# Status and trends of e-Health tools in Kuwait: A narrative review

Hessah Alaslawi[1], Ilhem Berrou[2], Dari Alhuwail[3, 4,] Zoe Aslanpour[1]

*[1]Department of Clinical and Pharmaceutical Sciences, School of Life and Medical Sciences, University of Hertfordshire, College Lane, Hatfield, Hertfordshire AL10 9AB, The United Kingdom.*
*[2]Faculty of Health & Applied Sciences, University of the West of England, Bristol, BS16 1DD, The United Kingdom.*
*[3]Department of Information Science, College of Computing Sciences and Engineering, Kuwait University, Kuwait.*
*[4]Health Informatics Unit, Dasman Diabetes Institute, Kuwait*

## Abstract

**Background:** Kuwait is witnessing an alarming increase in diabetes and high prevalence of multi-drug resistant strains. E-Health solutions have the potential to deliver timely, quality and cost-effective solutions to these public health challenges. However, little is known about the existing e-health solutions in Kuwait.

**Aims:** This study aims to explore the current e-health tools and applications in Kuwait, and the factors that affect their adoption and implementation.

**Methods:** A literature search was carried out for articles on e-health in Kuwait using the following electronic databases: PubMed, Google Scholar, Scopus, Web of Science, CINAHL, Medline and Proquest. Reference lists of all included items were additionally searched. A manual search was also conducted using WHO EMRO Virtual Health Sciences Library and MOH policies and standards.

**Results:** 1121 papers were retrieved from databases and 29 papers were added from manual searching of reference lists. 495 papers were considered for review after the removal of duplicates. Thirty studies met the inclusion/exclusion criteria. Implementing electronic health records and establishing a childhood-onset diabetes registry are the main e-Health achievements to date. Implementing e-Health tools has been hindered by various socio-political, financial, infrastructural, organizational, technical and individual barriers.

**Conclusion:** The modest e-Health achievements warrant bigger and faster implementation steps focusing on developing an e-Health policy framework and drawing an implementation road-map that is evidence based and research informed.

**Keywords:** e-Health; electronic healthcare records; m-health; telemedicine; Kuwait.

## 1. Introduction

Electronic health (e-health) generally refers to the use of online and off-line computer-based applications to deliver and enhance health services and facilitate the

* Ilhem Berrou – Faculty of Health & Applied Sciences, University of the West of England, Bristol, BS16 1DD, The United Kingdom; Email: ilhem.berrou@uwe.ac.uk.

exchange of health information [1]. The World Health Organisation (WHO) specifically defines e-health as "the cost-effective and secure use of Information and Communications Technologies (ICT) in support of health and health-related fields, including healthcare services, health surveillance, health literature, health education, knowledge and research" [2]. It further differentiates eHealth into domains/ tools such as electronic health records (EHR), telemedicine and mobile health (mHealth) [3].

The potential benefits of adopting e-health have been reported in developed countries [4, 5]; however, the adoption and implementation of such tools are still lagging in developing countries [6-8]. Kuwait [9] offers an interesting developing country context to explore e-Health applications and their potential to address urgent healthcare issues, including the epidemic levels of diabetes, the high costs associated with funding treatment abroad and the prevalent antimicrobial resistance.

Kuwait has a high prevalence of diabetes. Around 15% of the population in Kuwait have diabetes [10]. E-health can potentially aid the prevention and management of diabetes and other non-communicable diseases [11]. Moreover, the issue of medical tourism is currently under scrutiny especially since the dip in oil prices in 2015 and the subsequent reduction in expenditure in the public sector by Kuwaiti and other governments in the region. For specialities that are not available in the country, and/ or "complex cases", the Kuwaiti Ministry Of Health [MOH] funds treatment costs and patients and attendants' travel and living expenses [12].Telehealth could reduce the bill associated with "medical tourism" [13]. Another pressing issue and a top threat to public health is the widespread of antimicrobial resistance. Reports of multi-drug resistant strains from the Arab Gulf region [14, 15] and the lack of a national strategy to combat antimicrobial resistance [16] warrants urgent actions that include a national surveillance system and electronic prescribing support systems that are integrated with patients' health records.

