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A framework for eHealth readiness of dietitians

Kirsty Maunder

University of Wollongong, km932@uowmail.edu.au

Karen L. Walton

University of Wollongong, k Walton@uow.edu.au

Peter G. Williams

University of Canberra, peterw@uow.edu.au

Maree Ferguson

Dietitian Connection, maree_ferguson@health.qld.gov.au

Eleanor J. Beck

University of Wollongong, eleanor@uow.edu.au

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A framework for eHealth readiness of dietitians

Abstract

Aim To develop a framework for assessing the eHealth readiness of dietitians. **Methods** Using an inductive approach, this research was divided into three stages: 1. a systematic literature review to identify models or frameworks on eHealth readiness; 2. data synthesis to identify eHealth readiness themes and develop a framework; and 3. semi-structured interviews with Australian nutrition informatics experts to gain consensus and validate the framework. **Results** Two hundred and forty one unique citations were identified, of which twenty four met the research criteria and were included in the review and subsequent synthesis. Common eHealth readiness themes or dimensions were extracted from the literature, and five key dimensions were identified that were relevant to dietitian eHealth readiness: access, standards, attitude, aptitude and advocacy. A framework diagram was designed and discussed during semi-structured interviews with ten nutrition informatics experts to inform the final framework. The result of this research was an inductively developed Framework for eHealth Readiness of Dietitians (FeRD). **Discussion** The FeRD builds on existing theories and models, and provides a conceptual model for developing eHealth readiness evaluation tools to examine, measure and drive strategies to better prepare dietitian professionals for eHealth.

Keywords

ehealth, framework, readiness, dietitians

Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

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1 **ABSTRACT**

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3 **Methods:** Using an inductive approach, this research was divided into three stages: 1. a
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8 **Results:** Two hundred and forty one unique citations were identified, of which twenty four
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20 **Key words:** eHealth readiness, framework, dietitian, nutrition informatics, health
21 information technology.

22 23 **1. Introduction**

24 Hospitals and healthcare providers are challenged by the need to increase care delivery
25 without increasing resource consumption, due to the ageing population and corresponding
26 rise in chronic diseases [1, 2]. eHealth refers to electronic processes and communications
27 that support or enable healthcare practices [3]. The use of eHealth is rapidly increasing, and
28 is now widely accepted as integral in supporting and sustaining the challenge of healthcare
29 delivery, patient safety, efficiency, clinical decision-making, curtailing increasing
30 healthcare costs, supporting research and ultimately enhancing patient care [4-9]. The
31 potential of eHealth goes beyond supporting the burdened healthcare system; it can also
32 contribute to health-related behaviour modification, and improve accessibility of healthcare
33 to rural and remote populations [10].

In parallel with the increasing use of electronic health records (EHR), telemedicine, clinical information systems and other software solutions, there is increasing research into technology acceptance and adoption. However, technology acceptance research within healthcare is only just starting to extend beyond nursing and medical practitioners [11, 12]. In addition, in order to ensure the success of eHealth initiatives, readiness is more comprehensive than individual acceptance and willingness to use technologies, the solutions must also meet the needs of the healthcare practitioner, and implementations need to occur with engagement and communication amongst key stakeholders. Solutions must enable, support and enhance practice, and incorporate standards and processes required for the specific healthcare practitioner. Whilst models to identify, predict and manage user acceptance of technology will facilitate implementation efforts [11, 12], without the right solution or clinical leadership for example, the end result may not achieve the proposed benefits or may fail and, at worst, may increase the risk of adverse events [13-18]. Whilst failure rates are not well documented in the literature, figures suggest one-fifth to one quarter are a total failure, one-third to three-fifths are partial failure, and only a minority are a success [19].

eHealth readiness refers to the preparedness of healthcare organisations, societies, or healthcare workers, for the expected change caused by plans associated with a health information technology (HIT) solution [20, 21]. The prior assessment of readiness for a healthcare innovation, and the readiness for change, has been demonstrated to reduce the risk of failure after the introduction of a HIT solution [22-24]. In order to analyse eHealth readiness and identify areas for improvement, a standardised framework for assessment is required. Several such tools have been developed within areas such as e-business, e-commerce and e-government [25], but appear to be in their infancy within healthcare.

