AN E-HEALTH READINESS ASSESSMENT FRAMEWORK FOR PUBLIC HEALTH SERVICES – PANDEMIC PERSPECTIVE

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Abstract

A pandemic can increase the morbidity and mortality levels, and as a result cause social disruption and economic losses. E-Health, an application of information and communication technologies for health, may mitigate the impact of a pandemic by enhancing pandemic surveillance and control (e.g., rapid case reporting) and improving performance of medical practices (e.g., efficient documentation). The implementation of E-Health requires proper planning and management. E-Health readiness assessment represents an important step in change management, and including this step in the planning process increases the chances of E-Health implementation success. In this paper, we develop a framework of E-Health readiness assessment for a pandemic from healthcare organisational and providers’ perspectives.

Keywords: E-Health, Readiness, Evaluation, Assessment, Pandemic, Public Health, Framework.

1. Introduction

E-Health is an application of information and communication technologies (ICT) across the whole range of functions which affect health [1][2]. This is an emerging field in the intersection of medical informatics, public health, and business [3]. The Internet and related technologies provides a new medium for information dissemination and also for the interaction and collaboration among institutions, health professionals, healthcare providers, and the public [2].

Influenza pandemics can occur with the appearance of a new influenza virus against which none of the population has any immunity [11]. During the last century, influenza pandemics caused millions of deaths, social disruption, and economic losses worldwide [11]. With the increase in global transport, as well as urbanization and overcrowding conditions, any novel influenza strain would be likely to spread quickly around the world. This has been the case with the novel H1N1 swine influenza in 2009 [12]. The impact of a pandemic is likely to be greater in countries where there are limited surveillance and patient care resources (e.g. insufficient health system infrastructure, medical supplies, and workforce) [11]. E-Health can play a role in mitigating the impact. For example, the use of ICT can facilitate the detection and reporting of the potential pandemic strain and also provide public health authorities with the capability of information dissemination for a pandemic management and control [13][14].

Information systems researchers have recognised the problem of sustainability and complexity in E-Health implementations (e.g., [4][5]. The implementation of any information system in an organisational context (e.g., hospitals) requires proper planning and management for change [6]. With E-Health implementations, change occurs not simply due to the introduction of ICT infrastructure but also because the job design of interconnected health professionals should be reengineered to effectively and efficiently accommodate the technology [7]. E-Health implementations represent a disruptive change in the healthcare workplace. Consequently, resistance to change can occur at the individual level as well as at the organisational level [8]. E-Health readiness assessment becomes an essential requirement prior to its implementation [9][10]. The assessment is to understand problems with present clinical practice processes and activities, healthcare providers’ exposure to E-Health, and available resources and communication links of organisations to support the clinical IT/S innovation. Subsequent action taken that addresses areas of unsatisfactory level of readiness would hopefully facilitate changes resulting from E-Health systems implementation.

The aim of this paper, therefore, is on the development of an E-Health readiness assessment framework from healthcare organisational and providers’ perspectives for a pandemic response. The rest of the paper is organised as follows: Section 2 conducts a literature review to identify research gaps; Section 3 develops a five-dimension E-Health readiness framework for a pandemic;
Section 4 presents a conceptual method to quantify the constructs within the framework to assess E-Health readiness levels, and we conclude in Section 5 with a summary of the paper, contributions and limitations of this study, and future work.

2. Background and literature review

E-Health can be disruptive and intrusive in the healthcare context as discussed in the introduction part. Assessment of organisational readiness for an innovation can reduce the risk of its failure after introduction [10]. If motivational forces (e.g., healthcare providers’ dissatisfaction with status quo) are not present, the innovation process is unlikely to be initiated. Even though adequate motivations are present, sufficient resources are required to allow and support steps for change. Organisational readiness for change is the ‘strongest predictor of employee commitment to the organisation’ [15]. Further, if staff do not possess attributes necessary (e.g., adaptability and growth-orientation) for change or resist change, the change process is less likely to proceed [16]. E-Health readiness for a pandemic should take all these issues into account. A lack of information about healthcare organisational readiness for new IT/S can increase uncertainty for decision makers and decrease their ability to make effective decisions that would mitigate IT/S innovation risks and thus facilitate a pandemic response [17].

