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Literature Review

Using Information Technology for Data Collection in Epidemiological Research in Saudi Arabia

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Abstract

Background: E-epidemiology and its use of information technology to timelessness gather and analyze data to narrow the knowledge gab effectively to control pandemics and prevalent chronic diseases. Using Information Technology (IT) and other electronic means in data collection is highly convenient and portable.

Objectives: We have conducted this review to summarize the current researches in Saudi Arabia which used IT to collect data.

Methods: Studied were identified by searching PubMed, google scholar and Saudi Digital Library database and revealed 121 studies. After checking eligibility 11 articles were included in the review.

Results: About half of the studies used non-probability sample and Study population was a variety including, health care workers, general population, outpatient visitors, Makkah pilgrims and internet users. Data collected through different methods including, mobile applications, google forms, emails, WhatsApp, electronic devices and GIS information. The time period needed collect data is ranged from 10 days to 8 months. Regarding the sample were included was ranged between 48 and 6089 participants. Data were presented simply as frequency tables and percentages in some studies and in others were presented after advanced use of statistical tools.

Discussion: This review provides a comprehensive understanding of the use of IT in the collection of epidemiological data in researches conducted in Saudi Arabia covering communicable and non-communicable diseases. Smartphones and mobile applications in modern medical and hospital systems, made screening, monitoring and guided health providers to manage diseases up to date. E-epidemiology in hajj mass gathering season helped in prevent, detect and monitor health events efficiently.

Keywords: *E-epidemiology; Information Technology (IT); Data Collection*

Introduction

In recent era, epidemiological studies are one of the most crucial tools in promoting and maintaining health status, including the determination of the etiology of various diseases, recommend and evaluate health intervention as well as ascertaining disease distribution and several risk factors [1]. Healthy behavior practices and vaccination are some examples of utilization products of the results of epidemiological studies [2]. However, these studies need to include substantial resources and manpower [3]. The advancement of model information and technology and its wide use by the public has provided and will continue to provide remarkable opportunities for use in medicine, research and surveillance. Currently, smartphones are a common device that is mainly use for the decision of the adoption as

well as investigating human motivation lifestyle habits. First of all, smartphones are portable, internet-enabled computing device with a variety of sensors, providing us with a set of powerful research tools for data collection. This electronic device as well as other technology devices are accessible to plethora of people including rich to impoverished personnel: and as of 2020, there were approximately 3.5 billion global electronic devices used and subscribed as mobile phone and around 45% of these subscriptions are smartphones [4]. In addition, approximately 40% of mobile phones sold in 2012 were smartphones [4]. Smartphones provide the user with increased computational abilities, in particular, access to internet, global positioning systems (GPS), geographical information systems (GIS), microphones, accelerometers, and cameras with the capability to take high-resolution photographs, read QR/barcodes and record videos [5]. The introduction of personal digital assistants devices (PDA's), followed by smartphones and tablets has largely impacted on different fields as well as in the field of medicine. These devices can be used not only for computing but also for communication purposes with all salient features combined in a single device and the most important advantage is that devices are too portable to handle, even these devices can be carried either in hand or pockets, facilitating easy and quick access at the point of care [6]. This combination of computational power, sensors, and wide-scale user uptake means that applications provide a higher opportunity for mass data collection from public resources, that can be augmented by automating quality control and proper data management [7-9]. The easy and almost 24/7 access to the device makes it prominently useful when measuring variables which are varying over time, such as exercise, diet and alcohol consumption [10,11]. Compared to earlier used diaries, such as paper and web diaries, mobile phones can send reminders through different ways, for example, through short message services (SMS) or different alarm systems.