The integration of eHealth has initially focused on medical practitioners and nurses, but will inevitably impact on the practice of the allied health professionals. Dietitians are allied health professionals who play a critical role in the delivery of healthcare across a variety of practice areas. The development of eHealth systems which do not support dietetic standards and processes to maximise efficiencies and assist in delivery of patient care, could adversely affect patient care quality and safety [4, 6, 7]. The aim of this research was to

develop a framework for the analysis and identification of areas for professional improvement in relation to dietitian eHealth readiness, to enable the benefits of eHealth to be realised.

2. Methodology

Using an inductive approach this research was divided into three stages, reported below: systematic literature review (SLR), data synthesis to identify eHealth readiness themes and develop a framework; and semi-structured interviews with Australian nutrition informatics experts to gain consensus and validate the framework.

2.1 Systematic literature review

The SLR aimed to identify literature on eHealth readiness themes or models, designed specifically for health professionals. The search protocol was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement [26] and reported using a narrative synthesis. Searches were conducted in Scopus, CINAHL, Medline, Cochrane and Web of Science databases for peer-reviewed scholarly articles published from the earliest date until December 2016 (when the search was being performed). These databases were selected due to their relevance for journals in the field of health informatics. Search terms were determined through searching the literature, a Medical Subject Headings (MeSH) on Demand search and a Google search, and pilot tested to check that appropriate papers were being identified. The final search terms related to 1. healthcare and Information Technology ('eHealth', 'health informatics', 'medical informatics', 'Health Information Technology', 'health information systems', and 'hospital information systems') and 2. readiness ('readiness' or 'preparedness'). The full details of the electronic search strategies can be found in the Supplementary File 1. Additional articles were identified for inclusion through reference harvesting of relevant papers and a key author search based on these reference lists. A Google search was also conducted to identify additional non-journal publications (grey literature) on eHealth readiness frameworks.

After the removal of duplicates, titles and abstracts were screened to exclude articles which did not meet the inclusion criteria: English language articles; full-text; and including a model, framework or identified themes of eHealth readiness. The remaining articles were

assessed to identify unique empirical research specifically identifying a model, framework or themes for assessing eHealth readiness. Due to the paucity of articles with a focus on health professionals, those with a broader country/region or organisational focus were included for synthesis, as were those focusing on a specific eHealth field (such as telehealth), even if they did not specify or label a model, framework or themes. The broad topics still provided relevant insight into the potential readiness dimensions that could apply to health professionals for eHealth. Articles focused solely on patients or consumers were excluded.

All included articles were reviewed and key data extracted to a summary table for further analysis. The summary table included the authors, year and country of the study, model or framework name and description, study design, readiness dimensions or themes, and setting or target group and application.

2.2 Data synthesis and framework development

Following the data analysis phase of the literature review, the articles were reviewed for eHealth readiness themes applicable to dietitians. Key sentences and descriptions of the themes were recorded. Themes were categorised into related groups to form the framework dimensions, and the descriptions reviewed and summarised to form the framework dimension descriptions. The themes, groupings and dimensions were reviewed and refined to achieve the draft framework table.

eHealth readiness dimensions were extracted and overlapped around a central goal of eHealth readiness of dietitians, and a draft framework diagram created. The dimension descriptions were abbreviated and included in the diagram.

2.3 Interviews and framework validation

Semi-structured interviews with nutrition informatics experts were employed to identify perceived attributes of eHealth readiness of dietitians and to develop consensus and validate the framework. A combination of purposive and snowball sampling techniques were used to select participants with an expertise in the field of nutrition informatics and to ensure representation across a variety of dietetic practice areas. The selection of expert participants was based on four main criteria: their experience with an eHealth implementation; research

and publication on eHealth solutions for dietitians; role at a national level as an advocate for eHealth for dietitians; or Certified Health Informatician Australasia (CHIA) credentials. A total of ten Australian nutrition informatics experts were interviewed. The [removed for blind peer review] Human Research Ethics Committee granted Ethics approval (HE16/202).

The interviews consisted of four key questions. Firstly, participants were asked what attributes they considered reflective of a profession's readiness for eHealth (Question 1). They were then shown the draft framework diagram and asked Question 2: Do you feel this framework covers all of the dimensions of allied health eHealth readiness?; Question 3: Do you feel the dimension names and definitions are suitable?; and Question 4: Do you have any other suggestions?