The healthcare challenges facing Kuwait require urgent action, and e-health tools can address these challenges if the Kuwaiti government encourages the healthcare sector to implement e-health and provide more e-health services. This study aims to explore the current e-health tools and applications in Kuwait, and the factors that affect their adoption and implementation.

## 2. Methods

### 2.1 Search strategy

To explore e-health applications in Kuwait, a literature search was carried out from June to October 2017 for articles on e-health as defined by WHO published in or about Kuwait. The search was performed using the following electronic databases: PubMed, Google Scholar, Scopus, Web of Science, CINAHL, Medline and Proquest. The search terms used were: mHealth; mobile Health; smart phones health; e-health; Internet; health apps, telemedicine, electronic medical records, e-learning. Each of these key words was combined using 'AND' with Kuwait, Gulf, Gulf Cooperation Council (GCC) and Middle East (ME). The search was in English language [3]. Reference lists of all retrieved items were additionally searched. A manual search was also conducted using WHO EMRO Virtual Health Sciences Library and MOH policies and standards.

### 2.2 Inclusion/exclusion criteria

To widen the scope of evidence included in this review, an extensive search was conducted to include peer-reviewed articles, conference papers, graduate thesis, governmental reports and policies written in/ about Kuwait, GCC, ME, and any paper reported Kuwait on the topics of e-health. Technical papers, blogs and websites were excluded from the search.

### 2.3 Search results and study selection

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement was used. After applying inclusion/ exclusion criteria, 1121 papers were retrieved from databases and 29 papers were added from manual searching of reference lists. 495 papers were considered for review after the removal of duplicates. One related article was excluded as neither the abstract nor the full text of the article could be retrieved [17]. After reviewing of titles, abstracts and full texts, 30 studies were included in the analysis (see figure 1). Three authors reviewed the articles independently to ensure that they met the inclusion/exclusion criteria.
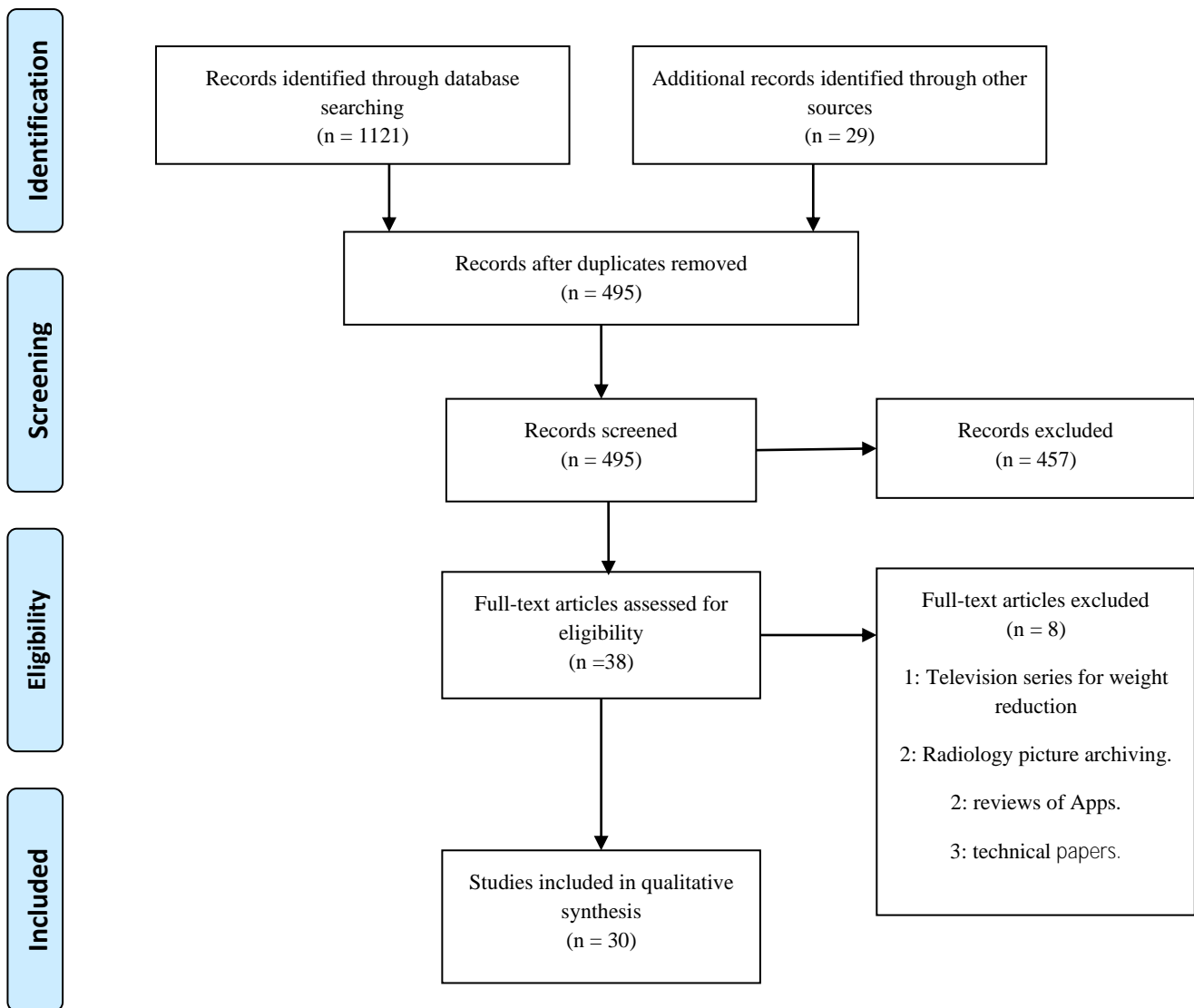
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Identification

