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HEALTH ECONOMICS, POLICY and LAW

ARTICLE

Promoting the systematic use of real-world data and real-world evidence for digital health technologies across Europe: a consensus framework

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Abstract
Despite the acceleration in the use of digital health technologies across different aspects of the healthcare system, the full potential of real-world data (RWD) and real-world evidence (RWE) arising from the technologies is not being utilised in decision-making. We examine current national efforts and future opportunities to systematically use RWD and RWE in decision-making in five countries (Estonia, Finland, Germany, Italy and the United Kingdom), and then develop a framework for promotion of the systematic use of RWD and RWE. A review assesses current national efforts, complemented with a three-round consensus-building exercise among an international group of experts ($n1 = 44$, $n2 = 24$, $n3 = 24$) to derive key principles. We find that Estonia and Finland have invested and developed digital health-related policies for several years; Germany and Italy are the more recent arrivals, while the United Kingdom falls somewhere in the middle. Opportunities to promote the systematic use of RWD and RWE were identified for each country. Eight building blocks principles were agreed through consensus, relating to policy scope, institutional role and data collection. Promoting post-market surveillance and digital health technology vigilance ought to rely on clarity in scope and data collection with consensus reached on eight principles to leverage RWD and RWE.

Keywords: digitization; post-market surveillance; digital health technology vigilance; Delphi method

1. Introduction

Post-market surveillance (PMS) systems are in place to collect relevant data in a systematic manner for medical devices and involve activities conducted by manufacturers once a product enters the market, to collect information on its quality, performance and safety (European Union, 2017). For regulators, the surveillance system is a tool to take action if there are safety concerns and risks of continued use of the medical device, which outweigh the benefits (WHO, 2021). This paper's objectives are (1) to investigate current efforts and future opportunities to systematically use real-world data (RWD) and real-world evidence (RWE) in PMS to support decision-making of digital health technologies (DHTs) and (2) to develop a framework to set out guiding principles (i.e. good practice guidelines) informed by the literature review and Delphi consensus-building exercise. Our research is timely because this is a new policy area where no country has yet established

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a well-designed, robust system, in part because digital health policy frameworks are a work in progress in many countries. In this paper, DHTs refer to health technologies as defined by the National Institute for Health and Care Excellence (NICE), including applications (apps), programmes and software used in the health and care system, which may be standalone or combined with other products such as medical devices or diagnostic tests (NICE, 2022). The definition is similar in scope to the one proposed by the World Health Organization in their guidelines on the use of digital health interventions. It refers to 'a broad umbrella term encompassing eHealth, including mHealth or mobile wireless technologies for health, as well as emerging areas, such as the use of advanced computing sciences in 'big data', genomics and artificial intelligence' (WHO, 2019).

A robust system of PMS has implications on the data needs for evidence generation and evidence thresholds, but also on how to learn from the technologies and inform policy once the DHT is on the market. In this paper, RWD and RWE are based on the US Food and Drugs Administration (FDA) definition (Box 1).

There are untapped benefits from large volumes of data being created. Data could inform providers and patients, feed back into decision-making similar to the health technology assessment (HTA) to inform regulation or set evidence thresholds. It could monitor the technology once it is on the market and could be used to inform upstream design of the DHT, or to understand the degree of generalisability of the DHT. However, it remains unknown whether digital technologies/consultations uncover more need, hence raising the burden. There could be implications on workload for general practitioners with a relatively young/healthy population that could be serviced quickly via online consultation (telemedicine), leading to equity concerns and commissioning/payment considerations. Online consultations attract younger, healthier patients while those who are older/or with long-term conditions are likely to be less comfortable attending remote consultations (Salisbury *et al.*, 2020; Sounderajah *et al.*, 2021; Wieringa *et al.*, 2022). For example, informing policy could systematically embed user feedback from providers and patients and on how to better mitigate the digital divide (e.g. disparities in the use of technologies among underserved populations). Unlike DHTs, there are 'pharmacovigilance' policies and systems for pharmaceutical products that are partly harmonised in Europe for the monitoring and evaluation of medicines once they are on the market, which also helps to understand their effects on different patient profiles and patient sub-groups.

One of the current challenges is the sheer volume of data arising from DHTs. Data come from a variety of sources, with no current international framework on guiding principles for data access and analytics, creating by default, global databases (e.g. an app may contain data from different countries). Related to large volumes of data is how to use data and to support interoperability at various levels (e.g. DHTs, healthcare settings, national borders) as raised in the EU4Digital's eHealth Network on patients' rights in cross-border healthcare. The initiative aims to connect national authorities responsible for eHealth issues to help share policy surrounding eHealth interoperability and standardisation (European Union, 2021). The extent to which real-time data are accessible to support analytics or evidence generation remains an open question.

This paper investigates the opportunities for systematically embedding RWD and RWE in PMS to support decision-making of DHTs drawing on five country experiences (Estonia, Finland, Germany, Italy and United Kingdom with a focus on England). Decision-making in this paper considers decisions taken at different levels in the system, such as by patients, healthcare workers or national and regional institutions (e.g. payers or HTA bodies). We then develop a framework including guiding principles informed by the literature review and Delphi exercise, through an international consensus-building exercise. The consensus framework will bring benefits in decision-making to support nationally and internationally coherent decision-making in PMS. It will assist health authorities in setting out clarity in policy scope, role of institutions in collection of RWD, regulators to set requirements using RWE and digital health developers in their compliance.

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Box 1. RWD and RWE definitions

Real-world data and real-world evidence offer potential new ways of collecting, monitoring, evaluating and assessing digital health technologies

- RWD includes electronic health records (EHRs), claims and billing activities, product and disease registries, patient-generated data including in home-use settings, and data gathered from other sources that can inform on health status, such as mobile devices.
- RWE is the clinical evidence regarding the usage and potential benefits, or risks, of a medical product derived from analysis of RWD. RWE can be generated by different study designs or analyses, including but not limited to, randomised trials, including large simple trials, pragmatic trials and observational studies (prospective and/or retrospective).

Source: FDA Definition of RWD and RWE: https://www.fda.gov/science-research/science-and-research-special-topics/real-world-evidence.