The primary research conducted the audio-taped face-to-face or over the phone with participants. The same researcher transcribed the interviews verbatim. A thematic analysis approach [27] was applied to Question 1 (attributes of eHealth readiness) whereby the text was labelled as an open code and then once the transcript was coded, all codes were grouped into categories to form the key themes within Microsoft Excel 2010. Key sentences and descriptions of the themes were also recorded. The researcher then compared the identified themes to those identified in the literature to determine overlap and differences, and update the framework table and diagram based on the literature and interviews. Responses to Question 2 formed part of the validation process, with responses being recorded as the percentage of consensus against each dimension. To achieve the final framework, Questions 3-4 responses were recorded and incorporated into the review, and refinement of the dimension names and definitions.

3. Results

3.1 Systematic literature review

Four hundred and eleven articles were identified, and after the removal of duplicates, 241 articles were reviewed. Two hundred and twenty one articles were excluded based on title or abstract, as they did not relate to a model, framework or identifying themes of eHealth readiness. The setting (whether it was a specific country/countries or region/s or organisation type, such as primary care, rural or remote settings or public or private

practice) and the application (whether it was eHealth in general or specific applications, such as telehealth or telemedicine), were not limited within the search. Many of the research studies identified in the search related to a specific eHealth intervention or innovation for the management of disaster, emergency or bioterrorism readiness or consumer or community interest in eHealth, and consequently were excluded. An additional 16 articles were found via hand searching reference lists and a Google search. Thirty six full text articles were assessed; twelve articles were excluded, leaving 24 articles for the data synthesis (Figure 1). The articles were excluded for the following reasons: articles that utilised an already published eHealth readiness framework (n=4); or did not report on a framework or assessment model (n=8). There were 15 unique authors that contributed to the final 24 articles. Twenty one articles were peer-reviewed, and three identified during the Google search, which were included due to their relevance to the topic. Of these three articles, the Australian government published two [28, 29] and Cisco and the Region of Southern Denmark jointly published the third (Pederson et al, 2013) [30].

3.1.1 Study characteristics

Results of the literature review analysis (Table 1) revealed the studies were conducted across a variety of countries, including United States of America (USA) (6), Australia (5), Canada (5), Pakistan (2), Europe (1), Iran (1), Italy (1), Lebanon (1) South Africa (1) and United Kingdom (1). The setting or target of each study differed, with most being healthcare organisations (15), followed by health practitioners (primarily physicians and nurses) (4), rural communities (3), primary care (1) and country/region (1). The health-based application also differed in each study, with the majority focused on eHealth (15), followed by telehealth (6), EHR (2) and health information exchange (1).

Of the four articles that included data on health practitioners, only one study specifically targeted allied health professionals and eHealth readiness, published in an Australian government report in 2011 [28]. Two studies were conducted in the rural healthcare setting and targeted a variety of levels, including medical practitioners, patients, administration staff and the organisation, with a specific focus on telehealth [31, 32].

3.1.2 Data analysis

Of the 24 studies included for synthesis, ten utilised a readiness framework to analyse the data, and 13 developed a framework or identified themes for the analysis of readiness. One Australian government report on allied health eHealth readiness identified the importance of clinical engagement in eHealth, and investigated three dimensions of readiness: infrastructure, attitude and aptitude [28]. Whilst the theories and models identified in this literature review focus on a variety of different settings or targets and applications, the commonality is that they seek to determine the factors that contribute to eHealth readiness and how this assessment process can be modelled and predicted using theoretical and empirical approaches. All of the models were analysed to identify factors that may contribute to eHealth readiness within dietitians, as the focus of this research.

3.2 Data synthesis and framework development

Common eHealth readiness themes or dimensions were identified across the articles, and all that were relevant to dietitians were tabled with a brief description, and the supporting literature referenced (Table 2). The key relevant dimensions extracted for the literature included access, standards, attitude, aptitude and advocacy. Due to the setting, target group and application in focus, none of the identified articles referenced all five dimensions. The majority of authors (7) referenced two dimensions, with four authors referencing three dimensions, and two more referencing four of the five dimensions.

Of the fifteen contributing authors, thirteen identified *access* in some form, reporting on information technology infrastructure, architecture, structural and/or resource readiness [2, 24, 25, 28, 30, 32-42]. One author only identified funding as a core readiness requirement [43], whilst another highlighted funding, but within the theme of structural readiness [44]. HIT infrastructure and funding is fundamental to any eHealth project, and could be considered the first step in preparing for any HIT project. The dimension is more clearly described as: access to the required information technology infrastructure (including hardware, software/apps and networks) and funding.

