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ORIGINAL ARTICLE

The Efficiency of Internet Base Healthcare System in Gastroenterological diseases: An Updated Systematic Review

AMIN ELZAKI[1], HANAN ELNOUR[1], MONA ELHAJ[1], SAMIH KAJOAK[1], AMEL F H ALZAIN[2]
[1]Department of Radiological Sciences, College of Applied Medical Sciences, Taif University, P.O. Box: 11099, Postal code 21944, Taif, Saudi Arabia
[2]Taibah University, Collage of Medical Applied Science, Department of Diagnostic Radiology Technology, AlmadinahAlmunawara, Saudi Arabia
Corresponding author: Amin Elzaki, Email: a.zaki@tu.edu.sa

ABSTRACT

Digital health systems such as tablet devices, smartphones, and online websites, are swiftly transforming the practice of medical science and reshaping health care approaches. A PRISMA guidelines-based systematic review was conducted using research databases (PubMed, Google Scholar, and Web of Science) to identify the applications and fill the literature gap in Gastroenterological disorders. A total of 212 articles were searched, excluding duplicate records, sixty nine articles were founded out of which only fifteen were selected using specific inclusion and exclusion criteria. Risk of a bias assessment tool called ROBVIS 2 is used to examine the risk of predisposition and precision of all the fifteen studies included. Most of the patients in these trials were females, educated, and have inflammatory bowel diseases. These clinical studies concentrated on Ulcerative colitis (n=5), Crohn's disease (n=4), and inflammatory bowel disease (n=6) with feedback of mostly 3 months (n=5) and 6 months (n=5). The internet-based intervention varied from study to study but the outcomes in each study were clear that either this system was efficient or not. Based on the searched literature and selected studies it was concluded that online health technologies can effectively cope with Gastroenterological disorders and patients with digestive disorders have shown good acceptability and pleasure in all the selected studies.

Keywords: eHealth technologies, Digestive disorders, Ulcerative colitis, Crohn's disease, Review

INTRODUCTION

The use of Digital health systems such as smartphones, tablet devices, online websites, and gadgets to enhance the quality of care are swiftly transforming the practice of medical science and reshaping health care approaches. It was calculated in the last quarter of 2018, that more than 66% of the world's population are addicted to internet mobile facilities, which would cross 71% in 2025 (Yin et al. 2019). A report issued by Pew Research Center, the United States in 2013 stated that last year over 71% of the internet subscribers used the internet for health-related issues (Kwan et al. 2019), while 35% said that during a medical emergency and for information health they browse on the internet (Hämeen-Anttila et al. 2018)It was predicted in 2015 that half of the earth's population have a healthcare application in their phone. In addition, Apple's iOS app store contained over 5000 self-inspection applications, like sleep, nutrition tracking, and physical exercise (Van Deen et al. 2016; Helsel et al. 2018). The online health system serves several uses in sustaining and stabilizing healthiness including disorder monitoring (Meyers et al., 2016), devotion and treatment compliance (Mbunge et al. 2021), signs and management of medication (Batra et al. 2017), filtering facilities (Van Deen et al. 2016), and surveillance of infection (Dunn and Hazzard, 2019). This system has been commonly applied in self-monitoring plans for emphysema, hypertension, heart failure, and asthma, but less research literature is available concerning online medicine in Gastroenterological disorders (Van Deen et al. 2016; De Jong et al. 2017).

Patients with digestive disorders have shown good acceptability and pleasure in earlier telehealth publications, but the trials conducted and the size of the sample is still insufficient (De Jong et al. 2017; Helsel et al. 2018). Both organic and functional digestive conditions are most common in the general public, each third person had functional Gastrointestinal (GI) disorder, Ulcerative colitis (UC) are found in more than 500 individuals in a population of 100,000 and more than 322 out of 100, 00 patients are Crohn's disorder affected (Helin, 2021). GI diseases are a considerable weight on the healthcare sector due to their extensive prevalence and treatment problems. In other words, this burden will likely increase with the (i) rise in frequencies of both types of digestive disorders conditions and (ii) lack of progressively more complicated integrated intensive care systems for Gastrointestinal diseases (Aziz and Simrén, 2021; Yang et al. 2022). As a result, there is a need for economical techniques to supplement the conventional healthcare medical system. Currently, the net-based health medication which involves prescription delivered through the internet, support, and surveillance is one of the most appropriate approaches. Review studies on applications of Digital health systems have been published, but not in such detail as presented in this review as per the PRISMA guidelines (Knowles and Mikocka-Walus, 2014; Helsel et al. 2018). While pointing out the potential pros, the literature also stresses that there is a lack of literature on online health systems' effectiveness in the public medical community. Up to now, patients having acute digestive disorders were mostly treated through an online system (Cross and Kane, 2017), but COVID-19 offers a potential opportunity for Gastroenterologists and healthcare institutions to adapt to a virtual healthcare management system. The pandemic provides an edge to medical experts to change their physical consultation to an online system.