┌─────────────────────────────────────┐     ┌─────────────────────────────────────┐
│ Records identified through database  │     │ Additional records identified through │
│ searching                            │     │ other sources                         │
│ (n = 1121)                           │     │ (n = 29)                             │
└─────────────────────────────────────┘     └─────────────────────────────────────┘

Screening

              ┌───────────────────────────────────────┐
              │ Records after duplicates removed        │
              │ (n = 495)                              │
              └───────────────────────────────────────┘

              ┌──────────────────────────┐        ┌──────────────────────────┐
              │ Records screened          │───────▶│ Records excluded          │
              │ (n = 495)                 │        │ (n = 457)                 │
              └──────────────────────────┘        └──────────────────────────┘

Eligibility

              ┌──────────────────────────┐        ┌──────────────────────────────┐
              │ Full-text articles        │───────▶│ Full-text articles excluded    │
              │ assessed for eligibility  │        │ (n = 8)                        │
              │ (n =38)                   │        │ 1: Television series for weight │
              └──────────────────────────┘        │    reduction                   │
                                                   │ 2: Radiology picture archiving. │
                                                   │ 2: reviews of Apps.            │
Included                                           │ 3: technical papers.           │
              ┌──────────────────────────┐        └──────────────────────────────┘
              │ Studies included in        │
              │ qualitative synthesis      │
              │ (n = 30)                   │
              └──────────────────────────┘
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Figure 1: Flow diagram of studies for inclusion.

## 2.4 Analysis

The characteristics of retrieved items were assorted by basic bibliometric data, format of items, study design, sample description and type of e-health. The outcomes of the retrieved papers were organised into descriptive narrative themes based on type of e-Health.

## 3. RESULTS

### 3.1 Characteristics of the retrieved studies

We retrieved 30 studies that met the inclusion/exclusion criteria. These are categorised, based on the domains/ tools reported, into: telemedicine, electronic health records (EHR), Health related e-learning, mHealth and health websites. Studies that explored ICT in health were categorised under e-Health. The characteristics and categories of the retrieved studies are summarised in table 1.

The earliest reports on e-Health in Kuwait; specifically about telemedicine, were published in 1999. Twenty-two of the retrieved studies were research articles, four were PhD theses, and three were conference papers and one organisational policy.

In addition to the MOH IT vision policy, five papers presented an overview of e-Health generally, addressing the current situation in Kuwait and future perspectives, and six papers focused specifically on telemedicine, teleconsultations and telepathology. Nearly half the retrieved papers explored the adoption and implementation of electronic health/medical records, and healthcare professionals and patients' satisfaction with EHR. One study reviewed the availability of m-Health apps and assessed their feasibility, and another study reviewed the available health websites in the GCCs. Three papers evaluated medical students and HCPs elearning. Only three papers explored the role of e-Health solutions in disease management including one on tooth avulsion and two on diabetes. The latter reported on the outcomes of the Kuwait Scotland e-Health Innovation Network (KSeHIN) established in 2010.