E-epidemiology

E-epidemiology is the science underlying the acquisition, maintenance and application of epidemiological knowledge and information using Information and Communication Technologies (ICT) such as the web, mobile phones, digital paper and interactive voice response. E-epidemiology also refers to the large-scale science that will increasingly be conducted through distributed global collaborations enabled by the internet. By using ICT in medical data collection, one can meet the high demands from a dynamic society. The new technologies also bring possibilities for enhanced data collection not possible through the traditional approaches, including real-time data collection, interactivity, tailored and personalized questionnaires and repeated measures. The advantages of using computerized methods within data collection are so prompt and crucial that one may not be able to ignore the possibilities of the outcomes by means of this approach [12-14]. However, these methods that are frequently used should be validated highly and in a conducive manner so that it can highly ensure the veracity and legibility of the high quality data [15]. Nowadays, the society has already accepted and implemented ICT in daily life and supposedly, there is no reason why the epidemiological science should lag behind.

Objective of the Review: E-epidemiology in KSA

The objective of this paper is to review the current studies in Saudi Arabia which used information technology method in order to collect data. As well as to summarize the benefit and disadvantaged of its use.

Search Methodology

Studied were identified by searching PubMed, google scholar and Saudi Digital Library database. The search was conducted in 15 March 2021, and the search dates included all studies done in Saudi Arabia in the last ten years. We used the following search term: (("Epidemiologic Studies"[Mesh]) AND (((mobile applications) OR (GIS)) OR (information and communication technology))) AND (Saudi Arabia AND ((y_10[Filter]) AND (English [Filter]))).

Inclusion criteria were: any open access epidemiological studies conducted completely or partially in the kingdom of Saudi Arabia and data collection tool were including (mobile Applications, emails, WhatsApp or any information technology tool.

The search through PubMed and google scholar yielded 107 records and 14 from Saudi Digital Library. After filtering the search to open access publications, the total records identified were 69 (55+14). Screening through title and abstract excluded 58 articles.

One article, still in the press, was added the list as it reached directly to us through the author of the article. Finally, a total of 17 article selected for thorough review and checking the eligibility for inclusion criteria. The ended records included in this review were 11 articles (See figure 1: Flow chart).

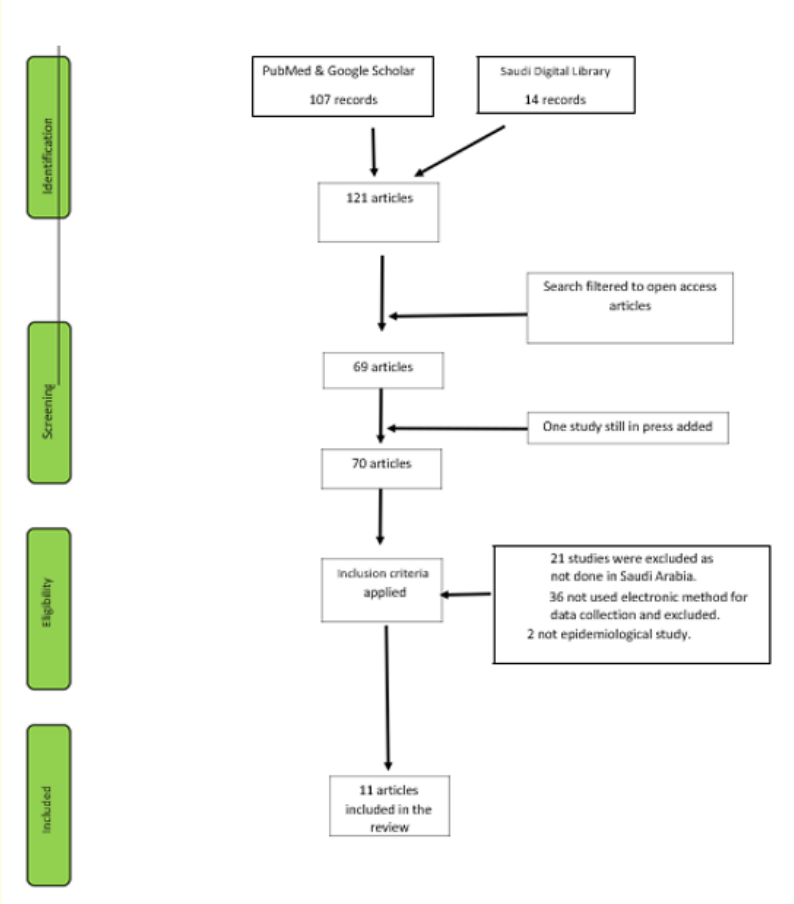

Figure 1: *Flow chart of the review process.*

The data extracted from each included the: the objective of the study, study population (proficiency and location), the study design, sampling techniques, method of data collection, duration of the study, type of results, statistical analysis used in the studies, the impact of results, limitations and type of bias might be associated with each reviewed study and the summarized results were presented in table 1 and a narrative summary in the result part.