Our research explores policy issues around RWD and RWE for DHTs to support their PMS and we propose '*digital health technology vigilance*' similar in concept to pharmacovigilance to avert potential adverse effects; we argue that this is currently missing in country policies and will be a key aspect for DHTs in the future (CIOMS, 2022). Country policies that include DHT vigilance in a systematic way in their surveillance will improve our understanding of the risks and functionalities of DHTs. A robust PMS system with information on RWD will facilitate the benefits for decision-making including monitoring for quality, safety and adverse events to inform users, governments and digital health developers.

2. Methods

2.1 Literature review

A review of the literature was conducted, inspired by the scoping review method, to map policy issues related to RWD and RWE for DHTs. This included a review of relevant literature, including grey literature in five select countries: Estonia, Finland, Germany, Italy and the United Kingdom (UK).

Countries were selected based on the extent of the application of RWD and RWE in the health system (Table 1). The countries are not a representative sample but rather our interest was to reflect a mix of models of healthcare delivery, including different levels of decentralisation, financing healthcare digitalisation, adoption of digital technologies and population perceptions in regard to collection, use and sharing of data (Ferré *et al.*, 2014; Habicht *et al.*, 2018; Keskimäki *et al.*, 2019; Vehko *et al.*, 2019; Blümel *et al.*, 2020; OECD *et al.*, 2021; Anderson *et al.*, 2022).

The literature search focussed on the following aspects: the countries' existing national frameworks and policy objectives, national efforts, ongoing activities and opportunities to further embed RWD and RWE into decision-making. These aspects were applied to each country to guide the search and gain information of the national context. Some countries have had policies in place for several years, but the study focussed on the past decade (2012–2022) to capture relevant and recent developments in digital health policy. An important contribution of our approach was that beyond publications in English, the literature search was conducted in the country's native language (Estonian, Finnish, German, Italian), across relevant national databases and sources of grey literature to discover relevant legal documents, reports and research articles (Table 2).

2.2 2.2 International consensus-building exercise

The Delphi was informed by findings from the review. In the literature, we identified what was missing from current country practices related to measuring and monitoring of DHTs and what

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Table 1. Country characteristics: Estonia, Finland, Germany, Italy and the United Kingdom (England)

Demographics	Estonia	Finland	Germany	Italy	United Kingdom
Healthcare model of delivery	Centralised model	Decentralised	Decentralised	Decentralised	Decentralised
Financing healthcare digitalisation	Wage-related contribution and general taxation	Wage-related contribution and general taxation	Wage-related contribution and tax subsidies	General taxation (national and regional taxation)	General taxation
Adoption of digital health technologies	Widespread	Widespread	Recent	Recent	Increasingly widespread
Public perceptions (collection use and sharing of data)	Strong	Strong	Growing interest	Recent interest	Growing interest

Table 2. Literature search for review

Academic query	Key words
Query	• [insert country name] AND • 'real-world data' OR 'real-world evidence' AND • ('digital' OR 'virtual' OR 'ehealth' OR 'remote' OR 'communication technology' OR 'clinical decision support') AND • ('primary care' OR 'ambulatory care' OR consultation OR care OR 'general practice' or 'outpatient care')
Grey literature query	Key words Websites (including databases) of relevant national or regional organisations: • Estonia: Estonian Health Insurance Fund • Finland (Finlex Data Bank: up-to-date legislative and other judicial information of Finland, Julkari: shared repository for the publications of the Ministry of Social Affairs and Health's administrative branch organisations) • Germany (German Ministry of Health (BMG), Federal Joint Committee, Federal Association of Sickness Funds, Federal Association of Statutory Health Insurance Physicians, German Hospital Federation) • Italy: Ministry of Health, Italian National Agency for Regional Healthcare Services (AGENAS), Italian National Institute of Health • UK: Department of Health and Social Care, NHS England and Improvement, NHS Digital, Health Foundation, King's Fund, Wellcome Trust, Nuffield Trust, NICE)
Databases	• Pubmed, EBSCO, CINHAL, Google Scholar

potential the countries have to make measuring and monitoring more systematic. We formed initial guiding principles based on our interpretation of the reviewed documents and then these guiding principles were further developed with the expert panel in the Delphi consensus exercise.

The second part of the methodology employed a consensus-building exercise using the Delphi method. The purpose of Delphi was to develop a framework based on guiding principles to embed RWD and RWE systematically to support decision-making for policy makers, providers and patients. The Delphi rounds involved a range of international experts identified through academic, clinical and research networks.

2.3 Expert recruitment and consent

Experts in DHTs, including experts and researchers affiliated with national and regional institutions, payers, healthcare professionals and experts from patient representative organisations were identified in each of the review countries. To achieve a broad range of views, and country representation beyond our country focus, members of the European Health Policy Group (EHPG) were also invited to participate in the wider clinical, academic and practitioner community. The EHPG consists of a wide range of European experts with affiliations in health policy, research and clinical settings. Experts were contacted via the academic institutions of the study authors. A total of 496 experts were contacted.

2.4 Ethical approval

This study was approved by the London School of Economics and Political Science (approval number 101617). The study's pre-registration can be accessed on the Open Science Framework (https://osf.io/y4bk6). Participation in the Delphi study was voluntary and all participants provided informed consent to participate via email.

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2.5 Data collection

The Delphi method was employed through online questionnaires over three rounds between 30 September 2022 and 15 November 2022. The study team agreed to construct the questionnaire in English. In each round, the Delphi questionnaire had two sections. The first part contained building block principles as key elements of a digital health policy framework. The second part contained principles that related to leveraging RWD and RWE for PMS and *DHT vigilance*.

The experts were asked to rate the importance for each principle using a five-point Likert scale: 1 = exclude, 2 = low priority, 3 = medium priority, 4 = high priority, 5 = essential to include. Additionally, the questionnaire collected demographic information on participants (geographic location, age, gender and occupation).

In the first round Delphi, consenting experts accessed the background information of the study via email, which included a link to the online questionnaire on Qualtrics. Experts were asked to rate and comment on the proposed principles. The given response time was 14 days and two reminders were sent before the first round closed.

Based on the comments from the first round Delphi, the study team modified the principles and established new principles for the subsequent two rounds. In the second and third round, all experts who had provided their consent were invited with their unique personal electronic link to access the questionnaire via Welphi (an online survey platform specifically designed for Delphi consensus-building exercises). Experts were asked to rate and comment on the proposed principles. Experts received a summary of anonymised ratings and comments from each of the previous rounds. This information was provided so experts could consider whether they wished to rank items differently. Experts were given 8 days to complete the second round and 5 days to complete the third round. In both rounds, two reminders were sent before the round closed.