The psychological health field has done the most detailed investigation into the use of Digital health communication within medicine (Thilakarathne et al. 2020). Investigations revealed that virtual psycho-therapies have high benefits, time-effective and economical as compared to physical therapies (Cuijpers et al. 2017). Up to now, a certain number of researchers have identified the potential applications of online health systems in Gastroenterology and no such detailed systematic review has been assumed in this reading from the last few years. Considering the lack of precious literature on applications, efficiency, health outcomes, interventions, and results of Digital health systems in Gastrointestinal disorders, the systematic review was designed to fill these gaps and provide the information. The present research aims to (i)summarize the importance of internet-based health technologies to efficiently supervise Gastrointestinal disease movement, surveillance the signs, increaseacquiescence to the prescription method, and boost the doctor's and individuals' conversations (ii) Explore the library for recently reported mobile online health technology treatments focusing on digestive illness symptoms signs and administration, such as mobile apps, dynamic web, and other video calling approaches and (iii) to provide recommendations about future internet-based eHealth Gastroenterology interventions. Doctors, researchers, and biotechnologists will be able to better comprehend from these findings how the current internet-based Digital systems approach is being utilized with persons who have a complaint of a Gastrointestinal disorder.

METHODOLOGY

Literature Search Strategy: The review was conducted as per the standard reporting requirements for systematic reviews and meta-

analyses (PRISMA). The exploration was carried out as per the PRISMA protocol for systematic reviews (Moher et al., 2009). Electronic databanks Google Scholar, PubMed, and Web of Science were used for searching all the terminologies related to applications of digitization in Gastroenterology using predefined literature published before 25th April 2022. The search took place from 1st March to 30 April 2022. Furthermore, we took into consideration the retrieved articles' references while trying to identify other potentially eligible publications. The findings were filtered using the titles and abstracts of the results. Duplicate articles were removed. Different types of keywords in various orders allied with the digestive system disorders were used such as,

E-health applications in digestive disorders OR Gastroenterology OR Gastro-intestinal disorders Gastrointestinal disorders OR gastrointestinal ulcers/ Colon disorders OR Gastrointestinal infections/ Internet-based OR web-based uses in peptic complaints ORgastric complications OR inflammatory bowel/ web-based therapy OR online therapy/ vomiting/ colitis/ irritable bowel OR inflammatory bowel.

Internet-based technology uses in digestive disorders OR digestive infections/ utilization of online health services in Gastroenterology/ applications of Digital health system OR electronic health system OR virtual health system in digestive disorders/

The mobile health system uses in Gastroenterology OR medical apps in digestive system disorders OR Telemedicine in digestive system infections / medical health OR telehealth applications in Gastroenterology/ online patient record/ Digital health records.

Inclusion and Exclusion Criteria: In this systematic review, a total of 212 articles were searched, excluding duplicate records, 69 articles were founded out of which only fifteen were selected. Specific inclusion and exclusion criteria were established for all the searched articles. Articles that conceded the criteria were included in the study. Such as research conducted on child patients (under 18) was excluded. Furthermore, Like reports or articles published in a language other than English were not included: since translating these manuscripts will be unfeasible. Non-English-language articles/reports were removed since translating the papers proved unfeasible. Owing to the difficulty in examining such documents, no dissertations, communications, or unreported findings were included. Studies with ambiguous pertinent data were also ruled out. Studies having unclear results were also not included in the review.

Data Extraction and Quality Assessment: The following data were abstracted from each study, such as available guidelines and protocols used, updated years, targeted patients characteristics, age group, organization and level of evidence, sample size, and outcomes. The two authorsautonomouslystudied all the headings, titles, and summaries and grasped a result about the manuscripts which passes the inclusion criteria. Consequently, the full-text papers were retrieved. As a result, the articles having full-text were fetched. The final assessment of the studies was determined after examining the articles and double-checking their bibliographies.

