Chapter 2
Connecting Health Immersion of Digital into eHealth

Pamela Hussey

Abstract Globally, in most countries the deployment and integration of national eHealth programmes is at an advanced stage. Digital progression in society is recognised as inevitable. Consequently, there is a growing awareness amongst nurse leaders for prioritisation of strategies relating to digital leadership and use of informatics competencies within the profession. As artificial intelligence, machine learning and robotics progress at an accelerated rate in society, thought leaders and policy makers turn their attention to consider how such technology can support healthy behaviors and health care delivery. Considerable efficiencies have been realised by deployment of digital in specific business domains such as fast food outlets, the hospitality and transport industries. Automation of passenger check in for example through air travel security has realised better use of staff time in processing of routine tasks and functions. The natural question is can such efficiencies be realised in the domain of healthcare? Large-scale deployment of digital within the health care domain lags somewhat behind other industries. Health administrations engaged with strategic business cases are deliberating on how the digital transformation can assist with planned service improvements from a macro, meso, and micro systems perspective. A key enabler in targeted service planning is the need to advance shared patient centric integrated care through interdisciplinary care service delivery. In this chapter we consider from a practical perspective the seismic impact of digital health, and how it will influence contemporary nursing practice.

Keywords eHealth · Digital · Reorientation health care models · Artificial intelligence · Machine learning · Nursing and technology

Electronic Supplementary Material The online version of this chapter (https://doi.org/10.1007/978-3-030-58740-6_2) contains supplementary material, which is available to authorized users.

P. Hussey (✉)
School of Nursing Psychotherapy and Community Health, Dublin City University, Dublin, Ireland
e-mail: pamela.hussey@dcu.ie

© Springer Nature Switzerland AG 2021

P. Hussey, M. A. Kennedy (eds.), *Introduction to Nursing Informatics*, Health Informatics, https://doi.org/10.1007/978-3-030-58740-6_2

Learning Objectives for the Chapter

1. Understand the nursing role in future health care delivery requirements.
2. Explain the principles underpinning change management in the implementation of the electronic health record and its variants.
3. Determine how information relating to patients can be used responsibly and ethically particularly in relation to Data Protection.
4. Understand the need for nursing engagement in design of systems and recording patient outcomes for self-management support.
5. Understand system theory agenda from the macro meso and micro context and explain where nursing can assist in advancing patient centered care.

2.1 Introduction

This chapter will introduce the reader to the topic of Connecting Health and using E-Health Systems and Digital. It will define key concepts used in digital and connected health in order to assist nurses to contextualise the role and use of eHealth in practice. The subject area is broad in scope, diverse in nature, and rapidly expanding. Globally, the context in which health and social care delivery processes occur varies widely. eHealth systems are at different stages of deployment internationally, and no country has achieved a fully interoperable Electronic Health Record across both community and acute services (Fennelly 2019a). There is however significant pressure to achieve fifth generation computing globally to advance interoperable Electronic Health Records and their variants. Fifth generation computing relates to using smart technologies such as artificial intelligence to have access to share and mine Internet data on platforms. This generation of computing is facilitating a surge of applications to support smart and mobile devices (Tutorialspoint 2020). Clinical opinion on the design of such devices is needed to align with the health domain and ensure what is implemented is ethically appropriate and safe. Health care strategic planning and revision on how we deliver health care has moved beyond acute episodic care. Increasingly a whole system approach to implementation of self-management support considers key actions are required across one to many service providers. Thus thinking and designing at a system level, which spans across the wider system, to the Organisation, and the health care professional and of course to the patient is required (Mullaney et al. 2016, p. 14). For this reason, in this chapter we use the wider and whole systems approach to present the evidence. Primary and ambulatory care is the foundation and the key to high-performing, sustainable and resilient health systems. Most health activity takes place in this setting with over eight billion encounters each year in OECD countries alone (Auraaen and Slawomirski 2018). In this chapter, we present the material from the three system levels and present with examples where appropriate. This approach provides a background context to unpack key insights required to explore and exploit eHealth and Digital in the connected health and social care domain.

2.2 The Wider System

There are many definitions of systems in the literature but core attributes of the definition is that a system involves a group of structures that together provide a function. From the perspective of informatics a system can be described as an ordered composition of inter related elements separated from and interfacing with its environment (Blobel 2019). Interfacing with the environment is important as it involves communicating with a number of actors such as organisations, people and technology. Each of these actors needs to be involved in designing and defining any changes in the existing system.

To understand systems in the domain of health care it is important to consider the concept of health, and how we define health globally. From as far back as 1948 the World Health Organisation defined health as a state of complete physical, mental and social wellbeing, and not merely the absence of disease and infirmity (World Health Organisation 1986). In 1986 at the First International Conference on Health Promotion, the World Health Organisation stated that health is a resource for everyday life and not just an objective for living. As a resource health is therefore important to monitor, and important to maintain for each individual in communities and within wider populations. Important dimensions in the quality of life of individuals include a number of contributory factors not only on the physical state of citizens, but also on the state of their mental and social well-being. Perceiving health maintenance and promotion activity as enabling processes can assist with maintaining or enhancing independence and self-efficacy (Mullaney et al. 2016). Increasingly national policy centres are using indicators to guide and evaluate quality improvements for population health. Both the population and individual system perspectives are now briefly expanded upon.

2.2.1 Population Health Perspective

Research and policy analysts in population health rely on health indicators to provide insights in tracking overall health and wellbeing of populations and monitoring of service requirements now and in the future. Patient Reported Experience Measures (PREM) and Paitent Reported Outcome Measures (PROMs) at the population level provide core metrics to drive quality and service improvements and are considered important metrics to signpost global health evaluation on quality of care and service delivery. For example reports from the Australian Health Services Research Institute informed the Australian Commission on Safety and Quality in Health Care (ACSQHC) by providing guidance on how reporting of PROMS and PREMS should be completed (Thompson et al. 2016). In this report they recommend that PREMS can guide service and quality improvements by capturing both experience and satisfaction measures. Collecting both types of measures they maintain is important as it offers the opportunity to identify particular aspects of patients'

experiences, which have the strongest influence on their satisfaction. Collecting satisfaction measures solely without experience measures has potential to lead to subjective metrics influenced by outside factors such as patient expectations and personal characteristics. Examples of PREMs include time spent waiting, access and ability to navigate services, involvement in decision making, knowledge of care plan and pathways and support to manage long term condition (Thompson et al. 2016, p. 4). Patient reported outcome measures (PROM) or Patient-reported outcomes (PROs) are described as a directly reported outcome by the patient without interpretation of the patient's response by a clinician or anyone else. They pertain to the patient's health, quality of life, or functional status associated with health care or treatment (Food and Drug Administration 2009). As a specific domain, analysts are spending time turning their attention to consider just what and how to measure wellbeing in the society of the digital age. A key focus of this attention relates to patient safety, whereby figures from OECD report that half the global disease burden arising from patient harm originates in primary and ambulatory care (Auraaen and Slawomirski 2018).

Generally focusing on outcomes of care examples include, patients reporting on their symptoms, functional status and health-related quality-of-life (HRQoL) during and after their treatment. Outcomes can be generic and measure 'general' health status (generic PROMs) or disease-specific (for example, for asthma or diabetes) or condition-specific whereby the PROMs do not focus on a particular disease but on a broader health condition or state, for example mental health. PROMs include varied assessments and measures and include health status assessment, the HRQOL, Symptom reporting measures and satisfaction with care and treatment. There are also PROM instruments for assessing dimensions of patient experience such as a depression and anxiety. An interesting resource is available to view by Chen who conducted a scoping review on the topic (Chen 2015).

Studies in Wales also provide a good case example of a large-scale national electronic PROM data collection programme that was published in 2018 as part of an effectiveness programme. This study found that implementation of an electronic PROM resulted in most questions being understood and easy to answer by patients within the study, however clarity on questions relating to alcohol and exercise warranted editing and refinement for future studies (O'Connell et al. 2018).

At an individual person centric level there is much evidence on the importance for citizens to possess control over, and maintenance of one's health. Some describe the patient centric approach where citizens monitor and make decisions on their health as shifting the locus of power to the individual as the *democratisation of care* (Topol 2016). Traditionally, the medical model has not recognised well the expertise of the individuals being treated in our services. Individuals have been positioned as passive clients of care whose role it was to be diagnosed, investigated and adhere to treatment as prescribed without any active participation in decision making of care planning. Contemporary health and social care policy reject this model and recommend a Self Management Support (SMS) approach to care delivery. Self-management as a support approach can be described as follows.

The systematic provision of education and supportive interventions, to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem solving support. It is an important element of person centred care, acknowledging patients as partners in their own care, supporting them in developing the knowledge, skills and confidence to make informed decisions (Mullaney et al. 2016, p. 6).

Self-Management Support as an approach therefore draws on social cognitive theory. Considering an individual's biography and specific characteristics as important factors to take in to consideration when building a plan of care for an individual citizen. Over their lifetime, this SMS approach takes into consideration the individual's knowledge, which they have acquired over time, who they are interacting with for example the context of social interactions, experiences, and outside media influences which will have a potential impact on their ability to manage their conditions. They can be summarised under four core elements, self-evaluation, self-observation, self-regulation and self-efficacy, however the promotion of self-efficacy is considered a cornerstone of self-management support. If individuals have relevant knowledge and skills, they are more likely to accept responsibility for, and have confidence in, managing their own health. In addition, they will have an increased ability for solving future health problems with supporting evidence-based information. An example of a self-management support guidance and information resources from the Irish National Health Service are available to view online (Health Service Executive 2020). Figure 2.1 provides a summary of what self-management support framework looks like from recent published policy reports in Ireland (Mullaney et al. 2016, p. 20).

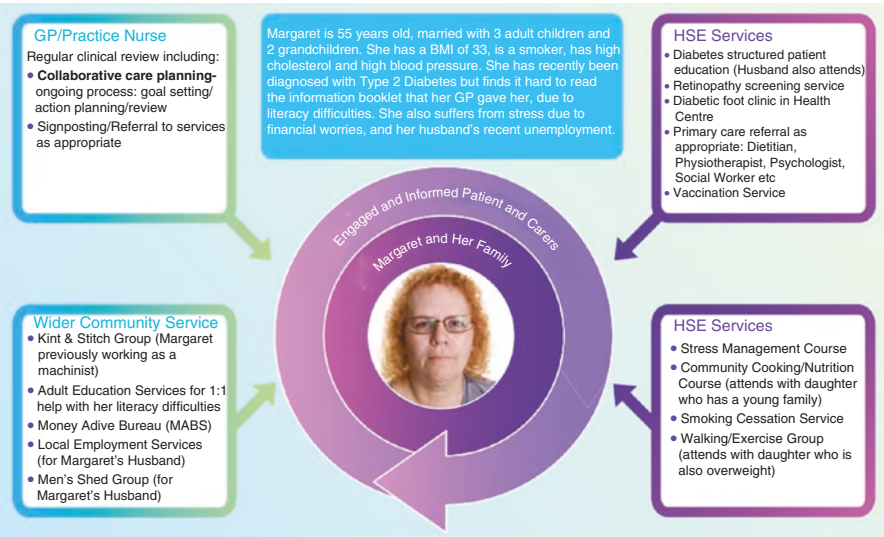


Fig. 2.1 Self-Management Support Framework (Mullaney et al. 2016)

The overall impact of this change for systems delivery is that individual patients play a more active role in self-management of health over the trajectory of their life course. This role includes emotional support, needs to consider the patients resilience and self-efficacy and includes a number of activities. These activities include but are not restricted to problem solving, shared decision making, action planning, and strong supports from health care professionals to access resources and provide supporting relationships.