2.6 Analysis

The analysis assessed the distribution of responses to determine the pooled level of agreement for each principle. Consensus was reached for a principle when at minimum 75% of the experts had given a rating of at least four, indicating that the inclusion of the principle in the proposed framework was agreed as a high priority. Guidelines for the Delphi survey technique recommend defining consensus as 75% is acceptable level of agreement (Hasson *et al.*, 2000). In the literature, some studies have defined consensus as ranging between 75 and 80% (Hasson *et al.*, 2000; Keeney *et al.*, 2011; Jünger *et al.*, 2017). Thereafter, sensitivity analysis was conducted. The analysis was informed by all comments received alongside the distribution of responses including the mean, median, interquartile range (IQR), standard deviation and variance. Analysis was conducted using Excel.

3. Results

3.1 Literature review

The country experiences highlight examples of policies to guide decision-making, but the depth and scope of these policies varies (see Appendix 1 for country summaries). Estonia and Finland have invested and developed digital health-related policies for several years since the 1990s. Germany and Italy are the most recent arrivals, in terms of significant innovations regarding digital health policies, within the past three years. The United Kingdom falls somewhere in the middle.

National efforts have focussed on a range of different activities including reimbursement, data collection efforts and monitoring of quality. Estonia set out reimbursement requirements for some DHTs. Finland's well-established infrastructure supports the flow of digital-related data to national repositories which collect some aggregate information on DHT usage. Germany recently developed an explicit approach for fast-track approvals of digital health applications. Italy set out a long-term vision to collect and harness large amounts of RWD including some digital health-related data on telemedicine. England in the United Kingdom systematically

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collects aggregate RWD on primary care visits (face-to-face and virtual) to support outcomes, commissioning and regulate quality (Table 3).

Although the pandemic catalysed a shift in demand towards the uptake of DHTs offering potential sources of RWD and RWE, there are opportunities to further embed and develop approaches for using RWD and RWE systematically. Sources of RWD could bring further insights on patient experience and support clinical decision-making as seen in the example of remote monitoring of patients with cardiac-related conditions in Estonia. National aggregate data collections do not yet offer ways to distinguish the type of DHT, nor offer systematic information on the uptake among underserved patient groups, but in Finland, the existing nationwide health data resources could provide better opportunities for them. The example from Italy suggests that large amounts of RWD require alignment with data protection but also conditions to create an open and accepting environment to foster expertise in DHTs. The examples of Germany and the UK stress the need for ongoing data collection to inform the product's benefits, quality, safety and reimbursement once the DHT is available on the market.

Country experiences with RWD and RWE arising from DHTs are in their infancy. These examples highlight opportunities and challenges that have implications for post-marketing surveillance but also for a notion we term as *DHT vigilance*. Adopting a total product lifecycle (TPLC) approach may better align the RWD and RWE data needs and requirements for decision-makers in policy and regulatory circles, manufacturers, providers and patients because it adopts a wholistic approach in the product's lifecycle from design to PMS (Figure 1). The Delphi consensus exercise builds on these findings, with guiding principles that could inform a country's digital health policy framework.

3.1.1 Results of the Delphi consensus-building exercise

Of the invited experts, 44 completed round one (response rate 9%). Of them, 24 (67%) completed round two, and similarly, 24 (67%) completed round three. Table 4 shows the demographic characteristics of experts in each round. Close to half or more were aged between 40 and 59 years, with a fairly even split between male and female experts in the first two rounds. Most participating experts came from the countries focussed on in this study: Finland, Germany, Italy, United Kingdom and Estonia. The experts came from a range of settings with most coming from scientist/academic research, healthcare professionals and national/regional institutions.

Summary of main findings. A total of 16 out of 20 principles reached consensus. Consensus was reached on five out of 15 principles in the first round. Feedback from round one informed the re-wording of principles and three additional principles in the Delphi questionnaire. In the second round Delphi, consensus was reached on a further eight out of 16 principles. Feedback from round two led to re-wording principles and removing one principle. Consensus was reached on three out of seven principles in the third round (see Appendix 2). Consensus ranged from 75 to 87%.

There are eight building block principles for a DHT framework presented in decreasing order of level of agreement (Table 5). They set out a range of considerations on explicit definitions of DHTs, institutional requirements and a strategy around the collection and use of RWD and RWE including for when a DHT is on the market (see Appendix 2).

Eight principles are proposed to set out how to consider where RWD and RWE could inform decision-making with respect to PMS and *DHT vigilance* presented in decreasing order of level of agreement (Table 6).

In summary, the first set of guiding principles identified areas to inform the development and digital health policy framework. The second set of principles extends these notions with respect to leveraging RWD and RWE once the DHT is on the market. The intersection between the two brings to the fore their interdependence with respect to PMS and a concept we propose as *DHT vigilance*. This paper argues that taking a TPLC approach is essential to frame these considerations.

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Table 3. Summary of findings from Estonia, Finland, Germany, Italy and the United Kingdom (England)

Country	National digital health policies or frameworks or legal policies in place	Recent national efforts	Opportunities
Estonia	• Policies in place to support digital health infrastructure and uptake since the 1990s • Evidence and procurement requirements introduced in 2020 and 2021	• Adapted from NICE Reimbursement	• Patient experience • Clinical decision making
Finland	• Policies in place since the 1990s • Promoting and prioritising digital public services since 2019 • Monitoring population health with secondary use of data 2019, • Digi-HTA tool in 2019 to support health technology assessment • Frameworks for digital health technology monitoring and quality registers under development since 2021	• National data collection efforts	• Systematic granular data collection on vulnerable patient groups
Germany	• Legislation policies in place since 2004, further developed and strengthened in 2015 and strengthened since 2019/2020 • Policies focus on telematics infrastructure, electronic health records • Introduction of a fast-track approval (assessment) for digital health applications in 2019 • 2023: National digitisation strategy, includes guidance on how to evolve care processes, data use and technologies to improve healthcare	• Data collection efforts • Efforts to support assessment of digital health technologies	• Infrastructure • Ongoing benefit evaluations • Quality and safety • Reimbursement
Italy	• Key rules and policy established to support remote consultations and various telemedicine services introduced in 2020 • Adjudication of the tender for the national telemedicine platform in 2023	• Data collection efforts includes telemedicine	• Infrastructure • Data protection • Change management and expertise in the NHS
United Kingdom (England)	• Policies in place since 2000s to support digital transformation and infrastructure • Frameworks focus on outcomes for commissioning • Quality (regulation)	• HTA (NICE) Guidance on evidence standards for digital health technologies (2019) • Updated HTA (NICE) guidance includes artificial intelligence (2022)	• Reimbursement • Digital health technology vigilance using a total product lifecycle approach

