development efficiency, effectiveness, impact and sustainability (1).

Benefit: a measurable improvement or change resulting from an outcome perceived as important by one or more stakeholders which may include quality, access and productivity outcomes. Measurement of benefits may be used to justify both initial and ongoing investment in digital health technologies and services by government (11)(12)(13).

Benefits measurement: the process of identifying, defining, tracking, realising and optimising the benefits delivered by business investment (13)

Benefits evaluation: examines the degree to which target benefits have been achieved and lessons learnt from implementation and rollout (13).

Economic Evaluation: aims to determine a probable value for money from an investment (1).

Effectiveness: the ability of a digital health intervention to achieve the intended results in a non-research (uncontrolled) setting (1).

Efficacy: the ability of a digital health intervention to achieve the intended results in a research (controlled) setting (1).

Feasibility: the ability of a digital health system to work as intended in a given context (1).

Financial evaluation: deals with whether the organisation and digital health users can afford the digital health system, and how it will be financed (1).

Impact evaluations: studies that aim to assess the effect the intervention has on outcomes and the impact on the intended beneficiaries or clients. These evaluations require a counterfactual and draw on data generated internally (i.e. inputs, processes and outputs) as well as data on outcomes external to the project (1).

Implementation research: research that seeks to understand and work in real-world or usual practice settings, paying particular attention to the audience that will use the research, the context in which implementation occurs, and the factors that influence implementation (1)(14).

Usability: the degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (1).



3.4 METHODS

All GDHP participant countries were invited to contribute to this report. In order to obtain the international examples of existing digital health evaluation and benefits measurement approaches, all GDHP country leads were requested to share their experience by responding to two surveys. The first questionnaire was sent in June 2018 and the second in November 2018. The second survey was sent to countries to elicit further information about their experience of digital health evaluation and benefits measurement. These questions are presented in Figures 1 and 2 below.

The following sets of questions were asked (please see Appendix A for details of participants who responded):

Survey 1 Questions:

1. Has your country adopted a standard approach to the evaluation of digital health technologies and services?
2. Could you provide us with a brief overview of the approach being used, and any resources or links to papers or websites that describe this?
3. Are you aware of any local digital health technology or service evaluations that you could share with us as case studies or examples of health technology evaluations being undertaken in your country?
4. Do you have any other information that you'd like to share about digital health evaluations, such as a report or publication, or what has made evaluations successful or otherwise in your country?

Figure 1: Survey 1 Questionnaire

Survey 2 Questions:

1. Please describe the main approach to benefits evaluation or other evaluation methodology that are being used in your country to assess digital health technologies and services. Please describe the key aspects of the approach and any strengths and/or limitations.
2. Please describe a case study from your country that applies to the evaluation methodology described above. Describe the technology or service being evaluated, the benefits and the outcomes being measured.
3. What factors support successful evaluation? Please describe key learnings from your country in completing an evaluation of digital health technologies and services. What are the key challenges of this evaluation? For example staff resourcing, digital health system maturity, fiscal limitations, stakeholder engagement.

Figure 2: Survey 2 Questionnaire

The responses to survey questions were synthesised and are presented in the results section of this report. Where countries provided examples of evaluation and benefits measurement approaches, case studies and lessons learnt, these are described. An analysis was then undertaken to draw out common themes concerning evaluation and



benefits measurement approaches applied to digital health technologies and services, and these were compared to findings from the literature.

3.5 LIMITATIONS

This report is a descriptive analysis of GDHP participants' responses to a survey on approaches to the evaluation of digital health technologies services within their countries, and case study examples.

The GDHP is a growing international collaboration; however, there are a range of maturity levels in terms of developed approaches to benefits evaluation among participants. In addition, there may be other national approaches to this question among non-GDHP countries and not described in the English language scientific literature.

The evaluation frameworks included in the analysis were applied to specific examples of digital health technologies and services and may not be generalisable to other digital health systems.

Furthermore, it is possible the gaps identified in the included evaluation frameworks do not apply to all countries and settings as a number of these issues will be context-dependent.

Despite strong support and response from work stream participants to the initial questionnaire, very few of the lessons learnt from the application of frameworks or case studies were presented that represented failures or negative results. This may reflect a reluctance to publish negative findings which limits our understanding of aspects of digital health benefits evaluations that don't work.



4 RESULTS: INTERNATIONAL APPROACHES TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

At the time of this report, there were a total of 24 GDHP participating jurisdictions, including the World Health Organization (WHO). Fifteen countries responded to the survey and the majority were able to provide examples of evaluation and/or benefits measurement approaches. A number of these were not necessarily nationally adopted approaches, but provided insights into evaluation of local initiatives. Austria and Japan are in the development phase of creating digital health evaluation approaches and were therefore not able to share their experience at this time. Responses are summarised in Appendix A.

4.1 ARGENTINA

4.1.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Argentina does not currently have a national standard approach to the evaluation of digital health technologies and services. However, there are key local initiatives that support digital health technology and service evaluation. Argentina participates in the Institute for Clinical Effectiveness and Health Policy which is a consortium of more than 40 public and private health and social security institutions from Argentina and other Latin American countries. Within this consortium, the agency for health technology assessment prepares reports that aim to clarify the actual benefits that can be expected from the implementation of new technologies.

Many initiatives implemented by the Ministry of Health and social development are funded by the World Bank or the Inter-American Development Bank. Each of these programs has very specific indicators that are aligned with its goals, and all programs have specific health information systems indicators. These lead to a heterogeneous mechanism for evaluating benefits. Examples of these programs include the SUMAR program which ensures the measurements of specific health system indicators, the REDES program for the enhancement of healthcare services networks or the PROTEGER program which is for the protection of vulnerable people against chronic non-communicable diseases. The outcome measures used as part of these programs include the percentage of health facilities billing online and the percentage of primary care centres that have implemented an interoperable health information system. The strength of this approach is that the indicators are strictly measured and followed but the indicators vary based on the specific program's objectives and metrics.

4.1.2 CASE STUDY: RESIDENCY PROGRAM

An example of digital health evaluation in Argentina is the Residency Program at the Hospital Italiano de Buenos Aires, Department of Health Informatics, which focuses on the integration of healthcare science, computer science, healthcare information systems as well as epidemiology and biostatistics. In this program, the trainees actively



participate in the development and implementation of the electronic health record (EHR) system so that they can evaluate the impact on healthcare.

One such evaluation from the residency program at Hospital Italiano de Buenos Aires describes user-centred design methodology to enhance drug-drug interaction alerts in clinical decision support systems (15). The approach included inquiry (i.e. semi-structured questionnaire, contextual observations), participatory design (i.e. interaction with simple prototype to record physician opinions and feelings), and usability testing (i.e. interaction with full prototype focusing on quantitative measures of effectiveness, efficiency and user satisfaction). The authors of the evaluation found that average user satisfaction was significantly increased with user-centred design methodology compared to traditional design. The authors note that clinician accessibility was low and suggest portable devices be used to conduct this type of study within the users' environment. Argentina has created a national strategy for eHealth which aims to harmonise the diverse digital health initiatives under the broader goals and principles of the strategy. The strategy includes digital health evaluation and benefits measurement.

4.1.3 LESSONS LEARNT

Argentina has observed that the evaluation and benefits measurement of digital health services and technologies is dependent on:

- The maturity of the digital health system; and
- Identification of the barriers to adopting digital health services and technologies so that sufficient evaluation can occur.

4.2 AUSTRALIA

4.2.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Australia does not have a nationally adopted approach to the evaluation of digital health technologies and services. However, the benefits evaluation framework (17) used by the Australian Digital Health Agency has been adapted from a local government benefits realisation framework. Benefits measurement is the process of identifying, defining, tracking, realising and optimising the benefits delivered by business investment. The framework has four phases: understand, plan, realise/report, and evaluation. Evaluation was added to the framework in order to create a feedback loop that enables the assessment of the impact of change. Evaluation focuses on benefits (i.e. getting benefits and are they the anticipated ones), delivery (i.e. getting them done well), design (i.e. doing things in the right way) and strategy (i.e. doing the right things). The core objective of the evaluation phase is to identify learnings from program activities to inform strategic decisions and priorities. The benefits framework has a focus on net benefits. That is, overall impact requires the assessment of both positive and negative benefits.

A strength of the framework is that it has five work streams (Appendix C) that provide evidence of benefit at varying stages of digital maturity. It can also measure the success of change management. An approach to scalability measurement and health economic evaluation is underway to evaluate more comprehensively the benefits of system improvements that are currently being trialled in 'test bed' environments.



4.2.2 CASE STUDY: MY HEALTH RECORD OPT-OUT TRIALS

The participation and use trials of the My Health Record system (16), Australia's national personal health record, were designed to address three key outcomes. These were: (a) understand public reaction to an opt-out participation arrangement; (b) understand the extent to which healthcare provider contribution and use of the system improved when the majority of patients had a record; and (c) understand implementation issues. The key measures used in the evaluation included: awareness and understanding of the My Health Record system; confidence to use the system; participation in, and use of, the system; as well as increased understanding of the effectiveness of different approaches for driving participation and use. A very broad range of data were collected. For example, interviews, focus groups, both patient and healthcare provider surveys, media monitoring, and clinical safety and quality audits. The evaluation found that the opt-out approach increased both individual and healthcare provider participation and use. Moreover, the opt-out trial sites achieved better outcomes in terms of participation, understanding and some aspects of use of the My Health Record system. The evaluation provided key lessons learnt to inform the Australian government's understanding of the effectiveness of different approaches for driving participation in and use of the My Health Record system.

4.2.3 LESSONS LEARNT

The lessons learnt from the Australian experience of evaluation and benefits measurement of digital health technologies and services include:

- Importance of engaging stakeholders; and
- The need to build the evidence base for economic and financial evaluation of digital health technology and services.

4.3 BRAZIL

4.3.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Brazil does not currently have a national standard approach to the evaluation of digital health technologies and services.

Brazil recently published the eHealth strategy reference document based on the "WHO-ITU National eHealth Strategy Toolkit". This document proposes an eHealth vision for the country and describes the contributory mechanisms for achieving the objectives of the National Health System. However, the digital health strategy is in the planning stage, and is not implemented.