Eight of the contributing authors referenced *Authority/Standards* and referred to in a variety of terms, such as data and standards, processes, policies, protocols, procedures, regulations and interoperability [2, 23, 25, 30, 33, 36-38, 41, 43]. Consequently, the description was

developed to encompass all of these components: documented terminology and process standards to support practice and processes of the practitioner.

Eleven of the authors referenced *Attitude*, and it was the dimension with the greatest variety of descriptions, all listed in Table 2 [24, 25, 28, 31-33, 35, 37-40, 42, 45]. This dimension is complex as it encompasses several individual traits in relation to HIT, and therefore was described as: awareness of the need to change; knowledge of the benefits of eHealth; and willingness to utilise eHealth solutions.

Aptitude is more easily defined as the: ability to utilise eHealth solutions. Six of the authors referenced this dimension, including terms such as aptitude, knowledge, education, capacity and competence [28, 30, 32, 33, 37, 38, 40, 45]. This was described as the: ability to utilise eHealth solutions.

Eight of the authors referred to the topics of ownership, leadership and collaboration, which were incorporated into the dimension of *Advocacy* [28, 30, 31, 40, 41, 43, 45]. Whilst often not referenced, the discussion of advocacy is compelling, and is probably the key dimension in eHealth readiness that is often overlooked. Ingebrigtsen et al.[1] conducted a SLR providing evidence that clinical leaders can have a positive impact on the success of HIT adoption in healthcare organisations, supporting the importance of including this as a dimension. Consequently, this dimension was listed last in the table, representing an advanced stage of preparing for a successful eHealth system implementation: capacity for leadership and ownership of eHealth initiatives.

Based on the initial themes and descriptions developed from the literature review, a draft framework diagram was created and abbreviated to FeRD (Framework for eHealth Readiness of Dietitians).

3.4 Interviews and framework validation

The practice areas of the ten interview participants included hospital (including management, clinical and foodservices) (4), research and education (2), private industry (2), government (1), and private practice/business (1). Many of the participants represented

multiple practice areas, however for the purpose of this summary, only the primary practice area was noted.

The analysis of the interviews identified the same five themes as the literature review. The results of the interviews were summarised in a table based on their responses to each of the four questions, along with the percentage of authors from the literature review that identified each dimension, to allow a comparison (Table 3). Similarly to the authors included in the literature review, none of the nutrition informatics experts identified all five dimensions of eHealth readiness.

Once interviewees were shown the framework however, all agreed on the included dimensions and identified their relevance and importance. All provided positive feedback about the framework and highlighted the usefulness of this tool for the profession. Three interviewees discussed the use of the tool to prepare dietitians and related staff for eHealth projects within their organisation. In addition, two interviewees suggested the potential applicability to other allied health professionals.

One interviewee suggested to include ‘experience’ as part of aptitude. However, this was rejected, as this framework is about guiding the preparation of the profession for eHealth readiness. Inclusion of experience would suggest dietitians who have not had eHealth experience are unable to be considered ready. All the other dimension description suggestions were incorporated into the final framework (Figure 2).

A number of participants identified external factors that can influence dietitians in some of these dimensions, such as professional associations, political climate and education. However, the focus of this research was specifically on the professional group eHealth readiness dimensions, and consequently these external factors were also not included. Future investigations would ideally to identify strategies to strengthen the capacity of each of these dimensions.

4. Discussion

There is a paucity of literature on eHealth readiness, and no frameworks were identified for assessing and reporting on the eHealth readiness of allied health professionals (including

dietitians). Consequently, a SLR and interviews were conducted to inform the development of a framework for investigating the eHealth readiness of dietitians, which was abbreviated to FeRD. The FeRD uniquely identifies all relevant dimensions through an inductive approach, having selected all of the key themes from a variety of authors and experts, who listed areas of which they felt important, within the context of their focus setting or their experience. The findings of this study led to the development and validation of the first framework for eHealth readiness assessment for dietitians.

