Assessing digital maturity of hospitals: Comparing national approaches in five countries

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Abstract

Background: Digital maturity assessments can inform strategic decision making. However, national approaches to assessing digital maturity of health systems are in their infancy, and there is limited insight into context and processes associated with such assessments.

Objective: To describe and compare national approaches to assessing digital maturity of hospitals.

Methods: We performed a narrative review of five national approaches to assessing digital maturity of hospitals in Queensland (Australia), Germany, the Netherlands, Norway, and Scotland. Data was collected in narrative form exploring context, drivers, and approaches to measure digital maturity in each country. We then performed a qualitative thematic analysis to compare approaches with the help of NVivo 12 to facilitate coding.

Results: We observed a common focus on interoperability, and assessment findings were used to shape national digital health strategies. Indicators were broadly aligned, but four of five countries developed their own tailored indicator sets. Key topic areas across countries included interoperability, capabilities, leadership, governance, and infrastructure. Analysis of indicators was centralised, but data was shared with participating organisations. Only one setting conducted an academic evaluation. Major challenges of digital maturity assessment included the high cost and time required for data collection, questions about measurement accuracy, difficulties in consistent long-term tracking of indicators, and potential biases due to self-reporting. We also observed tensions between practical feasibility of the process with the depth and breadth required by the complexity of the topic, and tensions between national and local data needs.

Conclusions: There are several key challenges in national assessments of digital maturity in hospitals that influence the validity and reliability of outputs. These need to be explicitly acknowledged when making decisions informed by assessments and monitored over time.

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Assessing digital maturity of hospitals: Comparing national approaches in five countries

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Abstract

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Introduction

Health systems are facing increasing pressure to achieve more with less, and health information technology (HIT) is widely recognised to tackle existing challenges, although it is still difficult attribute causal connections between HIT and healthcare outcomes.(1)

The concept of digital maturity has emerged from the field of organisational studies. It has been conceptualised as an organisational state that in which processes are digitalised and accompanied by other organisational transformations.(2) The assumption underlying the concept of digital maturity in healthcare is that organisations who have higher levels, achieve better processes and outcomes.(3,4) This may include improved quality and operational efficiency through implementing electronic health records (EHRs) and laying the foundation for learning healthcare systems, artificial intelligence and precision medicine.(5) We here define EHR as, a digital version of a patient's paper chart including medical history, treatment, and care over time.

The World Health Organization supports driving the improvement of digital maturity in health systems, aiming towards Universal Health Coverage (UHC).(6) National approaches to measuring digital maturity have emerged in public health systems relatively recently and are now increasingly applied to inform strategic decision making.(7) Although some measurements are widely applied (e.g. those by the Healthcare Information and Management Systems Society, HIMSS),(8) there are currently no universally accepted methods for measuring digital maturity in health systems.(9) This may partly be due to the evolving landscape of digital health, where the concept of digital maturity is difficult to define. Some have argued that it needs to be conceptualised as a journey without a definitive endpoint,(10) and digital health capability is sometimes used interchangeably with maturity to reflect a continuum of digital growth.(11)

To understand how best to assess digital maturity in health systems, to facilitate comparisons and sharing of lessons, there is a need to compare initiatives across nations. Although approaches to measuring digital maturity have been analysed within countries and local organisations,(4,12,13) there is currently limited evidence surrounding international comparisons. A nuanced view of the role of digital maturity assessments will help to shape implementation efforts. This effort needs to include deliberations surrounding value emerging from various digital maturity assessments, in relation to effectiveness and returns on investments and for quality and safety of care.

We therefore aimed to describe and compare national digital maturity approaches. We hope that this work will contribute to fostering an environment of learning and sharing lessons, which can inform future strategies and international comparisons.

Methods

Countries included in this review were sampled opportunistically through our existing networks in the International Medical Informatics Association (IMIA) and European Federation of Medical Informatics Evaluation Working Groups on technology assessment and evaluation. Snowballing through this network identified additional stakeholders. To be included, we needed to be able to access information on the digital maturity assessment process, and we therefore in some cases worked with policy makers who were involved in the exercise within their countries to gather data.

We assigned academic or policy leads to each of the participating countries, who were responsible for collecting descriptive data. Using nominal group technique with leads, we co-created a data collection template table for each country, representing key features and learnings identified through discussions in group meetings. These included description of the context/setting, rationale and

drivers for the digital maturity assessments, tools and methods used to collect digital maturity data, methods used to analyse and disseminate the data, challenges encountered, and lessons learned that are likely to be relevant to the international community (see Appendix). Missing fields were accepted and leads unable to provide complete data sets were still considered eligible. We then coded items under each table-field using NVivo 12 and extracted areas of convergence and areas of divergence under each of the categories through a qualitative thematic analysis. The constructed narrative including key themes (presented in the Results section below) and implications of our findings was then discussed amongst all members of the team in meetings with country leads.

Results

Context

The size of populations in participating countries varied significantly from five million in Queensland, Norway, and Scotland, to 18 million in the Netherlands and 84 million in Germany.

None of the included health systems were financed through out-of-pocket models or private insurance-based financing models, and all had UHC. Health systems varied from The Beveridge model, where healthcare is provided free at the point of care through taxation (Scotland, Norway), The Bismark model which is characterised by compulsory health insurance related to earnings (Germany, the Netherlands), and mixed models where universal public health insurance funded through tax can be supplemented by private health insurance (Queensland).(14)

All participating countries had a strong governmental focus on interoperability in their national strategies, but some had made more progress than others. This was particularly apparent when looking at regional examples. For instance, Queensland had a state-wide Integrated Electronic Medical Record (ieMR) with Cerner. In other countries, where regions had some autonomy over

budgets and procurements, there were a multitude of heterogeneous EHR systems sometimes spanning more than one provider organisation.

EHR coverage in hospitals was hard to assess, but between 50-100% of hospitals used some sort of clinical information system (i.e. systems designed to support the operations of specific clinical departments or functions within an organisation). Norway, Scotland and the Netherlands had 100% coverage.

Types of EHR systems varied significantly. Some countries were dominated by one vendor (e.g. Queensland with Cerner, Scotland with TrakCare), whereas others used a mixture of systems including United States-based mega systems (Epic, Cerner) and “home-grown” systems (Norway, Germany, the Netherlands).

Digital maturity assessments were national in all countries except Australia, which assessed the region of Queensland. All were initiated and executed by Government, except in Germany where the government commissioned a consortium.

Although the focus of this analysis was on digital maturity in hospitals, some digital maturity assessments included several health and care settings, including acute, primary, and social care (Norway, Scotland, the Netherlands).

All assessments had a longitudinal element, although what indicators were collected at any point in time was determined by local contextual factors such as availability and feasibility. In addition, the list of indicators evolved over time as some were added, and others were removed in line with strategic objectives and feasibility (explicitly mentioned in Germany and Scotland).