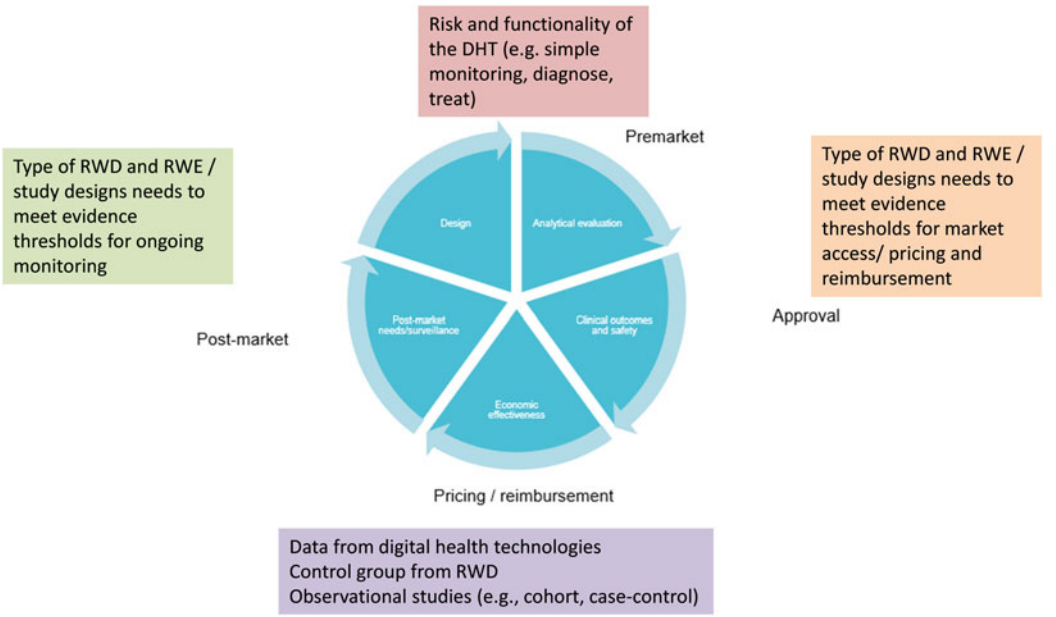

Figure 1. Different evidence needs arising from RWD and RWE.
Source: CDRH Transparency: Total Product Life Cycle (TPLC) | FDA.

The agreed consensus speaks to the need for key principles to set out a clear strategy, clarity around the application and use of RWD and RWE to support an agile environment drawing on data collections and evidence that are manageable and appropriate to inform decision-making. The agreement on guiding principles reflects their importance across a cross-section of key stakeholders concerning RWD and RWE. This is an important finding on its own that reflects a convergence in thinking among a group of stakeholders with a range of expertise.

Sensitivity analysis. We conducted sensitivity analysis on our findings (see Appendix 2). The threshold level of agreement was adjusted by five percentage points downwards and upwards to test the robustness of the results. With a 70% level of agreement (instead of 75%), the main findings stayed the same; the remaining four that were not included were still below 70% (between 56 and 65%). With an 80% level of agreement (instead of 75%), eight principles were removed: three building block principles and five from the PMS and DHT vigilance principles. The remaining principles with 80% agreement still reflect the priorities in terms of policy scope, institutional role and data collection requirements.

Our intention was to reach consensus among experts from five main affiliations: national/regional institution, payer, healthcare professional, scientist/academic research, patient/patient organisation. The experts contacted in the study countries, and via the EHPG and in academic institutions reflect this wide mix. A breakdown of responses by affiliations with sufficient sample size (five or more) was available for three out of the five categories. The sensitivity analysis shows that there is broad consensus across most of the guiding principles (Appendix 2).

4. Limitations

It is important to note the limitations in our analysis. Our review focussed on the most relevant evidence and was not systematic in design, so the results of the review are not exhaustive. However, the review was guided by the study team's pre-existing expertise on the subject, which promoted the construction of an overall picture of the national activities obtained with

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Table 4. Demographics of experts

Demographics	First round ($n = 44$)	First round (%)	Second round ($n = 24$)	Second round (%)	Third round ($n = 24$)	Third round (%)
Age						
Less than 30 years	2	5	2	9	1	4
30–39	11	25	3	13	3	12
40–49	13	30	7	30	8	32
50–59	10	23	8	35	8	32
60–69	7	16	3	13	4	16
70–79	1	2			1	4
Gender						
Male	23	52	13	54	15	63
Female	21	48	11	46	9	38
Country of residence						
Finland	6	18	8	36	8	33
Germany	6	18	5	23	4	17
Italy	6	18	2	9	2	8
United Kingdom	5	15	3	14	4	17
Estonia	3	9	2	9	3	13
Netherlands	2	6			1	4
Austria	1	3				
Greece	1	3				
United States	1	3				
Switzerland	1	3	1	5	1	4
Turkey	1	3	1	5	1	4
Affiliation						
Scientist/academic research	19	43	7	30	8	33
Healthcare professional	12	27	5	22	5	21
National institution/regional institution	7	16	5	22	5	21
Payer	2	5	2	9	2	8
Patient or patient representative	1	2	1	4	1	4
Other/prefer not to say	3	7	3	7	3	7

the chosen search strategy. The Delphi study was conducted over a month and so there may be key experts in the five countries that may have been missed. Nevertheless, every effort was made to gather a cross-section of views from the stakeholder groups in these country settings. Contact with all the country experts including introductory emails were sent, if necessary, in their native languages to describe their role and expectations. Experts who agreed to participate were

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Table 5. Consensus reached on building block principles

Principle	Digital health technology policy framework – building block principles
Institution	A central institution (or agency) oversees the implementation of the national digital health strategy with the support of all relevant stakeholders for the collection, use and best practice of real-word data and real-world evidence.
Collection	Real-world data are collected with the user's informed consent and follows country legislation/ guidance on data protection
Collection	The national digital health strategy supports sharing data across settings that follow country legislation/guidance on data protection and interoperability.
Policy scope	Real-world evidence needs for decision-making are aligned where appropriate to support national and sub-national health policy priorities.
Policy scope	The national digital health strategy explicitly defines digital health technologies, real-world data and real-world evidence drawing on working definitions
Institution	There is a central institution (or agency) that provides guidance to balance transparency and accountability with respect to access and use of real-world data needs for quality assurance.
Policy scope	The national digital health strategy takes a broad and inclusive approach in its definition on the scope of real-world evidence.
Collection	The national digital health strategy supports the collection and use of real-world data and real-world evidence to inform decision-making by making recommendations.