Both the population and individual patient centered approaches to care delivery as outlined above are supported at policy level as global population trends predict that people are increasingly living longer and living with rather than dying from chronic illness (McEvoy 2014). Increasing our collective understanding that systems we currently use cannot continue without radical transformation is important. Digital and eHealth resources provide supports for transitioning to new models of care by providing a number of different networks.

2.2.2 eHealth and Digital

Two key international organisations drive the policy agenda for eHealth and digital globally.

State side the Pan American Health Organisation (PAHO) is an international public health agency working to improve health and living standards of the people of the Americas. Founded in 1902 with its headquarters in Washington it has a dedicated web portal for eHealth to promote the use of information and communication technologies (ICT) for health, and thereby foster universal access to health in the Americas (Regional Office of the Americas World Health Organisation 2020). Since 2011 in association with the World Health Organisations PAHO has endorsed a strategy urging the Organization to work to improve health service accessibility and quality using ICTs. Primarily this strategy focuses its energies under seven key areas. These include, governance for co-ordination for eHealth at regional and global level, supporting national strategies across the region, promoting standards and interoperability in addition to deployment of electronic health records, telehealth, mHealth and digital literacy. A recent Global Survey on eHealth in the Americas provides insights on progress from 2016 in nineteen of the region's 38 countries and is now available to view on the PAHO website (Regional Office of the Americas World Health Organisation 2020).

From the perspective of the European Union, in 2020 a new digital strategy is proposed across Europe. The European Commission is creating a new Digital European Wide programme, with €9.2 billion allocation of funding, the objective of which is to align the EU's next long-term budget for 2021–2027 with the growing challenges in the digital field. Building on the earlier strategy a Digital Agenda for Europe, the EU's programme 2021–2027 will focus on building the strategic digital capacities of the EU and on facilitating the wide deployment of digital technologies, to be used by Europe's citizens and businesses. Core areas of investment include supercomputing, artificial intelligence, cybersecurity, advanced digital skills, and

ensuring a wide use of digital technologies across the economy and society. Its goal is to improve Europe's competitiveness in the global digital economy and increase its technological autonomy. Specifically investing in broadening the use of supercomputing in areas of public interest such as health, environment and security, and in industry and engaging with small and medium-sized enterprises is part of the new strategic plan. The new digital Europe plan commences on January 2021 and detail of this Progamme is available from the European Commission Website and associated fact sheet (EU Commission 2019; OECD 2020a).

In November 2019, the Organisation for Economic Co-operation and Development (OECD) an international Organisation that works to *build better policies for better lives* published a report on digital transformation defining indicators on a roadmap for the future. This report provides an interactive toolkit and seven key policy dimensions. These policy dimensions relating to advancing digital include key concepts relating to market openness, access, use, innovation, job, society, trust and growth and wellbeing (OECD 2020b). OECD indicate that in the policy dimension relating to growth and wellbeing that the ongoing digital transformation of the economy and society holds many promises to spur innovation, generate efficiencies and improve services. It can therefore boost growth in addition to empowering people by increasing access to information and enabling new forms of social engagement. OECD suggest however, that such benefits come with challenges. Digital transformation changes the nature and structure of health care organisations, markets and communities, potentially raising concerns about equity and inclusion in society. Offering guidance, this OECD report linking to articulated policy dimensions, list key themes with specific indicators one of which relates to skills.

Defined as foundational, ICT and complementary skills, OECD stresses the attainment of skills as important for both quality of work and life. Additional publications from the nursing perspective report that a large number of OECD countries are implementing educational, regulatory and/or payment specific reforms to expand the practice profile of nurses. Suggesting that advancement of the nursing role incorporates two concepts. First, task shifting (a concept also referred to as 'substitution') whereby nurses—after additional training—take up activities formerly performed by physicians to alleviate shortages, reduce physician workloads and/or improve access. Second, nurses can also take on new complementary roles in clinical areas (often referred to as 'supplementation'), such as case managers, liaison roles. Such roles they suggest include interventions relating to eHealth monitoring and providing lifestyle advice. OECD suggests that the boundaries between these two types of advanced roles are not always evident and in some instances, they can overlap. One commonality within the profession is the advancement of nurse education, particularly focusing on the expanding role of nursing which is extending beyond the traditional scope of practice of registered nurses (Maier et al. 2017, p. 8). A discussion on the topic of nurse education skills knowledge and competency attainment is progressed further in Chaps. 11 and 15. Here in this chapter we suggest that for the profession of nursing stressing that the right mixture of skills is important in a fast-moving digital landscape, and that there is scope to review practice roles. Core to these new roles will be understanding the shifting models of care and in particular how eHealth and digital competencies within the profession of

nursing need to considered as an important core competency. To look at set themes or indicators by country see OECD (2019) Measuring the Digital Transformation: A Roadmap for the Future which illustrates country indicators and themes in the following online resource http://goingdigital.oecd.org/en/themes/.

OECD (2019), measuring the Digital Transformation: A Roadmap for the Future, OECD Publishing, Paris.

Considering health and systems for delivery of care in the wider context, it is important to recognise that the domain of health does not operate in a vacuum. Just as social care determinants of health as defined in population demographic are important for the dimensions in management of illness so too is the attainment of the specific environmental goals. Delivery of the Sustainable Development Goals (SDG) by 2030 is the flagship policy of the United Nations (United Nations D of E and SA 2019). There are 17 goals, which are listed in the Table 2.1 and which were published in 2015.

Table 2.1 Sustainable Development Goals

1.	No poverty: End poverty in all its form everywhere
2.	Zero Hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3.	Good Health and Wellbeing: Ensure healthy lives and promote well-being for all at all ages
4.	Quality Education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5.	Gender Equality: Achieve gender equality and empower all women and girls
6.	Clean Water and Sanitation: Ensure availability and sustainable management of water and sanitation for all
8.	Decent Work and Economic Growth: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9.	Industry Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10.	Reduced Inequalities: Reduce inequality within and among countries
11.	Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient and sustainable
12.	Responsible Consumption and Production: Ensure sustainable consumption and production patterns
13.	Climate Action: Take urgent action to combat climate change and its impacts
14.	Life Below Water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15.	Life On Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16.	Peace Justice and Strong Institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17.	Partnerships for the Goals: Strengthen the means of implementation and revitalize the global partnership for sustainable development

For a full review of the MDG see the UN website (United Nations D of E and SA 2019).

Health and social care providers are primarily focused on SDG 3. This sustainable goal is to ensure healthy lives and promote wellbeing for all at all ages. Also to note target 9.1 of SDG 9 focuses on innovation and infrastructure and seeks to develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human wellbeing, with a focus on affordable and equitable access for all. An example of an EU project which links to SDG 3 and SDG 9 is provided here as an example of how the millennium goals are being actioned through the Connecting Europe Facility (CEF) (Connecting Europe Facility 2015).

The CEF benefits people across all European Member States, as it makes travel easier and more sustainable, it enhances Europe's digital infrastructure by facilitating cross-border interaction between public administrations, businesses and citizens. Since 2011, the European institutions have been engaged in cross-border health services which are being progressively introduced in all EU Member States. The cross border health services provides access to two core services. Firstly, ePrescription and eDispensation which allows any EU citizen to retrieve his/her medication in a pharmacy located in another EU Member State. This occurs through the electronic transfer of their prescription from his/her country of residence to the country of travel via the CEF services EU portal. Secondly, access to a Patient Summaries which provides background information on important health-related aspects such as allergies, current medication, previous illness, surgeries, etc., making it digitally accessible in case of a medical (emergency) visit in another country (EUR-Lex 2020; BELLERIN MLS 2019).

2.2.3 Progress on Health and Social Care Delivery Goals 2010–2020

A report published in 2018 by the UN provides concerning insights in relation to progression and status of the Millennium Goals using available data from 2013 to 2018. The report indicates that close to 40% of all countries had fewer than 10 medical doctors per 10,000 people, and more than 55% had fewer than 40 nursing and midwifery personnel per 10,000 people. In addition, this report indicates that all least developed countries are reported to have had fewer than 10 medical doctors and fewer than 5 dentists and 5 pharmacists per 10,000 people, and 98% had fewer than 40 nursing and midwifery personnel per 10,000 people (United Nations Economic and Social Council 2019, p. 10).

Predictive models published in 2017 through The Lancet Journal provides a framework for projecting health systems strengthening for population-level and individual-level health service coverage from 2016 to 2030 was devised. This paper estimated the associated costs and health effects projecting available funding by

country and year. The study found that an additional $274 billion spending on health is needed per year by 2030 to make progress with SDG 3 targets. Despite projected increases in health spending, a financing gap of $20–54 billion per year is projected when specific factors were taken into account. Should funds be made available and used as planned, the ambitious scenario would save 97 million lives and significantly increase life expectancy by 3.1–8.4 years in accordance with the country profile. This report recommended that all countries will need to strengthen investments in health systems to expand service provision in order to reach SDG 3 health targets (Stenberg et al. 2017). This prediction predates the Covid 19 pandemic of 2020.

Following on with the global policy agenda the publication of the World Health Organisation National eHealth Strategy Toolkit in 2015 (World Health Organisation 2012), reporting on global diffusion of eHealth in 2016 offers additional evidence from its third global survey on eHealth. Reports suggest the process of embedding eHealth everywhere still has a long way to go, in terms of both coverage and functionality. Suggesting a mixed picture, progress is reflected in different countries based on national and local priorities. Key anticipated enablers to drive developments over the next 5–10 years include the advancement of low cost smart phones, social media and big data. The potential over the next 10 years for low-cost smartphones to enable virtually everyone everywhere to have access to audio-visual examples of best (global and local) practices could impact on improving health behaviors and represent a paradigm shift in health care. Such advancements depend however on learning, vision, sharing and comparing experiences across communities (WHO 2020, p. 7). Later, in a 2018, the WHO published The Classification of Digital Health interventions (DHIs) which categorizes the different ways in which digital and mobile technologies are being used to support health system needs (World Health Organisation 2018). Targeting primarily public health audiences, this report reflects emerging uses of digital health interventions providing a set of overarching groupings for leveraging mobile health categorisations. These include Interventions for clients, interventions for health care providers, interventions for health system to resource managers, interventions for data services. Each digital health intervention represents a discrete functionality of the digital technology to achieve a health sector objective. Within the health system challenges the digital health intervention are listed in Fig. 2.2.