Rationale and drivers for digital maturity assessments

Across countries, the primary drivers for digital maturity assessments were to inform digital health strategy and priority areas of investment, evaluate national progress, and conduct local benchmarking designed to help participating organisations to compare themselves to others. In Scotland, the local use of data to guide and plan digital transformation was emphasised, and the German case also mentioned a desire to compare their digital maturity with international centres of excellence.

Some cases also mentioned the exploitation of data generated and the use of data to drive and provide evidence for progressing interoperability agendas. The Norwegian initiative was for instance designed to provide data for research and analysis in public health, and the Dutch strategy mentions the need to conduct a Societal Cost-Benefit Analysis to define if, when and how mandating digital data exchange can be implemented.

Tools and methods used to collect digital maturity data

Most countries assessed a combination of common elements of digital maturity, such as strategy, information technology capability, interoperability, governance and management, patient-centred care, skills and behaviours, and data analytics.(11) Which elements were assessed was often based on the context of the country. Queensland was the only region that used a HIMSS Digital Health Indicator (DHI).(15)

All countries collected data through standardised electronic self-assessment surveys that were completed by local organisations and supported by national stakeholders. Some had, or were in the process of developing, bespoke electronic data collection and analysis platforms. There was

significant variation both within and across countries as to which organisational stakeholders completed the survey.

Likert scales were mostly used to measure indicators, whilst some also had some multiple-choice items, precent scales, and the option for limited free text. The number of included items, however, varied significantly across countries, and did not always corelate with the number of health and care settings included, the size of populations, or the number of EHR systems. Norway's national eHealth Monitor included 30 indicators, followed by the Dutch Interoperability Maturity Model with 37 items. Queensland had 121 indicator statements, Germany had 234 items, and Scotland had the largest number with 355 discrete indicators (Scotland also included the widest range of care settings).

Areas of focus also varied significantly depending on how countries divided assessment elements. It was therefore difficult for us to compare where countries placed specific items and where they overlapped. Themes commonly measured across countries included interoperability and information exchange, capabilities and applications, organisational leadership and governance, and technological infrastructures.

Specific areas measured locally in individual countries included person-enabled health and predictive analytics in Queensland; resilience management, clinical, processes, telehealth, and patient participation in Germany; skills and competencies, sustainability, and secondary uses of clinical data in Scotland; laws, regulations and care processes in the Netherlands; and user satisfaction, and cost-monitoring in Norway.

Most assessments were voluntary but strongly encouraged. None of the countries used penalties. The only compulsory assessment was in Germany, but it was only relevant for hospitals who received

national funds to support digital transformation.

Methods used to analyse and disseminate digital maturity assessment data

Analysis was mostly centrally coordinated and quantitative in nature. We observed a lack of transparency of collected data and digital maturity calculations across countries.

Queensland used proprietary algorithms provided by HIMSS which allowed a degree of international benchmarking. These were supplemented by some academically led qualitative analyses. Benchmarking by geographical region or organisation was done in some countries (Queensland) but not in others (Scotland). Scotland wanted to gain an understanding of the national landscape in order to better focus strategic funding. They also wanted submitting organisation to develop improvement plans individually and with their linked organisations, across their local, integrated health and care system. There was an explicit agreement that ranking organisations would potentially hinder data collection and analysis. Some countries (the Netherlands and Scotland) also made (or will make) data available for analysis by local organisations themselves.

Outputs were in most cases disseminated directly to participating organisations (via dashboards and meetings) and externally through open webinars and public reports. They were across countries explicitly designed to inform ongoing eHealth strategy. Queensland was the only setting that had a systematic academic evaluation of the digital maturity assessment and associated findings were published in academic journals and conferences, as well as through HIMSS. Scotland and Queensland established an external steering group comprising of subject matter and policy experts.

Challenges encountered and lessons learned

Challenges encountered included limitations in the measurements used, such as uncertainties about the validity of constructs for assessing digital maturity. The analysis and data collection process were time-consuming, and indicators evolved over time, raising questions about the validity of longitudinal elements. Balancing the practical feasibility of the process with the depth and breadth required by the complexity of the topic presented a trade-off. There were also challenges in making international comparisons due to limited relevance in some local contexts. The self-reported nature of measurements introduced likely biases in assessments, dependent on local leadership support. Additionally, there was limited use of qualitative assessment of indicators, with qualitative follow-ups for context and clarification used only to a limited extent.

Some countries recognised that there is a need to address concerns that data might be used for performance management, which may hamper efforts to obtain accurate data.

Costs of digital maturity assessments were significant (although we did not make cost-benefit assessments), including the required resources to collect, complete, analyse and disseminate the data. In some countries, additional costs included consultancy support for data platforms, data collection and analysis (Queensland, Scotland, the Netherlands).

Discussion

Summary of findings

Although countries varied significantly in population size, existing EHR systems, settings, and indicators; some common themes emerged. These included a national focus on interoperability; a

desire to measure changes over time (and a concurrent difficulty keeping track of progress in line with changing circumstances); a need to inform national digital health strategy, priority areas of investment, and local benchmarking and strategy development; at least some alignment of common indicators tailored to local needs; a focus on quantitative measurements; and the self-reported voluntary nature of the exercises.

Common thematic areas across countries included interoperability and information exchange, capabilities and applications, organisational leadership and governance, and technological infrastructures. Analysis was centrally coordinated but data was made largely available to participating organisations. Rigorous independent evaluation was only present in one instance.

Challenges encountered included cost of the assessment and time-consuming data collection, potential issues surrounding the validity of measurements, issues with reliably measuring changes over time, and potential biases introduced through self-reporting.

Strengths and limitations

Our work is one of the first attempts to describe and compare how different countries measure digital maturity in hospitals. We included only a limited number of countries, chosen through a self-selected sample, which may limit the potential transferability of findings. Our results are also likely to only apply to relatively advanced health systems with high levels of EHR implementations and UHC.

The data for the study was collected directly by the authors in narrative form and from various sources, which is likely to have biased what was included as it was subjectively selected, and individual viewpoints may have influenced the accounts. This method of data collection also meant

that the study provided limited detail and did not delve deeply into specific thematic areas and indicators. We observed a significant variation in approaches and the number of indicators used by different countries, which was difficult to account for in the analysis.

As our focus was on providing an overview of approaches, we did not collect specific information on how the data was analysed within each country and we therefore did not obtain any insights into factors such as regional variations, or differences between digitally mature and less-mature sites. This could potentially be subject of follow-on work.

Despite these limitations, we offer a broad analysis that provides initial insights into the various methods countries have employed to assess digital maturity in hospitals and the lessons they have learned from these experiences. Building on this work, there is now an opportunity to explore the identified areas in more detail, potentially leading to a more comprehensive understanding of digital maturity assessments in heath and care settings across various health systems.

Integration of findings with the literature

There are many commercially available models for healthcare providers to assess digital maturity, and there are some general practical considerations that are likely to be relevant across settings.(16) Currently, there are however limited evidence-based methods to assess the quality, utility, and efficacy of maturity models and limited guidance on selecting the most appropriate model for any given context.(17) The underlying evidence base for national approaches is even less mature, highlighting the importance of our work.