Table 6. Consensus reached on leveraging RWD and RWE for post-market surveillance and digital health technology vigilance

Principle	Digital health technology policy framework – post-market surveillance and digital health technology vigilance
Collection	Real-world data collection includes clinical outcomes, and user experience that could come from patients, carers and healthcare professionals.
	Guidance and best practice of (a) real-world data and (b) real-world evidence are routinely shared and publicly accessible to increase transparency for digital technology vigilance and post-market surveillance.
	National and where appropriate, sub-national agreements are in place with companies (e.g. developers, manufactures and vendors) on the collection and reporting requirements of real-world data and real-world evidence.
	Real-world data are routinely collected in a comparable way where possible and consistently over time to allow for within- and between-country comparisons.
	The collection of real-world data uses study designs and collection methods to support and inform the national digital health strategy for ongoing evaluation, monitoring and evidence requirements.
	In the data collection, the characteristics of the type of digital health technology (e.g. real-time virtual consultation, remote monitoring platform) and its function (e.g. diagnosis, monitoring, self-management, treatment) are collected with sufficient precision, instead of collecting data in overly broad categories.
Decision scope	The national digital health strategy supports the appropriate use of real-world evidence to inform clinical decision-making.
	Depending on the type of evidence, real-world evidence that is based on routinely collected real-world data is used to inform decision-making. This could include in relation to utilisation, benefits, quality, equity, accessibility, safety and reimbursement.

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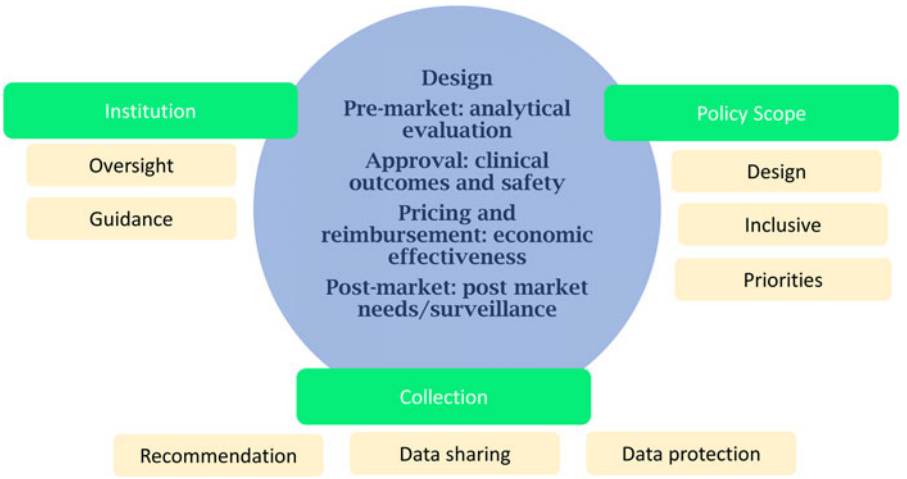

Figure 2. Building block principles to support a total product lifecycle approach.

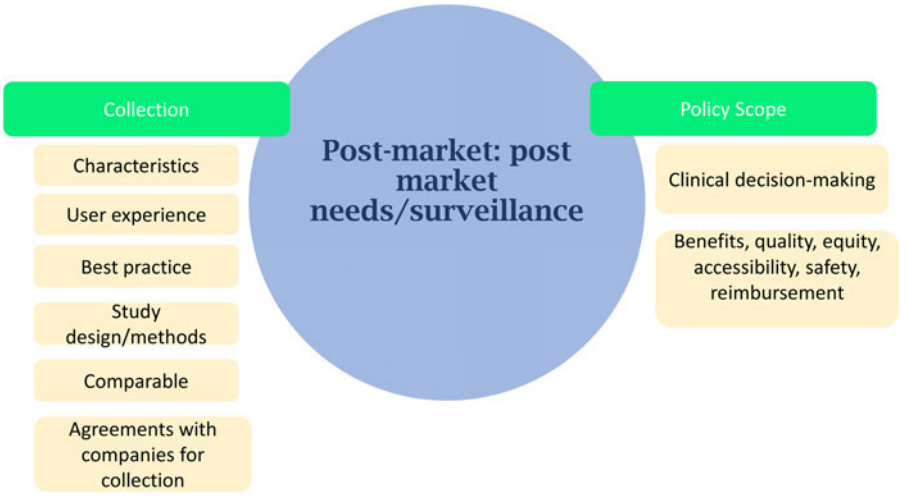

Figure 3. Principles for post-market surveillance and digital health technology vigilance.

informed that the survey and instructions were administered in English. There may be differences in interpretation of the statements by the experts, but we do not expect that differences in interpretation of the statements will have a large impact on our findings. When looking across affiliations, there is broad consensus with most of the guiding principles which further supports our study's results.

5. Discussion and conclusion

This paper set out to understand how RWD and RWE arising from DHTs are used in decision-making. The findings from the review of five countries filled this knowledge gap, identifying opportunities for each country and their progress with respect to digital health policymaking. The review informed the development of guiding principles to embed RWD and RWE systematically for DHTs to inform decision-making. The proposed principles were reached using the

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Delphi consensus-building technique among an international group of experts in the field. Consensus was reached for 16 out of 20 principles, which represent building blocks related to policy scope, institutional role and data collection and principles to promote PMS and *DHT vigilance* (Figures 2 and 3). For the four where consensus was not reached, the distribution of responses, however, reflects their relative high importance (responses had a median value of four) (Appendix 2). Currently, the principles are ranked in order of agreement. A next step for research will be to consider reflecting their importance and relationship with respect to the principles of economics and role and motivation for government intervention in the market of DHTs.