Table 1: Characteristics of retrieved papers:

| Typology | Author/year | Format | Location | Study design | Area of study | Sample description | Result |
|---|---|---|---|---|---|---|---|
| e-Health | Khalfan & Alshawaf, 2003 [20] | Article | Kuwait | Case study- Mix methods | IT in the health sector | No sample description for questionnaires. N= 11 IT managers and staff to be interviewed | Outsourcing health IT should be considered as a strategic tool and not as an immediate solution. It is predictable that IS/IT outsourcing practices will be increasing in the future in publichealth care sector in Kuwait. |
| | AlHuwail & Barnes, 2011 [19] | Conference paper | Kuwait | Descriptive (no formal design) | KSeHIN | - | - |
| | Conway et al., 2014 [52] | Article | Kuwait | Descriptive (no formal design) | KSeHIN | - | - |
| | Alsadan et al., 2015 [53] | Article | ME | Systematic review | HIT | 29 studies were retrieved, one about Kuwait | - |
| | Weber et al., 2017 [3] | Article | GCC | Systematic thematic review | e-Health in GCC | - | - |
| Telemedicine | Lattimore, 1999 [54] | Article | Kuwait/ US army | Case report | Ophthalmic telemedicine system | Images of 134 army optometry officers | Although the response rate was low, the tool could be successfully used for remote diagnosis with continuous health care training. |
| | Francis et al., 1999 [55] | Article | Kuwait | Cohort study | Tele-pathology | N=100 pathology cases from the pathology archive of the Mubarak Al-Kabeer hospital. | The process of using telepathology showed positive results in diagnosis from distant medical centers. It was simple and inexpensive. It promotes sharing knowledge and experience between pathologists. |
| | Patterson et al., 2007 [56] | Article | Other | Case report | Email - telemedicine | N= one case from Kuwait out of 283 cases from the ME. | Email telemedicine worked by sending an email of the case from the center in developing country to intermediate partner (Trust) that will send it to the specialist and then send back the reply. Only one case was referred from Kuwait between 2004 and 2007. Although the other results were not specific to Kuwait, but the overall attitudes towards email telemedicine in the ME were positive. |
| | McManus et al., 2008 [57] | Article | Kuwait/ US army | case report | Tele-diagnosis | N=153 tele-consultations from Kuwait | The use of telemedicine enhanced healthcare in remote and austere locations especially in the battlefield where there is a lack of specialised medical experts. |
| | Buabbas, 2013 [12] | PhD thesis | Kuwait | Cross sectional- Mix methods | Tele-consultation | N= 111 patients, N= 63 physicians, N= 7 policy makers, N= 6 IT | Patients showed a clear readiness for telemedicine adoption, despite worrying about quality of telemedicine, privacy and confidentiality issues. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | managers | The specialist physicians also showed readiness towards adoptionof telemedicine and their responses indicated that they are willing to use such systems. The current technical infrastructure for ICT in the Kuwaiti healthcare system is not ready for telemedicine adoption and there needs to be a change in culture to improve openness and trust among departments. |
| | Poropatich et al., 2013 [63] | Article | Kuwait / US army | Descriptive | Telemedicine | - | - |
| Electronic Health Records | Akbar; 2003 [22] | Conference paper | Kuwait | Descriptive (no formal design) | EHR implementation | - | - |
| | Akber& Gough; 2003 [23] | Article | Kuwait | Descriptive-conceptual framework (no formal design) | EHR implementation | - | - |
| | Al-Jafar, 2003 [28]* | PhD thesis | Kuwait | Cross sectional – Mix methods | Physicians perceptions | N= 463 physicians responded to questionnaires | Physicians had a positive attitude toward EHR implementation. Physicians reported organisational, technological and economic factors affecting HER implementation. |
| | Al-Azmi et al., 2006 [58] | Article | Kuwait | Cross sectional-Qualitative | Patient satisfaction | N=200, random sample from 10 PCCs, adults aged 18 and above, attending two-shift periods of the chosen center | Most patients noticed service improvement after EHR implementation. Patients agreed that the system helps in arranging patient appointments, dispensing medications, improving accuracy and ease of follow-up. Reasons for dissatisfaction with EHRs include: confidentiality of information in the records and some patients disliked the physician's use of the computer during consultation. |
| | Al-Hajerri, 2006 [46] | PhD thesis | Kuwait | Cross sectional-mix methods | Facilitators & Barriers to adaption | N= 493 participants were randomly selected from public and private sectors. | Factors affecting the successful implementation of HIS: 1)Top management perspectives: Incentives, resistance to change, organization's diversity, stability and accountability. 2)End users' perspectives: Training, incentives ease of use, uncertainty of use and lack of end user involvement. |
| | Alquraini et al., 200 [25] | Article | Kuwait | Cross sectional-Quantitative | Nurses perspectives | N=530 nurses were randomly selected working in MOH hospitals. | In general, the nurses had positive attitudes towards computerised HIS in MOH hospitals. With adequate training, the implementation of HIS could be effective for nurses in providing quality health services. |
| | Al-Azmi et al., 2009 | Article | Kuwait | Cross sectional-Quantitative | Medical receptionists' | N=332 medical receptionists were | The receptionists' tasks could be incorporated within the EHR system in a simpler way, leading to a more |