When readiness exists, an organisation is prepared to accept change; if an organisation is not prepared, the innovation is more likely to be rejected [8]. E-Health readiness assessment represents an important step in change management, and including this step in the planning process increases the chances of programme success as well as enhancing equity and reducing the digital divide [18]. E-Health readiness assessment may also provide other advantages, such as (1) avoiding huge losses in time, money and effort; (2) avoiding delays and disappointments among planners, staff, and users of services; and (3) facilitating the process of change in the institutions and communities involved, from the stage of precontemplation (firmness and resistance to change) through contemplation (acceptance of new ideas) and to preparation (readiness for change) [18][19].

E-Health evaluation is often criticised for the lack of common outcome indicators, the absence of an agreed theory, and the poor quality of research design [20].

1) Evaluators and decision makers must accept that E-Health evaluation may serve different purposes for different stakeholders, and therefore concede that no single evaluation framework or methodology is totally objective [20]. Reviewed frameworks (Table 1) were derived from different perspectives to evaluate E-Health readiness. Most studied components reflect healthcare organisational and providers’ perspectives, but those components are different more or less from one framework to another. In terms of readiness components from the organisational perspective, for example, ICT architecture/infrastructure was highlighted in Wickramasinghe et al.’s framework [21] but healthcare providers’ dissatisfaction with status quo identified by Jennett et al. [22] was neglected. By integrating those components, Li et al. [23] made efforts to develop a framework with four dimensions to assess healthcare organisational and providers’ readiness for the implementation of electronic health records (EHR). Nonetheless, their integrated framework has missed out some components such as availability of supportive policies at the organisational level.

2) The frameworks do not provide a method to precisely assess readiness status, even though some of the frameworks have described readiness levels as low, medium or high (discretely defined) (e.g., [21]). Readiness levels in real life are more fuzzy in nature, i.e., continuous scales.

3) Although there have been some preliminary attempts to develop a methodology for E-Health readiness assessment, there is no reported work on a systematic study on the development and evaluation of E-Health readiness for public health services.

<table>
<thead>
<tr>
<th>Author and date</th>
<th>Patient</th>
<th>Provider</th>
<th>System</th>
<th>Organisational</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell et al. 2001</td>
<td>V</td>
<td></td>
<td></td>
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<tr>
<td>Snyder &amp; Halpern, 2001</td>
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<td>V</td>
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<tr>
<td>Demiris et al. 2004</td>
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<td>Overhage et al. 2005</td>
<td>V</td>
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<td>V</td>
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<tr>
<td>Wickramasinghe et al. 2005</td>
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<td>Kluza et al. 2007</td>
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<tr>
<td>Li et al. 2009</td>
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</tbody>
</table>
3. E-Health readiness framework for a pandemic

The development of an E-Health readiness framework for a pandemic was a challenge. This is because frameworks are the product of analysing a substantial volume of literature which is often difficult to organise around specific themes [24]. To address this issue, Li et al. [25] developed a set of criteria that can guide researchers to develop comprehensive frameworks specifically in the complex E-Health domain. Aligned with those criteria, the framework has been developed.

By integrating healthcare organisational and providers’ readiness components of the reviewed frameworks (Table 1) with potential roles taken by E-Health in a pandemic response (e.g., [13][26]), an E-Health readiness framework has been developed with five dimensions (Fig. 1).

- Motivational forces for change reflect evaluators’ realisation of problems and providers’ dissatisfaction with present practices or circumstances for pandemic responses. Such a needs analysis for change assists organisations in defining their pandemic response problems and understanding how these pandemic response needs can be met with innovations (e.g. shared EHR systems) [8]. Unless motivation is “activated”, individuals within an organisation are unlikely to initiate change behaviours [16]. This can be because the motivational readiness assessment creates not only community awareness but also open communication with individuals at grass-roots level [8].

- Engagement is healthcare providers’ exposure to potential E-Health applications [9][27]. Healthcare providers are the key driving force in pushing E-Health initiatives [21]. Engagement allows them to express their understanding of E-Health benefits for pandemic responses, fears and concerns about using potential E-Health systems, as well as their willingness to make initial investment of extra time for E-Health training, indicating factors that would facilitate or impede further development of readiness [9][22].