RESULTS

Demography of the Publications: The databases and non-indexed guidelines searched reported212 publications and reports records. After excluding 143 identical searches, 69 articles were identified. Carefully examine their titles, headings, abstracts, and guidelines as per the fixed inclusion and exclusion criteria (pilot studies and unrelated studies, incorrect sittings, improper guidelines, suspicious research designs, language posters,s, and blurred data) further 54 articles were eliminated and a total of 15 complete-text publications were selected for the applications of Digital health systems in Gastroenterological disorders. These guidelines were updated from 2009 to 2016 (Figure 1). All the data related to the patient's demography like age, gender, education, disorders, sample population, feedback, and study type were gathered from

the selected articles (Table 1). The clinical studies conducted by McCormick et al. and Halpert et al. were the only two non-randomized controlled trials, in which the patients are uniformly distributed in different disorders groups (McCormick et al. 2010; Halpert et al. 2010). The majority of the participants were computer literate and can operate Digital health systems (Table 1). All the patients were old age and have the age over 18 years. The patient's gender ratio was random, but in most of the studies, the majority were women (Halpert et al. 2010; Ljótsson et al. 2011a; McCombie et al. 2015). This unbalanced ratio also indicates that the majority of the studies were RCT in nature and have random patient selection processes. These clinical studies concentrated on Crohn's ailment (n=4), UC (n=5), and inflammatory bowel disease (n=6).

Digital Health System in Inflammatory Bowel Diseases: The incorporation of digital technologies in medical care is fluctuating rehearsal in Gastroenterology and other therapeutics and diagnostics fields. One of the main goals of online intervention strategies is to give patients important health records about the purpose of the sample preparation methods to increase adherence and overall quality of medical care and patient communication. While inflammatory bowel syndrome and its linked diseases are among one the long-lasting diseases which may take the advantage of advancements in digital health technologies. Ljótsson and his colleagues stated that Crohn's illness and UC are the two core customs with several linked symptoms like blood in stool, stomach pain, abdominal pain, and diarrhea (Ljótsson et al. 2010). In relation to the technique of intervention; McCombie et al. used a web-based self-administrated method in which the patients were randomly placed in a computerized cognitive behavioral therapy group (McCombie et al. 2016). The questions about IBD at 3 months were the key results and the depression, symptoms, and controlling strategies after 24 weeks were secondary results. In the intervention of Halpert et al., the patients were subjected to a 30 minutes online portal for 4 continuous days (Halpert et al. 2010). Patients who responded well to the assignment were declared as writing one and the others were dropped from the study. Cross and Finkelstein also perceived the patients with a primary 30 minutes training talk to know them about the working method of the equipment (Cross and Finkelstein, 2007).

In terms of conclusion, all the studies have clear summaries with the statement that significant improvement has been observed in the patient's reports after feedback, except that of McCormick et al. clinical trial in which no substantial alterations were identified amid the behavior and groups in waitlist after the treatment (McCormick et al. 2010). A reduction was observed in the IBS signs and disability, instinctual compassion, and boostedQoL at after the intervention checkups (Ljótsson et al. 2011b). The fallouts of Elkjaer et al. documented that more than 85% of individuals like to use this fresh online intervention (Elkjaer et al. 2010). When weight up to the standard cohorts, compliance with one month of acute therapy rose by around 30% in the city of Denmark and 45% in Irish. IBD awareness and conformance were dramatically increased in Denmark. Finding et al. in their study concluded that the novel technology allows patients to detect gut infection quickly and accurately, making it an important complement to surgeons' and patients' medical decisions (Vinding et al. 2016).

Digital Health System Outcomes: All the included studies have outcomes to indicate their intervention reliability and how to implement the novel Digital clinical care therapeutic and diagnostic approaches. All the techniques used in the review studies are challenging but the outcomes clearly show these new technologies may be effective in Gastroenterological ailments. Elkjaer et al. reported that their fresh internet-directed technique (http://www.constant-care.dk) is safe, realistic, and eco-costly (Elkjaer et al. 2010). It recovers the individual who has UC without boosting depression and sickness.

Table 1: Studies on Applications of internet based health systems in Gastro-enterological disorders.