The World Health Organization has recently reviewed tools used to monitor digital health in eight

countries (including Australia and the Netherlands), but these were not specifically explored in relation to digital maturity.(9) Nevertheless, there was a degree of overlap in relation to focus. For example, infrastructure and governance as well as specific applications including EHRs, telehealth and electronic prescribing featured heavily in these assessments, illustrating the interlinked nature of digital health strategy, systems, infrastructures, and digital maturity. The report also points out a lack of indicators for measuring health inequalities and a tendency to prioritise outcomes over processes. (9) This may partly be due to the difficulty to measure processes in health and care digitalisation, and a lack of expertise to analyse such data.(18)

Approaches to assessing digital maturity have in the past been criticised for relying too heavily on assessing technological capabilities, overshadowing socio-organizational aspects.(19) This imbalance is reflected in the current analysis but there appears to be an increasing recognition of socio-organisational factors such as leadership and governance and consumer/patient-centred care.

The issue surrounding the evolution of intervention maturity over time has already been recognised, (20) but how digital maturity assessments can adequately account for this progression is less clear. Changing circumstances are recognised as a significant challenge in measuring progress of digitalisation in health and care, as the use and exploitation of digital systems is often accompanied by wider changes to organisational functioning, in which existing ways of working are transformed. (21) This in turn impacts on the way measurements can be compared over time. The challenge is unlikely to be easily resolved and may require defining a limited set of core measurements that will not be significantly affected over time, whilst being flexible in including new emerging indicators.

Implications for policy and practice

There is therefore a trade-off between breadth and depth influencing the scope of assessments. There is also a need to tailor assessments to different settings, as the prevailing one-size-fits-all approach whilst providing insights into overall trends, does not help to understand specific organisational circumstances.

The general lack of academic independent validation in digital maturity models and assessments is concerning and raises questions about the reliability and efficacy of existing approaches. There has also been a lack of focus on processes that lead to measured outcomes in assessments. There is further limited evidence on the interrelationships among maturity dimensions meaning that assessments do not provide evidence-based recommendations for improvement.

The role of common indicators across assessments is important. These bring a degree of international comparability, but contextual variations are significant, and digital maturity progress is determined by legal frameworks and financial resources. Scores developed by HIMSS may facilitate a degree of comparability and validation for digital maturity assessments. But standardised international tools may not pay sufficient attention to locally relevant metrics that organisations can use to inform local strategies. Such tools may also present challenges regarding equity, access and there may be commercial conflicts of interest.

Another significant challenge lies in deciding who should be responsible for collecting data, how they represent professional and organisational interests, and how a degree of uniformity across settings may be achieved. This also highlights the necessity of understanding who is best placed to answer specific questions and re-iterates the leading organisation (central Government) being explicit in the purpose of the assessment and communicating this repeatedly. A degree of

unpredictability regarding how data will eventually be used remains, and so does uncertainty of how individual assessments fit within wider long-term strategy. Amongst participating organisations, there may be concerns that the data might be used for performance management or resource allocation. Such uses could lead to apprehension and resistance, potentially exacerbating existing inequities.

Going forward, it will be important to assess how these challenges are tackled over time in individual countries, and across the evolving health and care ecosystem including primary and community care. Incorporating various stakeholder perspectives will be critical, including the voices of health and care providers and patients. We hope that our work provides a stepping stone for achieving this.

Conclusions

Digital maturity evaluations are driven by a national or regional impetus to identify both areas of excellence and those requiring investment in digitalisation. However, the process of assessing digital maturity is fraught with challenges that require transparency in decision making and monitoring through evaluation.

Existing work is frequently based on self-reporting, is very costly, lacking academic input, and is often conducted by stakeholders with diverse and at times conflicting agendas. Despite these concerns, having some data, however imperfect, is clearly better than none. This is especially true when it comes to making policy decisions that need substantiation.

National digital maturity assessments need to mature from being a vendor or consultancy funded project-based exercise towards longitudinal evidence-based and academically-led activity

characterised by international collaboration to facilitate learning.

Conflicts of interest: None

Author contributions: KC and EA conceived the paper. KC led on the data collection, analysis and write-up with all authors contributing to data collection, data analysis and various iterations of the paper.

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Affiliations: KC, EA and LS are members of the International Medical Informatics Association Working Group on Technology Assessment and Quality Development and the European Federation for Medical Informatics Working Group on Evaluation.

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Appendix

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Context	Conducting regular digital maturity assessments as a commitment within the Scottish Government's Digital Health and Care Strategy.
Healthcare model[9] (max. 20 words)	National Health Insurance
Size of country or region (# inhabitants)	Approximately 5 million
National hospital EHR strategy (in existence since when? Major focus?) (max. 50 words)	Not to implement EHRs specifically but national move towards an open EHR data platform
EHR coverage in hospitals (# of hospital with EHR) (EHR defined here as a partial or full electronic record of patient core data such as allergies, diagnosis, therapies, medication) (percentage of short verbal description)	100%
Types of EHR systems (indicate number of vendors of core EHR systems in hospitals) (max. 10 words)	12 of Scotland's 14 regional NHS boards have TrakCare
National or regional approach to	National

digital maturity (enter "national" or "regional", if needed max 10 words for explanation)	
Name	Digital maturity survey
Rationale and drivers (why is the benchmarking exercise conducted? What is the primary aim?) (max. 20 words)	Informing Strategy, Identifying areas for investment, benchmarking organisations, justifying investments
Anticipated outcomes (what are the primary anticipated outcomes of the benchmarking exercise?) (max. 20 words)	Data to facilitate local and national decision making. At national and organisational level inform: Priority setting Measuring and reporting on progress Strategic funding plans
Who is leading/driving the benchmarking exercise? (max. 20 words)	Scottish Government and Convention of Scottish Local Authorities (COSLA)
Origin (how were benchmarking measurement tools developed? Did they draw on existing tools?) (max. 20 words)	Bespoke model drawing on methodical review of UK and global models
How is the data collected? (what tools are used to collect and analyse benchmarking data? Who collects the data?) (max. 20 words)	Bespoke data collection platform, bespoke dedicated dashboards for commissioning stakeholders and participating organisations. Analysis by external consultants. Yearly assessment cycle.
Content (how many benchmarking items does the	355 discrete indicators (230 Likert / 42 Percent Scale / 83 Other) split by service type where relevant.

tool contain approximately? Are these free text or numerical?) (max. 50 words)	Indicators grouped into 20 topics each assigned to one of three themes. Staff survey component: 28 Likert indicators. Completion by organisations or jointly by local healthcare and social care systems.
Areas of focus (what overall benchmarking topics/dimensions does the tool address?) (max. 100 words)	Readiness Theme: Strategic Alignment, Leadership, Resourcing, Governance, Information Governance, Skills and Competences, Climate Emergency and Sustainability Infrastructure Theme: Enabling Infrastructure, Solutions Capabilities Theme: Records, Assessments & Plans, Transfers of Care, Orders & Results Management, Medicines Optimisation, Decision Support, Remote and Assistive Care, Digital Channels, Asset and Resource Optimisation, Business and Clinical Intelligence, Standards, Digital Clinical Safety Staff Survey: Selection from above sections, Benefits Tracking, Roles, Care Settings
Care settings (what care settings does the benchmarking exercise cover?) (max. 20 words)	General Health and Care Acute Primary care Community Adult Social care Children's Social Care Mental Health