2.3 The Organisation

In the previous section, we presented the systems wide perspective and considered progress towards achieving SDG3 health and wellbeing for all. In order to move towards ensuring that all people and communities have access to health services, the organisational culture of organisations needs to consider impact of connected health and transformative use of digital and eHealth. Having a shared understanding at an organisational level of core concept definitions is important Boxes 2.1 and 2.2 provide the definitions adopted for this fifth edition of this text to explain key concepts Digital and eHealth.

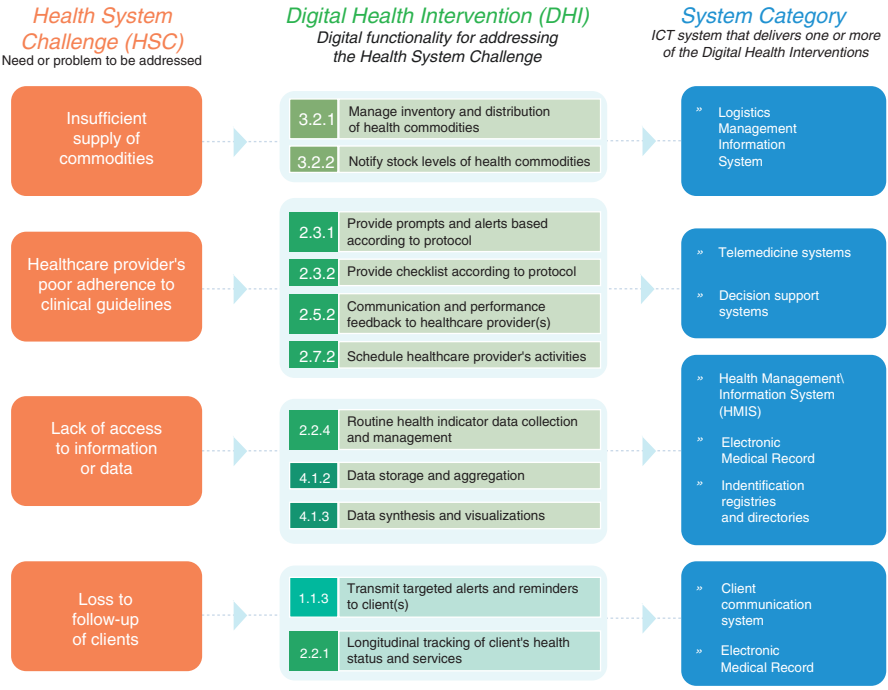


Fig. 2.2 Health System Challenges and Digital Health Interventions (World Health Organisation 2018)

Box 2.1 Definition of Digital Health

Digital Health is used as an umbrella term for areas including eHealth, telehealth, mHealth and more (see explanations below). Digital Health is the integration of all information and knowledge sources involved in the delivery of healthcare via information technology (IT)-based systems. This includes information created by caregivers, often within electronic health record systems at a hospital or GP practice, and information created by patients using apps, monitoring devices and wearable sensors. Digital health information also includes management and administrative information needed to coordinate and manage activities within the healthcare system cited from the Irish Platform for Patient Organisations, Science and Industry (IPPOSI 2020).

Box 2.2 Definition of eHealth
eHealth is the use of information and communication technologies that support the remote management of people and communities with a range of health care needs through supporting self-care and enabling electronic communications between health care professionals and patients. Source World Health Organisation eHealth Web (WHO 2020).

Organisations are increasingly seeking to collect indicators on quality of care to advance service improvement using digital and eHealth strategic transformational plans. The three indictors of quality defined by Berwick et al. in 2008 as the Triple Aim of Care has been widely accepted as foundational for effective health care system delivery (Berwick et al. 2008), and needs consideration in tandem with digital transformation. The triple aim proposes that health care organisations simultaneously pursue three dimensions of performance. Firstly improving the health of populations, secondly enhancing the patient experience of care, and thirdly reducing the per capita cost of health care. Subsequent publications by Bodenheimer and Sinsky in 2014, recommended the inclusion of a fourth dimension expanding the triple aim to the quadruple aim with a fourth goal improving the work life of health provider's clinicians and staff (Bodenheimer and Sinsky 2014). The topic of clinician work force planning and burnout is discussed further in Chap. 9. From a systems perspective for this chapter it is however useful to consider interventions and consider how they interface with the quadruple aims particularly for service improvement initiatives. For example, is it important that such initiatives include locally developed and context specific designed requirements to realise anticipated benefits and ensure clinicians and staff in organisations guide the development process. This approach supports the value proposition and is in line with good design for sustainable adoption (Berwick et al. 2008; Bodenheimer and Sinsky 2014; Greenhalgh et al. 2017).

An example of a framework which evaluates systems for health and social care technologies is presented in a research paper entitled the NASSS A New Framework for Theorizing and Evaluating Non adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies published by Greenhalgh et al. (2017). This large study reviewed 28 technology implementation frameworks and included over 400 hours of ethnographic observation. The net result of this was a matrix of a requirements analysis framework, which can be used for analysis on any technological innovations in health and social care. This analysis can provide insight on informing the design of a new technology; identifying technological solutions and gauging their chance of achieving large-scale, sustained adoption, or to plan the implementation, scale-up, or rollout of a technology program. The framework can also be used retrospectively to explain and learn from program failures. The framework includes seven domains and classifies each project as simple (straightforward, predictable, few components), complicated (multiple

interacting components or issues), or complex (dynamic, unpredictable, not easily disaggregated into constituent components). The seven domains used in the NASSS framework include the condition or illness, the technology, the value proposition, the adopter system (comprising professional staff, patient, and lay caregivers), the organization(s), the wider (institutional and societal) context, and the interaction and mutual adaptation between all these domains over time. In the domain of organisational management there is much literature published. In NASSS the organisational domain lists some key facilitators, which are critical as follows; the need for leadership with a capacity to innovate and the degree of the organisations readiness for the proposed change the system will necessitate. Finally, the nature of the adoption and extent of the change and work required to implement the change including any modifications to routine practices, which can cause additional burden (Greenhalgh et al. 2017, p.11).

Organisational theory stresses the need for strong leadership and recognition that staff in organisations provides the cultural glue to guide behaviors, create an overall sense of purpose and personal connection for digital transformation in healthcare (Organizational Change 2020, Kerr 2013). This process includes four stages for organisational change as defined by Hogg (World Health Organisation 2016).

- Building a case for change
- Building a compelling picture of the future
- Providing a sustained capability to change
- Providing a credible plan to execute

To achieve this target organisations need to advance patient centred integrated care services. WHO in 2016 published the Framework on integrated, people-centred health services (World Health Organisation 2016) which highlights that interventions need to be locally developed and negotiated. Each specific context dictates the mix of strategies to be used in response to local circumstances, values and preferences. There are five key strategies to achieve integrated care, which are expanded upon in the following section under Health Care Practitioner (HCP) and The Patient.

- Strategy 1: Empowering and engaging people and communities
- Strategy 2: Strengthening governance and accountability
- Strategy 3: Reorienting the model of care
- Strategy 4: Coordinating services within and across sectors
- Strategy 5: Creating an enabling environment

2.4 The Health Care Professional and Individual

Each of the five strategies listed in this framework has a key role to play in advancing connected health and realising people centred health services aligning with global policy on new models of care. Each one is briefly now expanded on in the following Sects. 2.4.1–2.4.4 with some related examples.

2.4.1 *Strategy 1: Empowering and Engaging People and Communities*

In Strategy 1 the WHO states, a call for change is urgently needed and indicates that it is essential to better respond to and prepare for health emergency crises providing examples such as the Ebola Virus Disease Outbreak (World Health Organisation 2016, p. 9). The purpose of Strategy 1 is to unlock community and individual resources for action at all levels. Empowering and engaging individuals to make decisions about their own health and to become co-producers of their own health. Over time, such strategic action will enable citizens to empower communities to co-produce healthy environments support the voice of minority populations and contribute to healthy public policy (World Health Organisation 2016, p. 21). Examples on how digital and connected health can advance Strategy 1 are illustrated here in the Nex project with some examples of digital devices in use in a feasibility study in Ireland. Further information on Strategy 1 is available from the following link:

https://apps.who.int/iris/bitstream/handle/10665/155002/WHO_HIS_SDS_2015.6_eng?sequence=1.

Case Study for Strategy 1: The NEX Digital Transformation Feasibility Study

The Nex research programme is conducting a feasibility study with a software company entitled Davra to determine how digital health devices can assist individual citizens to live independently in their home supported by appropriate digital health supporting services. Implementation research in Dublin City University (DCU), Dublin in Ireland with a team of academics and the industry partner Davra are testing digital resources using cross platform access to assist people to self-manage their own illnesses and co-produce design changes in their living environments to empower and make choices about care and treatment options. Figure 2.3a demonstrates health monitoring for the individual client using wearable personalized sensors. Figure 2.3b demonstrates how a home can be equipped with digital sensors to promote safety and wellness in the home. Providing structures to support reciprocal relationship between clinical and non-clinical professionals and the individuals using care services, their families, carers and communities (Organizational Change 2020; World Health Organisation 2016). Box 2.3 provides a case study and an example of a scenario used in the Center for eIntegrated Care (CeIC) in DCU to test health monitoring devices with a dedicated nursing scholarship group. Addtional examples of scenarios created in this case study are also included in Appendix 1 of this chapter. The focus of this learning activity exercise is to test and define requirements for continuity of care in the home for older adults with experienced nursing practitioners using digital health sensors.