| | | | | | satisfaction | randomly selected from MOH PCCs. | favorable user reaction and successful implementation. Above 80% of the receptionists found EHR flexible, easy to use and satisfying, while over 30% found it inadequate, dull and bad. Training of EHR users will increase their computer skills and confidence with the use of the system and help resolve minor computer and software problems. |
|---|---|---|---|---|---|---|---|
| | Almutairi, 2011 [18] | PhD thesis | Kuwait | Case studies- Quantitative | Facilitators& Barriers to adaption | N= 325 HCPs using EHR. N=12 policy makers. | HCPs perspectives: Facilitators: improve timely access to medical records, delivery of chronic illness care and overall quality of care to patient. Barriers: EHRs do not improve communication with patients, lack of EHRs awareness, system maintenance, system downtime, loss of clinical data and not sharing medical information. Policy makers perspectives: The MOH is looking to improve the quality, accessibility, and productivity of health services, but It requires converting strategic thinking into an actual plan. |
| | Mogli, 2012 [59] | Article | GCC | Descriptive – personal review | Challenges to implementation | - | - |
| | Buabbas & Al-shawaf, 2011 [26] | Article | Kuwait | Cross sectional – Quantitative | Pharmacists satisfaction | N= 40 pharmacists working in PCC. | Several improvements were recommended to upgrade the system, such as supply the system with a database full of drugs details and messaging alerts like drug-drug interactions to reduce medications errors and to enhance drug information management. |
| | Al-Jafar, 2013 [29] | Article | Kuwait | Cross sectional- Quantitative | Patients' satisfaction | N=518 patients were randomly selected from PCCs. | Decreased physician attention towards patients during patient visits due to the use of EHR. |
| | Moh, 2013 [60] | Policy | Kuwait | - | MOH IT vision | - | - |
| | Ali et al., 2015 [27] | Article | Kuwait | Cross sectional- Quantitative | ICT literacy prior to EHR adaption | N= 103 dieticians and nutritionists in MOH | The ICT literacy of dietitians and nutritionists is important to identify individual needs and ensure the proper use of ICT and to avoid wasting time and money. Recommending training courses on ICT for dietitians and nutritionists can provide better nutritional care to patients. |
| | Strudwick et al., 2015 [61] | Article | ME | Review | Nurse participation in EHR | N= 12 papers were retrieved, one about Kuwait | - |
| e L ea rn in | Ur Rehman & Ramzy, 2004 | Article | Kuwait | Cross sectional - Quantitative | Internet use | N= 131 faculty members in HSC. | Faculty members agreed that internet use isvital for research, information and communication. |