This strategy takes an approach to examining the benefits of implementing the eHealth components, including contributing to the improvement of the evaluation and monitoring process of national public health policies. However, it does not comment specifically upon the evaluation of the digital health technologies and services.



4.4 CANADA

4.4.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Canada Health Infoway has established a national evaluation lifecycle that is applied to each digital health investment program. These core areas of activity are: (a) evidence-informed value proposition; (b) indicators and tools; (c) evaluate investments; (d) surveys and primary research; and (e) pan-Canadian study. The benefits evaluation framework (see Appendix B: Country Responses) (17) is embedded within a broader clinical adoption framework (18) and aims to understand how investments in digital health translate to patient and health system outcomes. The outputs of the evaluation can be applied to guide future investment decisions. The framework covers the implementation, adoption and impacts of the digital health solution and takes into account system, information and service quality while considering use and satisfaction of the user. The benefits measurements identified include healthcare quality, access for providers and clinicians and productivity, which includes efficiency and costs.

The strength of the framework is that it has been applied for multiple evaluations, both nationally and internationally (e.g. Australia, the U.S., Malaysia, New Zealand), creating a strong evidence base for its application. Examples of the application of the framework include a remote monitoring solution for patients with chronic disease (19), remote patient monitoring solutions for community paramedicine (20), as well as comparison of electronic referral system features, adoption and benefits. (18) Published reports from Canada Health Infoway outline benefits evaluation examples in diagnostic imaging programs, drug information system programs, interoperable electronic health records (EHRs), telehealth programs, electronic medical record programs and public health surveillance programs. A limitation of the benefits evaluation framework is that an evaluation or an assessment of the scalability or translation of the digital health solution is not specifically addressed.

4.4.2 CASE STUDY: INTEROPERABLE EHRs AND EMERGENCY DEPARTMENT CARE

One example is the impact of interoperable EHRs to support the timeliness of emergency department (ED) care. The indicator of benefits evaluation was to demonstrate efficiency and effectiveness of the EHR in local EDs. A range of study designs were used to measure benefits which included: a focus group with ED personnel; time motion studies; comparison of data pre- and post-EHR implementation; a select sample of patients in ED to track time and specific aspects of their care while in ED; and measuring the number and types of lab and imaging tests ordered and associated costs. The application of this mixed methods approach offered an opportunity to measure a series of activities that contribute to the broader objective and the strengths and weaknesses of all of these.



4.4.3 LESSONS LEARNT

Canada Health Infoway has consolidated the lessons learnt from benefits evaluation experience. These are summarised in Table 1 below:

Table 1: Key benefits evaluation lessons learnt from Canada Health Infoway

<p>Defining the purpose for the evaluation concretely and confirming with key stakeholders is a commonly missed step.</p>	<p>Evaluations can be focused on demonstrating value, improving processes, or many other purposes, but evaluation approaches to meet these objectives will differ and there will be important trade-offs.</p>
<p>Incorporate your evaluation into a comprehensive benefits realisation approach.</p>	<ul style="list-style-type: none"> a. Target the benefits. Be specific and quantify adoption levels and benefits expected. b. Focus on the changes required. Achieving benefits will invariably require more than just technology. There will be processes, behaviours, and policies etc. that need to change. Identify and address critical success factors. c. Measure and improve over time. Evaluation can be most powerful when applied to continuous improvement. Measure adoption, perceptions of users and objective benefit indicators, so issues can be identified and successes celebrated.
<p>Stakeholder engagement is often not comprehensive enough in evaluation efforts.</p>	
<p>Governance is critical for long-term success in realising benefits. Evaluation will occur months or sometimes years after go-live so make sure it's clear who has accountability in those timeframes, and that the support for evaluation will be maintained. Benefits will cross the boundary between accountabilities of the IT organisation and clinical or business leaders.</p>	
<p>Defining the right set of indicators is a substantial challenge, but borrowing ideas from others is the easiest path to success.</p>	<ul style="list-style-type: none"> a. Mix of methodologies is recommended. Different methods will give different perspectives and some methods and data sources will inevitably fail, so mixed methods reduce risk. b. Be strategic about your sample – if it's a large deployment, measurement can be done selectively. c. Qualitative and quantitative methods can be very complementary. Short-term evaluations and long-term indicators are also complementary. Rigorously measuring an impact can be too costly to repeat, but once completed, a proxy indicator may be possible to track. d. Anticipated benefits may vary by specific use cases for the same solution. Factors that may affect use cases include context (primary vs emergency), end user's healthcare role, patient population, and specific care scenarios. e. Useful to develop a conceptual representation of the expected pathway to benefits realisation that clearly



articulates how the solution enables healthcare improvement benefits.

- f. Development of benefits evaluation measurement timelines should be informed by anticipated timelines for achieving sufficient adoption and usage to enable benefits realisation.

Planning timelines is critical, but keep in mind that evaluations are entirely dependent upon the implementation, deployment and adoption timeframes.

4.5 ESTONIA

4.5.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Estonia is currently developing a national public framework for the evaluation of the benefits of a new digital health technology initiative or activity. At present, benefits and evaluation frameworks, which are not digital health technologies or services specific, are used by the public health insurance fund, Estonian Health Insurance Fund (EHIF) and the Ministry of Health.

The benefits evaluation framework employed by EHIF is used to make decisions regarding the components and extent of the public health insurance benefits package. The basic structure of the EHIF evaluation framework is also legislated by the government. The benefits evaluation framework includes a medical efficacy assessment and cost-benefit analysis in order to reach conclusion about (a) whether a new proposed healthcare service (procedures and/or systems applied by healthcare service providers), medical device or medicinal product meets internationally recognised standards and is of higher efficacy than similar procedures/systems or a product already included in the EHIF benefits package; and (b) whether the new service, device or medicinal product is cost-effective in the Estonian health system context. Medical efficacy assessment relies mostly on international evidence while cost-benefit analysis takes into account cost structures of the Estonian health system. In this framework, digital health technologies can be assessed either as healthcare services (i.e. systems/procedures used in care provision that have a significant digital component, e.g. remote monitoring and care provision) or as stand-alone medical devices (e.g. mobile health applications).

One limitation of the evaluation approach applied by the EHIF is the limited international evidence base for digital health technologies and services on which this approach relies. Moreover, the availability of high-grade evidence provided by randomised control trials is also limited in areas of rapid innovation such as digital health. Similar methodology is also employed, albeit in a simplified format, by the agencies of the Health Ministry and applied to preventive public health services that are provided to citizens using government funding. Currently, there is limited experience applying this standard assessment methodology to digital healthcare services and no experience in assessing stand-alone software applications. However, a concept for evaluating digital health services and their benefits is being developed and should be finalised by Spring 2019.

Evaluation frameworks in a broader sense have been applied on a case-by-case basis by healthcare authorities and academia to provide input for major digital health policy and public investment decisions or post-hoc evaluations of digital health projects. Examples of these include electronic health records, ePrescription systems and personalised



medicine. This type of evaluation considers the entire value chain including inputs, processes, outputs and outcomes, in order to understand whether the expected goals of the technology or service were or were not achieved.

Decisions for adding new healthcare services to the national reimbursement list use traditional health technology assessment principles and do not specifically incentivise, nor take into account possible incentives, for digital health services or the digitisation of existing healthcare services. The methodology guidelines for health technology assessment in Estonia do not mention the need to evaluate or take into account the specific impact of digitisation or the opportunities for digital services.

In some cases, evaluation incentives are included in the reimbursement model and the adoption, and thus evaluation, of digital services is conducted by the adopting healthcare provider. On the other hand, in the case of most reimbursed healthcare services, there are disincentives in the reimbursement model for the adoption of digital technologies.

In addition to public sector frameworks, healthcare service providers, mostly hospitals, need to evaluate benefits of new healthcare procedures to be implemented. In most cases, these evaluations are of a limited scope, ensuring compliance with international/national guidelines as well as economic viability in the context of the service provider.

As digital health technologies are intertwined with the national information communication technology (ICT) infrastructure, the benefits measured as part of digital health evaluation take into account the added value to multiple parts of the economy. For example, solutions for personal identification, secure electronic communication, obtaining personal consent, privacy and access management, data intelligence, and others are common problems in digital health technologies and services that can be applied to other parts of the economy.

4.5.2 CASE STUDY: NATIONAL ELECTRONIC HEALTH RECORD EVALUATION

When evaluating national digital health infrastructure, Estonia used the PENG method for analysing the potential costs and benefits associated with the implementation of the National Electronic Health Record (EHR). The PENG model is based on a framework with ten steps that evaluate the benefits and costs of healthcare projects from different perspectives. This method was chosen primarily because of its integrated approach, enabling both numerical and non-numerical data to be inputted. The PENG method is a multi-dimensional framework that combines methods of project evaluation including Balance Scorecard applications, goal guidance models and institutional development methods. This approach enables the evaluation, not only of immediate financial gains and costs, but also the impact of tangible and intangible benefits to the patient, provider and broader society (21).

One of the limitations of the PENG model is that, in this evaluation, not all benefits attributed to the national EHR showed monetary value, despite the evaluation of important objectives and benefits.

4.5.3 CASE STUDY: EPRESCRIPTION SERVICE

The impact assessment on the ePrescription service comprised three categories: time, cost and quality. Time savings were primarily viewed from an individual's perspective



whereas cost savings were attributed to the administration of prescriptions by government agencies. The quality gains were projected to arise from less adverse drug events and better adherence to medications. The Estonian nationwide second-generation ePrescription was launched at the beginning of 2010. By the end of 2013, only 3.1 per cent of all prescriptions were paper-based. Moreover, the service has a high satisfaction rate among patients, physicians and pharmacists alike. This assessment demonstrated whether the objectives set for the service in 2008 were fulfilled (22).

It should be noted that for the national case studies presented above, mostly post-hoc evaluation methods were used, with the evaluation being completed by independent academic institutions.