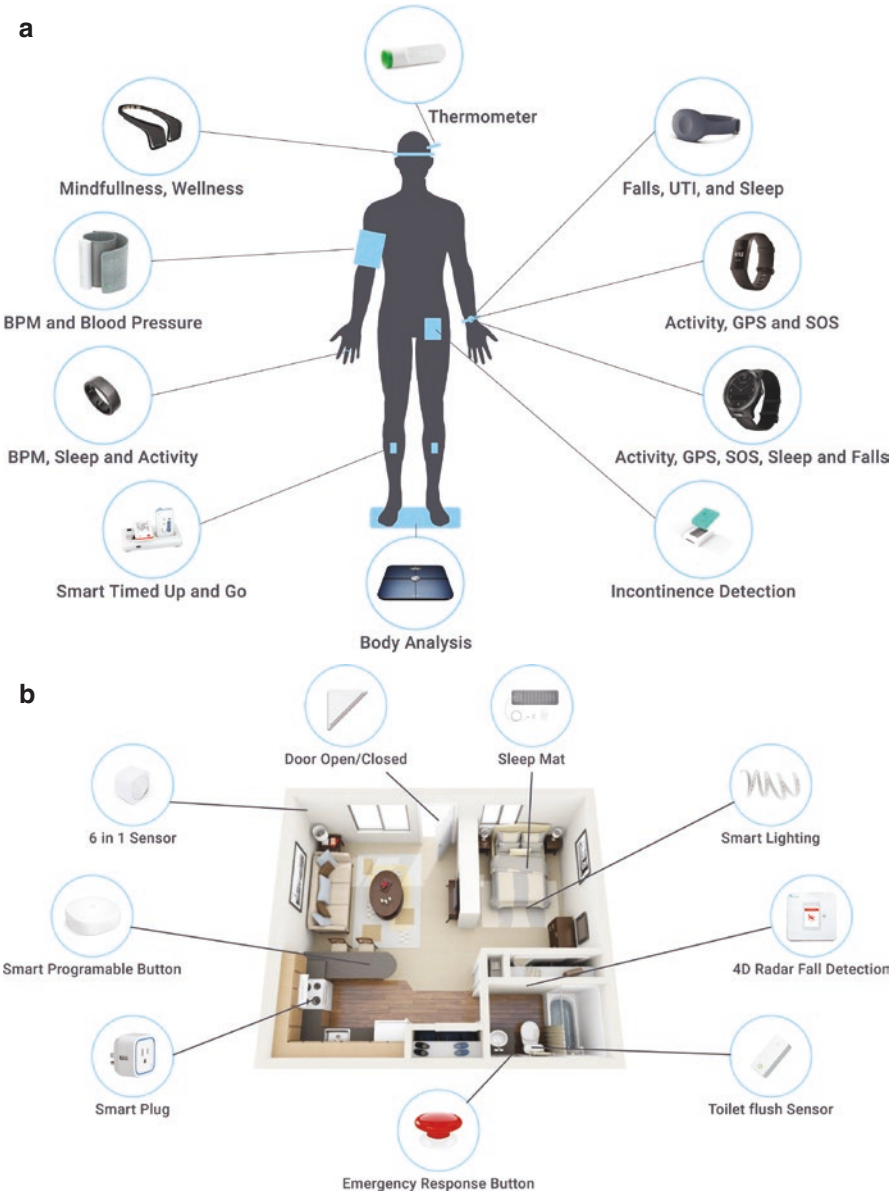


Fig. 2.3 (**a**) Personal Health Monitoring Suite Wearable The Nex Project; (**b**) Personal Health Monitoring Suite The Nex Project

Box 2.3 Case Example (Davra 2020; CeIC 2020) Example 1: The Nex Project

In this case based example a scenario is provided of how ambient and wearable sensors can be used in the home as illustrated in Figure 2.3a and Figure 2.3b.

Scenario A—Introducing John CEIC Simulation Case Study

Service User Background

Scenario 1 Introducing John CeIC Simulation Case Study  **About John** John is 72 year old widower, he lives in a residential complex with a mild cognitive decline. He has limited hearing and wears hearing aids in both ears. He also wears varifocal glasses for short and long vision. In 2018, John was diagnosed with Parkinson's disease and although he manages to mobilise in his residential home with the support of a walking stick, he is anxious about falling. He has a son Christopher and a daughter Mary who visit once a week and at the weekends, he often goes out to his family's home for lunch	**Health Management** His son Christopher manages his appointments and currently John is under the care of Three consultants: 1. Urologist 2. Neurologist 3. Gerontologist **Use of Technology—Dexterity** John can answer a mobile phone but cannot text; increasingly the television remote control is a problem for him to manage in his single room in which he resides. He does not use any other technology and needs help with his hearing aid remote control, which he finds difficult to operate with his tremor	**Current Medical Problems** Recurrent urinary tract infections × 3 in the past 12 months have led John to spend a lot of time in the toilet. **Activities of Daily Living** John is anxious about his increasing episodes of incontinence. He has fallen twice in the past 3 months once during the day when rushing to the toilet, and once at night mobilising from bed to the bathroom. In the past year, he finds eating meals difficult, his dietary and fluid intake are down, and his family have noticed that he has lost weight

Scenario Background 1—The setting is a residential community unit there is one member of staff available at night—they sleep from midnight to 0630 h.

John usually retires to bed at 22.30 h and sleeps for short periods only, he doesn't sleep well primarily because of the need to go the bathroom overnight—usually three times a night and he is anxious that he may be

incontinent. He also has restless legs which impede his mobility and is partly attributable to his Parkinson's disease.

Day of week and time	Location	Activity—patient	Monitoring/sensors in place in location	Action from sensor	Nurse/carer activity
Saturday Morning 00:30 h	John's bedroom Single bed Light bed linen Height of the bed is ideal for his height and does not impact on his mobility/falls risk. He uses a Zimmer frame to mobilise. This is usually left adjacent to his bed at night. There are no other obstacles in the room which could present a slip/trip or fall hazard	• Sleeping for short periods waking to go to the toilet. • Turning in bed from side to side. • Restless legs	1. Motion sensor—bedroom 2. Plug paired with strip light 3. Sleep Tracking Mat 4. Fit Bit watch 5. Toilet sensor	Status—all sensors monitoring	Carer in other part of house checking other service users before they go to bed
Saturday Morning 00:40 h	John's bedroom	John sits up in the bed and begins to get out of the bed John places his feet onto the floor and he attempts to put on his slippers and find his Zimmer frame	1. Motion sensor 2. Plug paired with strip light 3. Fit Bit Watch tracking 4. Sleep Tracking Mat 5. Toilet sensor	Status—monitoring 1. Motion sensor activated to alert carers that he is out of bed and moving 2. Light strip activated 3. Fit Bit Watch tracking 4. Toilet Flush sensor	Carer alerted by alarm from motion sensor Carer responds to alarm, enters John's room and escorts to bathroom

Day of week and time	Location	Activity—patient	Monitoring/sensors in place in location	Action from sensor	Nurse/carer activity
Saturday Morning 00:55 h	John's walks with carer to bathroom using his Zimmer frame wearing his slippers	John walks/ shuffles to bathroom	1. Motion sensor in bathroom activated 2. Plug paired with strip light 3. Toilet Flush sensor activated 4. Fit Bit Watch tracking	Status—monitoring 1. Room motion sensors activated 2. Light strip activated 3. Toilet Flush sensor 4. Fit Bit Watch tracking	Carer escorts John to bathroom and returns John to bed, ensures he is comfortable and a drink given. Zimmer frame and slippers are placed appropriately by the carer in case he needs to get out of bed again

Physical props required for Scenario 1	Actors required for Scenario 1	Technology IT props required
All sensors active as listed Links to Hub working Curtains/blind closed Slippers Pyjamas Zimmer frame Drink at bedside	John (service user) Carer Observer	• All sensors active as listed • Links to Hub working • Messaging device to alert carer to motion sensor being activated—*mobile phone send text message*—carer located in reception area of Clinical Skills Centre

Evaluation	

2.4.2 Strategy 2: Strengthening Governance and Accountability

Strategy 2 strengthening governance and accountability relates to effective governance and accountability in health systems. Recommending a need to promote transparency in decision-making and for health organisations to generate robust systems for the collective accountability of health providers and health system managers through aligning governance, accountability and incentives (World Health Organisation 2016, p. 24). Firstly that the report lists three characteristics for effective governance and accountability structures. Secondly, that mechanisms are established through which service providers are held accountable and thirdly that

Box 2.4
Improving health outcomes requires a renewed focus on tackling the social determinants of ill-health and placing health at the centre of all policies through strong stewardship and intersectoral action. Without this, the excessive specialization of health care providers and the narrow focus on disease management programmes that discourages holistic care will continue to predominate (p.10).

adequate information is available to be able to assess the services, which are provided. Finally, those structures are in place whereby patients are empowered to take action. The need for stewardship and citizen engagement is also emphasised as critically important as the following quote demonstrates;

2.4.3 Strategy 3: Reorienting the Model of Care

For Strategy 3, the focus is on reorientation models of care aligning, prioritising primary, and community care services with active engagement of citizens in the co-production of health. From a health care professional and individual citizen perspective, it encompasses the shift from inpatient to ambulatory and outpatient care, and the need for a fully integrated and effective referral system (World Health Organisation 2016, p. 27). The strategic focus for strategy three also includes investment on holistic models of care, which include interventions on health promotion and on ill health prevention supporting health and wellbeing to support social determinants of health. Challenges listed on reorientating models of care include addressing the Hospital "dominance" in terms of service organization and budget allocation. At a hospital organisational level key implications on the service approach of relevance in this text include

1. Ensuring that hospitals form part of a coordinated/integrated health services delivery network that balances budget allocations across all care settings
2. Improved coordination with rest of care providers to ensure continuity of care for patients with increased focus on quality, safety and person-centred care
3. Greater accountability for population health outcomes and clinical results (World Health Organisation 2016, p. 28).

Figure 2.1 provided in the earlier Sect. 2.2.1 demonstrates care plan on how a model of care for a citizen is structured (Mullaney et al. 2016).

2.4.4 Strategy 4: Coordinating Services Within and Across Sectors

Strategy 4 of the WHO PIC framework calls for better care co-ordination as a critical enabler for delivery of this framework drawing on material discussed in Sect. 2.2.1 and other associated strategies listed in the WHO Interim report. Arguing the

case that the core purpose of co-ordinating services across sectors is to overcome the fragmentations in care delivery, which undermines the ability of health care service teams and families to provide safe, accessible, high quality and cost-effective care in order to improve care experiences and outcomes for people (World Health Organisation 2016, p. 30). Supporting the aforementioned quadruple aim by Bodenheimer and Sinsky (Bodenheimer and Sinsky 2014), Strategy 4 draws the integration of key public health functions including surveillance, early detection and rapid emergency response capacity into the health service delivery system to address emergencies and potential hazards faced by the contemporary health care systems. From a health care professional perspective, the WHO report recommends moving from the traditional service delivery patterns, which have focused on episodic and vertically oriented interactions between individuals and health care providers. Such approaches fail to respond to the inherent complexity of people's health problems. What is required are co-ordinated systems that are sustainable and capable of evolving to better address patient needs.