Results

Data extraction table was generated, and the variables included were study design, sampling method, sample size, study duration, study population, data collection tool, statistical tools used and the primary objective of the study (See table 1).

Authors	Publication year/city	Study design/ sampling technique	Data collection tool	Sample size/ duration	Statistical Analysis tools	Subject of the study	Study population
Alahdal H., *et al*.	2020/Riyadh	Cross-sectional/convenient sample	Google form	1767/ 10 days	Frequency tables percentages	KAP toward Covid19	Riyadh community
Yosesf CC., *et al*.	2020/Jeddah, Riyadh and Alahsa	Cross-sectional/stratified random sampling	Electronic devices	546/3 months	Chi-square and multiple logistic regression (OR)	Personal Health Recorded (PHR)	National Guard Outpatients
Abdullah R *et al*	2019/Riyadh	Cross-sectional/convenient sample	Emails and WhatsApp	250	ANOVA	Use of Artificial Intelligence (AI) technologies among health care employees	Health care workers
Qadah T	2020/Jeddah	Cross-sectional/convenient sample	Google form	1023	ANOVA	KAP toward Covid19	Health care workers
El Tantawi M., *et al*.	2016/multi-arabic Cities (Algeria, Egypt, Jordan, Kuwait, Libya, Palestine, Saudi Arabia and Yemen)	Cross-sectional/convenient sample	Emails and WhatsApp	2936/8 months	Multivariate logistic regression	Dentists' intention to report suspected violence	Dentists in Some Arab Countries
Al-Ghamdi S	2018/All Saudi regions	Cross-sectional/simple random method	Emails	300/-	Frequency tables and mean and SD	Mobile medical apps popularity and impact of use on patients care	Physicians registered in Saudi council for health specialities
Al- Ahmadi K., *et al*.	2019/All Saudi regions	GIS clustering of MERS cases (Mapping)	Web based data	2008/-	-	Spatiotemporal clustering of MERS cases in Saudi Arabia	All laboratory confirmed MERS cases in Saudi Arabia

BinDhim NF., *et al*.	2015/66 countries including Saudi Arabia	Cross-sectional/convenient sample	English version apple application download	6089/4 months	Frequency tables percentages	Users looking for depression apps	Any user download the app and filled the form
Alqahtani AS., *et al*.	2016/ Makkah	Prospective cohort study/ convenient sample	English version apple application download	48/55 days	Frequency tables percentages	Feasibility of using smart phone in KAP studies ss well as tracking signs and symptoms of high risk pilgrims	Travelers to Makkah Hajj 2014
Khan AA., *et al*.	2021/ All Saudi regions	Cross-sectional/simple random method	Using mobile Application "Mawid"	Active phase: 42765 Community based: 29089/1 month	Chi-square goodness-of-fit	Effectiveness of mass screening programs in Saudi Arabia	All Saudi resident
Alshahrani AM., *et al*.	2021/Abha	Pretest/post-test randomized controlled open label experimental design	WhatsApp messages	110/3 months	Frequency tables and mean and SD	The effect of a WhatsApp-based intervention for promoting physical activity among female	Female college students at King Khalid University, aged 18 - 28 years

Table 1: *Summary of the reviewed articles.*

However, in terms of study population, the review showed that variety of population between studies including, health care workers, general population, outpatient visitors, Makkah pilgrims and internet users download specific mobile applications. Moreover, response rate was high in most studies. Two studies were conducted in each city of Riyadh and Jeddah. Also, two studies were done over the whole Kingdom and two other large international studies that include sample collected from Saudi Arabia. Only one studies were located on each of Dammam, Makkah, Alahsa and Abha. Eight studies were cross-sectional, one cohort, one randomized trial and one GIS mapping of coronavirus disease-2019 (COVID-19) cases in Saudi Arabia.