In conclusion, the three main contributions of this paper include first a more nuanced understanding of RWD and RWE with respect to DHTs in the countries reviewed. Second, this is the first study to offer the development of guiding principles to improve digital health policymaking for RWD and RWE introducing the notion of *DHT vigilance*. Third, the findings from the Delphi exercise highlight the need for greater focus on RWD and RWE across Europe. Considerations include clear criteria for decision-making, institutional involvement in overseeing how and where RWD and RWE are appropriate for decision-making. International involvement and engagement would be useful given the large amounts of data being collected, along with flexibility around evidence needs for the most appropriate study designs and a digital health strategy that is agile given the fast-paced nature of this sector.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1744133123000208.

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References

Agenzia per l'Italia Digitale (2014) *Linee guida per la presentazione dei piani di progetto regionali per il FSE*. Available at https://www.agid.gov.it/sites/default/files/repository_files/linee_guida/2_fse_linee_guida_dpcm_31032014.pdf

Ahlqvist J and Kalliola M (2021) *How can digital therapeutics help Europe?* (Working Paper), Sitra.

Ahlqvist J and Kalliola M (2022) *Digitaaliset terapiat – Vaikuttavuutta uudistuviin terveyspalveluihin [Digital therapeutics – Effectiveness for renewable health services]* (Working Paper), Sitra.

Anderson M, Pitchforth E, Edwards N, Alderwick H, McGuire A and Mossialos E (2022) *The United Kingdom: health system review. Health Systems in Transition* (Vol. 24(1).

Atherton H, Brant H, Ziebland S, Bikker A, Campbell J, Gibson A, McKinstry B, Porqueddu T and Salisbury C (2018) The potential of alternatives to face-to-face consultation in general practice, and the impact on different patient groups: a mixed-methods case study. *Health Services and Delivery Research* **6**, 1–199.

BfArM (2022) *The fast-track process for digital health applications (DiGA) according to Section 139e SGB V*. Available at https://www.bfarm.de/SharedDocs/Downloads/DE/Medizinprodukte/diga_leitfaden.html?nn=597198

Blümel M, Spranger A, Achstetter K, Maresso A and Busse R (2020). *Germany: health system review. Health Systems in Transition* (Vol. 22(5)).

BMG (2019*a*) *Gesetzes für mehr Sicherheit in der Arzneimittelversorgung (GSAV)*. Available at https://www.bundesgesundheitsministerium.de/gsav.html

BMG (2019*b*) Digitale-Versorgung-Gesetz (DVG). Bundesgesundheitsministerium. Available at https://www.bundesgesundheitsministerium.de/service/gesetze-und-verordnungen/detail/digitale-versorgung-gesetz-dvg.html

BMG (2020) *Krankenhauszukunftsgesetz (KHZG) – Bundesgesundheitsministerium*. Available at https://www.bundesgesundheitsministerium.de/service/gesetze-und-verordnungen/detail/krankenhauszukunftsgesetz-khzg.html

BMG (2023) Gemeinsam digital. Digitalisierungsstrategie für das Gesundheitswesen und die Pflege. Available at https://www.bundesgesundheitsministerium.de/service/publikationen/details/digitalisierungsstrategie-fuer-das-gesundheitswesen-und-die-pflege.html

CIOMS (2022) *Science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug-related problem*. Available at https://cioms.ch/pharmacovigilance/#:~:text=Definition%20According%20to

%20the%20World%20Health%20Organization%20%28WHO%29,of%20adverse%20effects%20or%20any%20other%20drug-related%20problem

Cylus J, Richardson E, Findley L, Longley M, O'Neill C and Steel D (2015) *United Kingdom: health system review. Health Systems in Transition*. WHO Regional Office for Europe on behalf of the European Observatory on Health Systems and Policies.

Dickstein K, Normand C, Auricchio A, Bogale N, Cleland JG, Gitt AK, Stellbrink C, Anker SD, Filippatos G, Gasparini M, Hindricks G, Blomström Lundqvist C, Ponikowski P, Ruschitzka F, Botto GL, Bulava A, Duray G, Israel C, Leclercq C and Linde C (2018). CRT Survey II: a European Society of Cardiology survey of cardiac resynchronisation therapy in 11 088 patients – who is doing what to whom and how? *European Journal of Heart Failure* **20**, 1039–1051.

Essén A, Stern AD, Haase CB, Car J, Greaves F, Paparova D, Vandeput S, Wehrens R and Bates DW (2022) Health app policy: international comparison of nine countries' approaches. *NPJ Digital Medicine* **5**, 31.

Estonian Health Insurance Fund. (2018) Available at https://www.haigekassa.ee/partnerile/raviasutusele/tervishoiuteenuste-loetelu/loetelu-muutmine-2013-2022%22%20/l%20%22tab-2018%22

Estonian Health Insurance Fund. (2020) *Digitaalsete tervisetehnoloogiate hindamisraamistik*.

Estonian Health Insurance Fund. (2022) Available at https://www.haigekassa.ee/koik-teenused

European Commission (2020) *Digital Economy and Society Index DESI. Digital public services*. Available at https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2019

Article 83, Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC (2017).

European Union (2021) *EU4Digital*. Available at https://eu4digitalua.eu/en/

Ferré F, de Belvis AG, Valerio L, Longhi S, Lazzari A, Fattore G, Ricciardi W and Maresso A. (2014) *Italy: Health System Review. Health Systems in Transition* (Vol. 16(4)).

Habicht T, Reinap M, Kasekamp K, Sikkut R, Aaben L and van Ginneken E (2018) *Estonia: Health system review. Health Systems in Transition* (Vol. 20(1)).

Häkkinen P, Mölläri K, Saukkonen S-M, Väyrynen R, Mielikäinen L and Järvelin J (2019) *Hilmo - Sosiaali- ja terveydenhuollon hoitoilmoitus 2020: Määrittelyt ja ohjeistus [National Care Notification Register of health and social care 2020: definitions and guidelines]*. Available at https://www.julkari.fi/handle/10024/138288files/829/138288.html

Hammersley V, Donaghy E, Parker R, McNeilly H, Atherton H, Bikker A, Campbell J and McKinstry B (2019) Comparing the content and quality of video, telephone, and face-to-face consultations: a non-randomised, quasi-experimental, exploratory study in UK primary care. *British Journal of General Practice* **69**, e595.

Hasson F, Keeney S and McKenna H (2000) Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing* **32**, 1008–1015.

Haverinen J, Keränen N, Falkenbach P, Maijala A, Kolehmainen T and Reponen J (2019) Digi-HTA: health technology assessment framework for digital healthcare services. *Finnish Journal of eHealth and eWelfare*, **11**, 326–341.