The results of the SLR and the interview responses highlight the complexity of eHealth readiness, specifically how different experiences and exposures to eHealth create different levels of knowledge and ideas with regard to what may be important for determining eHealth readiness. No single study (publication) or nutrition informatics expert interview respondent identified all the key dimensions. Whilst the most frequently reported dimension in the literature was *access* (87%), conversely the nutrition informatics experts reported this the least (10%). Nutrition informatics experts may not have identified *access* as important, as Australian dietitians report high levels of access to technology in the workplace, [46] and consequently it may be presumed that dietitians take it for granted [47]. Interviewees were uniformly supportive of the proposed dimensions, once these were revealed during their interview. The results emphasise the importance of having a framework for guiding the profession to identify all essential dimensions, and not leave out any based on assumptions or experience, as every eHealth readiness assessment will be unique.

The FeRD will enable the assessment of readiness of dietitians at all levels, from single facilities or areas, to organisations, and even at the state or national level. It is anticipated that this framework will be part of the preparation for the implementation of any eHealth solution for dietitians. Our previous research has included a national eHealth readiness survey of Australian dietitians [47]. Future iterations of this work will be analysed using the FeRD, which is an example of how this framework can be applied to the profession at a national level. Using the FeRD to either develop assessment tools (such as a questionnaire) or review existing tools to ensure they assess all eHealth readiness dimensions, will enable the development of targeted improvement strategies for the profession.

An example of how the framework can be utilised at a facility or organisational level, is for the preparation of dietitians for the implementation of a nutrition-related eHealth solution. A specific case would be the implementation of a hospital patient electronic meal ordering solution for food and nutrition services which requires significant preparation and eHealth readiness of the end users (including dietitians). The ordering system requires institutional review, but individuals also require preparation. The FeRD provides a comprehensive methodology essential for identifying all relevant project requirements, and assists in developing preparation activities (such as education and in-services) to ensure increased success of the eHealth solution. As identified in the interviews reported here, dietitian readiness has multiple dimensions but some are potentially overlooked without application of a framework.

This study was limited to the design and initial validation of the framework for dietitians. Future studies utilising the FeRD for processes such as a hospital patient electronic meal ordering solution implementation, will strengthen the validation of this framework. Future research could investigate the applicability of the FeRD to other allied health professionals, such as physiotherapists and occupational therapists.

The FeRD offers a comprehensive platform for the analysis and identification of areas for professional improvement to enable the benefits of eHealth to be realised and for the prevention of innovation failure. It provides a conceptual model for developing eHealth readiness evaluation tools to measure, examine and drive strategies to better prepare dietitians for eHealth. It may also prove relevant and useful to assess the eHealth readiness of other allied health professions. This framework builds on existing theories and models of eHealth readiness and incorporates expert opinions, and consequently covers a comprehensive range of dimensions, including access, standards, attitude, aptitude and advocacy. The evaluation of dietitian readiness for eHealth should not be limited to acceptance and adoption of eHealth, but should cover all of the dimensions identified in this framework.

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Conflict of Interest

[Removed for blind peer review]

Authorship

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Figure 1: PRISMA flow chart for selection of studies on eHealth readiness.

Figure 2: Framework for eHealth readiness of dietitians (FeRD).

Alternative coloured Figure 2:

Figure 2: Framework for eHealth readiness of dietitians (FeRD).

Table 1: Summary of studies included in the synthesis

Author (Country)	Publication/s (Year)	Setting / Application	Framework	Readiness dimensions / themes	Study type / assessment tool
Snyder-Halpern R ^[33-35] (USA)	Assessing health care setting readiness for point of care computerised clinical decision support system innovations. (1999) Indicators of organizational readiness for clinical information technology/systems innovation: a Delphi study. (2001) Measuring hospital readiness for information technology (IT) innovation: a multisite study of the organisational information technology innovation readiness scale. (2006)	Organisation / eHealth	Described and applied a Clinical information technology innovation model (CITIM) – earlier version of the OITIM framework. Developed a framework of indicators for organisational readiness for clinical information technology/system innovation, called the: organisational information technology/systems innovation model (OITIM) framework. Developing an assessment tool (organisational information technology/systems innovation readiness scale (OITIRS)) based on this framework. Validation of the OITIM sub-dimensions, and designing and pilot testing the OITIRS.	Sub-dimensions (7): 1. Knowledge 2. Staffing and skills 3. Technology 4. Operations 5. Processes 6. Resources 7. Values and goals	Description of the CITIM and a case illustration showing the CTIM application. An expert panel using a two-round modified Delphi technique to develop framework and tool/questionnaire. Multi-site study to re-evaluate the psychometric adequacy of the OITIRS in a larger sample.
Campbell et al ^[31] (USA)	Introducing telemedicine technology to rural physicians and settings. (2001)	Rural healthcare providers (physicians, nurses and administrative personnel) / telehealth	Developed a framework for assessing rural health providers' readiness to adopt telemedicine. Provided strategies for implementing new technology documented based on level of readiness.	Themes (6): 1. Turf 2. Efficacy 3. Practice context 4. Apprehension 5. Time to learn 6. Ownership	Semi-structured interviews and thematic analysis.
Jennett et al ^[22]	The essence of	Rural	Identified themes that can be used to	Types (4):	Semi-structured