Regarding the method used to collect the data for the reviewed articles, three used mobile applications. Then two studies have used google forms and both emails and WhatsApp. The rest have used either electronic devices, WhatsApp only, email only or GIS information as a tool to collect data from participants each has been used by one study.

The time was needed to recruit participants and to collect data is ranged from 10 days to 8 months. However, the majority of studies were finished data collection within 3 months only.

Regarding the sample size which were included, some were able to collect small number as 48 participants only. On the other hand, some were successful in reaching up to 6089 participants in a four month duration.

In term of presenting or analyzing the data, some studies were only present data as frequency tables and percentage. However, other have used advanced methods of analysis such as ANOVA or multivariate logistic regression.

Alahdal H., *et al*. (2020), was a cross-sectional study aimed to study the awareness, attitude and practices toward COVID-19 among Riyadh community population to fill the gap and to design the needed health education program and messages. Data were gathered by Google form distributed through 10 days duration to collect 1,767 completely filled forms and the questionnaire was design as per valid surveys published in previous articles. Importantly, all the participants were need to sign a consent form included in the study. Some differences noticed in response rate in regard to gender type. Less than two third of the participants showed moderate awareness in regard to COVID-19; however, their attitude and practice were notably better. One of the major drawbacks of the study was the greater participation of male personnel compared to that of the female subjects used in the study. Previously published article reported that gender influences greatly responsible for online survey. Other limitations was related to the sampling techniques and generalizability [17].

Yousef CC., *et al*. (2020), a cross-sectional study conducted between outpatient visitors of the National Guard hospitals around the Kingdom. The objectives of the study was to examine the use of personal health record (PHR) electronic files adopted by the hospital and to know which most featured were used and what are the predictors affecting its adoption by patients. Using stratified random sample technique, 546 responses were collected by filling the questionnaire handled to them through a password-protected electronic device in the waiting area. The study showed that 70% of the sample were using the PHR, especially if they were younger, educated, employed or have chronic conditions. However, older subjects who are more prone to have chronic conditions, most of them are not interested in the way that PHR is working on. In addition, the study reported that the most commonly used feature was the appointment scheduling option. Regarding limitations issues such as self- reporting and recall bias, social desirability, low generalizability limitation might be in issue [18].

Abdulla R., *et al*. (2020), a cross-sectional study conducted to investigate the perception and the attitude to emergence of and implementing artificial intelligence (AI) technologies in health care systems. The research targeted health care workers in four main large hospitals in Riyadh city. 250 participants filled the questionnaire that was distributed to them through emails or WhatsApp. The majority of responders have moderate acceptance to AI technologies as they concern about the fact that technology might replace human jobs. The most significant outcome of the study indicated that due to the work-nature of technicians with AI technologies, which lack direct interaction with patient, they feel uncomforted with wide implementing of AI technology in health care settings. Therefore, the doctor and other direct health care provider do not feel that AI technology will not significantly intervene the doctor-patient interactions. Limitations are in term of sampling techniques as well the size of the sample and representatives of the samples [19].

Qadah T (2020), a cross-sectional study aimed to measure the knowledge, attitude and practice of HCW's toward COVID-19 clinical aspects and infection. The study was done in Jeddah city using Google forms that was distributed without randomization. The findings of the study showed that HCW's have positive knowledge in regard to COVID-19 infection and they gain most of the information from social media or through their workplace education activities. The author reported that social media as well as education through workplace modalities, is highly effective in spreading the news in regard to COVID-19. Additionally, most of HCW's showed adequate consciousness about causative agent and their mode of transmission, including droplets and physical contact. But, the author reported that water is not a potential source of transmitting the causative agent of COVID-19. Importantly, the author reported the incubation period of the virus is about 1 - 14 days, which justified the claim about the quarantine period of approximately 14 days. Further, HCW's revealed that supporting therapy is first and foremost preventive and therapeutic strategy regarding COVID-19. Limitations of the study are related to non-probability sampling method as well as self-reporting [20].