- Technological readiness in a healthcare organisation is the ability of existing hardware, software, network, and internal IT support for troubleshooting to support a clinical IT/S innovation and healthcare providers’ IT skills [10][22][28].

- Resource readiness is organisational non-technical ability to support a clinical IT/S innovation. The assessment requires decision makers knowledgeable about the type and availability of organisational resources for both initial IT/S adoption and implementation processes, as well as ongoing maintenance of the innovation [28]. Resource readiness has three aspects, i.e., decision makers’ specific knowledge (e.g., IT project procurement management), supportive policies, and sufficient funding [9][22][28]. A certain level of resource readiness appears to be necessary for healthcare providers to feel comfortable and confident in participating in E-Health implementation [22].

- Societal readiness assesses communication links and partnerships within and between organisations. This readiness dimension deals with an organisation’s socio-cultural issues related to E-Health implementation and covers intra-group, inter-group and inter-organisation dynamics [18].

Each dimension has its own construct. Regarding the motivational readiness dimension (Fig. 2), for example, pandemic responses from healthcare organisational and providers’ perspectives require their participation in pandemic disease surveillance and control, and performance of medical practices. The surveillance and control needs

- Case reporting to the state or local health department;
- Accessing and providing patient information (e.g., lab test results) after the case is reported to the public health authorities for epidemiologic investigations;
- Capturing health risk alerts issued by public health authorities.

During a pandemic, medical capacity would be significantly challenged. The challenges rest on

- Documentation efficiency (i.e., retrieval, update, and storage of clinical information): during a pandemic, healthcare providers can experience a rise in workload and there be increase demands for diagnoses and prescriptions to members of the community [29]. Provision of quality care requires the documentation of clinical information, which as an intrinsic aspect of routine clinical activity, is essential from both professional and legal standpoints [30]. The employment of an electronic process
(e.g., EHR) can result in efficient documentation [31][32];

- Sharing of patient health records: in an environment where healthcare services are offered by a variety of healthcare professionals at multiple locations, patient health records must be accessible at all of them [33][34]. Compared to patient health records with the traditional means (i.e., paper-based), those with shared EHR systems are no longer restricted to the data generated within healthcare professionals’ local settings. Data about patients’ health history and their current health status which may be recorded by multiple healthcare professionals at different locations can be presented in a coherent and legible way [32]. This facilitates the completeness and accuracy of patient records which provide the full picture of patient health status and therefore helps reduce errors in diagnoses and prescriptions [26];

- Protection of patient privacy and the security of patient information: although patient health records must be accessible to a variety of healthcare professionals, the degree and extent of access needs to be controlled [26]. By using E-Health applications (e.g., E-Consent), access rules can be made explicit and strictly adhered to [35][36]. Otherwise, the records can even end up in the hands of unauthorised persons. As a result, patient privacy and the security of patient information can be seriously breached;

- Correctness of diagnoses: incorrect diagnoses could be made if diagnoses are fully dependent on physicians’ individual knowledge on diseases which may be limited especially around rare diseases [26]. With the application of ICT, once a stated diagnosis is not in agreement with common medical knowledge, the system can warn the user and suggest more probable diagnosis [37]. To this end, the Stand-alone Reminder System (SRS) uses a set of logical if-then rules, which could be extracted from medical guidelines [37];

- Appropriateness of prescriptions:
inappropriate prescription of medicines can be attributable to a lack of access to complete and accurate patient records [26]. Even if prescribing physicians were able to access these records but failed to consider relevant patient characteristics (e.g., contraindications) or had insufficient knowledge of drug-drug interactions and new drugs, considerable harm would still be caused (e.g., [38][39]). Clinical Decision Support (CDS) systems can improve medication safety by a review to assure instant, accurate, reliable, and computer-generated orders [40][41];

- Assistance to answer patients’ questions during their visits: patients may ask similar questions on, for example, drug information, immunisations, and travel health, and as a result physicians have to utilise scarce resources to duplicate efforts for different patients’ visits [42]. It was indicated that physicians preferred the presentation of those answers within an electronic resource in the form of summary charts, tables, and information [42][43]. Such an electronic resource can accelerate the creation of evidence relevant to everyday practice needs and facilitate real-time use of knowledge in practice [44]. The PrimeAnswers portal, for instance, provides a customised reference portal designed to reduce time and effort at the point of care [42]. The objective of this portal is to create a filtered and customised set of content that would 1) make best available evidence as accessible as commonly used textbooks; 2) design automated methods to search the most commonly used external clinical reference systems; and 3) integrate information objects frequently used during the clinic day (e.g., calculators, tables, patient handouts).