Heponiemi T, Jormanainen V, Leemann L, Manderbacka K, Aalto A-M and Hyppönen H (2020) Digital divide in perceived benefits of online health care and social welfare services: national cross-sectional survey study. *Journal of Medical Internet Research* **22**, e17616.

Hughes G, Wood G and Shaw S (2020) *Video consultations in the NHS: summary findings from a UK-wide survey*.

Hyppönen H and Aalto AM (2019) Citizen experiences of e-health and e-welfare services. In Vehko T, Ruotsalainen S and Hyppönen H (eds), *E-health and e-welfare of Finland: Check Point 2018*. Helsinki: Finnish Institute for Health and Welfare (THL), pp. 148–167. Available at https://www.julkari.fi/handle/10024/138244files/782/138244.html.

Jonsson PM, Pikkujämsä S and Heiliö P-L (2019) National quality registers in healthcare and social services – operating model, organization and financing (Report 16/2019, Issue. Available at https://www.julkari.fi/handle/10024/138834files/806/138834.html

Jünger S, Payne SA, Brine J, Radbruch L and Brearley SG (2017) Guidance on conducting and REporting DElphi studies (CREDES) in palliative care: recommendations based on a methodological systematic review. *Palliative Medicine* **31**, 684–706.

Kaihlanen A-M, Virtanen L, Buchert U, Safarov N, Valkonen P, Hietapakka L, Hörhammer I, Kujala S, Kouvonen A and Heponiemi T (2022) Towards digital health equity – a qualitative study of the challenges experienced by vulnerable groups in using digital health services in the COVID-19 era. *BMC Health Services Research* **22**, 188.

Keeney S, McKenna H and Hasson F (2011) *The Delphi Technique in Nursing and Health Research*. Chichester: Wiley. Available at https://books.google.co.uk/books?id=vd2sDwAAQBAJ.

Keskimäki I, Tynkkynen L-K, Reissell E, Koivusalo M, Syrjä V, Vuorenkoski L, Rechel B and Karanikolos M (2019) *Finland: health system review*.

Koivisto J (2021) *Esiselvitys sosiaali- ja terveydenhuollon kansallisten digitalisaatio-ohjelmien arviointikehikon kehittämiseksi [Preliminary study to develop an evaluation framework for national digitalisation programs in health and social care]* (Working paper 28/2021, Issue. Available at https://www.julkari.fi/handle/10024/143248files/800/143248.html

Kyytsönen M, Aalto A-M and Vehko T (2021*a*) *Sosiaali- ja terveydenhuollon sähköinen asiointi 2020–2021: Väestön kokemukset [Social and health care online service use in 2020–2021: Experiences of the population]* (Report 7/2021). Available at http://urn.fi/URN:ISBN:978-952-343-680-0

https://doi.org/10.1017/S1744133123000208 Published online by Cambridge University Press

Kyytsönen M, Vehko T, Jormanainen V, Aalto A-M and Mölläri K (2021*b*) *Terveydenhuollon etäasioinnin trendit vuosien 2013-2020 Avohilmon aineistossa [Trends in remote healthcare in the Avohilmo data in 2013-2020]*. Available at https://www.julkari.fi/handle/10024/141162files/797/141162.html

Laki julkisista hankinnoista ja käyttöoikeussopimuksista [Act on Public Procurement and Concession] 1397/2016 (2016) Available at https://www.finlex.fi/fi/laki/ajantasa/2016/20161397files/779/20161397.html

Laki sosiaali- ja terveydenhuollon asiakastietojen sähköisestä käsittelystä [Act on the Electronic Processing of Client Data in Healthcare and Social Welfare] 784/2021 (2021) Available at https://www.finlex.fi/fi/laki/alkup/2021/20210784files/824/20210784.html

Laki sosiaali- ja terveystietojen toissijaisesta käytöstä [Act on the Secondary Use of Health and Social Data] 552/2019 (2019*a*) Available at https://www.finlex.fi/fi/laki/ajantasa/2019/20190552files/820/20190552.html

Laki Terveyden ja hyvinvoinnin laitoksesta annetun lain muuttamisesta [Act amending the Act on the Finnish Institute for Health and Welfare] 553/2019 (2019*b*) Available at https://www.finlex.fi/fi/laki/alkup/2019/20190553files/822/20190553.html

Lantzsch H, Eckhardt H, Campione A, Busse R and Henschke C (2022) Digital health applications and the fast-track pathway to public health coverage in Germany: Challenges and opportunities based on first results. Available at https://doi.org/10.21203/rs.3.rs-1586622/v1

Lotman EM and Viigimaa M (2020) Digital health in cardiology: the Estonian perspective. *Cardiology* **145**, 21–26.

Ministero della Salute (2011) *The National eHealth Strategy. National context, state of implementation and best practices*. Available at https://www.salute.gov.it/imgs/C_17_pubblicazioni_1653_allegato.pdf

Ministero della Salute (2016*a*) *Patto per la sanità digitale*. Available at https://www.camera.it/temiap/2016/09/29/OCD177-2387.pdf

Ministero della Salute (2016*b*) *Piano Nazionale della Cronicità*. Available at https://www.salute.gov.it/imgs/C_17_pubblicazioni_2584_allegato.pdf

Ministri PDCD (2014) *Intesa tra il Governo, le Regioni e le Province autonome di Trento e Bolzano sul documento recante 'Telemedicina – Linee di indirizzo nazionali'*. Available at https://www.salute.gov.it/imgs/C_17_pagineAree_2515_1_file.pdf

Ministry of Finance (2022) *General government fiscal plan for 2023–2026*. Available at https://julkaisut.valtioneuvosto.fi/handle/10024/164010

NHS England and NHS Improvement (2021) *Supporting general practice in 2021/22*. Available at https://www.england.nhs.uk/wp-content/uploads/2021/01/C1054-supporting-general-practice-in-21-22.pdf

NHSX (2019*a*) *Artificial intelligence how to get it right*.

NHSX (2019*b*) *NHSX: new joint organisation for digital, data and technology*. Available at https://www.gov.uk/government/news/nhsx-new-joint-organisation-for-digital-data-and-technology

NHSX (2020) Using online and video consultations during Covid 19 (2020) Available at https://www.nhsx.nhs.uk/blogs/use-online-and-video-consultations-during-covid-19-pandemic-delivering-best-care-patients/

NICE (2022) *Evidence Standards Framework for Digital Health Technologies*. NICE.