4.5.4 LESSONS LEARNT

The key lessons from Estonia's experience include:

- Reimbursement incentives for implementation, adoption and evaluation of digital health technologies and services by health services may encourage the completion of evaluations
- The benefits measured as part of digital health evaluation take into account the added value to multiple parts of the economy
- One of the reasons the digital health evaluation evidence base is limited is the difficulty in conducting a comprehensive cost-benefit analysis as the perceived benefits drawn from the literature are themselves lacking evidence

4.6 ITALY

4.6.1 APPROACH: MODEL FOR ASSESSMENT OF TELEMEDICINE

The Model for Assessment of Telemedicine (MAST) (23) was developed to provide a framework for decision-making for telemedicine applications. The MAST was developed with clinical, administrative and political decision-makers as the main users, enabling decisions to be made in various environments including hospitals, communities, regions and government departments. The MAST is intended to be used when an investment decision needs to take into account the effectiveness and value-add to healthcare of a particular digital health solution.



The model consists of three components:

1. Conducting an assessment of all multi-component factors involved before an evaluation commences;
2. Conducting a multidisciplinary assessment of the outcomes of telemedicine; and
3. Conducting an assessment of the transferability of results found in the scientific literature and empirical evidence to a broader population.

The three components of the evaluation framework can be used individually or as a whole. Three ways have been described in which MAST can be used:

- For design of telemedicine research studies;
- For developing a checklist for domain inclusion and outcomes in telemedicine research studies; and
- For performing an assessment of a telemedicine application using literature and other relevant information on the telemedicine application.

A strength of the model is that it can be applied for multidisciplinary purposes and it considers a broad range of factors that may influence the decision to implement a telemedicine application (e.g. digital maturity or legislation). The model also includes considerations of scalability and generalisability of outcomes. Limitations of the model are described by its creators as being time-consuming (if new studies need to be created), an inability to determine why the solution works, no understanding of implementation requirements for the solution and the model being only appropriate for use with mature digital health solutions. In practice, the MAST has not been used in its entirety to plan and evaluate a digital health technology or service design. This is because the model does not provide detail as to which criteria should be completed as a minimum, and therefore the quality of evaluations using the framework varies significantly (23).

4.6.2 CASE STUDY: HEALTH TECHNOLOGY ASSESSMENT SURVEY

Arsenà.IT led, in collaboration with Agenas, a health technology assessment survey and set up a permanent observatory on technologies, specifically focusing on telemedicine services and international standards. Partners involved were the University Cattolica del Sacro Cuore, IRCCS San Matteo of Pavia, APSS Trento, Emilia Romagna Region, and "G. d'Annunzio Chieti Pescara" University. Measures focused on the economic, clinical and organisational impact, considering the specific characteristics of the sector and the interoperability of each solution.



4.6.3 LESSONS LEARNT

The lessons learnt from digital health evaluation and benefits management in Italy include:

- Evaluations should be flexible for multidisciplinary purposes and consider a broad range of factors that may influence the decision to implement a telemedicine application (e.g. digital maturity or legislation);
- Evaluation should consider scalability and generalisability of outcomes; and
- Evaluation and benefits measurement approaches should be applicable at all stages of digital health system maturity.

4.7 PORTUGAL

4.7.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Although the Ministry of Health Portugal does not have a nationally standardised approach to the evaluation of digital health technologies and services, it is fully committed to implementing new forms of analysis. Specifically, the strategy is to provide a methodology that integrates international standards and frameworks, including the development of shared policies, financial instruments, and cost-benefit analysis, adapted from the European Commission 2016 framework “Guide to Cost-Benefit Analysis of Investment Projects” (24).

The cost-benefit analysis methodology aims to determine whether initiatives that support digital health technology and services are likely to have a positive or negative impact on both the “do nothing” or “do something” scenarios.

4.7.2 CASE STUDY: PAPERLESS RECEIPTS AND ELECTRONIC IMMUNISATION REGISTRY

Although only in the early stages, it is anticipated that the cost-benefit analysis methodology will be used to evaluate the following digital health pilot initiatives:

- Paperless Receipts
- Electronic Immunization Registry.

The aim of the evaluation for these digital health technologies and services is to measure the impact and effectiveness with regard to the national health system, and to quantify the benefits and savings for patients and all health entities.



4.7.3 LESSONS LEARNT

The lessons learnt from digital health evaluation and benefits measurement in Portugal include:

- When developing a national approach consider using an economic evaluation method such as cost-benefit analysis; and
- Cost-benefit analysis enables quantification of the cost savings and expenditure associated with a digital health evaluation and benefits measurement.

4.8 KINGDOM OF SAUDI ARABIA

4.8.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Currently, the Kingdom of Saudi Arabia has no national benefits evaluation framework. The current approach to benefits evaluation in the Ministry of Health is tailored to each digital health deployment.

Initially the focus has been on measuring:

- Process indicators (i.e. user numbers, sites deployed, etc.); and
- Impact indicators mainly relating to user satisfaction and/or access to healthcare services.

4.8.2 CASE STUDY: NATIONAL HEALTH OBSERVATORY

The Kingdom of Saudi Arabia is in the process of implementing the National Health Observatory (Marsad) on Health Data, Health Systems and Policies. This supports and promotes evidence-based health and healthcare services insight and intelligence, and will facilitate comprehensive analysis and reporting of the dynamics of healthcare and health services data across the Kingdom of Saudi Arabia. It includes:

- Key disease mapping and analytics;
- Enabling informed decisions, collaborating and benchmarking with global health programs;
- Publishing accurate and up-to-date national public health and healthcare statistical reports;
- A decision support tool for bodies like the Ministry of Health (MOH), Ministry of Finance and Ministry of Economy and Planning;
- Single point of truth for the national public health and healthcare services; and
- Disseminating data and information for clinical research and improving health service procedures.



4.8.3 CASE STUDY: PATIENT EXPERIENCE MEASUREMENT

Beginning in January 2018, MOH implemented a Patient Experience Measurement Program where a weekly sample of all patients receiving a healthcare service in all MOH healthcare facilities are surveyed. This data is monitored via a real-time dashboard, MOH-wide, by region, by service and over time. It allows facilities to set targets and to develop action plans. This service will be expanded to include a digital healthcare service in the next phase. The Patient Experience Measurement Program is a MOH-wide real-time indicator of the status of the patient experience.

4.8.4 CASE STUDY: CENTRALIZED APPOINTMENT SYSTEM

The Kingdom of Saudi Arabia is currently deploying a Centralized Appointment System. The objectives of this system are to improve patient engagement through multi-access channels (mobile, web, call centre) and notification capabilities, reduction in the number of no-shows, leading to better clinical services utilisation, potentially reduce Emergency Room visits for non-critical cases by directing patients to alternative service options and automate the outpatient referral process from PHCs to secondary hospitals; and from secondary hospitals to tertiary hospitals. This evaluation is dynamic and ongoing with the following measures currently monitored: patients (users) accessing the system; number of appointments booked by region; and patient (user) satisfaction.

4.8.5 LESSONS LEARNT

The lessons learnt by the Kingdom of Saudi Arabia include:

- Real-time dashboards can be an effective mechanism for monitoring and reporting digital health services and technology in real time;
- Developing an evidence and evaluation culture requires correct workforce skills, processes and tools to complete digital health evaluation; and
- Nationally agreed processes and policies, such as a benefits evaluation framework, are required for the evaluation of digital health services and technologies.

4.9 SWEDEN

4.9.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

There is no national approach to digital health evaluation or benefits measurement in Sweden. The Swedish Agency for Health Technology Assessment and Assessment of Social Services is responsible for completing evaluations of existing academic evidence for healthcare interventions, which includes digital health technology assessments. Evaluation of evidence includes reviewing the benefits, risks and costs of methods used in healthcare delivery and social services. The MAST framework (see above in the section on Italy) is sometimes applied to digital health technologies and services in Sweden.

In Sweden, there are some digital health technologies that require regulatory approval and therefore digital health evaluation is completed as part of post-market surveillance. One example is the clinical decision support systems that are intended to support the diagnosis and treatment of a patient. These digital health technologies are required to



meet quality assurance requirements, and as such, have ongoing evaluation requirements (25).

4.9.2 CASE STUDY: APPLICATION AND EVALUATION OF THE HEALTH TECHNOLOGY ASSESSMENT APPROACH

One example of a digital health evidence evaluation was the review of Computer-Aided Detection (CAD) in mammography screening (26) and an evidence map that was completed for assistive technology – digital tools that involve social stimulation for mental health in later life (27). The impact of this evidence evaluation on policy and clinical practice was researched. This showed that the health technology assessment reports had a high impact on clinical guidelines, as well as a moderate or high impact on comprehensive decisions, the commencement of research and changes in clinical practice (28).

4.9.3 CASE STUDY: EVALUATION OF THE UPTAKE OF DIGITAL HEALTH SERVICES

Sweden has undertaken a digital health research and evaluation project to understand the extent and focus of digital healthcare services available to patients in Sweden. Digital healthcare services were defined as a form of digital communication where the patient and healthcare provider are spatially separated. The goal of this project was to provide recommendations as to which types of care and treatment were suitable to be managed through digital healthcare services. The research aimed to understand the number of consumer users accessing the services as well as their demographics, location, reason for using the service and when the service was being accessed. The number of providers who were offering digital healthcare services were collected as well as their clinical speciality and where they were located. The research found that digital healthcare services should follow the principles of face-to-face care including; good quality; satisfaction of the patient's need for security, continuity and safety; and that principles specifically for digital health services should be developed.

4.9.4 LESSONS LEARNT

The key learnings from Sweden in evaluating digital health technologies and services are:

- The importance of: engaging relevant stakeholders – being healthcare practitioners, policy makers and/or consumers – before and after completing an evaluation; and identifying those who will be using the evaluation results;
- The importance of setting the expectation for key stakeholders about the quality of evidence that will be produced and the quality of evidence that currently exists for digital health technologies and services;
- The critical need to develop the skill sets of researchers in digital health technology and evaluation as the results can be dependent on who undertakes the evaluation; and
- The need to take time and money into consideration as the more complex the evaluation, the more money will need to be provided to fund the evaluation. The overall cost of the technology or health service must be considered when decided whether or not to complete an evaluation.



4.10 THE REPUBLIC OF KOREA

4.10.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

In the Republic of Korea, each of the ministries is responsible for evaluating digital health programs for their relevant domains. These ministries include the Ministry of Health and Welfare, the Ministry of Justice and the Ministry of Defence.