The more serious these problems are realised to be, and the higher dissatisfaction that is expressed, the more prepared healthcare organisations and providers are to adopt new practices (E-Health) and to create change [22][45]; and vice versa.

4. Quantification of constructs

The E-Health readiness constructs can be quantified using graph theory and the Analytic Hierarchy Process (AHP) [46][47]. The purpose behind the approach is to assess E-Health readiness status mathematically and precisely.

4.1. Graph theory

Graph theory essentially provides mathematical structures to model pair wise relations between objects from certain groups [23]. A graph in this context refers to a collection of nodes or vertices as well as collected edges or leafs. A graph structure can be extended by assigning a weight to each edge of the graph. Graphs with weights (called as weighted graphs) are used to represent structures in which pair wise connections have some numerical value (Fig 2). For example, if a graph represents the motivational readiness construct of E-Health readiness assessment, then the weights could represent the parameters (i.e., problems and providers’ dissatisfaction with participation of pandemic diseases surveillance and control, and performance of medical practices) that decide the motivational readiness level. This is essentially the rationale behind using the graph-based approach in the present work.

A graph with weighted edges in the context of graph theory is called a network that has been used specifically in this study. Many applications of graph theory exist in the form of network analysis. Those split broadly into two categories: 1) analysis to determine structural properties of a network, such as the distribution of vertex degrees and the diameter of the graph, and 2) analysis to find a measurable quantity within the network. Graph theory has been a popular technique for network analysis, such as biological networks related to molecular biology [48], physiological networks [49] and social network related to sociology research [50].

It is worth mentioning that there are other related approaches, e.g., hierarchical modeling, clustering, and classification-based algorithms that could also be used to measure the readiness level mathematically. As graph theory is inherently more distinctively presentable and moreover the E-Health assessment concept is to be modeled from scratch, the graph-based approach has been chosen for this study. The other approaches noted above could be tested in future research.

Graph-based construct: (Motivational Readiness)

The present work focuses on E-Health readiness assessment from the five dimensions. Here only the motivational readiness dimension is used to illustrate the graph-based constructs. A similar approach can be used for the other dimensions.
The motivational readiness construct is explained as a connected graph ‘G’ that has two child nodes, ‘Pandemic Surveillance and Control’ and ‘Performance of Medical Practices’ (refer to Fig. 2). Problems or healthcare providers’ dissatisfaction with the participation in pandemic surveillance and control are formed by three ‘sub-nodes’: efficiency of case reporting to the state or local public health unit, accessibility and provision of patient information (e.g., lab test results) for public health authorities’ epidemiologic investigations, and timeliness of capturing health risk alerts issued by public health authorities. Similarly, problems or providers’ dissatisfaction with performance of medical practices has six sub-nodes. Each is connected with the parent node. The edges are directed from those sub nodes to their parent node and each vertex has a label or name; thus the graph ‘G’ may be called a ‘labelled directed graph’. The graph ‘G’ therefore is formed by two sub graphs, i.e., G {PSC, PMP}. PSC and PMP consist of vertices, {ECR, ACI, CA} and {DE, SPHR, PPIS, CD, AP, APQ} respectively. Edges are defined as ‘E’ {E1-1 {E1-1-1, E1-1-2, E1-1-3}, E1-2 {E1-2-1, E1-2-2, E1-2-3, E1-2-4, E1-2-5, E1-2-6}} and have a weight ‘w’ { w1-1 { w1-1-1, w1-1-2, w1-1-3 }, w1-2 { w1-2-1, w1-2-2, w1-2-3, w1-2-4, w1-2-5, w1-2-6 }}. Likewise, there are graphs for the other four readiness constructs.