El Tantawi M (2018), a cross-sectional study was conducted in some Arab countries aiming to assess the intention of dentists to report suspected violence cases and to report factors associated with their intention. Authors have distributed the questionnaire in different

ways, including paper forms and electronic ways such as via emails or WhatsApp. The results are helpful to enhance implications of training that are helpful for the dentists to improve their reporting of suspected violence cases and to ensure their ability to diagnose such cases as well as stressing on the available rules and policies that support preventing domestic violence. The study limitations include, sampling techniques, the study measured the intention to report not the reporting itself and the external validity regarding representative of the sample to include private sector dentists [21].

Al-Ghamdi S (2018), a cross- sectional study conducted among physicians who are registered in the Saudi Council for health specialties to find their preferred mobile medical applications and to assess the impact of using such applications on patient care. From a total of 86,765 registered physicians, the invitation was sent to 384 doctors after using simple random method of selection. Response rate was 78.5% after distributing the questionnaire through emails. Results showed that medical applications are useful and common medical resources for physician practice in Saudi Arabia. The findings of the study depicted that Saudi Arabian physician believe that mobile app usage is related to the beneficial effect on patient care. In addition, they agreed that medical apps are useful for teaching purposes as well as learning different approaches and definitions, which is crucial for medical education for students, resident physicians and likely the experienced physicians. Moreover, hospitals are allowing the use of medical applications to access more medical information. Limitation of the study include, small sample size, patients are not included in the assessment and there was no comparison between rural and urban use of such medical applications in patient care. In addition, respondent bias is expected [22].

Al-Ahmadi K., *et al*. (2019), the study was a spatiotemporal clustering of all confirmed Middle East respiratory syndrome-coronavirus (MERS-CoV) cases in Saudi Arabia. Till 31 of March 2019, 2008 MERS cases were included in the mapping process to find trends, predict and prevent MERS outbreaks. The result of the study reported that overall, the most of the MERS-CoV infections was secondary infections, including hospital or community acquired infections. Importantly, most of the primary cases were linked directly or indirectly to a contact with camels. Additionally, dealing with products related to camels, including raw unpasteurized milk and slaughter processes are related to the risk factors for primary MERS-CoV infection. Initially, the results of the study provided the risk assessments that are used for potential environmental risk factors. However, the study was only a descriptive one [23].

BinDhim NF., *et al*. (2015), designed a cross-sectional study, conducted internationally along with data from Saudi Arabia focusing the characteristics and subsequent determinants of people looking for the application of depression. The application wase launched globally on Apple store for adults above 18 years for a duration of 4 months. The smartphone application used patient health questionnaire (PHQ-9) for depression screening. The responses rate was 73.9% out of the 8241 participants. The analysis disclosed that large number of people from several countries were interested in and willing to use an application that deals with the screening of depression. Apart from this, most of the people are willing to share their sensitive data about their health through an anonymous way of communication. Moreover, the study provides a consolidated base that smartphone app may tend to be a tremendous platform in the health research tool. The result of this study emphasizes on the importance and the feasibility of using such technology to reach needed people. Self- selection bias and language limitation were of the few limitations in the study [24].

Alqahtani AS., *et al*. (2016), prospective cohort study, targeted Hajj pilgrims in the year of 2014. The aim of the study was to investigate the feasibility of using smartphone in knowledge, attitude and practice studies as well as tracking signs and symptoms of high risk pilgrims. Samples were collected conveniently upon downloading a specific smartphone application. Only 48 participants have downloaded the application and only 61% of them completed the phases of the study. A pre and post hajj questionnaire to be filled using the application which released in English version at Apple store on September the 5th, 2014. The completion of the questionnaire went through three phases. Phase one include the sociodemographic info of the participants. Phase two that lasted for six weeks during Hajj period and to be filled on daily basis, measuring adherence to infection prevention practices as well as monitoring signs and symptoms of acute respiratory illness (ARI). Phase three needed to be completed after hajj period by one week, asking about use of the infection prevention methods

regarding the development of ARI symptoms. The study showed that using smartphone to track and monitor travel associated illness is feasible and alert that hajj pilgrims are not strictly complainant to infection prevention practices on order to prevent acquiring of possible emerging infectious diseases. In addition, the data from the study revealed that all pilgrims are aware about hand hygiene. Limitation of the study including, language restriction to English users, selection bias and availability of the application is limited to Apple users only [25].