4.10.2 CASE STUDIES

The Ministry of Health and Welfare has completed evaluations in the topic areas of remote care, transfer and return, aged care, and emergency care. For all of these evaluations, patient satisfaction was a core measurement as well as the demographics of their healthcare providers and the patients themselves. Clinical effectiveness, economic evaluation and service compliance was measured in the remote care program while economic effectiveness was the only measurement in the aged care programs.

4.10.3 LESSONS LEARNT

The key learning from South Korea in evaluating digital health technologies and services is:

- The choice of evaluation measures varied between evaluations and were dependent on the purpose of the evaluation.

4.11 UNITED KINGDOM

4.11.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

The National Institute for Health and Care Excellence (NICE) provides national guidance and advice to improve health and social care. NICE selects and evaluates medical technologies to determine whether evidence supports the case for adoption in the health and social care system through the medical technologies evaluation programme (MTEP). The selection criteria in the evaluation of medical technologies include the following (29):

- **Claimed additional benefit to patients** – The extent to which a medical technology claims measurable benefit to patients over currently available National Health Service (NHS) technologies in terms of its impact on quality of life or life expectancy.
- **Claimed healthcare system benefit** – The extent to which the technology is likely to reduce use of staff or facility resources. For example, the extent to which a technology:
 - facilitates outpatient diagnosis or treatment;
 - has the potential to replace several technologies in current use;
 - requires fewer staff than the technologies in current use; and
 - reduces length of hospital stay.



- **Patient population** – The larger the number of patients on whom the technology may be used, the greater the likelihood that a national evaluation is important.
- **Disease impact** – The greater the impact of the disease or condition on quality of life or life expectancy, the greater the likelihood that a national evaluation is important. For technologies aimed at treatment, consideration should take into account the likely degree of improvement in life expectancy, disease severity and quality of life, paying particular attention to conditions associated with social stigma.
- **Cost considerations** – Consideration of the costs of the technology, including initial acquisition costs (including associated infrastructure) and running costs (including maintenance and consumables).
- **Sustainability** – Is the technology likely to contribute to the sustainability agenda through, for example, less energy usage or less waste generation during production or clinical usage?

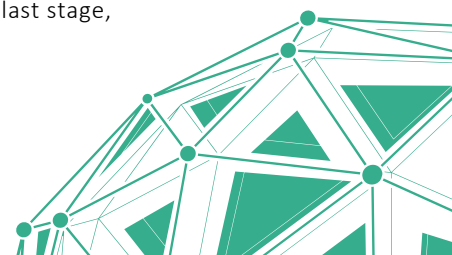
NICE publishes Medtech innovation briefings that address the type of technology, evidence on effectiveness, resource use and user experience. With regard to digital health technologies, these briefings have been published for a sleep improvement program delivered via mobile app (30), a web-based messaging system that allows patients to directly contact healthcare professionals (31), and a diabetes mobile app which has a secure clinician-facing component to allow remote monitoring of blood glucose levels (32).

The NHS Digital Benefits Eligibility Framework (BEF) (11) defines governance, benefits eligibility and attribution, as well as the management approach. The BEF applies to all programs and services provided by NHS Digital. The BEF defines a benefit as “a measurable improvement results from change, which is perceived as positive by one or more stakeholders, and which contributes to one or more organisational objectives.” Within the BEF, benefits are classified into five different types. These are:

1. Cash releasing benefit, i.e. reduce costs to organisations in a way that resources can be completely re-allocated, or benefit is claimed from a budget;
2. Non-cash releasing benefits, i.e. provide economic value through efficiency and effectiveness savings within the health and care system, but do not release money to budgets;
3. Public benefits, i.e. provide economic value outside of health and care system;
4. Quality benefits, i.e. benefits which are agreed to have value but cannot easily be monetised; and
5. Disbenefits, i.e. ongoing negative impact or consequence.

The BEF outlines critical success factors that are related to business rules and can be applied to optimise benefits realisation. These critical success factors are: (a) a balancing act of management and governance; (b) people buy-in; and (c) clear unambiguous benefits.

Complementary to the BEF is the Guide to Benefits Management of Informatics. (33) The benefits management cycle has five steps: identify and quantify; value and appraise; plan; realise; and review. Following identification and quantification, the guide recommends valuing benefits in monetary terms and then planning for the realisation and monitoring of benefits. The planning stage also includes planning effective stakeholder engagement. The realise stage is core to the change effort and requires active management of emergent benefits and mitigation of disbenefits. The last stage,



review, is important to ensure that benefits are achievable, continue to represent value for money and arrangements have been made for monitoring and evaluation.

4.11.2 CASE STUDY: GP AT HAND

GP at Hand is a primary care practice within London offering digital-first primary care through the use of a mobile app and video consultations. The app allows patients to access GP services 24/7, at short notice, via a virtual appointment using video conferencing and voice calls on a smartphone. Patients can also access symptom-checker services (driven by artificial intelligence) and health monitoring software. The evaluation began in August 2017 and is split into three different phases which are summarised in Table 2 below.

Table 2: Phases of GP at Hand evaluation

Phase of evaluation	Start date	Aim	Key components
Assurance	August 2017	Conduct ongoing clinical assurance process to ensure the practice is safe and effective.	Clinical review to ensure the practice is safe and is meeting contractual requirements, and assess whether the practice has addressed questions from previous reviews Financial impact of GP at Hand on commissioning group finances Financial impact of GP at Hand on primary care
Rapid analysis of emerging policy questions	January 2018	Rapid, focused, policy analysis on questions that emerge on GP at Hand as the practice develops.	N/A
Independent evaluation	March 2018	Provide robust, independent, and rapid analysis of the outcomes and impacts of GP at Hand.	Business model and practice characteristics. Impact of GP at Hand on users of practice Impact of GP at Hand on wider system Impact of GP at Hand on the workforce The future of a digital-first model and required policy changes

A wide range of data sources and metrics were collected including patient demographics, use and effectiveness of artificial intelligence triage, workforce makeup and utilisation, secondary care utilisation pre and post, GP patient survey and prescribing data.



4.11.3 CASE STUDY: DIGITAL CHANGE MANAGEMENT

A recent publication from the King’s Fund outlines five case studies across digital change in health and social care (34). The digital change addressed in the case studies included shared care records, barcoding, and medical device integration. From these case studies, key themes in successful digital change management are presented with key lessons on how to overcome barriers as illustrated in the case studies. These themes are summarised in Table 3.

Table 3: Key themes in successful digital change management

Theme	Why it is important	Overcoming barriers
Leadership and management	Generates interest and support among key decision-makers inside organisations; sends a message about importance of programme within organisation	<ul style="list-style-type: none"> • Use the right leadership and manage relationships carefully • Be motivated by the right things and don’t expect an immediate cost saving • Change culture where necessary and keep board involved • Adapt approach to suit project • Do not see implementing technology as ‘IT projects’ – see as clinical change
User engagement	Workforce gains sense of ownership over change process and feel they can influence and shape the technology	<ul style="list-style-type: none"> • Get users involved early on and make their involvement continuous • Explore what is possible with digital technology • Reach across the spectrum of attitudes and bridge cultures • Use and support clinical leadership • Avoid imposing fixed solutions • Decide on appropriate implementation model
Information governance	Vitally important to keeping patient data confidential	<ul style="list-style-type: none"> • Approach information governance as a cultural issue rather than technical • Relationship-building a core part of cross-organisational information governance strategy • Be transparent about sharing information • Build a positive case for sharing data
Partnerships	How organisations undergoing digital change were supported by other bodies to support that change	<ul style="list-style-type: none"> • Put effort into building relationships • Use suppliers for their change management expertise • Get a single vision of success across partnerships • Delineate clear roles and responsibilities in the partnership • Organisations should work together to get the best deal from partners • Choose a supplier that is open to sharing data



Theme	Why it is important	Overcoming barriers
Resourcing and skills	Resourcing (finance, capacity and people) and skills (ability, attitudes and experience) are key enablers for delivery	<ul style="list-style-type: none"> • Plan how you will deploy your resources at key points • Identify the skills you need from those managing and facilitating your project • Give your team incentives to bring about change

4.11.4 LESSONS LEARNT

The key lessons learnt from the United Kingdom’s experience include:

- Prioritise what needs measuring;
- Stakeholder engagement and input to get the right people on board;
- Collect rapid insights into key aspects of practice; and
- Use appropriate comparators and counterfactuals.

4.12 URUGUAY

4.12.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

Uruguay does not have a national approach to digital health evaluation and benefits measurement. Uruguay is currently developing a national health strategy, National Health Objectives, which will direct the measurement of evaluations. This will also enable all key stakeholders within the health system to work towards the same objectives. The key objectives are listed below:

- Achievement of population health improvements;
- Reduce inequalities associated with healthcare access;
- Improve the quality of care processes; and
- Create a health system where individuals have positive healthcare experiences.

In 2007, the Electronic Government and Information and Knowledge Society Agency (AGESIC) was created to lead the Electronic Government strategy and its implementation at a national level, and to promote the use of health data and address inclusion and equity issues with the use of ICT. In 2012, this Agency created a digital health area, known as the Salud.uy Program, whose main objective was to support the strengthening of the National Health System through the use of ICT (eHealth).

4.12.2 CASE STUDY: NATIONAL ELECTRONIC HEALTH RECORD

Salud.uy Program led the implementation of the National Electronic Health Record (HCEN), which stores electronic documents and clinical content. The main objective of this project is to improve continuity of care, as well as obtaining data to support the development of public policy. In 2017, it was decreed that healthcare facilities must have electronic medical record technologies. Currently, healthcare facilities have varying degrees of ICT maturity, with the decree increasing digital health system maturity.



The ICT and Health survey has been conducted in Uruguay since 2014, with the goal of gathering data on the evolution of ICT in the health sector, as well as evaluating the progress of the Salud.uy program in providing input into public policy. The key stakeholders engaged in this evaluation are public and private healthcare facilities, healthcare providers and individual users. This year, there will be an impact evaluation of the HCEN. The analysis of the data collected from this evaluation will be presented in 2019.