2.4.5 Strategy 5: Creating an Enabling Environment

In order to make the four previous strategic plans an operational reality, The WHO framework for patient centreed care advocates the need to create an enabling environment that brings together the different stakeholders to undertake transformational change. Recognising the complexity of this task the following critical enablers are recommended and illustrated in the following Fig. 2.4 which summarises structures required for an enabling environment.

Fig. 2.4 Structures for enabling environment (World Health Organisation 2016)

As is evident from the material presented here to advance universal health care and align the WHO global strategy on people-centred and integrated health services at each system level of development and design, there is extensive work needed to implement the changes required. From a health informatics perspective, interoperability is considered the core foundation stone or building block required to realizing structural functional and behavioural shifts in care delivery to underpin integrated care. This is required across all three system viewpoints the macro mesa and micro. Recognised as difficult to achieve (Benson and Grieve 2016), Interoperability is not solely about sharing data but rather sharing knowledge across a number of different dimensions of the health care domain (Blobel 2019). This chapter therefore includes a brief introductory section on interoperability.

2.5 Interoperability and Risk

Described as difficult to achieve interoperability is at the heart of building next generation models of care at the systems level. Considered as a critical springboard to drive transformation at a global and national level, Interoperability and its clinical counterpart integrated care, form the foundation stone for connecting digital and eHealth services. Both are linked to patient safety, are complex and dynamic to deliver effectively, and require adoption of standards across services for successful deployment (Benson and Grieve 2016). As such an essential topic we believe it is important for nurses to understand some of the theory underpinning interoperability and therefore provide the reader with some finer points on the topic some of which will be expanded upon in Chap. 6.

2.5.1 What Is Interoperability and Why Is It Important

Interoperability is defined in the literature in many different ways. Experts from the European Health Informatics Standards Working Groups (CEN Portal 2020) emphasise the need to consider interoperability as having social, political, and technical dimensions. Indicating that any development initiative relating to interoperability needs to consider all three dimensions concurrently in service requirements design. Alternatively, Palfrey and Glasser suggest interoperability has four layers namely Technology, Data, Human, and Institutional layers which require analysis (Palfrey and Gasser 2012). The most widely used definition adopted is by the IEEE in 1990 which states that

> Interoperability is the ability of two or more systems or components to exchange information and to use information that has been exchanged IEEE 1990 (IEEE 1990).

The core message is that interoperability is a multidimensional dynamic and evolving phenomenon. Different perspectives need careful consideration across the

aforementioned system levels, focusing solely on one dimension for deployment in a programme does not fully address the complexity of the topic (Beránková et al. 2010). At the organisational level, for example it is critically important to be cognisant to potential barriers that work against national agendas for sharing and access to data. In large scale deployment of enterprise wide systems project managers must be diligent at the initial procurement stage to ensure vendors conform with national approved standards for interoperability in order to optimise future care co-ordination nationally. In addition, the value proposition and maximising a return on investment for organisations and national bodies needs to be evident. There is much evidence, which demonstrates negative impact towards cost containment on original budget. A core aspect of the procurement process includes avoiding vendor lock in, ensuring privacy concerns are addressed and access by individual patients are realised (Fortune 2020).

Some core principles in procurement to minimise risk and anticipated return on investment include adopting a system wide approach underpinned by focused engagement and consultation during the pre-tender process. Procurement processes should include a competitive procedure, which involves negotiation to cultivate innovative partnerships. Procurement should also use a balanced approach developing procurement in lots ensuring that the appropriate procurement approach is selected. This is achievable by reviewing all procurement options with value based award criteria in order to choose the option that best suits the technology (Davis and Brady 2015).

The 36 billion dollars investment by Obama care is a good case study, which illustrates problems encountered in organisations where a number of issues were identified. Some of major issues relate to interoperability and access of patients to their health records (Fortune 2020). Reporting Fred Schulte and Erika Fry conducted a review of the Obama based programme entitled Meaningful Use, which was published in Fortune Magazine. Summarising the issues identified related to the following; Access to health information across and between hospitals communities and individual patients. Poor integration and closed systems design. Spiralling costs at the local and organisational level Poor interface design accuracy of data and an overall absence of standards conformance. A review of clinical information capture in Electronic Health Records in Ireland published in 2019 identified 21 key issues from the literature from the literature through an advisory group approach. These issues could be defined in three sections.

Firstly in regards to data entry methods, what and how personal health information is stored and used in accordance with data protection and security is important. In additon to considering how health care professionals practice recording health information or use patient information. Otherwise information systems and associated workflow are inefficient and may have unintended consequences leading to workarounds.

Secondly, a broad approach to clinical data types is recommended. The need for unstructured, structured, coded and semi structured data types should be included to accommodate different clinical scenarios and for secondary use of data which is considered important.

Finally data entry by patients should be included and capacity to connect adjunct devices to interface to the Electronic health record in the future should be considered (Fortune 2020; Fennelly 2019b).

Chapter 10 discusses Data Protection and Data Security in detail. Increasingly with new regulations enacted in the European Union in 2018 organisations are obliged to uphold the the General Data Protection Regulation laws across member states. Failure to adhere to the privacy and security standards regulations leaves organisations open to paying harsh fines. Considered the toughest privacy and security law in the world Europe with this latest regulation adopts a firm stance on data privacy and security. This they argue is warranted at a time when more people are entrusting their personal data with cloud services and breaches are a daily occurrence. The regulation itself is large, and has far-reaching consequences on industry and organisations and we include here a summary of the detail and core concepts defined in the new regulation (GDPR 2018).

- GDPR defines personal data as any information any information that relates to an individual who can be directly or indirectly identified.
- Data processing involves any action performed on data, whether automated or manual. This includes collecting, recording, organizing, structuring, storing of information.
- Data subject is described as the person whose data is processed including site visitors on webpages.
- Data controller is the person who decides why and how personal data will be processed and relates to the owner of an organisation.
- Data processor is a third party that processes personal data on behalf of a data controller. The GDPR has special rules for these individuals and organizations.

There are seven protection and accountability principles, which individuals must comply with, and these are;

- Lawfulness
- Fairness and transparency
- Purpose limitation
- Data minimization (Collect and process only as much data as absolutely necessary for the purposes specified)
- Accuracy
- Storage limitation
- Integrity and confidentiality (Processing must be done in such a way as to ensure appropriate security, integrity, and confidentiality e.g. by using encryption)
- Accountability (The data controller is responsible for being able to demonstrate GDPR compliance with all of these principles) (GDPR 2018).

As individuals increasingly adopt digital in society, the debate on data protection grows more important. Considering GDPR it is important to achieve the optimal balance and level of interoperability particularly for data access and sharing of sensitive health information. As the Vice President-Designate of the European

Commission for a Europe fit for the Digital Age Margarethe Vestager in an EU interview on digital deployment within the EU says, *what we will accept and what we will not accept in society should not be any different in a digital world (*European Commission 2020*)*.

A body of work is required to define the ways systems work together and to consider what data the systems shall and shall not share. This is best achieved by building case studies called Use Case to identify core functionality and structural elements of any planned system. Use Case can then be used to test prototypes and determine how they should interact with each other to support care co-ordination without undue patient risk or comprising patient confidentiality. This approach will be further expanded upon in Chap. 5 of this text.

Today Digital transformation continues to bring unprecedented changes to every aspect of the economy and society, it is important to remember that it brings both new opportunities challenges and risks and these risks need be monitored carefully. From a systems wide perspective the challenges standards and solutions paper published by Blobel to address the interoperability challenge is summarised (Fig. 2.5). This diagram is followed by a short description of the core elements discussed in this paper which need to be considered at both the information and the organisation level (Blobel 2018; Blobel and Oemig 2016).

A number of the core concepts as identified in Fig. 2.5 will be discussed in detail in the proceeding chapters, in this initial chapter on connecting health we provide summary of this structure with some broad examples for clarity.

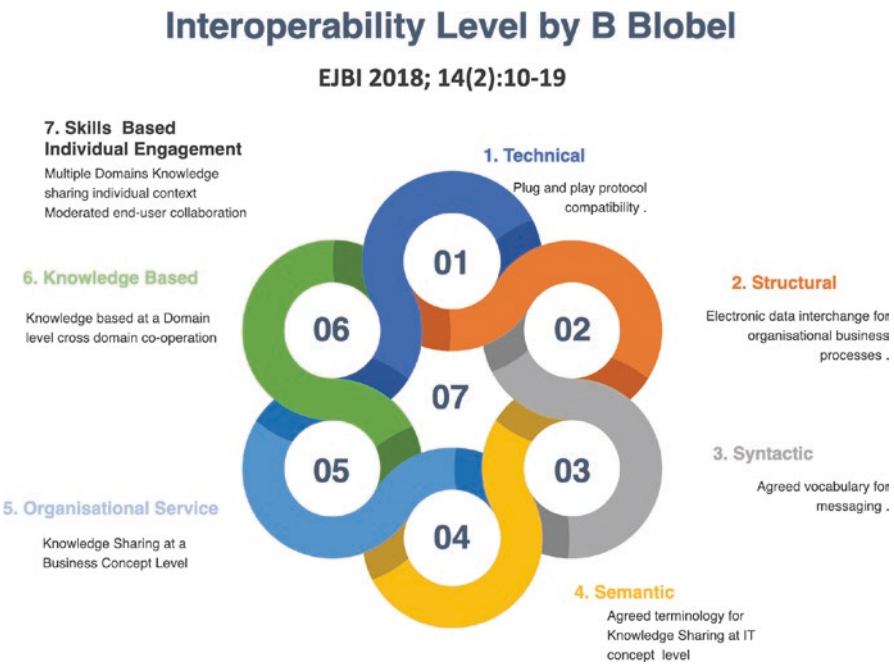


Fig. 2.5 Summary representation of *Blobel Interoperability Levels* (Blobel 2018)

1. The *Technical* challenge is required to address connectivity of systems. Examples of technical solutions for connecting health include protocols for compatibility such The File Transfer Protocol (FTP). As standard FTP is a network protocol used for the transfer of computer files between a client and server on a computer network (Fennelly 2019b).
2. The *Structural* challenge addresses the different levels of data exchange. Examples provided by Blobel include Electronic Data Interchanges (EDI) for exchange of business transaction documents across a network of different service providers.
3. The *Syntactic* challenge deals with structured messages such as clinical documents using an agreed vocabulary. This approach is addressed in health care systems with messaging standards such as HL7 and a set of structured protocols such as IHE profiles, which are expanded upon in detail in Chap. 5.
4. The *Semantic* Challenge is well documented in the evidence base. Here the challenge relates to the creation of detailed coded data sets underpinned by common information models and common terminologies. Much progress has been made in the past 20 years globally on defining detailed semantic platforms to share concepts and terms in health and social care records. The most commonly referenced one being Snomed CT (Fennelly 2019b). This is topic is expanded upon in Chap. 6.
5. The *Organisational* challenge has been discussed above. Core to addressing the issues raised in the organisational challenge is the need for a well defined business case which describes in detail the common business processes from both the functional and behavioural aspects of the system to meet defined business objectives. Here we also include additional earlier references from Blobel (Blobel and Oemig 2016, p. 16). What is also noted in the organisational challenge is the need for correct representation of the domains of knowledge using domain ontologies. For nursing engagement in domain ontologies see (Hussey and McGlinn 2019).
6. The *Knowledge based* challenge is described by Blobel as those domains of discourse which use domain specific terminologies which are underpinned with defined ontologies. They shoud align with business objectives and be defined by domain experts. An example of a domain of discourse could be the family of WHO classifications such as the International Classification for Nursing Practice (ICNP©) (ICN 2020).
7. The need for *Skills Based* I*ndividual* Engagement where different domains share knowledge explain and share context and end-user collaboration is moderated is the final challenge to achieve interoperability. Advances in the global diffusion of Open Innovation 2.0 principles aligns well to this agenda. Key aspects of this methodology include defining a platform, participating in ecoystems for focused group discussions on planning for adoption on new models of care. This approach also needs to be underpinned with agile production innovation and engagement with industry to advance data driven agendas. For a case example of how nursing informaticians are engaging in this process see earlier work by the author (Hussey and McGlinn 2019; Curely and Salmeli, 2018).