| | | | | | | Training is needed to improve users skills |
|---|---|---|---|---|---|---|
| | Al-Dousari et al., 2009 [62]** | Conference paper | Kuwait | Cross sectional-Mix methods | ICT sources for doctors | N=541 questionnaires response. N=3 focused group. N= 20 semi-structure telephone interviews. | Lack of ICT resources and online databases in hospitals. Mobile phone used between doctors to facilitate quick peer-consultations. Enhancing ICTs in hospitals is a key to improve health care services and clinical decision making. |
| | Buabbas et al. 2016 [34] | Article | Kuwait | Cross sectional-Quantitative | Student e-learning | N= 171 students in HSC. | Significant improvement of students' ICT skills before and after the informatics course. The attitudes of most of the students toward the potential of e-Learning were positive. |
| **Mobile apps** | Al-Musawi et al., 2017 [31] | Article | Kuwait | Cross sectional-Quantitative | Apps feasibility | N=87 school teachers. | The App alone is an effective means of providing accessible knowledge to guide lay people in managing tooth avulsion, and it can be superior to a lecture-based delivery of information. |
| **Health website** | Weber et al., 2014 [33] | Article | GCC | Review of websites | Health websites in the GCC | - | - |

IT: information technology; IS: information system; KSeHIN: Kuwait-Scotland e-Health Innovation Network; ME: Middle East; HIT: health information technology; GCC: Gulf cooperation countries; US: United States; ICT: information and communication technology; EHR: electronic health records; PCC: primary care centers; HIS: health information system; MOH: Ministry of Health; HCPs: health care professionals; HSC: health science center; KPHs: Kuwait public hospitals.

*Only abstract was retrieved.

** Conference paper is attached to this reference.

## 3.2 The current e-Health tools and applications in Kuwait

A case study report by Khalflan and Alshawaf [20] highlighted the lack of a robust IT infrastructure and suggested the need to outsource health IT solutions to meet the demands of the Kuwaiti health sector. However, the establishment of the Central Agency for IT (CAIT) by the Kuwaiti government in 2006 improved the potential of Kuwaiti health sector to source health IT locally, since the CAIT's mission was to build IT infrastructure, set out plans and policies and coordinate the implementation of e-government initiatives.

Although the MOH has been implementing IT solutions through the Department of InformationSystem (DoIS) over the last three decades, the plans were published as recently as 2013.These outline the role of DoIS in providing IT services to all MOH general and specialised hospitals, primary care centres (PCCs) and different departments using "the best breed systems, IT governance and standards". These also highlight the government's capabilities to build and maintain a robust IT infrastructure that could support e-Health applications.

As it is a novel practice in the Kuwaiti context, many challenges faced the implementation of e-Health solutions in Kuwait. These barriers can be categorised into organizational factors such as the absence of strong leadership and strategic plans, no clear vision of implementation, lack of financial support, challenges related to value and role of e-Health, and ambiguous policy frameworks. Other barriers relate to IT management including poor quality of IT infrastructure, lack of technically competent staff, the huge volume of data and the concern about data security and confidentiality. In addition to organisational and technical barriers, it is important to consider the individual barriers that hinder IT implementation, such as patients and HCPs resistance to change [12, 18-20].

### 3.2.1 Diabetes register

MOH also sought collaboration with internal partners including the Dasman Diabetes Institute (DDI), and external partners including; the National Health Service Tayside (NHST), the University of Dundee (UoD) and Aridhia Informatics, a Glasgow-based research informatics company. This collaboration resulted in the establishment of a diabetes register for children (Childhood- Onset Diabetes eRegistry (CODeR)), as well as the establishment of postgraduate programmes such as he PG Cert/Dip/MSc in diabetes care, education and management, which is presented and awarded by the UoD. A register for adults with diabetes is yet to be established. The DDI is leading the strategic initiative to create and maintain the

register, and foresees potential for successful implementation given that EHR are already routinely used, and diabetes data can be polled from them [19].

### 3.2.2 Telemedicine

Despite the fact that Kuwait cofounded the Arab Telemedicine Society in 1999 to promote the development of telehealth, telemedicine and telecare [21], little has been reported on the activities of this body.

Telemedicine has been suggested as a means to address "health tourism" and the associated high bill of sending patients abroad for medical treatment. Buabbas investigated the readiness of stakeholders to adopt telemedicine [12] and found that patients and physicians believed that telemedicine is a viable approach for providing medical care services. However, the current IT infrastructure within their setting may not be ready to integrate telemedicine solutions. Furthermore, organisation and management support were identified as key factors to facilitate adoption and implementation of telemedicine solutions.