Reference	Age (years)	Education	Gender	Disorder	N	Study type	Feed back	Intervention
McCombie et al. (2015)	18 to 65	Literate	199♀, 33♂	Chronic inflammation of the gastrointestinal tract	231	RCT	3 Months	Internet based a self-administered CCBT intervention for patients with IBD focused on coping with IBD
Hunt et al. (2009)	19 to 59	Literate and illiterate	44 ♀, 10 ♂	Abdominal pain occurring on at least 3 days per month over three month	54	RCT	3 Months	Randomized, controlled trial of a five week internet based cognitive-behavioral intervention
Halpert et al. (2010)	18 to 85	Literate	94 ♀, 62 ♂	Inflammatory bowel syndrome	156	NRCT	3 Months	Participants were to wrote for 30 min over 4 days. Those that completed the task were identified as the "writing Group". Who wrote for <4 days were defined as "Dropouts"
Cross and Finkelstein, (2007)	28 to 58	Literate	13 ♂, 12 ♀	Diarrhea and abdominal pain	25	RCT	6 Months	All patients received an initial 30-40-min instruction session during which they were taught how to operate the equipment. During the study, patients continued to receive usual IBD care in addition to the weekly home telemanagement System (HAT) sessions
Cross et al. (2012)	25 to 55	Literate	30♀, 17♂	Ulcerative colitis	41	RCT	12 Months	Participants answered though HAT regarding disease activity, adherence, side effects, and measured their weight weekly
McCormick et al. (2010)	14 to 46	Literate and illiterate	18♂, 13♀	Ulcerative colitis and Crohn's disease	31	NRCT	6 Months	Web-based skill review including homework assignments and weekly group chat sessions
Ljótsson et al. (2011a)	Average 48	Literate	154♀, 41♂	Irritable bowel syndrome	195	RCT	6 Months	10-week 5-module CBT-protocol was used. Participants had access via internet to student - therapist.
Ljótsson et al. (2010)	20-61	Literate	72♀, 13♂	Irritable bowel syndrome	85	RCT	-	10-week 5-module CBT-protocol based on a previously published group intervention
Ljótsson et al. (2011b)	Average 39 years	Literate	45♀, 16♂	Irritable bowel syndrome	61	RCT	12 Months	10-week 5-module CBT-protocol was used. Participants had access via internet to student therapist who provided feedback within 48 hours
Pedersen et al. (2012)	18 to 66	Literate and illiterate	10♂, 13♀	Crohns disease	23	RCT	3 Months	The inflammatory burden score was calculated, placing patients in the green, yellow or red zones of a 'traffic light' system
Elkjaer et al. (2010)	18 to 69	Literate	126♀, 59♂	Ulcerative colitis	211	RCT	6 and 12 Months	Web intervention: (a) 1.5 h disease psycho-education, and a presentation of IBD-specific information; (b) 1.5 h theoretical and practical training (c) the web patients were asked to log on to www. Constant-care.dk and follow the web Program's recommendation
Krier et al, (2011)	50 to 72	Literate and illiterate	26♂, 8♀	Inflammatory bowel disease	34	RCT	-	Control group on the basis of patient scheduling: telemedicine encounter clinic on weeks 2 and 4, and control standard encounter clinic on weeks 1 and 3. We did not have IBD clinic if there was a fifth week of the month
Vinding et al. 2016	20 to 84	Literate and illiterate	46♂, 69♀	Ulcerative colitis and Crohn's disease	221	RCT	6 Months	Patients were instructed at inclusion and had a video guide of the procedure as support. When using CalproSmart at home, patients also sent in 2 fecal samples to be analyzed by ELISA
Arteja et al. (2015)	-	Literate	-	Inflammatory bowel disease	300	RCT	24 Months	Collaborative decision making and quality improvement interventions at the point of care. Patients will enter data at baseline, during office visits, and at the end of the study but will not receive any decision support.
Sainsbury et al. (2013)	30 to 60	Literate	165♀, 24♂	Ulcerative colitis and Crohn's disease	189	RCT	3 Months	6-module program (one module lasting 30 min/week) comprising sessions on celiacdisease information.

The study of Hunt et al. resulted that their novel virtual clinical trial composed of effective conversation between patient and doctor and a system to regulate the waiting list and follow-up in the intervention system (Hunt et al. 2009). Vinding et al. also concluded that eHealth is a consistentsubstituteforphysical examination and offers novel methods for nursing individuals (Vinding et al. 2016). However, due to its interdisciplinary approach (combination of medical science and technology) future development will be crucial and must be handled with extra care.