2.5.2 *Immersion of Digital in Connected eHealth*

New frontiers with digital are now a reality with global organisations recommending a strong push for public funding investment with AI and robotics, and machine learning. Chapter. 16 discusses new frontiers in a futures chapter. Here we provide a summary of what such technologies involve and consider key factors including the human and ethical implications for the profession. It is only by focusing on the virtues that guide us in our human interactions in society that we can proactively use democratic processes and take control of the frameworks in which we build to make platforms to support our interactions.

Academic publications on translational science in AI report that there is much published in the media about the seemingly limitless power of AI to truly revolutionise patient healthcare. The father of AI Marvin Minsky described AI as simply a machine that is able to do a task, which is considered an intelligent one performed by a human being. Dividing the capacity of AI into two tasks, firstly, as an attempt to reproduce the capabilities of the human mind, and secondly for the creation of tools to carry out tasks which today need a human action. AI can also be understood as a concept presented as an abstract object of thought that enables it to associate the various perceptions that it has of that object (Laï et al. 2020, p. 2). Definitions that are more recent are included in the following Boxes Artificial Intelligence Box 2.5 and Machine Learning Box 2.6.

Durant (AACC 2020) suggests that there are examples of AI and ML increasingly evident in everyday life in society. For example, when on social media, companies provide sites with targeted adverts which are sent to an individual user. This targeting is based on what the user has been searching on the internet perhaps a holiday destination. Other examples include AI tools presenting a viewer with a "best matched" movie selection based on previous choices on television streaming services such as Netflix.

Box 2.5 Definition of Artificial Intelligence (AACC 2020)
AI as the ability of a machine to demonstrate intelligent behavior. It can be further divided into two types of algorithms exhibiting rule based or non-adaptive functions or machine learning adaptive functions (AACC 2020).

Box 2.6 Definition of Machine Learning (AACC 2020)
Machine learning (ML) which can provide adaptive functions is a type of artificial intelligence, which uses mathematical models to automatically map inputs into desired outputs in a way that does not rely on explicit rule based programming (AACC 2020).

There is much discussion on the widespread potential for adoption and integration of machine learning and digital in health and social care (Curley 2018; Laï et al. 2020; AACC 2020; Risling and Low 2020; Healthcare Innovation 2018; Skiba 2018; The Royal College of Nursing 2020). Despite this being the case, a study by Risling and Low (2020), suggests there is very little nursing consultation in relation to the use and potential implications of AI Integration within the profession. Specific areas where implementation of AI relating to nursing occurs include patient decision support particularly in the field of diagnostics and in robotic devices to support the process of care delivery. Results on a literature review conducted in 2020 report only two articles were identified which included discussion on the nursing role or professional view about AI use in healthcare (Risling and Low 2020, p. 38). Qualitative studies, which included professional and public service engagement completed in France, support the need for more focused analysis on impact and use of AI within the health and social care domain. Moving on from innovative research findings on potential benefits there is a need to conduct focused analysis on how AI Tools can meaningfully support service improvements and to identify where best to apply AI tools in practice (Laï et al. 2020). Stressing the need to consider the impact of automation of tasks on human interactions will be important, for example is there potential for loss of competence and skills by humans on tasks that they no longer perform and is there a risk of deskilling of professionals in their roles (Laï et al. 2020; Skiba 2018).

Regulation is required particularly for adoption and use of AI within health care domain, and as the gatekeepers of care both clinician and patient opinion are important in order to decide what is good for practice integration in addition to what is good for patients.

To develop reliable AI tools for predictive modelling and clinical decision making immense amounts of individual health data are essential for testing, training and refining models and this data must be accessed in accordance with the General Data Protection Regulation. Studies suggest that initial integration of AI in health will happen in radiology, but what is key is the translation of research and innovation into tools that focus on utility and service effectiveness (Davis and Brady 2015, p. 6). AI can have a direct impact on organisational of health care systems; there is a need to define responsibilities of AI tools within organisations particularly to avoid error. In the study by Lai et al. findings suggest that radiologists appear to be the least reluctant to integrate AI tools in their practice (Laï et al. 2020).

From an industry perspective,vendors are increasingly introducing machine learning into their electronic health record systems (Healthcare Innovation 2018), however in many instances vendors package machine learning software into clinical decision support blending machine learning with clinical medicine and this can raise concerns as implemented regulation is still under developed in this domain. Knowing where machine learning can be applied and understanding what it is good and not good for in deployment of health and social care is essential to optimise safety and minimise risk. Some institutions have successfully developed and integrated machine learning systems into their laboratory systems and associated workflows, however few have successfully transitioned to clinical practice (AACC 2020; Risling and Low 2020). With a view to the future, and specifically considering the

Box 2.7 Skiba Quote on AI and Nursing (Skiba 2018, p. 265)
With the intersection of data, devices and AI who will be your health care professional in the future. Will your health care provider partner with you as an invisible AI assistant?

Will it be Molly your virtual nurse?

Or will it just be the invisible AI wizard on your smartphone?

Nurses will not disappear in the future but their roles and responsibilities will change.

Skiba (2018, p. 265)

profession of nursing we conclude this section with a quote from Diane Skiba which summarises well the challenges facing the profession in terms of AI going forward.

2.6 Conclusion

In Chap. 2 we have discussed the topic of connecting health using eHealth and digital. We have approached the topic from the perspective of the grand societal challenges which nursing as a profession must meet and actively have a role in addressing. Since the birth of fifth generation computing in 2010 where search engines have been using Artificial Intelligence to mine Internet data on platforms, giant leaps have been realised with a surge of applications to support smart and mobile devices. Health administrators are designing new approaches to data collection, examining data flows and monitoring the transformative nature of how care can be delivered more effectively and efficiently. At a citizen level, Individuals are using smart devices and increasingly embracing digital in their daily routines. They are generating significant data with supporting personalised devices and this provides potential to create new knowledge for understanding health care delivery. This poses the profession with a number of questions

- What role will nursing play in delivery of care?
- Who will design the devices and algorithms that provide silos of data from connected health?
- As regulation of this industry is yet under developed, how can nurses trust the data produced?

The indications are that such questions are currently in debate although early indications are that nursing is not as involved, as it could be. More focused engagement is perhaps now required.

Two key truths are recognising that our existing care models are not sustainable and use of AI and machine learning in society is now inevitable. In the realm of health and social care, citizens need support to be lifelong, self-directed learners who can avail of digital to assist in managing their health. Leadership will be key and nursing today is at a crossroads. The professsion needs to grow digital capabilities and informatics competencies to provide a clear direction for nursing to

evolve as a practice based profession. This will be instrumental to understand the evolving roles and responsabilities for the profession that will inevitably come to pass in a digitally enabled and connected health society.

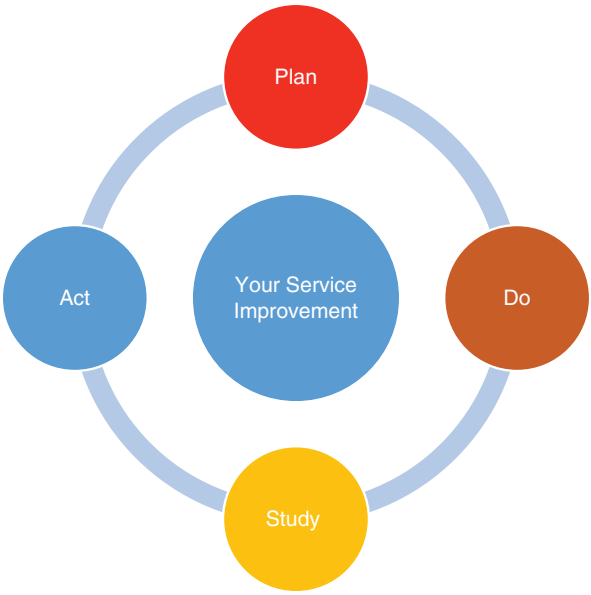
Review Questions
Template One for Group and Individual Assignment Work

1. Consider using template below to formalize your thoughts on what you have read in Chap. 2 on the WHO strategic plans for patient centered integrated care. How you would instigate a project to address a problem based on your current or past work experience, which could bring about a patient centered service initiative?

Template 1 pattern of an information handling activity
Problem: Describe the problem in one or two sentences
Solution: Provide a summary of the solution that you would like to propose
Aim: State the aim to be achieved in the short medium or long term
Objective: Explain what you will have delivered by the end of the module and how it will or could affect the problem
Evaluate: Explain how you would evaluate

2. Consider using template two to formalise your thoughts on what you have read in Chap. 2 and how you could plan a project based on your current or past work experience to implement digital smart or mobiles devices in to your practice?

Template 2 Plan—Do—Study—Act



3. *Learning activity* Access the Millenium Development Goal website and view this video https://youtu.be/0XTBYMfZyrM and consider to be completed.

Glossary

Architecture A specific design approach to determine how the information system will work. A variety of architectures exist such as conceptual, operating system, software, etc.