4.12.3 LESSONS LEARNT

The key lessons learnt from Uruguay's experience include:

- Political support is required when implementing and evaluating a system-wide initiative; and
- Evaluation and implementation is limited by the digital maturity of individual health services.

4.13 UNITED STATES

4.13.1 APPROACH TO DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT

The first standard approach identified by the U.S. is the publication by the Agency for Healthcare Research and Quality, [Guide to Evaluating Health Information Exchange Projects](#) (35). It is designed to assist evaluators to create an evaluation plan and evaluate health information exchange (HIE) projects. The key sections of the guide address selecting an evaluation team, defining the project, assessing the value of HIE, developing an evaluation plan, and disseminating findings. The methodology outlined is consistent with other similar guides and directs the reader to both formative and summative evaluation, prospective and retrospective evaluation designs, as well as qualitative and quantitative methodologies.

A key strength of the guide is that, in order to support evaluation plan development, it provides detailed guidance on data sources, measures, and points for consideration when designing an evaluation. For example, suggested data sources include EHR databases, HIE server log files of transactions and reaching out to HIE organisation members as a source for information. An additional key strength is its guidance on selecting an evaluation team, the methods used and project management approach.

4.13.2 CASE STUDY: SYSTEMS ENGINEERING INITIATIVE FOR PATIENT SAFETY

The Systems Engineering Initiative for Patient Safety (SEIPS) model provides a framework to examine the structures, processes and outcomes in health and the interactions between a series of components (listed in Table 4). The framework identifies aspects for improvement and intervention by characterising the interaction between people and their environment (36). The SEIPS model places the individual at the centre of the work system and stresses that work systems should be designed such that they enhance and facilitate the performance of the individual (28). In the context of evaluating digital health technologies, Table 4 shows that technologies and tools are highlighted as a core component of the work system or structure.



Moreover, the SEIPS model applies the concept of “balance” – that some negative elements may be minimised by enhancing positive elements.

Table 4: Core components of the Systems Engineering Initiative for Patient Safety (SEIPS) model

	Components	Elements (examples)
Work system or structure	Person	Education, skills and knowledge; Motivation and needs; Physical characteristics
	Organisation	Teamwork; Organisational culture and patient safety culture; Management style
	Technologies and tools	Various information technologies (EHR, computerised provider order entry, bar coding medication admin); Other technologies and tools Human factor characteristics of technologies and tools (e.g. usability)
	Tasks	Job content, utilisation of skills; Job demands
	Environment	Layout, noise, work station design
Process	Care processes and other processes	Care processes; Information flow; Process improvement activities
Outcomes	Employee and organisational outcomes	Job satisfaction; Employee safety and health
	Patient outcomes	Patient safety; Quality of care

The strengths of the SEIPS model include the provision of a broad view of processes, as well as a focus on system design and the impact on processes and outcomes. Moreover, the framework provides a description of a system, the components of that system as well as the interactions between these. A key limitation of the framework is that it is descriptive and unable to provide insight into how changes in factors may impact employee, organisational or patient outcomes (36).

4.13.3 CASE STUDY: APPLICATION OF SEIPS FRAMEWORK

Examples of the application of the SEIPS framework include evaluating contributors to readmission after complex surgery and the role of electronic health records (38), evaluating the role of technology design in vaccine documentation in paediatric primary care (39), and seeking to understand changes to mental health care with the wide use of computer programs and smartphone applications (40).



4.13.4 LESSONS LEARNT

The key lessons learnt from the U.S. experience include:

- The need for step by step guidance in designing and delivering evaluations (this includes accessing appropriate data sources);
- The importance of measures having a focus on clinical and financial value; and
- The need to promote stakeholder and technical engagement.



5 DISCUSSION

5.1 KEY FINDINGS: DIGITAL HEALTH EVALUATION AND BENEFITS MEASUREMENT APPROACHES

Due to the inherent complexity of the nascent field of digital health benefits evaluation, international collaboration is required in order to avoid the duplication of effort and to ensure rapid adoption of best practice approaches to evidence building and its application.

By increasing standardisation of approaches, and using the growing international evidence base to support the quality, safety and efficiency benefits of digital health, countries will have a greater ability to assess their digital health investment decisions, before, during and after implementation.

To facilitate these outcomes, a number of common themes have been identified across the responses, from case studies and the approach to benefits evaluation. These key findings are presented below.

5.1.1 SIGNIFICANT VARIATION EXISTS IN CURRENT EVALUATION APPROACHES

The previous chapter of this report presents an overview of the international approaches used to evaluate the benefits of digital health technology and services among GDHP participant countries. These approaches show significant variation, not only in maturity, but also in methodology. By understanding these variations, it is hoped that greater standardisation of evaluation approaches can be achieved, and that less mature countries can benefit through the adoption of existing benefits measurement methodologies, rather than having to develop their own from scratch.

More advanced countries such as Canada, Australia and the United Kingdom have relatively mature, emerging national frameworks for the evaluation of digital health benefits, supported by a growing evidence base. These frameworks, such as NASSS (a framework for theorising and evaluating Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies), provide a strong structure and form a basis for a consistent approach to benefits evaluation. However, work is still required to drive greater consistency between international approaches. In particular, this includes techniques for the selection of key measures depending on context, complexity and the available evidence base for specific digital health technologies or services.

The majority of countries responding to the survey do not currently have a national approach to digital health evaluation and benefits measurement, and are at an early stage in this journey. For these countries, collaboration, the ability to understand lessons learnt, and the potential to adopt existing standardised evaluation approaches should be a key goal of the GDHP Evidence and Evaluation work stream.



5.1.2 DEFINING THE PURPOSE OF EVALUATION IS A CRITICAL FIRST STEP

As noted in the Canadian response, defining the purpose of evaluation is a critical step that is often missed.

Evaluations can be undertaken for a variety of reasons, and may focus on demonstrating value, improving processes, justifying the continuation of a program of work, or a variety of other purposes. The understanding of this purpose and the context that it provides may then indicate the most appropriate evaluation approach.

The purpose of the evaluation is instrumental in deciding which evaluation methodology to use. Research by Eslami *et al.* (42) found that the ‘why’ or purpose of an evaluation was least commonly reported in the health information system evaluation frameworks. When considering the development of a national digital health evaluation and benefits measurement framework, participant countries might consider requiring the purpose of an evaluation to be specified to ensure the methodology chosen is fit for purpose. Eslami *et al.* also report the context being the ‘who’ as well as the ‘why’ of the evaluation, the process being the ‘how’ and ‘when’ of the evaluation and the content being the ‘what’ of the evaluation. Figure 3 demonstrates how a participant country might consider developing a framework (43) with these questions in mind:

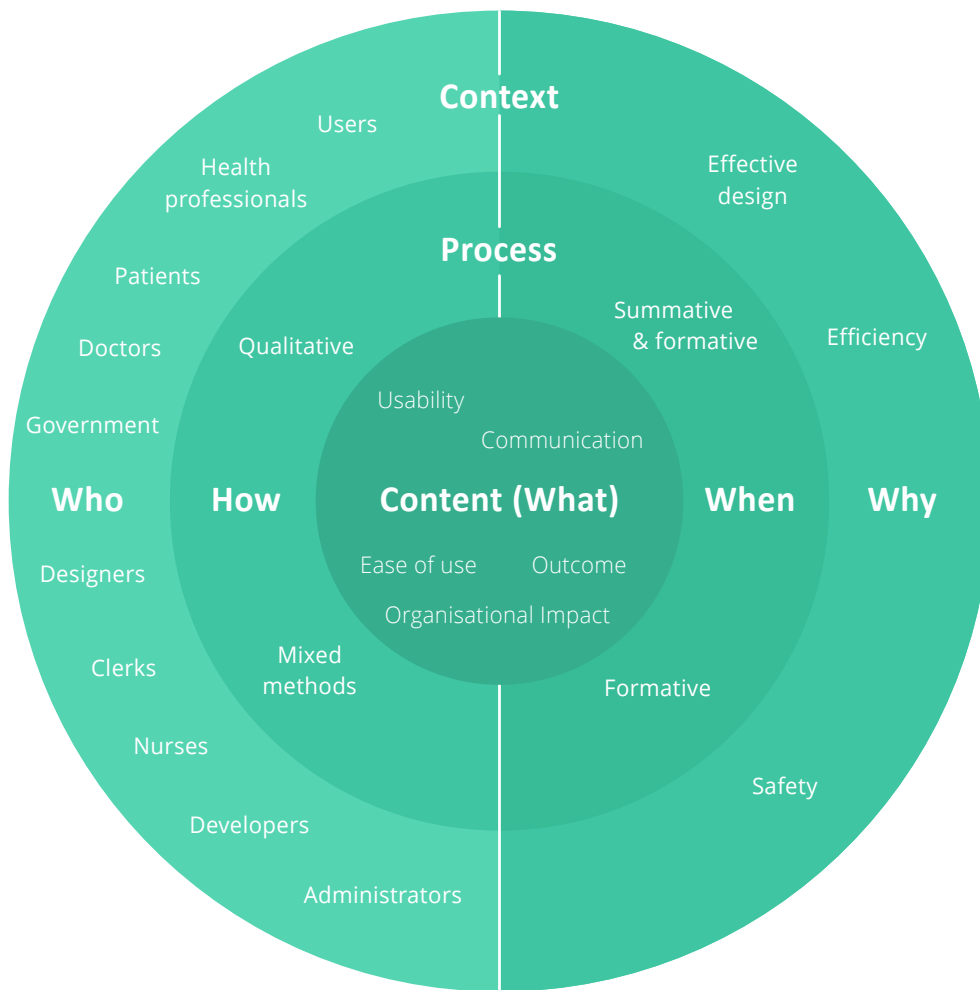


Figure 3: Considerations when developing a digital health evaluation and benefits measurement framework



5.1.3 KEY STAKEHOLDERS MUST BE IDENTIFIED AND THEIR CONTEXT UNDERSTOOD

Many participants noted that their approaches to digital health evaluation and benefits measurement included the need to engage relevant stakeholders before, during and after the completion of the evaluation.

Identifying a wide range of stakeholders is critical, as this allows a full and frank assessment of both benefits and disbenefits. Only by engaging this full set of stakeholders can a contextual understanding of users, their clinical settings, and the policy environments in which they operate be developed, and correct measures then chosen to evaluate digital health technologies and services.