23, 32, 36] (Canada)	<p>telehealth readiness in rural communities: an organizational perspective. (2005)</p> <p>A study of a rural community's readiness for telehealth. (2003)</p>	communities (patient, practitioner, public and organisation) / telehealth	investigate the readiness of rural and remote communities for telehealth.	<ol style="list-style-type: none"> 1. Core 2. Engagement 3. Structural 4. Non-readiness <p>Main themes within types of readiness (6):</p> <ol style="list-style-type: none"> 1. Core readiness 2. Structural readiness 3. Projection of benefits 4. Assessment of risk 5. Awareness and education 6. Intra-group and inter-group dynamics 	interviews, community awareness sessions and focus groups.
	Organisational readiness for telemedicine: implications for success and failure. (2004)	Organisation / telemedicine	Identified themes of organisational readiness and examples of success and failure in telemedicine implementation.	<p>Themes (11):</p> <p>Planning readiness</p> <ol style="list-style-type: none"> 1. Telemedicine strategic plan 2. Needs assessment and analysis 3. A business plan 4. Leadership readiness <p>Workplace readiness (human resources and structural readiness)</p> <ol style="list-style-type: none"> 5. Preparing staff 6. Telemedicine coordinator 7. Change management readiness 8. Technical readiness 9. Policy 10. Access 11. Communication and participation <p>Factors contributing to failure:</p> <ol style="list-style-type: none"> 1. Inadequate needs assessment and lack of buy-in 2. Lack of staff preparation 3. Resistance to change 	Semi-structured interviews and analysed using an iterative qualitative approach.
	Preparing for success: Readiness models for rural telehealth. (2005)	Rural and remote health / telehealth	Analysed of published telehealth readiness models within rural communities.	<p>Common themes (3):</p> <ol style="list-style-type: none"> 1. An appreciation of practice context 2. Strong leadership 3. Perceived need to improve practice 	Literature review and analysis of readiness models.

Overhage et al ^[37] (USA)	Communities' readiness for Health Information Exchange: the national landscape in 2004. (2005)	Government agencies, national associations and organisations / Health Information Exchange	Developed a questionnaire based on 7 dimensions; and data analysed based on 4 topics to assess communities' readiness for Health Information Exchange.	Question categories (7): 1. Clinical component 2. Leadership 3. Funding 4. Technical readiness 5. Business plans 6. Data standards 7. Replicable and scalable tools Data analysis topics (4): Organisational phase; technical approaches; data and standards; and initial funding and sustainability.	Questionnaire and analysis.
Wickramasinghe et al ^[2] (USA)	A framework for assessing eHealth preparedness. (2005)	Country/region / eHealth	Developed a framework and e-health preparedness grid for assessing a country's/region's e-health potential.	Main pre-requisites (4): 1. Information communication technology architecture/infrastructure 2. Standardisation policies, protocols and procedures 3. Government regulations and roles 4. User access and accessibility policies and infrastructure	Presentation of assessment framework and e-health preparedness grid.
Mannan et al ^[38] (UK)	Is primary care ready to embrace e-health? A qualitative study of staff in a London primary care trust. (2006)	Primary care / eHealth	Identified the perceptions of primary care staff regarding the readiness to implement eHealth initiatives.	Recurrent themes (6): 1. Perceptions of technology 2. Issues relating to resources 3. Patient choice 4. Confidentiality and security 5. Political pressure 6. Ways in which practices currently use information and communication technology	Interviews of staff from primary practices.
Khoja et al ^[21, 25] (Pakistan)	e-Health readiness assessment tools for healthcare institutions in developing countries. (2007) E-health readiness assessment: Promoting	Public and private healthcare institutions in developing countries / eHealth	Identified themes/assessment categories and developed eHealth readiness assessment tools for managers and healthcare providers.	Readiness categories (4): 1. Core readiness 2. Societal readiness 3. Policy readiness 4. Technological readiness (<i>for managers</i>) and 4. Learning readiness (<i>for healthcare providers</i>)	Expert opinion, literature review and in-depth semi-structured interviews.