The weight may be generated by pair-wise comparisons (e.g., AHP [47]) and participants’ varied judgements could be dealt by calculating the mean, i.e., average of a set of data values. This will be discussed in detail in the section 4.2.

All vertices at the bottom level can be labelled with natural numbers. For the organisation, where an E-Health system is planned to be implemented for public health services, the value of the vertices can be obtained from survey questions for the E-Health implementation manager, internal IT manager, or healthcare providers (end users of the planned system). The value may represent, for example, the degree of healthcare providers’ dissatisfaction with documentation efficiency (e.g., 7-point scale where 1 stands for “strongly disagree” and 7 stands for “strongly agree”).

Now the level of the motivational readiness can be calculated by the following steps (a bottom-up approach),
\{(ECR \times w_{1,1}) + (ACI \times w_{1,2}) + (CA \times w_{1,3})\} = 'PSC'

\{(DE \times w_{1,2,1}) + (SPHR \times w_{1,2,2}) + (PPIS \times w_{1,2,3}) + (CD \times w_{1,2,4}) + (AP \times w_{1,2,5}) + (APQ \times w_{1,2,6})\} = 'PMP'

\{(PSC \times w_{1,1}) + (PMP \times w_{1,2})\} = 'MP'

Similarly, weights can be assigned to the edges of the other four constructs and consequently overall E-Health readiness can be calculated using the bottom-up approach.

4.2. AHP

As discussed before, the weight of edges can be generated by using the AHP which is a structured technique for dealing with complex decisions [47]. In doing this, information is elicited from participants’ judgments about the various elements (i.e., pairwise comparisons) in the hierarchy and processed mathematically [51].

In order to decide the relative importance of the evaluation components, each participant compares evaluation component i and evaluation component j, and gives a value $a_{ij}$ as follows:

<table>
<thead>
<tr>
<th>Value</th>
<th>Comparison Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluation components i and j are of equal importance</td>
</tr>
<tr>
<td>2</td>
<td>Evaluation component i is weakly more important than j</td>
</tr>
<tr>
<td>3</td>
<td>Evaluation component i is more important than j</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation component i is strongly more important than j</td>
</tr>
<tr>
<td>5</td>
<td>Evaluation component i is very strongly more important than j</td>
</tr>
</tbody>
</table>

Of course, we set $a_{ii} = 1$. Further, if I set $a_{ij} = k$, then I set $a_{ji} = 1/k$. For example,

Table 2. Pairwise comparison values

<table>
<thead>
<tr>
<th>Value</th>
<th>Comparison Results</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Evaluation components i and j are of equal importance</td>
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<td>2</td>
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<td>3</td>
<td>Evaluation component i is more important than j</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation component i is strongly more important than j</td>
</tr>
<tr>
<td>5</td>
<td>Evaluation component i is very strongly more important than j</td>
</tr>
</tbody>
</table>

Now, some simple calculations can be made using the AHP for the relative weight that each evaluation component (i.e., vertex) is being assigned to: the weight is between 0 and 1, and those weights add up to 1. Each entry is divided by the sum of the column it appears in. For instance, the (ECR, ECR) entry would end up as $1/(1+3+5) = 1/9$. Then, the relative weight can be assigned by averaging across the row (Table 4).

Table 4. Weights on evaluation components

<table>
<thead>
<tr>
<th></th>
<th>ECR</th>
<th>ACI</th>
<th>CA</th>
<th>Relative Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECR</td>
<td>1/9</td>
<td>1/10</td>
<td>2/17</td>
<td>0.1096</td>
</tr>
<tr>
<td>ACI</td>
<td>1/3</td>
<td>3/10</td>
<td>5/17</td>
<td>0.3091</td>
</tr>
<tr>
<td>CA</td>
<td>5/9</td>
<td>6/10</td>
<td>10/17</td>
<td>0.5813</td>
</tr>
</tbody>
</table>

Aside from the relative weight, the consistency of participants’ judgements needs to be checked. Since CA is more important than ACI and ACI is more important than ECR, logically, we hope that CA is more important than ECR or CA must be important than ECR. This logic of importance is called transitive property. If the participant’s answer in the comparison is transitive (i.e., CA is more important than ECR), his/her judgement is consistent; otherwise, his/her answer is inconsistent.