How is the benchmarking data analysed (nationally? Locally? Qualitatively? Quantitatively?) (max. 20 words)	Quantitatively/aggregated at national level via dashboard and report; quantitatively/qualitatively at local level via dashboard. No benchmarking by organisation (deliberately)
What are the outputs and how are they communicated? (What is done with the insights obtained through the benchmarking analysis? And who disseminates the benchmarking data to whom and how?) (max. 50 words)	Outputs by organisation disseminated via self-service analytics dashboard and dedicated tool supporting planning; further, follow-up meetings with ~50% of sample. Benefits tracking tool to be made available once data volume supports it. National outputs disseminated via public report, stakeholder self-service analytics dashboard and bespoke specialist presentations.
Longitudinal element? (Is the benchmarking data collected over longer periods of time? Are different time periods compared?) (max. 20 words)	Strongly featured, reporting draws comparisons with previous assessment. Dashboards will include longitudinal self-service tools once data volume supports it.
Compulsory? Penalties? (Are there penalties or incentives to complete for participating organisations? Which ones? Is the benchmarking exercise compulsory?) (max. 20 words)	Organisations are incentivised by benefits extended to them rather than penalised.
Cost/effort involved (what are the cost categories involved in	Developing data collection and dissemination instruments, completing questionnaires, conducting

collecting, analysing and disseminating the benchmarking data?) (max. 20 words)	follow-up meetings, analysis and reporting
Issues encountered (what are the main challenges encountered during the benchmarking exercise?) (max. 50 words)	Trading off practical feasibility of the process with the depth and breadth required by the complexity of the topic, ensuring support for content and method are easy enough to access for all, ensuring that organisations make generous use of provided facilities to collaborate on their assessments.
Evaluation/monitoring (has the benchmarking exercise been evaluated or monitored? If so, by whom?) (max. 20 words)	Internal and separately external stakeholders steering groups each comprising of subject matter and policy experts.
Lessons (what are lessons learned to date that may be relevant for the international community?) (max. 50 words)	Involvement of Senior Leadership can vary Qualitative follow-up is valuable for context and data quality Important to address concerns that data might be used for performance management Valuable to identify individual good practice (hence our decision to promote learning via specific development platform.
References (max. 4)	https://www.digihealthcare.scot/our-work/digital-maturity/ https://www.digihealthcare.scot/digital-maturity-results-published/

NORWAY	Line Silsand (line.silsand@uit.no) Sevala Malkic (sevala.malkic@helsedir.no)
Healthcare model[7] (max. 20 words)	National health and social Insurance
Size of country (# inhabitants)	Approximately 5,5 million
National hospital EHR strategy (in existence since when? Major focus?) (max. 50 words)	National strategies for interoperability/infrastructure for exchange of information (National Core record, HelseNorge (national platform of information, gives citizens info about their own health/medication, eCommunication with GPs, etc), ePrescription (national service). Health organisations (hospitals, primary healthcare, GPs etc) make independent decision about which system to procure. National control, in terms of government budgets but the 4 health regions are largely independent and responsible for hospitals in each region. Health organisations (hospitals, primary healthcare, GPs etc) make independent decision about which system to procure.
EHR coverage in hospitals (# of hospital with EHR) (EHR defined here as a partial or full electronic record of patient core data	100% coverage of EHRs

such as allergies, diagnosis, therapies, medication) (percentage of short verbal description)	
Types of EHR systems (indicate number of vendors of core EHR systems in hospitals) (max. 10 words)	**DIPS ASA in 3 of 4 health authorities, EPIC in 1 of 4 health authorities**
National or regional approach to digital maturity (enter "national" or "regional", if needed max 10 words for explanation)	National – eHealth Monitor
Name	National e-health monitor
Rationale and drivers (why is the benchmarking exercise conducted? What is the primary aim?) (max. 20 words)	National target indicators to monitor effects of national political actions, quality improvement in healthcare services, provide data for research and analysis in public health.
Anticipated outcomes (what are the primary anticipated outcomes of the benchmarking exercise?) (max. 20	Document whether the objectives of the political guidelines are being realized.

words)	
Who is leading/driving the benchmarking exercise? (max. 20 words)	Norwegian Government
Origin (how were benchmarking measurement tools developed? Did they draw on existing tools?) (max. 20 words)	The proposed target indicators are based on criteria recommended in WHO's report on the development of national e-health strategies (World Health Organization (2012): National eHealth Strategy Toolkit (who.int)).
How is the data collected? (what tools are used to collect and analyse benchmarking data? Who collects the data?) (max. 20 words)	Self-assessment, data from national platforms/infrastructures managed by national representatives.
Content (how many benchmarking items does the tool contain approximately? Are these free text or numerical?) (max. 50 words)	The national e-health monitor consists of 30 different target indicators which are compiled in five strategic objectives corresponding to the national digital eHealth strategy.
Areas of focus (what overall benchmarking topics does the tool address?) (max. 100	**Overview of indicators and strategic objectives** The national e-health monitor consists of 30 different target indicators which are compiled in five strategic objectives corresponding to the national digital eHealth strategy. Reference 2: 24.78% coverage

words)	**Objective 1: Active participation in own and close one's health**. Digital health and care services must facilitate that citizens can easily get involved in prevention, treatment, and follow-up of their own and close one's health. How, when and where health and care services are carried out must to a greater extent be adapted to the citizen's needs. This will contribute to better utilization of competence and capacity. **Indicators**: National monitoring through HelseNorge (digital platform) - **different indicators by using HelseNorge are;** Number of visits to Helsenorge, Number of logins to Helsenorge – self-service solutions, Most used services on Helsenorge, Citizens visit/use Self-registered diseases: At Helsenorge, citizens can log in to view the different kind content/information and Helsenorge monitors the number of visits to the various pages of HelseNorge. Monitoring through **Core Record** (National platform) - Citizens' use of privacy settings in the core record, Citizens' own registrations (diseases, allergies) in the core record, Citizens' searches in the core record, clinicians registering critical information/selected information in the core record. **Citizen survey on e-health** (questionary) **Nordic health portals** (National Health Portals in the Nordics) **Patient Travel** represent patients are journeys to and from publicly approved treatment. Patients register the travel via a Self-service solution at HelseNorge. **Objective 2: Easier working day**. Healthcare professionals should have access to user-friendly digital tools that provide good decision support and supports administration