### 3.2.3 Electronic Health Records (EHR)

The Kuwaiti MOH started to implement EHRs in primary healthcare centres over a period of four years (1999- 2003) through the MOH-DoIS. By the year 2009, EHRs were implemented in all 96 primary healthcare centres. The overall strategy was to create one single records system, connecting patients' records in primary and secondary care, promoting continuity of and improved quality of care. But, according to Akbar 2003, the implementation of such systems faces financial challenges as well as lack of knowledge and appreciation of the benefits of such system [22, 23]. Although healthcare professionals (physicians, pharmacists, nurses, dieticians and nutritionists) demonstrate a positive attitude towards EHRs, patients are still sceptical of the benefits of EHRs, and they report that this tool affects their relationship with their physician [24-29].

Similar findings were reported in three doctoral theses by Al-Jafar [28], Al-Hajerri [46] and Almutairi [18]. Their studies explored multiple stakeholder perspectives towards the adoption of EHR and implementation of Health Information Systems (HIS). Physicians demonstrate a positive attitude towards EHR adoption, and they report organisational, technological and economic factors as barriers to EHR adoption in their organisations. This was further reported in Almutairi doctoral study (2011); Healthcare professionals reported barriers including: lack of EHR awareness, lack of computer skills and experience, loss of personal attention with the patient while entering data. Other barriers were EHR system

related, including: system's maintenance, concerns for loss of clinical data, security concerns regarding system's use and access. The study further reported that ease of use, the ability to generate reports, and the facility to access previous records instantaneously would facilitate the adoption of EHRs by healthcare professionals.

Al-Hajerri [46] explored perspectives of top managers and end-users (including clinicians, pharmacists, nurses, technicians and clerks) in public and private hospitals in Kuwait towards the implementation of HIS. The barriers from managers perspectives were organisational e.g. additional money for performance and resistance to change within the organisation, and cultural barriers e.g. workers responsibility. End users reported lack of awareness, lack of involvement and lack of training as main barriers to implementation. On the other hand, ease of use was reported as a main facilitator towards implementing HIS. These and other barriers and facilitators affecting the adoption of e-Health tools in Kuwait are summarized in table 2.

Table 2 Factors affecting the adoption of e-Health tools in Kuwait

| Barriers | Themes | Facilitators | References |
|---|---|---|---|
| Lack of strategic plans<br>Lack of clear vision of implementation | Socio-political | MOH IT vision policy | [15, 28-30] |
| Lack of financial support | Financial | MOH funding | [15, 28, 30, 46] |
| Poor IT infrastructure | Infrastructural | High internet and mobile phone coverage | [15, 29, 30] |
| Lack of strong leadership<br>Lack of training<br>Lack of expertise | Organisational | Collaboration with internal and external partners | [15, 28-30, 46] |
| Complex systems | Technical | Ease of use | [28, 46] |
| Lack of awareness of e-Health benefits<br>Resistance to change<br>Data security and privacy | Individual | Perceived usefulness<br>Willingness to adopt | [15, 28-30] |

### 3.2.4 Mobile health (mHealth)

Kuwait is fully covered by the mobile network, and 97% of the land has 4G LTE (Internet) coverage. Mobile accessibility among the Kuwaiti population accounts for 240%, which is the highest percentage among GCC countries. Moreover, mobile phones including smart phones penetration among households exceeds the penetration of television and computers (100%, compared to 91% and 60% respectively) [30].

Only one study explored the potential of mHealth apps in improving school teachers' knowledge on the management of tooth avulsion. The study concluded that the App alone is an effective means of providing accessible knowledge to guide lay people in managing tooth avulsion, and it can be superior to the lecture-based delivery of information [31].

### 3.2.5 Health websites and e-learning resources

In Kuwait, the internet is one of the main sources of medical information [32]. Furthermore, 34% of personal activities on the internet involve getting information related to health or health services. In the absence of health websites that are maintained by health authorities, the main concern regarding health websites in the GCC is the quality of information available that is often unreliable and misleading [33]. Moreover, even though the first language in the GCC is Arabic, more than 50% of the health websites were in English [33], and these mainly relate to health services such as private hospitals or clinics, private medical practice and commercial products. Overall, the available "health" websites in the region showed a lack of privacy and security policies as well as out of-date information [33]. The availability and use of e-learning resources, unlike in the case of internet sites, remains low in Kuwait. In 2016, Buabbas compared university students' attitude towards e-learning before and after an introductory course on informatics and reported a significant improvement of IT skills among students after the course [34]. Moreover, this study revealed a significant shortage of e-learning resources in health and medical sciences at Kuwait University, the only university that offers medical and health sciences education.