	hope in the health-care institutions of Pakistan. (2008)				
Ajami et al ^[39] (Iran)	Readiness assessment of electronic health records implementation. (2011)	Organisation / EHR	Utilised a Community Clinic EHR Readiness Assessment tool.	Assessment sections (4): 1. Organisational alignment 2. Management capacity 3. Operational capacity 4. Technical capacity	Review article of literature on EHR readiness assessment.
Australian Government ^[28, 29] (Australia)	The eHealth readiness of Australia's allied health sector. (2011) The eHealth readiness of Australia's medical specialists. (2011)	Health practitioners (allied health and medical practitioners) / eHealth	Dimensions identified to analyse survey and interview questions.	Dimensions (3): 1. Infrastructural readiness 2. Aptitudinal readiness 3. Attitudinal readiness	Interviews and surveys.
Pare et al ^[40] (Canada)	Clinicians' perceptions of organisational readiness for change in the context of clinical information system projects: insights from two cross-sectional surveys. (2011)	Organisation / clinical information system projects (eHealth)	Classes of variables were identified and tested to develop a research model to identify variables associated with clinicians' perceptions of organisational readiness. The variables were based on Holt et al's 'Readiness for organisational change' to relate directly to healthcare.	Classes of variables (4): 1. Attributes of the change 2. Leadership support 3. Internal context 4. Attributes of the change targets	Two cross sectional surveys to test the research model.
Li et al ^[24, 42, 43] (Australia)	An eHealth readiness assessment framework for public health services - pandemic perspective. (2012) Issues Regarding the Implementation of eHealth: Preparing for Future Influenza Pandemics. (2012)	Public health services / eHealth – for a pandemic response	Developed a framework of eHealth readiness assessment for a pandemic from a healthcare organisational and providers' perspectives.	Dimensions (5): 1. Motivational readiness 2. Engagement readiness 3. Technological readiness 4. Resource readiness 5. Societal readiness	Literature review and interviews.
	E-Health Readiness Framework from	Healthcare organisations /	Developed an eHealth readiness assessment framework (EHRAF) for	Components (4): 1. Core	Literature review and framework

	Electronic Health Records Perspective. (2010)	EHR	healthcare organisations for EHR.	2. Engagement 3. Technological 4. Societal	development.
Tamburis et al [44] (Italy)	The LITIS conceptual framework: measuring eHealth readiness and adoption dynamics across the Healthcare Organizations. (2012)	Healthcare organisations / eHealth	Developed the LITIS conceptual framework for measuring eHealth readiness of healthcare organisations.	Functions (3): 1. Citizens 2. Healthcare professionals 3. Managers and administrators Components (3): 1. Technological infrastructures 2. Applications 3. Non-technological	Literature review and questionnaire.
Coleman et al [45] (South Africa)	Activity Theory Framework: A basis for eHealth readiness assessment in health institutions. (2013)	Health institutions / eHealth	Developed a framework that maps the identified eHealth readiness constructs onto the activity theory analytical components.	Categories/constructs (4): 1. Need-change readiness 2. Engagement readiness 3. Technological readiness 4. Societal readiness	Literature review and semi-structured interviews.
Pederson et al ^[30] (Europe)	Readiness evaluation model: TREAT: Telemedicine readiness assessment tool. (2013)	Regions and healthcare organisations (leaders and funding partners) / telemedicine	Developed the TREAT: Telemedicine Readiness Assessment Tool framework which guides telemedicine assessment – encompassing a readiness assessment tool and facilitated workshops.	Organisation enablers (3): 1. Leadership and Collaboration 2. Measurement and Evidence 3. Governance and Sustainability Technological and operational enablers (3): 1. Capacity and Competence 2. Standards and Interoperability 3. Infrastructure and Architecture	Presentation of a telemedicine readiness assessment tool.
Saleh et al ^[46] (Lebanon)	Readiness of healthcare providers for eHealth: the case from primary healthcare centers in Lebanon. (2016)	Healthcare providers / eHealth	Determination of sections and factors to develop a questionnaire. The third section was adapted from Holt et al's 'Readiness for organisational change' [41] to relate directly to healthcare.	Sections (3): 1. Socio-demographics 2. Computer use, computer literacy and computer access 3. Readiness for organisational change (4): a. Appropriateness of eHealth applications b. Management support c. Change efficiency d. Personally beneficial	A self-administered questionnaire.