	processes. This will contribute to strengthened patient safety, a reduction in unwanted variation and a more attractive work situation for healthcare professionals. **Indicator: Healthcare personnel survey on e-health (digital questionary)**; The Directorate of e-Health conduct an annual survey of healthcare professionals' use of, attitudes toward, and satisfaction with digital health services, including both primary and specialist healthcare services **Objective 3: Health data for renewal and improvement**. The health and care services, healthcare professionals and the health and care authorities will increasingly make decisions based on data. More data-driven decisions will contribute to better resource utilisation, increased quality, and innovation in the services, as well as better research, health monitoring, emergency preparedness and overall better public health. **Indicator:** A national webportal (helsedata.no) aimed to provide faster and more secure access to health data from the country's many health registries and data sources. Monitoring the use of the webportal. **Objective 4: Available information and strengthened collaboration**. Digital collaboration and strengthened information management along with increased standardisation will ensure that health information is secure and easily accessible when needed. This will facilitate a more active citizen, better and more effective health care, as well as better data analyses for quality improvement, health monitoring and governance. Objective 5: Cooperation and instruments that strengthen

	implementation The implementation in the eHealth area will be strengthened through increased cooperation and better use of financial and legal instruments. This will result in coordinated and comprehensive eHealth development that provide sustainable health and care services of good quality. **Indicators:** **National platform E-Prescription** enabling national monitoring of different variables; Percentage of e-prescriptions issued in specialist healthcare, E-prescription – issuing and dispensing **National platform Electronic message exchange (incl. both primary- and specialist health services**. **Basic data** – which is a technical solution that gives actors in the sector access to relevant registers through information services. Provided by the Norwegian Health Network HelseNorge – monitor number of "lookup" on patients' own medication. **Objective 5: Cooperation and instruments that strengthen implementation**. The implementation in the eHealth area will be strengthened through increased cooperation and better use of financial and legal instruments. This will result in coordinated and comprehensive eHealth development that provide sustainable health and care services of good quality. **Indicators:** National monitoring of **ICT expenses in the health and care sector in terms of,** Distribution of ICT expenses between operating and investment costs in the four different health regions, ICT expenses per employee in the health regions, ICT expenses as a share of total

	operating costs in the health regions, development in total ICT expenses. **National platform E-Prescription**; monitoring of Unique prescribing entities using e-prescriptions. National eHealth strategy(2023-2030) (ehelse.no)
Care settings (what care settings does the benchmarking exercise cover?) (max. 20 words)	Health and care (hospital, municipalities, GPs and citizens)
How is the benchmarking data analysed (nationally? Locally? Qualitatively? Quantitatively?) (max. 20 words)	National analysis Quantitatively, focus on figures,
What are the outputs and how are they communicated? (What is done with the insights obtained through the benchmarking analysis? And who disseminates the benchmarking data to whom and how?) (max. 50 words)	National e-health monitor displaying the results of the data collected through different indicators. Informing national strategy. Five strategic objectives represent the focus areas that the sector will collaborate on towards 2030. Each objective has set of key performance indicators which will help to measure achievement of the objective, and the set of the strategic initiatives that presents the most important strategic activities.
Longitudinal element? (Is the benchmarking data	Yes. The target indicators for the five

collected over longer periods of time? Are different time periods compared?) (max. 20 words)	strategic objectives are determined based on 1) what are relevant indicators and 2) possible to collect at the present time (2023). There is an addressed need for further development of the target indicators, which starts during 2023. Then, iteratively improvement and adjustment of target indicators will be done, in line with the step-by-step follow-up of the strategy. Most of the indicators for 2023 are adoption- or perceived performance indicators. When the development of target indicators evolves, the range of result- and effect indicators will increase. An appropriate balance between quantitative and qualitative target indicators is preferred.
Compulsory? Penalties? (Are there penalties or incentives to complete for participating organisations? Which ones? Is the benchmarking exercise compulsory?) (max. 20 words)	Most of the benchmarking is based on monitoring digital traces in various registries and systems.
Cost/effort involved (what are the cost categories involved in collecting, analysing and	National government responsible for the monitoring.

disseminating the benchmarking data?) (max. 20 words)	
Issues encountered (what are the main challenges encountered during the benchmarking exercise?) (max. 50 words)	See the cell marked GREEN
Evaluation/monitoring (has the benchmarking exercise been evaluated or monitored? If so, by whom?) (max. 20 words)	See the cell marked GREEN
Lessons (what are lessons learned to date that may be relevant for the international community?) (max. 50 words)	See the cell marked GREEN
References (max. 4)	Nasjonal e-helsemonitor - ehelse

AUSTRALIA	**Leanna (Lee) Woods**
Context	The state of Queensland in Australia. In Australia, hospital healthcare is delivered by the states.
Healthcare model[9] (max. 20 words)	Queensland Health (state government) funds universal free health care across acute inpatient care; emergency care; mental health and alcohol and other drug

	services; outpatient care; prevention, primary and community care; ambulance services, and; sub and non-acute care.
Size of country or region (# inhabitants)	>5million in Queensland
National hospital EHR strategy (in existence since when? Major focus?) (max. 50 words)	Queensland has a state-wide Integrated Electronic Medical Record (ieMR) with Cerner vendor.
EHR coverage in hospitals (# of hospital with EHR) (EHR defined here as a partial or full electronic record of patient core data such as allergies, diagnosis, therapies, medication) (percentage of short verbal description)	Cerner ieMR first implemented 2017 at Princess Alexandra Hospital, Brisbane. In 2022, there were 15 hospitals with more going live every year. At the time of the assessment, 15 individual hospitals across nine health care systems (of total 16 healthcare systems) had the single instance Cerner integrated Electronic Medical Record (EMR) system. The full stack of advanced EMR capability covers the patient journey across various health care sites, and is integrated with computerised provider order entry, ePrescribing, and clinical decision support systems. The remaining hospitals use paper-based clinical documentation with various levels infrastructure, connectivity, and point of care technologies for integration of business, patient administration,

	diagnostics and virtual care systems.
Types of EHR systems (indicate number of vendors of core EHR systems in hospitals) (max. 10 words)	Cerner
National or regional approach to digital maturity (enter "national" or "regional", if needed max 10 words for explanation)	"Regional" to reflect the state of Queensland
Name	HIMSS Digital Health Indicator
Rationale and drivers (why is the benchmarking exercise conducted? What is the primary aim?) (max. 20 words)	To evaluate the digital health capability in Queensland to inform digital health strategy and investment.
Anticipated outcomes (what are the primary anticipated outcomes of the benchmarking exercise?) (max. 20 words)	To understand progress made towards the state's digital health vision.
Who is leading/driving the benchmarking exercise? (max. 20 words)	Queensland Health (government)
Origin (how were benchmarking measurement tools developed? Did they draw on existing tools?) (max. 20 words)	The DHI documents the digital capability of health care services (beyond simple assessments of the presence or absence of electronic medical record systems) using outcome driven, specific and balanced measures.