CARE An acronym within nursing informatics initially devised by Hannah and Ball and adapted within this text to refer to Connected health administration research and education

C-HOBIC Canadian Health Outcomes for Better Information and Care

Clinical intelligence The electronic aggregation of accurate, relevant and timely clinical data into meaningful information and actionable knowledge in order to achieve optimal structures, processes, and outcomes" (Harrington 2011, p. 507)

eHealth The use of information and communication technologies (ICT) for healthcare delivery WHO defines it as the transfer of health resources and healthcare by electronic means

EHR Electronic Health Record

Health Informatics Health informatics is the intersection of information science, computer science and health care. Health informatics is the intersection of clinical, IM/IT and management practices to achieve better health Source http://www.imia-medinfo.org/new2/node/66

HRQoL Health-related quality-of-life

IHE IHE is a world-wide initiative created by healthcare professionals and industry to improve the way computer systems in healthcare share information by working together on interoperability use cases. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care

Information Facts provided or learned about something or someone

Interoperability IEEE in 1990 defined Interoperability is the ability of two or more systems or components to exchange information and to use information that has been exchanged IEEE 1990

IoT Internet of Things

mHealth A collective term used to describe cellular type of mobile technology

Nursing Data Any information element obtained by a nurse during an encounter relating to the assessment of a client's health state, diagnostic of ailments/diseases and/or treatments

Nursing Informatics Nursing Informatics science and practice integrates nursing, its information and knowledge and their management with information and communication technologies to promote the health of people, families and communities world wide" IMIANI.

OECD Organisation of economic co-operation and development

PREMS Patient Reported Experience Measures

PROMS Patient Reported Outcome Measures
SDG Sustainable Development Goals devised by the United Nations
Self Efficacy People's judgements of their capabilities to organise and execute courses of action required to attain designated types of performance. It is concerned not with the skills one has but with the judgements of what one can do with whatever skills one possesses (Bandura 1986, p. 391)
Self Management Support An approach providing education and support to optimize patients' self management and ability to make informed decisions about their health
Theory An abstract generalisation that presents a systematic representation about relationships among phenomena
UN United Nations
Use Case An integration profile used as a guideline for implementation of a specific process called use case. The use case provides precise definitions of how standards can be implemented to meet specific clinical needs for a specific purpose. For example, integration profiles organize and leverage the integration capabilities that can be achieved by coordinated implementation of communication standards, such as DICOM, HL7, W3C and security standards in Digital Health
WHO World Health Organisation

Appendix: Simulation Exercise and Review Questions

1. Review the scenario case study presented in this chapter. Complete this case based exercise which is linked to Box 2.3 and Figs. 2.3a, 2.3b as a role playing simulation and consider the value proposition on the use of connected digital sensors in the home from a patient safety perspective.
2. What are the benefits of implementing digital devices as described in the simulation exercise?
3. What are the potential barriers to implementation and how can they be address?

Appendix 1 of Chapter 2 Detail is as follows;

Additional Scenarios Case Study

John wakens from a fitful sleep and is conscious he needs to go to the toilet as a matter of urgency. He gets out of bed puts his slippers on and uses his Zimmer frame to go to the toilet.

Day of Week & Time	Location	Activity—Patient	Monitoring/Sensors in Place in Location	Action from Sensor	Nurse/Carer Activity
Saturday Morning 02:30hrs	John's bedroom Bathroom	Sleeping for short periods waking to go to the toilet—urgency to pass urine. Restless Legs	1. Motion sensor—bedroom 2. Plug paired with strip light 3. Fit Bit Watch 4. Sleep Tracking Mat 5. Toilet sensor	Status—monitoring all sensors	Carer in bed
Saturday Morning 02:45hrs	John's bedroom	John sits up in the bed and begins to get out of the bed John places his feet onto the floor and he attempts to put on his slippers and get his Zimmer frame	1. Motion sensor 2. Plug paired with strip light 3. Fit Bit Watch 4. Sleep Tracking Mat Toilet sensor	Status—monitoring 1. Motion sensor activated 2. Light strip activated in bed room	Carer alerted by alarm Carer responds to alarm
Saturday Morning 02:50hrs	John's walks/shuffles from bedside to bathroom using Zimmer frame	John walks to bathroom and puts on light and enters the bathroom with his Zimmer frame. Goes to the toilet after flushing the toilet washes his hands	1. Motion sensor in bathroom activated 2. Toilet Flush sensor activated 3. Fit Bit Watch	Status—monitoring 1. Motion sensor activated 2. Light in bathroom activated 3. Toilet Flush sensor	

Day of Week & Time	Location	Activity—Patient	Monitoring/Sensors in Place in Location	Action from Sensor	Nurse/Carer Activity
Saturday Morning 02:55hrs	Bathroom	After flushing the toilet John washes his hands- water spills on to the floor and he then slips as he turns to reach for the towel which is on the bath (Zimmer frame is occupying circulating space)	1. Motion sensor in bathroom activated 2. Falls alert sensor device		Carer arrives having been alerted to John being out of bed and being on the move at 0245hrs

03:00hrs	Bathroom	John is assessed for injury post fall—no HI or evidence of bony injury. John manages to get himself up off the floor with the assistance of the carer and a chair is brought into the bathroom for him to rest on for a short while.	1. Fit Bit Watch 2. Ambient lighting or SMART lighting	Clinical assessment post fall
03:15hrs	Bedroom	John is escorted back to bed with his Zimmer frame and made comfortable. He is feeling a little shaky following the fall. BP recorded, reassured and drink offered before settling.	1. Motion sensor 2. Plug paired with strip light 3. Fit Bit Watch 4. Sleep Tracking Mat Toilet sensor 5. Digital BP Cuff	Assessment complete. Zimmer frame and slippers are placed by bed appropriately by carer

Physical Props Required for Scenario 2	Actors Required for Scenario 2	Technology IT Props Required for Scenario 2
All sensors active as listed Links to Hub working Curtains/blind closed Slippers Pyjamas Zimmer frame Drink at bedside Towel in bathroom on side of bath Small chair to move into bathroom post fall	John (service user) Carer Observer	• All sensors active as listed • Links to Hub working • Messaging device to alert carer to motion sensor being activated—**mobile phone send text message—Carer located in CeIC Centre**

Evaluation	

Scenario Background 3

At 07:30hrs John begins to get himself out of bed as per his normal routine—his Zimmer frame and slippers are always left beside his bed.

Day of Week & Time	Location	Activity—Patient	Monitoring/Sensors in Place in Location	Action from Sensor	Nurse/Carer Activity
Sunday Morning 07:30hrs	John's bedroom	Awakening-keen to get up and get his breakfast.	1. Motion sensor—bed room 2. Plug paired with strip light 3. Fit Bit Watch 4. Sleep Tracking Mat	Status—monitoring	With other service users in other location
Sunday Morning 07:40hrs	John's bedroom	John sits up in the bed and begins to get out of the bed John places his feet onto the floor and he attempts to put on his slippers and get his Zimmer frame	1. Motion sensor 2. Plug paired with strip light 3. Fit Bit Watch 4. Sleep Tracking Mat	Status—monitoring 1. Motion sensor activated 2. Light strip activated	Carer alerted by alarm Carer responds to alarm

Day of Week & Time	Location	Activity—Patient	Monitoring/Sensors in Place in Location	Action from Sensor	Nurse/Carer Activity
Sunday Morning 07:45hrs	John's walks/ shuffles from bed side to kitchen on his way to the bathroom	John walks/ shuffles to the kitchen and fills kettle with water, puts mug out with tea bag and puts bread in toaster—shuffles to bathroom	1. Motion sensor in bathroom activated 2. Fit Bit Watch	Status—monitoring 1. Motion sensor activated 2. Light strip activated in bathroom	
Sunday Morning 07:55hrs	Bathroom	John walks to bathroom and puts on light and goes to the toilet after flushing the toilet washes his hands and is distracted in the bathroom. Toast burning in the kitchen	1. Motion sensor in bathroom activated 2. Toilet Flush sensor activated 3. Smoke sensor activated in kitchen from toaster		
Sunday Morning 08:00hrs	Kitchen	John returns to kitchen carer arrives and toaster turned off and smoke sensor deactivated	1. Motion sensor in kitchen activated 2. Fit Bit Watch 3. Smoke sensor in kitchen		Carer arrives having been alerted to John being out of bed and being on the move.
	Bedroom	John returns to his bedroom assisted by carer—John uses his Zimmer frame and is complaining of feeling a little light headed.	1. Motion sensor in bedroom activated 2. Fit Bit Watch 3. BP & HR & Temp recorded		

Physical Props Required for Scenario 3	Actors Required for Scenario 3	Technology IT Props Required for Scenario 3
All sensors active as listed—including Smoke Sensor for this scenario Links to Hub working Curtains/blind closed Slippers Pyjamas Zimmer frame Drink at bedside Towel in bathroom on side of bath Toaster, Kettle, Mug Bread/Butter/Jam, Tea Bags, Sugar Plate Knife Milk	John (service user) Carer Observer	• All sensors active as listed • Links to Hub working • Messaging device to alert carer to motion sensor being activated—**mobile phone send text message—Carer located in Reception of Skills Centre** • Sensor data recorded and visualisation accessed through John's profile

Evaluation	

References

AACC. Machine learning and laboratory medicine: now and the road ahead | AACC.org. 2020. https://www.aacc.org/publications/cln/articles/2019/march/machine-learning-and-laboratory-medicine-now-and-the-road-ahead. Cited 30 Jan 2020.

Auraaen AL, Slawomirski NK. (2018) The economics of patient safety in primary and ambulatory care: flying blind. Paris: OECD Publishing. OECD Health Working Papers, No. 106.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.

BELLERIN MLS. First EU citizens using ePrescriptions in other EU country thanks to CEF Telecom. Innovation and Networks Executive Agency – European Commission. 2019. https://ec.europa.eu/inea/en/news-events/newsroom/first-eu-citizens-using-eprescriptions-other-eu-country-thanks-to-cef-telecom. Cited 30 Jan 2020.

Benson T, Grieve G. (2016) Principles of health interoperability SNOMED CT, HL7 and FHIR. 3rd ed. London: Springer-Verlag. (Health Information Technology Standards).

Beránková M, Kvasnička R, Houška M. Towards the definition of knowledge interoperability. In 2010 2nd international conference on software technology and engineering. 2010. p. V1-232–6.

Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. Health Aff. 2008;27(3):759–69. https://www.healthaffairs.org/doi/10.1377/hlthaff.27.3.759. Cited 29 Jan 2020.

Blobel B. Interoperable EHR systems – challenges, standards and solutions. ejbi. 2018;14(2). https://www.ejbi.org/scholarly-articles/interoperable-ehr-systems%2D%2Dchallenges-standards-and-solutions.pdf. Cited 30 Jan 2020.

Blobel B. Challenges and solutions for designing and managing pHealth ecosystems. Front Med. 2019;6:83. https://www.frontiersin.org/article/10.3389/fmed.2019.00083.