### 4. Discussion

This narrative review identifies the current availability and uses of e-health tools in Kuwait and the factors affecting their adoption and implementation in healthcare settings and by healthcare professionals. The adoption and implementation of these e-Health tools are affected by various factors including socio-political, financial, infrastructural, organisational, technical and individual barriers and facilitators.

The childhood onset diabetes registry will provide commissioners, healthcare professionals and public health practitioners with a valuable opportunity to follow up disease progression throughout the patient's life and is an excellent manifestation of how the benefits of e-Health could be harnessed. The efforts to establish a much-needed diabetes registry for adults remain fruitless. Data from these registries would provide a better understanding of the

burden of the disease and could inform, assess and improve care at an individual as well as population level [35].

Furthermore, the establishment of EHR in all primary healthcare centres is a considerable achievement since these retain information relating to diagnosis and treatment. EHRs not only enhance patients care, reduce medication errors and facilitate communications with patients and other healthcare professionals [36], but they can further contribute to establishing an adult diabetes registry; as diagnosis of diabetes data could be extracted from the EHRs to establish an "initial registry" and a national diabetes audit.

Telemedicine enhances communication and diagnostics [37, 38] and can reduce the need for patients to travel long distances to seek medical attention [39]. The benefits of telemedicine could also be harnessed locally in the contexts of diabetes management and antimicrobial stewardship. In relation to diabetes Bashshur et al. reviewed the available evidence and confirmed the benefits of telemonitoring and telescreening in improving glycemic control, early detection of retinopathy, reducing body weight and increasing the uptake of physical activity [40]. Furthermore, providing training through e-learning resources could improve practices and reduce the need for inappropriate disease management and/ or prescribing [41, 42].

Kuwaitis, and many people around the world, rely on the internet and "health websites" to seek health related information [33]. However, in the absence of heath websites, that are maintained and updated by Kuwaiti healthcare authorities and the minimal use of m-Health, the public is often misinformed and exposed to out-of-date and potentially unsafe information [43, 44]. The low and slow adoption and implementation of e-Health tools in Kuwait can be attributed to a number of socio-political, financial, infrastructural, organizational, technical and individual factors. The adoption and implementation of e-Health applications is only possible if organizations have a robust IT system that facilitates workflow and is compatible with eHealth solutions [45].

Despite the MOH publishing its IT vision and plans including implementing e-Health applications, there is a clear lack of strategic plans for implementation of e-health applications. The lack of e-Health policies has been shown to hinder the adoption of e-Health solutions at organizational [12, 18-20, 46] and healthcare professional levels [12, 18-20]. E-Health policies reduce healthcare professionals' anxieties and liability pressures in relation to patients' data and improve organizations' collaborations and communications [47]. Furthermore, organizations could also be incentivised financially by MOH to adopt e-health applications [48, 49]. Funding could be provided to cover implementation costs as well

achieving performance indicators [49, 50]. Here, strong leadership is an important determinant of e-Health adoption and implementation [45], and lack of engagement of top management has been shown to hinder the process of adoption and undermine the success of implementation. Managers can recognise the organisation's needs and can decide on and allocate the required resources in terms of funding, training and hiring expert staff/ champions to facilitate e-Health adoption and implementation [51].

Furthermore, fostering a culture of open communication about the benefits of e-Health and involving the end user in all stages of adoption and implementation are likely to challenge the negative attitudes towards e-Health adoption [49].

## 5. Limitations

To our knowledge, this is the first review of the current e-Health applications and tools in Kuwait. We reviewed evidence from a variety of study types and grey literature resources to widen the scope of evidence and provide a more complete picture of the current e-Heath trends in Kuwait. However, the quality of the retrieved studies was not assessed due to the heterogeneity of the retrieved items in terms of format, study designs and methods.

## 6. Conclusion

An e-Health policy framework is urgently required to address the various factors affecting Kuwaitis health including diabetes and antimicrobial resistance. This framework should be based on evidence for e-Health improving citizens' health, and needs to incorporate an integrated approach that links disease prevention, disease treatment and promoting public health through harnessing the potentials of e-Health.

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