	Launched in the global market in 2019, the DHI was developed from a critical analysis of published, peer reviewed digital health literature, and was tested in health care organisations. *Snowdon A. Digital Health: A Framework for Healthcare Transformation. Illinois, USA: Healthcare Information and Management Systems Society; 2020*
How is the data collected? (what tools are used to collect and analyse benchmarking data? Who collects the data?) (max. 20 words)	Self-assessment survey administered electronically to each site. Respondents voluntary staff who (1) had an awareness of digital health across the health care system, (2) the ability to network with local workforce to complete the survey accurately, and (3) provide informed consent. The survey respondents included chief information officers (n=8), chief digital officers (n=2), clinical directors of digital health (n=2), director of information communication technologies (n=2), executive director of medical services (n=1), and chief digital director medical services (n=1). Respondents required at least 2 hours to complete the survey, receiving support and clarification from HIMSS to avoid partial completions.
Content (how many benchmarking items does the	121 indicator statements measured on a five-point scale ranging from not enabled to fully enabled

tool contain approximately? Are these free text or numerical?) (max. 50 words)	covering the dimensions of digital transformation. Organisational data are collected using 10 demographic questions which do not contribute to the overall DHI score.
Areas of focus (what overall benchmarking topics/dimensions does the tool address?) (max. 100 words)	The DHI assesses four key dimensions of digital transformation: 1. Interoperability: subdimensions include foundational, structural, semantic and organisational interoperability 2. Person-Enabled Health: subdimentions include personalised care, proactive risk management and predictive population health 3. Predictive Analytics: subdimensions include personalised, predictive and operational analytics 4. Governance and Workforce: subdimensions include data stewardship, policy and decision-making processes, transparency, workforce capacity and competency.
Care settings (what care settings does the benchmarking exercise cover?)	All Queensland Health funded healthcare systems (n=16). Each health care system has variable numbers of health services covering the full spectrum of

(max. 20 words)	complexity from quaternary academic hospitals to small rural hospitals. Publicly funded health care systems were assessed in this study with a focus on digital capabilities of the hospitals contained within, and not the private hospitals across the systems.
How is the benchmarking data analysed (nationally? Locally? Qualitatively? Quantitatively?) (max. 20 words)	The DHI score was calculated for each health care system using pre-built algorithms; proprietary of HIMSS. Through application of this algorithm each DHI dimension (i.e., interoperability; person-enabled health; predictive analytics; and governance and workforce) can be scored from zero to 100. A proprietary algorithm is then applied to calculate a total score (i.e., the total score is not the sum of the dimension scores). Analysis included: • Dimension capability – to determine strengths and weaknesses in capability • Regional capability – to examine DHI differences among metro, regional and rural sites • Regional dimension analysis – to examine dimensional differences among metro, regional and rural sites • Digital hospital analysis – to determine

	differences with EMR sites and non EMR sites • External benchmarking – to benchmark Queensland globally with Oceana (n=7) and North America (n=10).
What are the outputs and how are they communicated? (What is done with the insights obtained through the benchmarking analysis? And who disseminates the benchmarking data to whom and how?) (max. 50 words)	Academics and HIMSS: Relevant findings are informing the updated state-wide digital health strategic plan. HIMSS: Co-designed a report with executives from the healthcare systems for their planning. Academics: various publications, reports, presentations.
Longitudinal element? (Is the benchmarking data collected over longer periods of time? Are different time periods compared?) (max. 20 words)	First assessment done in 2021. The state government may plan to repeat the process.
Compulsory? Penalties? (Are there Longitudinal element? Which ones? Is the benchmarking exercise compulsory?) (max. 20 words)	Not compulsory. No incentives. No penalties. There is no national requirement to complete maturity assessments in healthcare. This was an academic-led grant in partnership with state government and HIMSS.

Cost/effort involved (what are the cost categories involved in collecting, analysing and disseminating the benchmarking data?) (max. 20 words)	Cost for the DHI. In-kind cost to healthcare systems to complete the self-assessment survey – approx. 2 hours plus correspondence and education time. 2 year program of research t
Issues encountered (what are the main challenges encountered during the benchmarking exercise?) (max. 50 words)	1. The individual indicator statements and algorithm to calculate the DHI scores are proprietary of HIMSS, and the weighting of the dimension scores to generate the total DHI is unknown. We do not believe this will discredit the approach as it still provides a useful benchmark for others employing the DHI. 2. The ability to assess the digital capability at an individual hospital level, longitudinally or objectively was not possible using this study design. 3. The state health system was assessed by aggregating multiple site analyses, and therefore subject to the accuracy of localized assessments. 4. Global comparisons were limited to DHI scores, with no accompanying comparison of

	health care systems or point-of-care digital health capabilities.
Evaluation/monitoring (has the benchmarking exercise been evaluated or monitored? If so, by whom?) (max. 20 words)	Academic evaluation
Lessons (what are lessons learned to date that may be relevant for the international community?) (max. 50 words)	There are many models available commercially for healthcare providers to use to assess their digital health maturity. Currently, there are limited evidence-based methods to assess the quality, utility, and efficacy of maturity models to select the most appropriate model for the given context. Woods LS, Eden R, Duncan R, Kodiyattu Z, Macklin S, Sullivan C. Which one? A suggested approach for evaluating digital health maturity models. Frontiers in Digital Health. 2022 24 November 2022. doi: 10.3389/fdgth.2022.1045685.
References (max. 4)	Woods L, Eden R, Pearce A, Wong YCI, Jayan L, Green D, et al. Evaluating Digital Health Capability at Scale Using the Digital Health Indicator. Applied Clinical Informatics. 2022;13(05):991-1001. doi: 10.1055/s-0042-1757554. Woods L, Dendere R, Eden R, Grantham B, Krivit J, Pearce A, et al. Perceived Impact of Digital Health

	Maturity on Patient Experience, Population Health, Health Care Costs, and Provider Experience: Mixed Methods Case Study. J Med Internet Res. 2023;25:e45868. PMID: 37463008. doi: 10.2196/45868. Duncan R, Eden R, Woods L, Wong I, Sullivan C. Synthesizing Dimensions of Digital Maturity in Hospitals: Systematic Review. Journal of Medical Internet Research. 2022;24(3):e32994. Woods LS, Eden R, Duncan R, Kodiyattu Z, Macklin S, Sullivan C. Which one? A suggested approach for evaluating digital health maturity models. Frontiers in Digital Health. 2022 24 November 2022. doi: 10.3389/fdgth.2022.1045685.

GERMANY	Elske Ammenwerth, Franziska Jahn
Context	In line with the Hospital Future Act (2020), the Ministry of Health initiated the evaluation of the digital maturity of hospitals to measure the impact of the Hospital Future Fund. The funding volume of the hospital future fund for digitisation projects in hospitals amounts to 3 billion €.