Blobel B, Oemig F. Why do we need an architectural approach to interoperability? Interoperability is more than just technology. Eur J Biomed. 2016. https://www.ejbi.org/scholarly-articles/interoperability-is-more-than-just-technology.pdf.

Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. Ann Fam Med. 2014;12(6):573–6. http://www.annfammed.org/cgi/doi/10.1370/afm.1713. Cited 29 Jan 2020.

CeIC. The Nex Project 1. Centre for eIntegrated Care – Dr Pamela Hussey, DCU CeIC. 2020. https://www.ceic.ie. Cited 30 Jan 2020.

CEN Portal. 2020. https://login.cen.eu/portal/. Cited 20 Jan 2020.

Chen J. Integrated Care Patient reported outcome measures and patient reported experience measures – a rapid scoping review. Australia: University of New South Wales: Simpson Centre for Health Services Research; 2015. p. 116. https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0009/281979/ACI_Proms_Prems_Report.pdf.

Connecting Europe Facility. Innovation and Networks Executive Agency – European Commission. 2015. https://ec.europa.eu/inea/en/connecting-europe-facility. Cited 30 Jan 2020.

Curley MSB. Open Innovation 2.0. Switzerland: Springer; 2018.

Davis P, Brady O. Are government intentions for the inclusion of innovation and small and medium enterprises participation in public procurement being delivered or ignored? An Irish case study. Innovation. 2015;28(3):324–43. https://doi.org/10.1080/13511610.2014.985192.

Davra. Industrial Internet of Things (IoT) Platform for Enterprise • Davra. 2020. https://davra.com/. Cited 30 Jan 2020.

EU Commission. Digital Europe Programme: a proposed €9.2 Billion of funding for 2021–2027. Digital Single Market – European Commission. 2019. https://ec.europa.eu/digital-single-market/en/news/digital-europe-programme-proposed-eu92-billion-funding-2021-2027. Cited 29 Jan 2020.

EUR-Lex – 52018DC0233 – EN – EUR-Lex. 2020. https://eur-lex.europa.eu/homepage.html. Cited 30 Jan 2020.

European Commission. State aid and a green, digital future. European Commission. 2020. https://ec.europa.eu/commission/commissioners/2019-2024/vestager/announcements/state-aid-and-green-digital-future_en. Cited 31 Jan 2020.

Fennelly O. Factors for success in electronic health record implementation: literature review and key considerations. eHealth Ireland Dublin: insight Centre UCD; 2019a. p. 1–66. https://www.ehealthireland.ie/Strategic-Programmes/Electronic-Health-Record-EHR-/Information-Resources/Factors-for-Success-in-EHR-Implementation-Literature-Review-and-Key-Considerations.pdf.

Fennelly O. Clinical information capture in the electronic health record: literature review and key considerations. Dublin, Ireland: eHealth Ireland; 2019b. p. 30. https://www.ehealthireland.ie/Strategic-Programmes/Electronic-Health-Record-EHR-/Information-Resources/Clinical-Information-Capture-in-the-EHR-Literature-Review-and-Key-Considerations.pdf.

Food and Drug Administration. Guidance for industry – patient-reported outcome measures: use in medical product development to support labelling claims. U.S. Department of Health and Human Services, Food and Drug Administration. 2009.

Fortune. Death by a thousand clicks: where electronic health records went wrong. Fortune. 2020. https://fortune.com/longform/medical-records/. Cited 30 Jan 2020.

GDPR. What is GDPR, the EU's new data protection law?. GDPR.eu. 2018. https://gdpr.eu/what-is-gdpr/. Cited 30 Jan 2020.

Greenhalgh T, Wherton J, Papoutsi C, Lynch J, Hughes G, A'Court C, et al. Beyond adoption: a new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. Eysenbach G, editor. J Med Internet Res. 2017;19(11):e367. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688245/.

Harrington L. Clinical intelligence. J Nurs Adm. 2011 Dec;41(12):507–9. https://doi.org/10.1097/NNA.0b013e318237eca0. PMID: 22094613.

Health Service Executive. Self management support for chronic conditions. HSE.ie. 2020. https://www.hse.ie/eng/health/hl/selfmanagement/self-management.html. Cited 30 Jan 2020.
Healthcare Innovation. Why analytics is at the foundation of healthcare transformation. Healthcare Innovation. 2018. https://www.hcinnovationgroup.com/home/article/13011305/why-analytics-is-at-the-foundation-of-healthcare-transformation. Cited 30 Jan 2020.
Hussey P, McGlinn K. The role of academia in reorientation models of care—insights on eHealth. Informatics. 2019;6(3):37. https://www.mdpi.com/2227-9709/6/3/37. Cited 31 Jan 2020.
ICN. International Classification for Nursing Practice about ICNP. ICN – International Council of Nurses. 2020. https://www.icn.ch/what-we-do/projects/ehealth-icnp/about-icnp. Cited 31 Jan 2020.
IEEE. IEEE standard computer dictionary compilation of IEEE standard computer glossaries. The Institute of Electrical and Electronics Engineers, Inc. 1990.
IPPOSI – The Irish Platform for Patient Organisations, Science and Industry. IPPOSI. 2020. https://www.ipposi.ie/. Cited 29 Jan 2020.
Kerr J. Legacy: 15 lessons in leadership: what the All Blacks can teach us about the business of life. 2013.
Laï M-C, Brian M, Mamzer M-F. Perceptions of artificial intelligence in healthcare: findings from a qualitative survey study among actors in France. J Transl Med. 2020;18(1):14. https://doi.org/10.1186/s12967-019-02204-y. Cited 30 Jan 2020.
Maier CB, Aiken LH, Busse R. Nurses in advanced roles in primary care: policy levers for implementation. 2017. https://www.oecd-ilibrary.org/social-issues-migration-health/nurses-in-advanced-roles-in-primary-care_a8756593-en. Cited 30 Jan 2020.
McEvoy P. Chronic disease management: a new paradigm for care. Boca Raton, FL: CRC Press; 2014.
Mullaney C, O'Reilly O, Quinn G. Development of a national self management support framework for Ireland, for patients with cardiovascular disease, COPD, asthma and diabetes. Int J Integr Care. 2016;16(6):176. https://www.ijic.org/article/10.5334/ijic.2724/. Cited 29 Jan 2020.
O'Connell S, Palmer R, Withers K, Saha N, Puntoni S, Carolan Rees G. Requirements for the collection of electronic PROMS either "in clinic" or "at home" as part of the PROMs, PREMs and effectiveness Programme (PPEP) in Wales: a feasibility study using a generic PROM tool. BioMedicalCentral. 2018. https://pilotfeasibilitystudies.biomedcentral.com/articles/10.1186/s40814-018-0282-8.
OECD. OECD Going Digital Toolkit. 2019. https://goingdigital.oecd.org/en/themes/. Cited 29 Jan 2020.
OECD. Measuring the digital transformation – a roadmap for the future – en – OECD. 2020a. https://www.oecd.org/publications/measuring-the-digital-transformation-9789264311992-en.htm. Cited 30 Jan 2020.
OECD. Measuring the digital transformation: a roadmap for the future. 2020b. https://www.oecd-ilibrary.org/science-and-technology/measuring-the-digital-transformation_9789264311992-en. Cited 30 Jan 2020.
Organizational Change | | Bill Hogg. 2020. https://www.billhogg.ca/tag/organizational-change/. Cited 30 Jan 2020.
Palfrey JG, Gasser U. Interop: the promise and perils of highly interconnected systems. New York: Basic Books; 2012. p. 296.
Regional Office of the Americas World Health Organisation. Pan American Health Organisation. PAHO eHealth. 2020. https://www.paho.org/ict4health/index.php?lang=en.
Risling T, Low C. Advocating for safe, quality and just care: what nursing leaders need to know about artificial intelligence in healthcare delivery. Nurs Leadersh (Tor Ont). 2020;32(2):31–45. https://www.longwoods.com/content/25963. Cited 30 Jan 2020.
Skiba D. The invisible health care professional: exploring the intersection of data, devices, and artificial intelligence. Nurs Educ Perspect. 2018;39(4):264–5.
Stenberg K, Hanssen O, Edejer TT-T, Bertram M, Brindley C, Meshreky A, et al. Financing transformative health systems towards achievement of the health Sustainable Development

Goals: a model for projected resource needs in 67 low-income and middle-income countries. Lancet Glob Health. 2017;5(9):e875–e887. https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(17)30263-2/abstract. Cited 30 Jan 2020.

The Royal College of Nursing. eHealth | Clinical | Royal College of Nursing. The Royal College of Nursing. 2020. /clinical-topics/ehealth. Cited 30 Jan 2020.

Thompson C, Sansoni J, Morris D, Capell J, Williams K. Patient-reported outcome measures an environmental scan of the Australian healthcare sector. Wollongong Australia: Centre for Health Service Development, Australian Health Services Research Institute; 2016. https://www.safetyandquality.gov.au/sites/default/files/migrated/PROMs-Environmental-Scan-December-2016.pdf.

Topol E. The patient will see you now: the future of medicine is in your hands. Boulder: Basic Books; 2016. http://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=4786012. Cited 30 Jan 2020.

Tutorialspoint. Computer—fifth generation—Tutorialspoint. 2020. https://www.tutorialspoint.com/computer_fundamentals/computer_fifth_generation.html. Cited 30 Jan 2020.

United Nations D of E and SA. Division for Sustainable Development Goals. Sustainable Development Goals Knowledge Platform. 2019. sustainabledevelopment.un.org.

United Nations Economic and Social Council. E/2019/68 – E – E/2019/68. Special edition: progress towards the Sustainable Development Goals Report of the Secretary-General. 2019. https://undocs.org/E/2019/68. Cited 30 Jan 2020.

World Health Organisation. Ottowa Charter for Health Promotion. 1986. https://www.who.int/healthpromotion/conferences/previous/ottawa/en/.

World Health Organisation. National eHealth toolkit. eHealth. 2012. https://www.who.int/ehealth/publications/overview.pdf. Cited 29 Jan 2020.

World Health Organisation. Framework for people centred integrated care services. 2016. http://www.who.int/servicedeliverysafety/areas/people-centred-care/en/.

World Health Organisation. Classification of Digital Health Interventions v1.0. Geneva: WHO; 2018. p. 20. (Health Research Impact). Report No.: WHO/RHR/18.06. https://apps.who.int/iris/bitstream/handle/10665/260480/WHO-RHR-18.06-eng.pdf?sequence=1&ua=1. Cited 30 Jan 2020.

WHO | eHealth at WHO [Internet]. WHO. 2020. http://www.who.int/ehealth/about/en/. Cited 30 Jan 2020.