Rahman and Ko (44) describe an approach for identifying which stakeholders to include in a health information system evaluation. The authors suggest that the features of the technology solution should be defined, followed by the stakeholders who are involved with these features. The stakeholders are then classified as either acceptors, providers, supporters, controllers and producers, and their involvement in the system ranked. This allows the evaluator to understand which stakeholders are going to have the largest impact on the digital health technology, enabling prioritisation of engagement.

Stakeholders described across 11 research studies include healthcare providers, technology developers, management, government agencies, consumers, policy makers, technology vendors, professional associations, health organisation administrators, academic / research institutions and regulators. The approach described by Rahman and Ko (44) describes a systematic approach to engaging stakeholders in digital health technology and services evaluation which is an important consideration when performing digital health evaluation and benefits measurement.

5.1.4 EVALUATION APPROACH SHOULD BE CONTEXT-DEPENDENT

There is an increasing range of methodologies being supported by the literature to evaluate digital health technologies, recognising they are being deployed in complex health systems that require a contextual understanding of users, clinical settings, and the policy environment in which they operate.

Rather than using a single approach for all digital health technology and service evaluations, it is increasingly clear that the selection of evaluation approach should be dependent upon both context and scale. Recent debate in the literature highlights the importance of fostering evaluation designs which combine different research methods, using qualitative, quantitative and co-design principles, as well as process measures.

Having selected an evaluation technique, a “mixed method” approach using qualitative and quantitative designs, as well as behavioural economic and health economic evaluation methods, is shown to deliver better outcomes than using a single method. This approach also recognises the large numbers of stakeholders involved in many digital health programs of work, and the different types of benefits that accrue to these various stakeholders.

In Australia, the foundations of the Benefits Evaluation Framework are based upon the application of a range of different measurement methodologies, including customer and market insights, behavioural economics, data analytics, impact evaluations and health economic evaluations. The relative mix of reliance upon these methodologies varies depending on the digital health technologies and services being evaluated.



5.1.5 EVALUATION SHOULD FOCUS ON BENEFIT MEASUREMENT MODELS WHERE POSSIBLE

Where possible and appropriate, evaluation approaches should focus on the development (or reuse) of benefits measurement models, supporting the quantification of benefits against well-defined baselines. However, it is acknowledged that there are many situations in which this may not be straightforward, and it may be pragmatic to use other methods.

When using benefits measurement models, it is critical to ensure that the purpose of services, as well as the definition of benefits, are clearly articulated, and that disbenefits are appropriately accounted for.

5.1.6 WORKFORCE CAPABILITY REQUIRES SIGNIFICANT DEVELOPMENT

Participant countries identified that workforce capacity to complete digital health evaluation and benefits measurement are key considerations when evaluating digital health technologies and services.

Argentina has described a program in which trainees actively participate in the development and implementation of their electronic health record system, developing evaluation skills to understand the impact of the implementation of the health record system on healthcare outcomes.

Building research capacity is considered critical in ensuring continuous improvement of health systems (45), which is necessary for developing digital health technology and services that support healthcare.



6 RECOMMENDED NEXT STEPS

To facilitate progress in the GDHP Evidence and Evaluation work stream, the following next steps are recommended:

- 1. Develop standard benefits categories**
In order to drive greater consistency between international evaluation approaches, work to drive greater standardisation of benefits categories (for digital health technology and service evaluations) is required, drawing from established methodologies where appropriate. These categories will underpin quantitative, qualitative and health economic evaluations.
- 2. Develop standard benefit and outcome measures**
There are a range of benefit and outcome measures discussed in this initial report. Standardising the use of these across digital health evaluations will assist with the comparison of evaluation results between participating GDHP countries, and will allow more direct comparison across the growing research and evidence base.
- 3. Assist developing countries with evaluation and health economic approaches**
Countries with established evaluation approaches and benefits measurement models should seek to assist develop countries by, where appropriate, sharing existing frameworks and models. This collaboration should be undertaken through the GDHP Evidence and Evaluation work stream.
- 4. Continue to develop research and evidence base**
Despite the ongoing interest in digital health benefits evaluation frameworks, there are limited published examples of their use in the evaluation of digital health services internationally. Countries should continue to work collaboratively with academia where relevant to contribute new methodologies and key findings in order to bolster the available evidence base for digital health technology and service evaluation.



7 APPENDIX A: NASSS FRAMEWORK

Table 5: Domains of Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies (NASSS) Framework

Domain	Questions
The condition or illness	<p>1A: what is the nature of the condition or illness?</p> <p>1B: what are the relevant socio-cultural factors and comorbidities?</p>
The technology	<p>2A: what are the key features of the technology?</p> <p>2B: what kind of knowledge does the technology bring into play?</p> <p>2C: what knowledge and/or support is required to use the technology?</p> <p>2D: what is the technology supply model?</p>
The value proposition	<p>3A: what is the developer’s business case for the technology (supply side value)?</p> <p>3B: what is its desirability, efficacy, safety and cost-effectiveness (demand side value)?</p>
The adopter system	<p>4A: what changes in staff roles, practices and identities are implied?</p> <p>4B: what input is expected of the patient (and/or immediate carers) and is this achievable by, and acceptable to them?</p> <p>4C: what is assumed about the extended network of lay carers?</p>
The organisation	<p>5A: what is the organisation’s capacity to innovate?</p> <p>5B: how ready is the organisation for this technology-supported change?</p> <p>5C: how easy will the adoption and funding decision be?</p> <p>5D: what changes will be needed in team interactions and routines?</p> <p>5E: what work is involved in implementation and who will do it?</p>
The wider system	<p>6A: what is the political, economic, regulatory, professional (e.g. medico-legal) and socio-cultural context for program rollout?</p>
Interaction and adaptation over time	<p>7A: how much scope is there for adapting and co-evolving the technology and the service over time?</p> <p>7B: how resilient is the organisation to handling critical events and adapting to unforeseen eventualities?</p>



8 APPENDIX B: COUNTRY RESPONSES

Table 6: Summary of responses received from GDHP Evidence and Evaluation work stream participants

Country	National approach	Name of approach	Case studies	Observations and lessons
Argentina	No	N/A	<p>From two key institutions: Department of Health Informatics, Hospital Italiano de Buenos Aires and Institute for Clinical Effectiveness and Health Policy (IECS)</p> <p>Recent publications and reports available</p>	<ol style="list-style-type: none"> 1. Recently launched a Digital Health Agenda and seeking best approach to evaluation, according to their situation. 2. Recently joined Pan-American Health Organization (PAHO) meeting regarding Information Systems for Health (IS4H) framework to assess national digital maturity levels. 3. Digital health evaluation is often included as part of funding agreements with the World Bank or the Inter-American Development Bank.
Australia	No	Benefits measurement framework	<p>Evaluation of the participation trials for the My Health Record</p> <p>Evolution of eHealth in Australia</p> <p>My eHealth Record to National eHealth Record Transition Impact Evaluation</p>	<ol style="list-style-type: none"> 1. Stakeholder engagement is critical to the delivery of the benefits measurement. 2. Further approaches to conducting economic analysis are required.
Brazil	No	N/A	N/A	<ol style="list-style-type: none"> 1. Brazil recently published their eHealth vision for the country, the based on the "WHO-ITU National eHealth Strategy Toolkit". 2. This is not digital health specific but comments on methods for contributing to the improvement of the evaluation and monitoring process of national public health policies



Country	National approach	Name of approach	Case studies	Observations and lessons
Canada	Yes	Canada Health Infoway – Benefits Evaluation Framework	<p>Community Paramedicine Remote Patient Monitoring</p> <p>Newfoundland and Labrador Remote Patient Monitoring evaluation</p> <p>Holland Bloorview family portal evaluation</p> <p>Ontario Shores patient portal evaluation</p>	<p>Successful conditions for evaluating at Infoway due to key factors:</p> <ol style="list-style-type: none"> Building a culture of evaluation: First few years of evaluation strategy were about engaging stakeholders to build consensus that evaluation could be a constructive part of an overall approach to digital health. Target the benefits: be specific about the benefits that require measuring Building capacity: Educate and empower others to participate Focusing on communication: The impact of evaluations depend entirely upon who sees the results and in what context. Some show great results and others reveal challenges. Both are important and need to reach the right audience. Timelines and project management: Build into system adoption. <p>Handbook of eHealth Evaluation</p> <p>Canada Health Infoway Benefits Evaluation Toolkit</p> <p>Canada Health Infoway Benefits Evaluation Indicators Technical Report</p>
Estonia	No	EHIF Evaluation Framework PENG Model	<p>National electronic Health Record Evaluation</p> <p>ePrescription Service</p>	<ol style="list-style-type: none"> Reimbursement incentives may encourage the completion of evaluations. Inclusion of an impact assessment in health service digitisation in methodology guidelines may increase adherence. Evidence base for benefits needs to be increased to optimise economic analyses that rely on these benefits.



Country	National approach	Name of approach	Case studies	Observations and lessons
Italy	No	Model of Assessment in Telemedicine (MAST)	Tele-monitoring of Type 2 Diabetes Mellitus in Italy Carewell (Multilevel integration for patients with complex needs) Mastermind (Management of Mental Health disorders through advanced technology)	<ol style="list-style-type: none"> 1. Multiple partners: getting the right expertise on board to support the design and delivery of the research. 2. Collecting baseline data: 'permanent observatory' of technology and standards used in telemedicine – detailing specific characteristics of the sector. 3. Defining managerial needs: linking to change management.
Portugal	No	N/A	Paperless Receipts Electronic Immunization Registry	<ol style="list-style-type: none"> 1. When developing a national approach consider using an economic evaluation method such as cost-benefit analysis. 2. Cost-benefit analysis enables quantification of the cost savings and expenditure associated with a digital health evaluation and benefits measurement.
Saudi Arabia	No	N/A	Centralized Appointment System	<ol style="list-style-type: none"> 1. Ongoing measurement and real-time dashboards have been extremely effective in monitoring and reporting on progress in enabling digital health. 2. Key challenges include effectively reporting on outcome measures, and developing an evaluation and evidence culture, including the necessary people, processes and tools.
Sweden	No	Health Technology Assessment	Evaluation of the Health Technology Assessment approach Evaluation of the uptake of digital health services in Sweden	<ol style="list-style-type: none"> 1. Engaging relevant stakeholders before and after completing an evaluation and setting the expectation for key stakeholders around quality of evidence. 2. Developing the skill sets of researchers within digital health technology and evaluation. 3. Time and money need to be considered as the more complex the evaluation, the more money will need to be provided to fund the evaluation.