Healthcare model[1] (max. 20 words)	Bismarck model
Size of country or region (# inhabitants)	84 Mio.
National hospital EHR strategy (in existence since when? Major focus?) (max. 50 words)	Since 2023, there is a German digitalisation strategy for health care and nursing with a focus on inter-institutional data exchange, interoperability and processes (through German telematics infrastructure), better data for patient care and research as well as beneficial technologies and applications. One specific goal for hospitals: 50 % of all hospitals supported by the Hospital Future Fund should improve the digital maturity level in at least two categories of the DigitalRadar assessment by the end of 2025. There is no dedicated national EHR strategy for hospitals, as hospital legislation and (partial) funding is the responsibility of the states. Hospitals most likely have their individual EHR strategies.
EHR coverage in hospitals (# of hospital with EHR) (EHR defined here as a partial or full electronic record of patient core data such as allergies, diagnosis, therapies, medication) (percentage of short verbal	Can only be answered indirectly based on the DigitalRadar assessment. The median EMRAM indicator score for the dimension “clinical information system / clinical data repositories (KIS/CDR)” is 90 (min=48, max=100).

description)	
Types of EHR systems (indicate number of vendors of core EHR systems in hospitals) (max. 10 words)	no official numbers available, >10 different vendors [2]
National or regional approach to digital maturity (enter "national" or "regional", if needed max 10 words for explanation)	National (different approaches, "DigitalRadar" with largest reach)
Name	DigitalRadar
Rationale and drivers (why is the benchmarking exercise conducted? What is the primary aim?) (max. 20 words)	Part of improving the digital infrastructure of German hospitals Legal basis: Hospital Future Act (Krankenhauszukunftsgesetz). Primary aim: To assess the status of digital maturity in hospitals and measure effects of the Hospital Future Fund by surveys before and after funding (2024)
Anticipated outcomes (what are the primary anticipated outcomes of the benchmarking exercise?) (max. 20 words)	to evaluate improvements in digital maturity in German hospitals, basis for the development of digital transformation strategies, to compare digital maturity among German hospitals and worldwide (based on EMRAM indicator scores)

Who is leading/driving the benchmarking exercise? (max. 20 words)	Ministry of Health is the driver and launched a tender to evaluate the digital maturity level and appointed a consortium consisting of academic institutions, companies and HIMSS.
Origin (how were benchmarking measurement tools developed? Did they draw on existing tools?) (max. 20 words)	Self-Developed by project consortium together with experts HIMSS EMRAM indicator scores can be derived from DigitalRadar (DigitalRadar comprises around 65% of the EMRAM items).
How is the data collected? (what tools are used to collect and analyse benchmarking data? Who collects the data?) (max. 20 words)	Self-assessment, collected via standardised online survey by the DigitalRadar consortium
Content (how many benchmarking items does the tool contain approximately? Are these free text or numerical?) (max. 50 words)	234 items (mostly single-or multiple-choice, partly free-text options) in seven dimensions (see below). Items cover the funding areas of the Hospital Future Fund as well as the support of clinical, administrative and other data-related processes.
Areas of focus (what overall benchmarking	Structures and systems (IT performance indicators, software applications)

topics/dimensions does the tool address?) (max. 100 words)	Resilience management and performance (IT security, performance and staff satisfaction) Organisational governance and data management (organisational governance, data management) Clinical processes (order management, medication management, sample management, documentation of findings, decision support, flexible working, quality and risk management, information access) Information exchange (information exchange with external actors, information exchange with patients, information exchange of clinical staff, integration of medical devices, interoperability) Telehealth (emergency room, teleconsiles, teleconsultation, telemedicine networks) Patient participation (indicators for use, participation possibilities, strategy, access to information)
Care settings (what care settings does the benchmarking exercise cover?) (max. 20 words)	Hospitals
How is the benchmarking data analysed (nationally? Locally? Qualitatively? Quantitatively?) (max. 20 words)	Nationally, quantitatively

What are the outputs and how are they communicated? (What is done with the insights obtained through the benchmarking analysis? And who disseminates the benchmarking data to whom and how?) (max. 50 words)	Public report with anonymised statistics. Key results of the first assessment were also presented in an open webinar. Dashboard with different statistics for the Ministry of Health. Each participating hospital got an individual dashboard.
Longitudinal element? (Is the benchmarking data collected over longer periods of time? Are different time periods compared?) (max. 20 words)	Yes, measurements were done in 2021 and will be repeated in 2024.
Compulsory? Penalties? (Are there penalties or incentives to complete for participating organisations? Which ones? Is the benchmarking exercise compulsory?) (max. 20 words)	Compulsory for hospitals funded by the Hospital Future Fund; there are no plans to link the digital radar survey to penalties.
Cost/effort involved (what are the cost categories involved in collecting, analysing and disseminating	One-time funding for the Digital Radar Consortium for the two planned surveys (including collection, analysis and dissemination). Funding sum is not known. Time efforts for the hospitals: 10 hours (median) for

the benchmarking data?) (max. 20 words)	preparation, 6 hours (median) for completing the survey. No fees for participating hospitals
Issues encountered (what are the main challenges encountered during the benchmarking exercise?) (max. 50 words)	lowest maturity in dimensions "patient participation": mean: 3.5 out of 100, "telehealth": mean=18.0 out of 100, "information exchange" mean=25.1 out of 100; overall DR score mean=33.3 out of 100
Evaluation/monitoring (has the benchmarking exercise been evaluated or monitored? If so, by whom?) (max. 20 words)	Yes, by the Institute for Applied Health Services Research (inav GmbH), Health Care Business GmbH (hcb) and Leibniz Institute für Economic Research (RWI)
Lessons (what are lessons learned to date that may be relevant for the international community?) (max. 50 words)	Comparison of the EMRAM indicator scores of DigitalRadar with EMRAM scores of the USA, Ontario (Canada) and Australia showed that German hospitals do not lag behind the others, i.e., in all these countries the majority of hospitals only reach stage 0; strong relationship between the EMRAM indicator and the DigitalRadar scores; the issues encountered (see above) were addressed by the Hospital Future Fund
References (max. 4)	[1] Amelung et al. DigitalRadar – Zwischenbericht, 2022, https://www.bundesgesundheitsministerium.de/service/publikationen/details/digitalradar-zwischenbericht.html [2] Team digitales-gesundheitswesen.de: Welcher KIS-Hersteller stellt wann welche TI-Anwendung bereit? 2022, https://magazin.digitales-gesundheitswesen.de/kis-ti-anwendung/

	[3] Bundesministerium für Gesundheit: GEMEINSAM DIGITAL – Digitalisierungsstrategie für das Gesundheitswesen und die Pflege, 2023, https://www.bundesgesundheitsministerium.de/fileadmin/Dateien/3_Downloads/D/Digitalisierungsstrategie/BMG_Broschuere_Digitalisierungsstrategie_bf.pdf

THE NETHERLANDS	Tim Postema (tim.postema@nictiz.nl)
Context	Maturity assessments as part of achieving compliance to the Wegiz (Dutch law for mandatory electronic information exchange in healthcare) . Two tools are available on a national level int his respect: 1. Volwassenheidsscan (VHS) = Dutch Interoperability Maturity Model (DIMM) (more info) 2. Self-assesment: Self-scan. Both related to specific Data exchanges (use-cases)
Healthcare model[9] (max. 20 words)	National Health Insurance
Size of country or region (# inhabitants)	Approximately 18 million
National hospital EHR strategy	Strong focus on interoperability of a multitude of