Northern Ostrobothnia Hospital D (2022) Digi-HTA: assessment method. Available at https://www.ppshp.fi/Tutkimus-ja-opetus/FinCCHTA/Sivut/Digi-HTA.aspxfiles/768/Digi-HTA.html

Northern Ostrobothnia Hospital D. About FinCCHTA. Available at https://www.ppshp.fi/Tutkimus-ja-opetus/FinCCHTA/Sivut/In_other_languages.aspxfiles/760/In_other_languages.html

Nuffield Trust (2020) *Quality Watch. Digital and remote care in the NHS during covid-19*.

OECD (2019) *UK Country Health Profile*.

OECD, European Observatory on Health Systems and Policies (2021). Italy: Country Health Profile 2021. Available at https://doi.org/doi:https://doi.org/10.1787/5bb1946e-en

Oliver, D. (2019). David Oliver: lessons from the Babylon health saga. *BMJ*, **365**, l2387. https://doi.org/10.1136/bmj.l2387

Petracca F, Ciani O, Cucciniello M and Tarricone R (2020) Harnessing digital health technologies during and after the COVID-19 pandemic: context matters. *Journal of Medical Internet Research* **22**, e21815.

Presidenza del Consiglio dei Ministri (2021) *Piano Nazionale di Ripresa e Resilienza*. Available at https://www.governo.it/sites/governo.it/files/PNRR.pdf

Primary Care Training Centre (2020) *The changing world of the asthma telephone review*. Available at https://www.primarycaretraining.co.uk/the-changing-world-of-the-telephone-asthma-review/

Reponen J, Keränen N, Ruotanen R, Tuovinen T, Haverinen J and Kangas M (2021) *Tieto- ja viestintäteknologian käyttö terveydenhuollossa vuonna 2020: Tilanne ja kehityksen suunta [Use of information and communications technology in Finnish health care in 2020. Current situation and trends]*. Available at https://www.julkari.fi/handle/10024/143508files/791/143508.html

Ricciardi W and Tarricone R (2021) The evolution of the Italian National Health Service. *The Lancet* **398**, 2193–2206.

Salisbury C, Quigley A, Hex N and Aznar C (2020) Private video consultation services and the future of primary care. *Journal of Medical Internet Research* **22**, e19415.

Scobie S and Castle-Clarke S (2019) *What can the NHS learn from learning health systems?* Available at www.nuffieldtrust.org.uk/files/2019-05/learninghealth-systems-v3.pdf

https://doi.org/10.1017/S1744133123000208 Published online by Cambridge University Press

Sheikh A, Anderson M, Albala S, Casadei B, Franklin BD, Richards M, Taylor D, Tibble H and Mossialos E (2021) Health information technology and digital innovation for national learning health and care systems. *The Lancet Digital Health* **3**, e383–e396.

Simovic S, Providencia R, Barra S, Kircanski B, Guerra JM, Conte G, Duncker D, Marijon E, Anic A and Boveda S (2022) The use of remote monitoring of cardiac implantable devices during the COVID-19 pandemic: an EHRA physician survey. *EP Europace* **24**, 473–480.

Skrami E, Carle F, Villani S, Borrelli P, Zambon A, Corrao G, Trerotoli P, Guardabasso V and Gesuita R (2020) Availability of real-world data in Italy: a tool to navigate regional healthcare utilization databases. *International Journal of Environmental Research and Public Health* **17**, 8.

Sounderajah V, Clarke J, Yalamanchili S, Acharya A, Markar SR, Ashrafian H and Darzi A (2021) A national survey assessing public readiness for digital health strategies against COVID-19 within the United Kingdom. *Scientific Reports*, **11**, 5958.

Srivastava D, Scarbrough H and Stavropoulou C (2020) *Current regulatory challenges to support the spread of digital health technologies, Centre for Healthcare Innovation Research Policy Report*, London: City University.

Stern AD, Brönneke J, Debatin JF, Hagen J, Matthies H, Patel S, Clay I, Eskofier B, Herr A, Hoeller K, Jaksa A, Kramer DB, Kyhlstedt M, Lofgren KT, Mahendraratnam N, Muehlan H, Reif S, Riedemann L and Goldsack JC (2022) Advancing digital health applications: priorities for innovation in real-world evidence generation. *The Lancet Digital Health* **4**, e200–e206.

Taltech Centre for e-medicine (2022) Digitaalsete tervisetehnoloogiate hindamisraamistiku töötoad: Raport. Available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwir0LWspJz4AhViw4sKHeBLC5EQFnoECAIQAQ&url=https%3A%2F%2Fwww.haigekassa.ee%2Fsites%2Fdefault%2Ffiles%2Fl%25C3%25B5ppraport_digitaalsete_tervisethnoloogiate_hindamine.pdf&usg=AOvVaw2kLMNdInAGdgCg84efYDpB

TK (2022) Vier Forderungen zur Optimierung von Apps auf Rezept. Availabe at https://www.tk.de/resource/blob/2125172/e546be96b6ba756e1ec6acc5b2a36dfd/position-zu-diga-data.pdf.

Torkki P and Mäki-Opas T (2021) *Vaikuttavuuden vuosikymmentä rakentamassa [Building a decade of effectiveness]* (Statement by University of Helsinki and University of Eastern Finland, Issue.

Valtioneuvoston asetus (582/2017) erikoissairaanhoidon työnjaosta ja eräiden tehtävien keskittämisestä [Government Decree on the division of labour in specialised care and the centralisation of certain tasks 582/2017] (2017) Available at https://www.finlex.fi/fi/laki/alkup/2017/20170582files/771/20170582.html

Vehko T, Ruotsalainen S and Hyppönen H (2019) *E-health and e-welfare of Finland: Check Point 2018*. Available at https://urn.fi/URN:ISBN:978-952-343-326-7

WHO (2019) *Recommendations on digital health interventions*.

WHO (2021) *Guidance for post-market surveillance and market surveillance of medical devices, including in vitro diagnostics*.

Wieringa S, Neves AL, Rushforth A, Ladds E, Husain L, Finlay T, Pope C and Greenhalgh T (2022) Safety implications of remote assessments for suspected COVID-19: qualitative study in UK primary care. *BMJ Quality & Safety*. doi: 10.1136/bmjqs-2021-013305

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