Country	National approach	Name of approach	Case studies	Observations and lessons
The Republic of Korea	No	N/A	Remote care Transfer and return Long-term care facilities Emergency care	1. Evaluation measures chosen were varied between evaluations and depended on the purpose of the evaluation.
United Kingdom	Yes	National Institute for Health and Care Excellence medical technologies guidance Benefit management framework	Digital Maturity Assessment NHS 111 GP at Hand Digital Diabetes Prevention Programme	GP at Hand Evaluation Principles: 1. Prioritise what needs measuring. 2. Stakeholder engagement and input get the right people on board. 3. Collect rapid insights into key aspects of practice. 4. Use appropriate comparators and counterfactuals. NHS Digital Assessment Questions
Uruguay	No	N/A	National Electronic Health Record	1. Political support is required when implementing and evaluating a system-wide initiative. 2. Evaluation and implementation is limited by the digital maturity of individual health services .
United States	No	SEIPS (System Engineering Initiative for Patient Safety)	Evaluating contributors to readmission after complex surgery	1. Process driven , recent reviews have concluded this needs to include clinical outcomes. 2. Describes/maps out the system , and its multiple components in its entirety; therefore can assess the workflow across the system.
		Guide to evaluating health information exchange projects	Evaluating contributors to readmission after complex surgery	1. Step by step guidance is provided in designing and delivering evaluations. This includes accessing appropriate data sources . 2. Provides examples of measures with a focus on clinical and financial value. 3. Promotes stakeholder and technical engagement .



9 APPENDIX C: INTERNATIONAL BENEFITS MEASUREMENT ACTIVITIES

9.1 AUSTRALIA

EVALUATION WORK STREAM	DESCRIPTION
1 Customer and Market Insights	Surveying and analysis of service users (consumers and clinicians) to generate insights into attitudes, experiences and behaviours. Examples include research panels, workflow study, focus groups, net promoter score (NPS), and social media analysis.
2 Behavioural Economics	Laboratory-based scientific evaluation of service use to reveal insights into experience and behaviour. Informs design enhancements and generates evidence of changes in behaviour for benefits measurement purposes. E.g. heuristic review, eye ball tracking, A/B testing.
3 Big Data Analytics	Mining and modelling available big data assets (e.g. routinely collected administrative data) on a presumed consent basis. Examples include descriptive analysis of MHR registration and usage data, data integration (linkage), and epidemiological modelling.
4 Impact Evaluation	Work with research community to commission research evaluating test beds where health outcomes are being realised, and validate the link between proxies and outcomes. E.g. consent-based, bespoke academic research requiring ethics approval.
5 Health Economics	Evaluation and forecasting of indirect population health outcomes and downstream economic benefits using health economic modelling.

Figure 4: Current My Health Record benefits measurement work streams

9.1.1 BENEFITS MEASUREMENT PROJECT PRINCIPLES GUIDING DELIVERY

The following broad principles are guiding the development of the Benefits Measurement Project.

A broad range of benefits will be demonstrated through a variety of different methodological approaches and settings

- focus upon a key benefit (e.g. medication safety), and multiple benefits wherever possible within the same project

A range of research methods will be used (qualitative, quantitative and mixed methods) to generate a variety of evidence levels

- Qualitative approaches include polling, user surveys and semi-structured interviews – the 'why' a benefits outcome may be observed
- Quantitative measures using data analytics (MyHR usage information, MBS and PBS data, other potential data sets for ADEs and reduced duplicate tests)



- Mixed methods evaluations combine quantitative and qualitative measures, strengthening the association between the 'what' and the 'why'

A range of research 'workstreams' have been developed to guide delivery

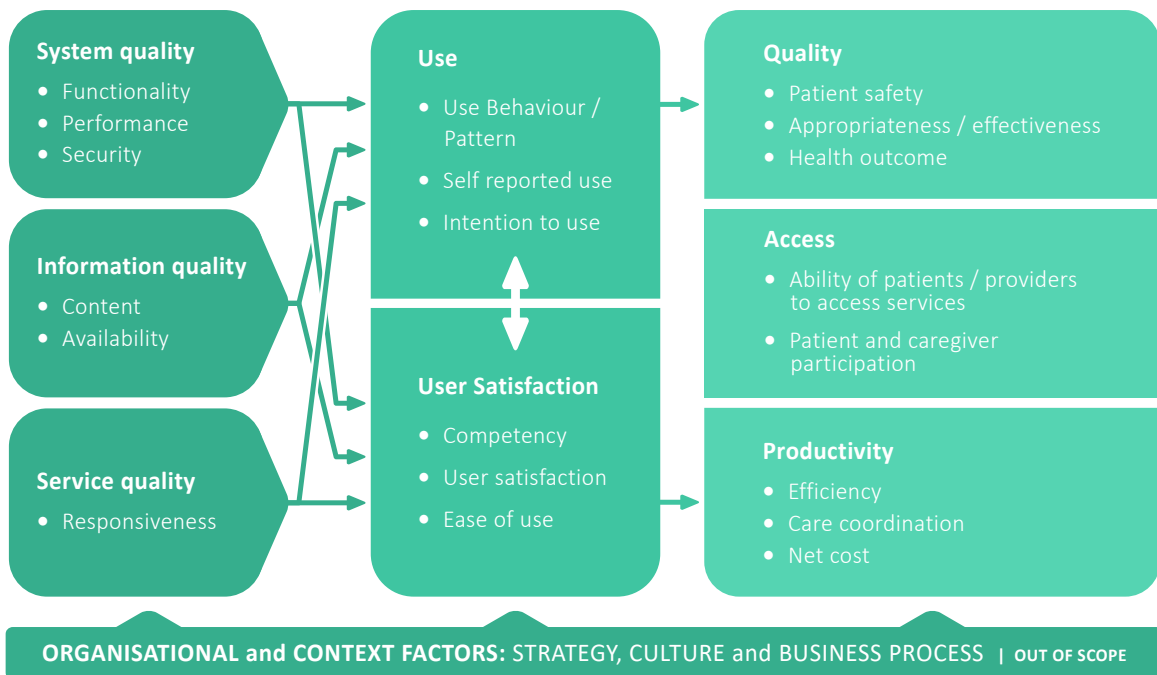
- Evaluations will be undertaken both internally and with external research groups that have expertise in different broad research areas
- Ensures a variety of 'evidence levels' in terms of the strength of our findings

Observed and 'enhanced' MvHR benefits measurement approaches will be used

- Plan to measure benefits as observed through the expansion program and other Agency work AND stimulate benefits realisation in a number of 'test bed' projects
- This will demonstrate evidence of benefits that may be anticipated over a longer term than the timeframe available within the planned expansion program

A broad range of subjects and settings will be included in evaluations

- Consumer opinion and behaviours, and a variety of clinician groups and different clinical settings (e.g. primary care, hospital, pharmacy, allied health, specialty etc.)
- 'Test beds' and other commissioned evaluations will be established in different geographies
- A focus upon the opt-out trial areas – PHN regions where there is a 98% coverage of consumers with MvHR



Based on the Delone & McLean IS Success Model

Figure 5: Canada Benefits Evaluation Framework



10 REFERENCES

1. World Health Organization. Monitoring and Evaluating Digital Health Interventions: A practical guide to conducting research and assessment [Internet]. 2016 [cited 2018 Jan 2]. Available from: <http://www.who.int/reproductivehealth/publications/mhealth/digital-health-interventions/en/>
2. Garber S, Gates SM, Keeler EB, Vaiana ME, Mulcahy AW, Lau C, et al. Redirecting Innovation in U.S. Health Care [Internet]. RAND Corporation; 2014 [cited 2018 May 21]. Available from: https://www.rand.org/pubs/research_reports/RR308.html
3. Greenhalgh T, Wherton J, Papoutsis C, Lynch J, Hughes G, A'Court C, et al. Beyond Adoption: A New Framework for Theorizing and Evaluating Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies. *J Med Internet Res* [Internet]. 2017 Nov 1 [cited 2018 May 16];19(11):e367. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/29092808>
4. Jenner S, APMG International. Managing benefits : optimizing the return from investments. 271 p.
5. Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. *Ann Fam Med* [Internet]. 2014 Nov 1 [cited 2018 Aug 3];12(6):573–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25384822>
6. Australian Digital Health Agency. Australia's National Digital Health Strategy [Internet]. [cited 2018 Jan 8]. Available from: <https://www.digitalhealth.gov.au/about-the-agency/publications/australias-national-digital-health-strategy>
7. Gray K, Gilbert C, Gilbert MC. Digital Health Research Methods and Tools: Suggestions and selected resources for researchers. In: *Advances in Biomedical Informatics* [Internet]. 2017 [cited 2018 Jan 3]. Available from: http://clinicalresearch.mdhs.unimelb.edu.au/__data/assets/pdf_file/0003/2541792/Gray-Gilbert_Digital-health-research-methods-and-tools_In-press_2017.pdf
8. Agarwal S, LeFevre AE, Lee J, L'Engle K, Mehl G, Sinha C, et al. Guidelines for reporting of health interventions using mobile phones: mobile health (mHealth) evidence reporting and assessment (mERA) checklist. *BMJ* [Internet]. 2016 Mar 17 [cited 2018 May 8];i1174. Available from: <http://www.bmj.com/lookup/doi/10.1136/bmj.i1174>
9. World Health Organization. WHO Evaluation Practice Handbook [Internet]. Geneva; 2013 [cited 2018 Jan 8]. Available from: www.who.int/about/licensing/copyright_form/en/index.html