(in existence since when? Major focus?) (max. 50 words)	heterogeneous EHR systems, both in terms of semantics as on technical standards. Move towards more government coordination since approximately 2018.
EHR coverage in hospitals (# of hospital with EHR) (EHR defined here as a partial or full electronic record of patient core data such as allergies, diagnosis, therapies, medication) (percentage of short verbal description)	100%
Types of EHR systems (indicate number of vendors of core EHR systems in hospitals) (max. 10 words)	With respect to Dutch hospitals (69, including 8 academic hospitals), there are 4 core EHR systems (2021). (source a.o. Ziekenhuiszorg | Aanbod | Instellingen | Volksgezondheid en Zorg (vzinfo.nl) EPD-marktinventarisatie ziekenhuizen 2021: consolidatie EPD-markt zet door | M&I/Partners (mxi.nl))
National or regional approach to digital maturity (enter "national" or "regional", if needed max 10 words for explanation)	National
Name	DIMM (Dutch Interoperability Maturity Model): A scan to establish maturity, to plan the roadmap to

	obligation under the Law on Electronic Exchange of Information in Healthcare. Based on HIMSS models. Selfscan: A tool for A tool for healthcare providers to help them: check their status and advices how to get ready to adhere to the goals of the roadmap from the DIMM.
Rationale and drivers (why is the benchmarking exercise conducted? What is the primary aim?) (max. 20 words)	Data to establish the status and gaps within the relevant healthcare providers in relation to the Data Exchange. Together with the Societal Cost-Benefit Analysis (MKBA in Dutch) to define if/when and how mandating digital Data Exchange can be implemented. The scan must give insight into what care institutes and caregivers need to do before they can electronically exchange the specific data (gap)
Anticipated outcomes (what are the primary anticipated outcomes of the benchmarking exercise?) (max. 20 words)	Data to facilitate local and national decision making. At national and organisational level inform: Priority setting Measuring and reporting on progress Strategic funding plans
Who is leading/driving the benchmarking exercise? (max. 20	Ministry of Health, welfare and sports (VWS)

words)	
Origin (how were benchmarking measurement tools developed? Did they draw on existing tools?) (max. 20 words)	Self-Developed by project consortium together with experts together with HIMSS. Starting point was the HIMSS EMRAM/CCMM models.
How is the data collected? (what tools are used to collect and analyse benchmarking data? Who collects the data?) (max. 20 words)	Self-assessment in an Excel form, which is processed by an algorithm also in Excel. Currently, a webbased platform is developed by the Dutch SDO (Nictiz) to facilitate the assessments.
Content (how many benchmarking items does the tool contain approximately? Are these free text or numerical?) (max. 50 words)	The questionnaire comprises 37 compliance statements • Laws and regulation – 3 compliance statements • Organisation – 9 compliance statements • Care Processes – 7 compliance statements • Information – 4 compliance statements • Application – 10 compliance statements • Infrastructure – 4 compliance statements • Each compliance statement was rated on a 5-point scale • Each option of the 5-point scale corresponds to a DIMM Stage (from Stage 0 to Stage 4) • Each compliance statement has the same weight in both evaluation pilots • In a workshop setting, initial responses have been discussed with stakeholders from each healthcare

	provider • The data were analyzed using the DIMM algorithm • Final achievements have been calculated and findings have been prepared and shared with the client The questions are ordered to follow the Nictiz 5 layer framework.
Areas of focus (what overall benchmarking topics/dimensions does the tool address?) (max. 100 words)	Healthcare providers that exchange their data that fall under the scope of the Data Exchange (more info) The model consists of 5 stages (0-4) and identifies the levels of HIE capabilities from six different perspectives: Laws and Regulation, Organisation, Care Process, Information, Application and IT Infrastructure.
Care settings (what care settings does the benchmarking exercise cover?) (max. 20 words)	Depending on scope/Data Exchange (use case) General Health and Care Acute care Primary care Community Adult Social care Children's Social Care Mental Health

How is the benchmarking data analysed (nationally? Locally? Qualitatively? Quantitatively?) (max. 20 words)	Self-assessment is analysed by the healthcare institution itself. The DIMM is used on a national level. Quantitatively, input for more qualitative research and decisionmaking.
What are the outputs and how are they communicated? (What is done with the insights obtained through the benchmarking analysis? And who disseminates the benchmarking data to whom and how?) (max. 50 words)	Informing national strategy, feedback to participating organisations for internal purposes The mentioned webbased tool will support in advice on current and desired maturity levels on each theme. National outputs disseminated via public report, published on the government websites among others. Eg: Volwassenheidsscan (VHS) van de Basisgegevensset Zorg (BgZ) | Rapport | Gegevensuitwisseling in de zorg
Longitudinal element? (Is the benchmarking data collected over longer periods of time? Are different time periods compared?) (max. 20 words)	The same DIMM model is reused over multiple Data Exchanges. Dashboards will include longitudinal self-service tools once data volume supports it.

Compulsory? Penalties? (Are there penalties or incentives to complete for participating organisations? Which ones? Is the benchmarking exercise compulsory?) (max. 20 words)	Participation in the maturity scans are voluntary. The maturity model serves as input for the government to assess the baseline in relation to proposed legislation, the ;self-assessment scan primarily must give insights into what care institutes and caregivers need to do before they can electronically exchange the specific data (gap)
Cost/effort involved (what are the cost categories involved in collecting, analysing and disseminating the benchmarking data?) (max. 20 words)	Developing data collection and dissemination instruments, completing questionnaires, conducting follow-up meetings, analysis and reporting, consultancy support.
Issues encountered (what are the main challenges encountered during the benchmarking exercise?) (max. 50 words)	The time consuming effort for healthcare institutions to supply the data. Representations of the questions to actually assess maturity – it remains a selection of items used.
Evaluation/monitoring (has the benchmarking exercise been evaluated or monitored? If so, by whom?) (max. 20 words)	Representativity of the results in relation to the questions can be challenged. The first results are being evaluated with the Ministry of health and Nictiz based on the first surveys.
Lessons (what are lessons learned to date that may be relevant for the international community?) (max. 50 words)	Confidence in the model and the initial findings appear to align reasonably closely with reality. The DIMM requires further modification in terms of the question wording and response options. Further

	tests for ‘logic should take place prior to further roll-out. There appears to be a clear case for the Dutch MoH to recommend data exchange standards (transport FHIR, DICOM and also content, HL-7) and to monitor the use thereof. Data exchange standards to be mandated over time as well as national clinical coding classification (ICD-10, LOINC, SNOWMED CT) for diagnoses and procedures. The absence of a unified vocabulary leads to miscommunication. All care providers should be encouraged and incentivised to submit electronic activity data to payers and insurers thereby improving data quality and reimbursement times. The MoH may consider national indicators to manage system performance and access including staff satisfaction surveys.
References (max. 4)	Volwassenheidsscan (VHS) = Dutch Interoperability Maturity Model (DIMM) (more info) Evaluation DIMM: HIMSS PowerPoint Presentation