Table 2: Development of the dietitian eHealth readiness framework

Proposed readiness dimension	Detailed description	Supporting readiness dimensions from the literature that apply to a health practitioner
Access	Access to the required information technology infrastructure (including hardware, software/apps and networks) and funding.	Technological ^[21, 23-25, 33-39] , technological infrastructural ^[40, 41] Access to computers at work ^[39, 42] Appropriateness (of applications within their context) ^[42] ICT architecture/infrastructure ^[2, 30] , infrastructural ^[28, 29] Resources ^[24, 33, 35, 37, 38, 41, 43] Structural readiness ^[22, 32, 44] Funding ^[44, 45]
Authority/ Standards	Documented terminology and process standards to support the practice and processes of the practitioner.	Processes ^[33, 37, 38] Data and standards ^[45] Standardisation policies, protocols and procedures ^[2, 41] , policy ^[21, 23, 25] Policies and regulations ^[40] Standards and interoperability ^[30]
Attitude	Awareness of the need to change; knowledge of the benefits of eHealth; and willingness to utilise eHealth solutions.	Turf (perception of eHealth as a threat to competency or autonomy); efficacy; practice context; apprehension; and time to learn ^[31] Core ^[21-23, 25, 32, 39, 44] , motivational ^[24, 35] , need-change readiness ^[36] (the realisation of needs and expressed dissatisfaction with the present situation and conditions), vision clarity (the sense that change is needed) ^[46] , personally beneficial ^[42] Engagement ^[24, 32, 35, 36, 39, 44] Attitudinal ^[28, 29] Awareness and education ^[23, 32, 44] Perceived need to improve practice ^[22] Efficacy ^[31] , projection of benefits ^[32] , aware of benefits ^[43] , change appropriateness ^[46] , assessment of risk ^[32] Self-efficacy ^[46] Practice context ^[22, 31] Apprehension ^[31] Time to learn ^[31] Values and goals ^[33, 37, 38]
Aptitude	Ability to utilise eHealth solutions.	Knowledge ^[33, 37, 38] Computer literacy ^[42] Change efficacy ^[42, 46] Staffing and skills ^[33, 37, 38] Aptitudinal ^[28, 29] Awareness and education ^[32, 44] , preparing staff ^[23] Capacity and competence ^[30]
Advocacy	Capacity for leadership and ownership of eHealth initiatives.	Ownership ^[31] Leadership ^[22, 23, 28, 34, 41] Leadership and collaboration ^[30] Management support ^[41, 42] Presence of a project champion ^[46]

Table 3: eHealth readiness framework dimensions validation findings.

Proposed readiness dimension	Framework short description	Literature review dimensions identified (n=15)	Dimensions identified in interviews (Q1) (prior to seeing the framework)	Dimensions consensus in interviews (Q2) (after seeing the framework)	Dimension names and descriptions from interviews (Q3 & Q4) (after seeing the framework)
Access	Access to IT infrastructure and funding.	87% (n=13)	10% (n=1)	100% (n=10)	Add 'suitable eHealth solutions' (n=1).
Authority / Standards	Terminology and process standards.	53% (n=8)	30% (n=3)	100% (n=10)	Preferred 'Standards' over 'Authority' (n=10).
Attitude	Knowledge of the benefits of eHealth and willingness to utilise eHealth solutions.	71% (n=10)	80% (n=8)	100% (n=10)	Add 'awareness of what eHealth is' (n=2). Add 'awareness of the need to change' (level of frustration with existing solutions) (n=2).
Aptitude	Ability to utilise eHealth solutions.	43% (n=6)	70% (n=7)	100% (n=10)	Add 'experience' (n=1).
Advocacy	Capacity to lead eHealth initiatives.	53% (n=8)	50% (n=5)	100% (n=10)	Add 'communicate requirements' (n=1). Add 'capacity to support' (n=1). Add 'engage stakeholders' (n=1).