A measure is called Consistency Index (CI) as deviation or degree of consistency using the following formula [47]:

$$CI = (\lambda_{\text{Max}}-n)/(n-1)$$

$$\lambda_{\text{Max}} = 9(0.1096) + 10/3(0.3091) + 17/10(0.5813) = 3.0049$$

$$n = 3 \text{ (the size of comparison matrix)}$$

Thus, the consistency index is

$$CI = (\lambda_{\text{Max}}-n)/(n-1) = (3.0049-3)/(3-1) = 0.0025$$

To check the consistency of the participant’s judgements, Consistency Ratio (CR) which is a comparison between Consistency Index and Random Consistency Index (RI) (see Table 5) is used.

Table 5. Random consistency Index [47]

<table>
<thead>
<tr>
<th>n</th>
<th>RI</th>
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<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.58</td>
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<tr>
<td>4</td>
<td>0.89</td>
</tr>
<tr>
<td>5</td>
<td>1.12</td>
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<tr>
<td>6</td>
<td>1.24</td>
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<tr>
<td>7</td>
<td>1.32</td>
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<td>8</td>
<td>1.41</td>
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<tr>
<td>9</td>
<td>1.45</td>
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<tr>
<td>10</td>
<td>1.49</td>
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The formula of Consistency Ratio is

$$CR = CI/RI$$

If the value of Consistency Ratio is smaller or equal to 10%, the inconsistency is acceptable; otherwise, we need to revise the subjective judgement [47]. For this illustrative case, CI = 0.0025 and RI = 0.58 (n=3), then CR = 0.0025/0.58 = 0.43% < 10%. Therefore, the participant’s
subjective judgements about the importance of the evaluation components are consistent.

The final relative weight for each evaluation component is the mean of varied results from participants.

4.3. Preliminary study

The framework is being validated and enhanced by semi-structured interviews with the domain experts. The development of the interviews instruction and analysis of the interviews data applied the AHP. Twenty contextual interviews were conducted — ten with E-Health implementation practitioners and the rest with medical/public health practitioners. A majority of the former group (e.g., the director of a business development and technology firm) had been working on various E-Health projects (e.g., electronic health records and electronic diseases surveillance) with different types of healthcare organisations (e.g., primary health care and hospitals). All participants of the latter group (e.g., a senior epidemiologist in a state health department) were involved in the pandemic (H1N1) 2009 response and undertook various activities (e.g., pandemic surveillance and patient treatments). The interviews help us understand the importance of different readiness components in our framework. Through the response of the participants, weights (i.e., relative importance of sub nodes to their parent node) can also be assigned to the edge of the graph-based constructs. The work is in progress. The findings will be reported and submitted for publication with full details.

5. Conclusions

Existing E-Health readiness frameworks in Table 1 were limited due to, for example, no systematic study on E-Health readiness for public health services. Pandemic influenza can increase the morbidity and even mortality levels, and as a result threaten all critical infrastructure by removing essential personnel from the workplace. The impact of a pandemic may be mitigated by E-Health applications. Before the implementation of those applications, readiness assessment is required and serves as a preventive action to proactively seek and address failure to innovate. Accordingly, we developed a five-dimension framework incorporating the potential role of E-Health for a pandemic response.

Those frameworks were also limited to provide a method to precisely assess readiness status. In this paper, we present a method using graph theory to quantify the E-Health readiness constructs. The graph-based model is a novel way of looking at the E-Health readiness level, but the presented in this paper is conceptual and needs validations with real-world data in the E-Health scenario.

Theoretically, this paper contributes to the body of knowledge on E-Health readiness for public health services by addressing the gaps identified in the literature. On the other hand, the validated and enhanced model would be practically useful to assess an organisation’s readiness status when there is a plan to implement an E-Health system. The assessment results may assist decision makers at the organisation to take action to address deficient areas of their readiness, and as a result facilitate the E-Health implementation success.

Although this framework has been developed to assess E-Health readiness for a pandemic, it should be applicable for other various clinical environments. However, its application in those contexts would require further studies. The main limitation of this study is that the framework is only concerned with healthcare organisational and providers’ readiness. In the future, a more comprehensive model needs to incorporate constructs from patients’, system, and public perspectives according to evaluation needs.

References