DISCUSSION

The utilization of internet-based health technologies can be a potential store to aid people who are suffering from several digestive disorders. However, due to the lack of precise and advanced Digital tools studies on patients having Gastrointestinal problems are limited as compared to other patients having other disorders. The review was designed to explore the applications of internet-based health technologies in Gastroenterology and to provide suggestions for electronic health interventions. Despite the diversity of conclusion metrics, electronic health interferencesseemhopeful, and it has been stated that about 21%

of cases in higherreferralhubs can now be managed remotely (Helsel et al., 2018). As documented in a current review Digital healthcare interventions have generated constant improvements in the patient's quality of life. The methodologies used in electronic healthcare systems have strong relation with the disease activity but still, there is some conflicting relation observed with disorder sub-kind and severity of the disorder (Stone and Gibbons, 2018). Most of the research studies or clinical trials on applications of eHealth interventions have mostly Ulcerative colitis patients cases rather than Crohn's disease patients. The reason is that UC symptoms and nature is less complex and is non-corticosteroid thereby increasing the chances of Digital health intervention (Kopylov et al. 2015).

Digital healthcare efficacy and feasibility are mostly linked to the severity of a disease. Cross and his colleagues describe this as a negative contributing element in the web-based intervention outcomes. His study shows that the higher the baseline disorder severity so greater will be the immune-modulator utilization in the Digital intervention (Cross et al. 2012). The clinical trials conducted by Elkjaerhave patients with steady disorder and those patients which tumor necrosis factor inhibitors were excluded from the study (Elkjaer et al. 2010). Research conducted by Helsel and his group is in line with the present review findings, due to the consultation time with a healthcare doctor. His findings also revealed that Digital heath systems may be beneficial in patients who are diagnosed with irritable bowel syndrome or with inflammatory bowel disorders (Helsel et al. 2018). Besides online intervention, there are many challenges in the registration and treatment steps. Most of the studies don't include biological indicators of disorders' activity because telemedicine systems are designed to swiftly and accurately evaluate complaints to aid illness management (Marques et al. 2021). Moreover, several studies had had very small sizes in terms of patients, and the clinical trials with havingmaximumsamplesdid not have an assortment of disorders sternness (Huang et al. 2018). Studies having online interventions have a high bias in selection because all the patients are willing and know how to operate this technology (Polunina et al. 2020). Furthermore, people living in remote or dense populated areas may lack smartphone services and have slow-speed connectivity (Knapp et al. 2021). Helsel and his colleagues also described that all the patients were satisfied with the online intervention protocol irrespective of their study design (complete randomized design) (Helsel et al. 2018). Since, the emergence of the COVID-19 outbreak the utilization of Digital health management experienced an increase of 4000 times in the first fourteen days of the Gastroenterological problems as compared to the last six years' data (Perisetti and Goyal, 2019). Online or video call consultations offer immediate and easy treatment and less expose the patient by preserving individual protective apparatus. Online medical consultation provides an opportunity to improve disease surveillance and the patient's life quality having digestive disorders. The study concludes that patients' encouragement to pursue virtual healthcare facilities remotely with tools and boosting Digital learning without the help of corporeal checkups is a challenge, however despite such challenges such techniques have a high success ratio in the healthcare system.

Conclusion and Novelty Perspectives: Owing to the limited health resources and increasing healthcare demands, the applications of electronic health apps in Gastroenterologyare increasing day by day and becoming more prominent. Patients appear to find eHealth therapies to be very acceptable, although they may have a lower preservation rate. This study guides medical researchers and Gastroenterologists on current techniques to treat patients with digestive disorders, as well as a roadmap for upcoming studies designed to expandGastrointestinaldisorderssignssupervision via online systems or Digital healthcare interventions. Most of the patients in these trials are females, educated, and have inflammatory bowel diseases. These clinical studies concentrated on IBD (n=6), Crohns disorder (n=4), and Ulcerative colitis (n=5) with feedback of mostly 3 months (n=5) and 6 months (n=5). Only a few studies have looked into the possible uses of electronic health internet systems in Gastrointestinal disorders with the risk of bias assessment so far, and no systematic review has been done in this area over the last few years.

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Abbreviations: Gastrointestinal (GI); Ulcerative colitis (UC); Inflammatory bowel disease (IBD); Crohn's disease (CD); Inflammatory bowel syndrome (IBS); (Randomized control trials (RCTs); Cognitive behavioral therapy (CBT); Quality of life (QOL);

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