10. Eysenbach G, CONSORT-EHEALTH Group C-E. CONSORT-EHEALTH: improving and standardizing evaluation reports of Web-based and mobile health interventions. *J Med Internet Res* [Internet]. 2011 Dec 31 [cited 2018 Jan 5];13(4):e126. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22209829>
11. NHS Digital. Benefits Eligibility Framework. 2017.
12. Canada Health Infoway. Canada Health Infoway Benefits Evaluation Indicators Technical Report [Internet]. 2012 [cited 2018 Jul 20]. Available from: <https://www.infoway-inforoute.ca/en/component/edocman/450-benefits-evaluation-indicators-technical-report-version-2-0/view-document?Itemid=0>
13. NSW Government Finance S& I. Benefits Realisation Management Framework | Department of Finance, Services and Innovation [Internet]. [cited 2018 Apr 27]. Available from: <https://www.finance.nsw.gov.au/publication-and-resources/benefits-realisation-management-framework>
14. Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it: Implementation research is a growing but not well understood field of health research that can contribute to more effective public health and clinical policies and programmes. *Thi. Br J Sports Med* [Internet]. 2014 [cited 2018 Aug 23];48(8):731–6. Available from: <https://www.bmj.com/content/bmj/347/bmj.f6753.full.pdf>
15. Luna DR, Rizzato Lede DA, Otero CM, Risk MR, González Bernaldo de Quirós F. User-centered design improves the usability of drug-drug interaction alerts: Experimental comparison of interfaces. *J Biomed Inform* [Internet]. 2017 Feb [cited 2018 Aug 9];66:204–13. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28108211>
16. Australian Department of Health. Evaluation of the Participation Trials for the My Health Record Final Report [Internet]. 2016 [cited 2018 Aug 15]. Available from: [http://www.health.gov.au/internet/main/publishing.nsf/content/A892B3781E14E1B3CA25810C000BF7C6/\\$File/Evaluation-of-the-My-Health-Record-Participation-Trials-Report.pdf](http://www.health.gov.au/internet/main/publishing.nsf/content/A892B3781E14E1B3CA25810C000BF7C6/$File/Evaluation-of-the-My-Health-Record-Participation-Trials-Report.pdf)
17. Benefits Evaluation Framework | Canada Health Infoway [Internet]. [cited 2018 Jul 10]. Available from: <https://www.infoway-inforoute.ca/en/what-we-do/research-and-insights/benefits-evaluation/benefits-evaluation-framework>
18. Lau F, Kuziemy C. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]. 2016 [cited 2018 Jan 8]. Available from: <https://dspace.library.uvic.ca/handle/1828/7814>
19. An Evaluation of a Remote Patient Monitoring Solution within Eastern Health. [cited 2018 Jul 11]; Available from: <https://www.infoway-inforoute.ca/en/component/edocman/3472-an-evaluation-of-a-remote-patient-monitoring-solution-within-eastern-health/view-document?Itemid=101>



20. Community Paramedicine Remote Patient Monitoring (CPRPM): Benefits Evaluation & Lessons Learned Community Paramedicine Remote Patient Monitoring (CPRPM): 2018 [cited 2018 Jul 11];(December 2017). Available from: <https://www.inforoute.ca/en/component/edocman/3542-community-paramedicine-remote-patient-monitoring-cprpm-benefits-evaluation-lessons-learned/view-document?Itemid=101>
21. Saluse J, Aaviksoo A, Ross P, Tiik M, Parv L, Sepper R, et al. Assessing the Economic Impact/Net Benefits of the Estonian Electronic Health Record System DIGIMPACT Final Report [Internet]. 2010 [cited 2018 Dec 4]. Available from: <http://www.praxis.ee/fileadmin/tarmo/Projektid/Tervishoid/Digimoju/Digimimpact.pdf>
22. Parv L, Kruus P, Mõ K, Ross P. An evaluation of e-prescribing at a national level. Inf Heal Soc Care [Internet]. 2014 [cited 2018 Dec 4];1–18. Available from: <http://www.egov.ee/media/1341/an-evaluation-of-e-prescribing-at-a-national-level-liisa-parv-et-al.pdf>
23. Kidholm K et al. The MAST Manual. 2010 [cited 2018 Jul 10];1–64. Available from: www.telemet.no/methotelemed
24. Guide to Cost-Benefit Analysis of Investment Projects. 2014 [cited 2018 Dec 4]; Available from: http://ec.europa.eu/regional_policy/index_en.cfm
25. National Medical Information Systems Guidance on the Medical Product Agency’s regulation (LVFS 2014:7) regarding National Medical Information Systems [Internet]. 2014 [cited 2018 Dec 4]. Available from: https://lakemedelsverket.se/upload/lvfs/vagledning/Vagledning_LVFS_2014_7_version_1_engelsk.pdf
26. sbu alert-early assessment of new health technologies [Internet]. [cited 2018 Dec 4]. Available from: www.socialstyrelsen.se
27. beredning för medicinsk och social utvärdering, Agency for Health Technology Assessment S, of Social Services A. Välfärdsteknik. Digitala verktyg som sociala stimulans för äldre personer med eller vid risk för psykisk ohälsa. En kartläggning av systematiska översikter, Digital tools as a social incentive for older persons with or at risk for psychic ill health. A map of systematic reviews. [Internet]. [cited 2018 Dec 4]. Available from: www.sbu.se/268e
28. Rosén M, Werkö S. Does health technology assessment affect policy-making and clinical practice in Sweden? International Journal of Technology Assessment in Health Care [Internet]. 2014 [cited 2018 Dec 4];30(3). Available from: www.sbu.se
29. National Institute for Health and Care Excellence. Medical technologies evaluation programme process guide. Guidance and guidelines. NICE [Internet]. 2017 [cited 2018 Aug 9]. Available from: <https://www.nice.org.uk/process/pmg34/chapter/introduction>
30. Health app: Sleepio for adults with poor sleep. Guidance and guidelines. NICE [Internet]. 2017 [cited 2018 Aug 9]. Available from: <https://www.nice.org.uk/advice/mib129/chapter/The-technology>



31. Health app: ChatHealth communication platform in school nursing services. Guidance and guidelines NICE [Internet]. 2017 [cited 2018 Aug 9]. Available from: <https://www.nice.org.uk/advice/mib130/chapter/The-technology>
32. Health app: GDM-Health for people with gestational diabetes. Guidance and guidelines. NICE [Internet]. 2017 [cited 2018 Aug 9]. Available from: <https://www.nice.org.uk/advice/mib131/chapter/The-technology>
33. NHS Digital. The 5-Stage Approach: Guide to Benefits Management of Informatics. 2017.
34. Maguire D, Evans H, Honeyman M, Omojomolo D. Digital change in health and social care [Internet]. 2018 [cited 2018 Jul 5]. Available from: https://www.kingsfund.org.uk/sites/default/files/2018-06/Digital_change_health_care_Kings_Fund_June_2018.pdf
35. Agency for Healthcare Research and Quality. Guide to evaluating health information exchange projects. Agency Health Res Qual [Internet]. 2014 [cited 2018 Jul 3]; Available from: <https://healthit.ahrq.gov/sites/default/files/docs/page/guide-to-evaluating-hie-projects.pdf>
36. Khunlertkit A, Jantzi N. Using the SEIPS framework to reveal hidden factors that can complicate a vaccine documentation process. Proceedings of the Human Factors and Ergonomics Society Annual Meeting [Internet]. 2016 Sep 15 [cited 2018 Jul 4];60(1):541–5. Available from: <http://journals.sagepub.com/doi/10.1177/1541931213601125>
37. Carayon P, Schoofs Hundt A, Karsh BT, Gurses AP, Alvarado CJ, Smith M, et al. Work system design for patient safety: The SEIPS model [Internet]. Vol. 15, Quality and Safety in Health Care. 2006 [cited 2018 Jul 3]. p. 50–8. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2464868/pdf/i50.pdf>
38. Acher AW, LeCaire TJ, Hundt AS, Greenberg CC, Carayon P, Kind AJ, et al. Using human factors and systems engineering to evaluate readmission after complex surgery. Journal of the American College of Surgeons [Internet]. 2015 Oct 1 [cited 2018 Jul 4];221(4):810–20. Available from: <https://www.sciencedirect.com/science/article/pii/S1072751515004329>
39. Wooldridge AR, Carayon P, Hundt AS, Hoonakker PLT. SEIPS-based process modeling in primary care. Appl Ergon [Internet]. 2017 Apr [cited 2018 Dec 4];60:240–54. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/28166883>
40. Garafalo J, Nathan-Roberts D. Assessment of the impacts from the addition of novel assistive technologies in mental health care. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting [Internet]. 2016 Sep 8 [cited 2018 Jul 4];60(1):1245–9. Available from: <http://journals.sagepub.com/doi/10.1177/1541931213601290>
41. Greenhalgh T, Russell J. Why do evaluations of eHealth programs fail? An alternative set of guiding principles. PLoS medicine [Internet]. 2010 Nov 2 [cited 2018 Apr 26];7(11):e1000360. Available from: <http://dx.plos.org/10.1371/journal.pmed.1000360>



42. Eslami Andargoli A, Scheepers H, Rajendran D, Sohal A. Health information systems evaluation frameworks: A systematic review. *Int J Med Inform* [Internet]. 2017 Jan [cited 2017 Dec 22];97:195–209. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27919378>
43. Eslami Andargoli A, Scheepers H, Rajendran D, Sohal A. Health information systems evaluation frameworks: A systematic review. *Int J Med Inform* [Internet]. 2017 Jan [cited 2017 Dec 21];97:195–209. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/27919378>
44. Rahman MS, Ko M. Toward systematic identification of stakeholders for healthcare information systems: A feature-based method [Internet]. [cited 2018 Dec 11]. Available from: <https://pdfs.semanticscholar.org/9243/01b76b43ca2fcf7b6e57d7eca7bae6dd620d.pdf>
45. Beran D, Byass P, Gbakima A, Kahn K, Sankoh O, Tollman S, et al. Research capacity building-obligations for global health partners. 2017 [cited 2018 Dec 12]; Available from: <https://naturalsciences.ch/organisations/kfpe>



11 ABBREVIATIONS

EHR	electronic health record
GDHP	Global Digital Health Partnership
HIE	health information exchange
ICT	information and communication technologies
NASSS	Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies framework
WHO	World Health Organization