Khan AA., *et al*. (2021), a cross-sectional study, conducted to determine the effectiveness of mass screening programs in Saudi Arabia by analyzing the number of detected COVID-19 cases, their demographic data, and the most affected regions. Sampling was done in two phases, phase one, which is defined as an active screening phase for individuals who are randomly selected from the whole country districts and phase two was referred as community phase in which screening people from the Central Application System (Mawid) who already filled self-assessment checklist. The Response rate was 18.18% and 6.62% for phase one and phase two, respectively. Simple random method was used from 16 April to 3 May 2020 and 4 May to 19 May 2020. Results are emphasized on the importance of performing mass screening programs to control COVID-19 pandemic as its enabling early detection, isolation of COVID-19 cases and applying immediate public health measures. In addition, the study provides a consolidated base in predicting the relationship between the age of the subjects and the rate of infections. The data revealed that the group having an age between 30 to 39 years are more likely to be infected in both active screening and community phase. Moreover, this mass data provides information about the onset and rate of infection on individual districts, which is useful for imposing enforced lockdown to suppress the spread of the causative agent. However, one of the most important drawbacks of the study include the missing of some variables in the database, including patients' disposition and clinical profile. Further, selection and information bias is expected [26].

Alshahrani AM., *et al*. (2021), a pretest/post-test randomized controlled open label experimental design to measure the effect of using WhatsApp- based intervention messages for promoting physical activity among female college students in Abha region, Saudi Arabia. 120 participants were assessed for eligibility by convenient sampling, 110 agreed to participate, and 55 were allocated randomly to each group. According to the study, engaging to physical activity practices increased significantly after intervention and it reported that recreational activity is the most common activity. Despite it is challenging due to the social obligations that limits the participation of female in interactive sessions and community exercise programs, the study results showed the importance of using social media to promote physical activity in youth group. In addition, the study did not find any significant relationship between the marital statues and physical activity. The study revealed that older participants and highly educated females are more interested in physical activities. However, the study was conducted only on small number of females as well as the study is restricted to only one city. Moreover, recall bias due to self-reporting are mentioned limitations of the study [27].

Discussion

Knowledge gap during the time of pandemics and epidemics is the one of the most important reason for chaos and disparity among the people. Importantly, negative attitude towards the disease and its causative agents is detrimental during an epidemic and eventually it turns the epidemic into a pandemic situation. Awareness, positive attitude along with well-practiced activities are crucial for maintain strength during any pandemic situation and previously it has been reported that these activities are reported in the case of several previous epidemics such as swine flu, MERS-CoV infection, dengue etc. [28-30].

It is well known that epidemiology is essential to control diseases because it deals with the progression, spreading of the diseases and analysis of the data of death and infection rate. The transmissibility as well as the reproduction rate of any causative agents are also well described using epidemiological study. Additionally, these studies provide key alert to any governing body of a country to enforce critical situation to curb the transmission of the causative agents.

Currently, e-epidemiology is mostly used due to its portability and cost-efficiency. Indeed, by means of e-epidemiology data collection is highly convenient and portable. Using IT and other electronic means, including mobile phones, electronic devices and papers and web-questionnaires. Determination of data in a rapid and economic way is highly appreciated and representing a titanic concern in the future field of the epidemiological study. A recent study reported the use of e-epidemiology in the identification of heart failure by using electrical medical records [31].

Globally, there has been occurrence of several epidemics from the onset of this century. For example, in 2014, World Health Organization declared Ebola pandemic as a public health concern. One of the most important concern regarding the epidemic is lack of community health concern in the case of Ebola management, which ultimately led to cross-infection [32]. In 2002, severe acute respiratory syndrome-coronavirus (SARS-CoV) has emerged in Hong Kong and subsequently transmitted to many Asian countries rapidly, causing death [33]. The key determinant of the magnitude of the epidemic includes the interval between the onset of symptoms and infection and in between the interval of hospital admission. Very recently, another strain of coronavirus, SARS-CoV-2, which is recognized as the most detrimental biological threat and responsible for severe death worldwide currently. Like SARS-CoV, this virus also targets the respiratory tract and unlike SARS-CoV, its transmitted mainly by means of respiratory droplets and aerosol [34]. By means of proper understanding about the etiology and epidemiology of any fatal disease, the estimate of the burden of the diseases and their impact can be analyzed. E-epidemiology would play a crucial role in this regard.

To the best of the authors knowledge, this is the first review to summarize the epidemiological studies in Saudi Arabia which used IT methods to collect data. Author extracted data and screened articles. There were 10 articles that fulfilled inclusion criteria, all are cross-sectional except two; one cohort study and the other was experimental study. All studies were published from 2015 G which reflect the limited use of information technology to perform epidemiological studies in Saudi Arabia. Three studies were conducted to measure knowledge, attitude and practice, two of them in regard to COVID-19. It is apparent from the review that it is feasible to conduct epidemiological studies relaying on mobile and IT data collection. Additionally, it is possible to screen, monitor and measure variant health events by using mobile technology. The number of participants who can be recruited using such techniques can reach large numbers and within comparatively short time. Sampling techniques were non-probability methods in six studies. Such limitation is recognized when using information technology data collection in another (reference). Apart from this, selection bias is a limitation, as requiting the participants by using mobile or information technology is limited to people using smart phones and are able to reach such applications or owning gadgets needed to download and fill the required questionnaire. Additionally, information bias is expected in such studies because of self-reporting.

This review provides a comprehensive understanding of the use of IT in the collection of epidemiological data and progression towards the root cause of the disease. As it is now well-known that COVID-19 is a pandemic worldwide currently. In the case of COVID-19, e-epidemiological studies showed that females showed better practice relative to that of manes. Apart from this, the use of smartphones in modern medical and hospital systems has brought a tremendous change in the case of disease diagnosis and medication. Rikesh., *et al*. reported that mobile apps are most frequently used by medical students for recruiting more important information about health events related to their own perspectives [35]. Hence, hospitals are recommending the usage of medical applications.

Additionally, MERS-CoV infection was regarded as mainly secondary infections which were acquired by either hospital or community. The new cluster of the MERS-CoV strain were associated with healthcare workers [36-38]. Hence, e-epidemiology and usage of IT related devices is a better option in this regard to reduce the connection between the healthcare workers and also provide the patient information in a rapid way.

Moreover, having Hajj season yearly in Saudi Arabia and mass gathering of about 2 million pilgrims coming from all over the world, increasing the chance of outbreaks and spreading of new emerging disease [39]. Factors increasing the susceptibility of infection and

practicing some risky behaviors by pilgrims such as shaving and crowded residency places, is necessitating close monitoring and surveillance to prevent and control such evets [40]. Therefore, taking advantage of E-epidemiology in hajj mass gathering season would ease and empower the governance of disease spreading as well as making preventive measures to make the Hajj season safe for national and international pilgrims.

Conclusion

E-epidemiology is the smartest way to maintain, and application of epidemiological knowledge based on the information using mainly IT devices. This review showed the usage of e-epidemiology and its application in several health condition such as depression screening, promoting healthy habits, screening for emerging diseases, spatiotemporal analysis and evaluating the knowledge, attitude and practice. Smartphone apps, showing the future potential for E-epidemiology due to its feasibility, availability and its acceptance by users in different age groups globally. Screening and self-monitoring stigmatic condition such as depression through mobile App found to be acceptable and effective. In addition, the data obtained by the IT approach would make a great impact in the control of the burden of several epidemics and pandemics. In Kingdom of Saudi Arabia, taking advantage of E-epidemiology in Hajj seasons would assist in applying the suitable preventive measures and to protect vulnerable people who at risk of various health conditions. The review has some limitation such as, including only published English national studies. Doing expanded review might be recommended.

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