

A Review of e-Health Research in Information System

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ABSTRACT

e-Health—a new form of health care service using information technology—has received a great deal of academic attention in the past. What can we learn from these prior studies? This article analyses the development of prior work using the scientific literature related to e-Health from the Web of Science core database. Our systematic review suggest that: 1) IT adoption is the most important research topic in this field, 2) Research methods are growing in diversity, 3) Research topics are reasonably differentiated.

1. INTRODUCTION

e-Health, defined as a new form of health care service that enables medical processes such as remote treatment, recovery and healthcare through the use of internet technology [1, 2]. Originally from the 1990s, e-Health has been becoming an essential ICT application in recent years as the Internet grows in popularity. Numerous scholars conducted substantial research on e-Health, covering a wide range of disciplines including medicine, information technology, psychology and behavioral science.

In the field of Information Systems, early research focused on the improvement of artifacts, with topics such as “Technology Acceptance”, “IT adoption” and “user engagement”. With the sophistication of healthcare services, various types of e-Health service platforms with different subjects have emerged. Accordingly, differentiated and diversified research has dominated in recent years.

The goal of this review is to provide a bibliographic lens to e-Health research in the field of Information Systems. This paper investigates relevant research, analyses the development of prior studies, reveals the current state and suggests an informative guide for future research.

2. STUDY DATA AND METHOD

We developed an effective information retrieval strategy for data collection. The term “e-Health” has a considerable number of synonyms, such as “online medical”, “mobile health”, “remote healthcare”. The studies related to these keywords are substantially close to “e-Health”. Therefore, in order to avoid redundancy, only “e-Health” was used as the only keyword for the literature search in this study. We have also

restricted the subject of the article. There are many disciplines involved in related papers as e-Health is an interdisciplinary research topic. In this study, only three closely related areas of information systems were selected to filter the search results.

In our survey of studies for review, we included any research method evaluation of information technology affecting e-Health. We did not include studies before 2004 because technology application has changed dramatically and other reviews exist [3, 4].

Therefore, we searched “e-Health” on the core collection of “Web of Science” platform for the period 2004 to 2021, limiting the article subject to 1) computer science, 2) information science library science 3) communication. Searches retrieved 1344 articles in March 2022.

For each article, the author, title, abstract and bibliographic citations are recorded. We used CiteSpace to analyze the citation networks of these articles and to map the visualization. Some representative studies were found from the citation networks. We analyzed the relevant literature statistically and listed the highly cited articles to give an overview of the research hotspots over time.

3. ANALYSES

3.1. Time Distribution

The time distribution of relevant papers is presented in [Figure 1](#). The number of research papers in the field of e-Health represents an increasing momentum. The research arose in the mid-1990s with the progress of information technology. Prior to 2010, healthcare-related applications were not yet widespread and research was scattered, leading to an unimpressive research phenomenon. However, after 2010, with the ongoing advancement of Internet technology, especially the widespread use of mobile devices, the number of e-Health papers has increased incrementally.

3.2. High Centrality Research

We analyzed the citation network in CiteSpace. We list 11 high Centrality literature in [Table 1](#). According to the citation analysis, we found the technology acceptance model (TAM) is the most discussed term in this field [5]. As a new type of information system, e-Health received a great deal of attention from academics and a lot of research has been directed towards its adoption. Prior work has often found that users reactions to health information technology are difficult to classify, as Holden and Karsh [5] found that certain Technology Acceptance Mode (TAM) relationships were consistently found to be significant, whereas others were inconsistent. Meanwhile, some studies, based on TAM, found that the redistribution of tasks and responsibilities to patients in their daily lives requires more attention [6].

In addition, the most influential group of articles are reports [7]. The high citation of these articles indicates that the researcher places more interest on the current state of e-Health and aims to combine research with industry. For instances, Kummervold, Chronaki [7] investigated trends and patterns of European health-related Internet use over a period of 18 months, and found the importance of the Internet as a source of health information increasing compared to other traditional sources. Their research also noticed that a growing number of people are using e-Health for more interactive services than just reading health information. Kontos, Blake [1] focus on addressing communication inequalities and persistent disparities in health. Their study statistically analyzed eHealth use by sociodemographic factors, such as race/ethnicity, socioeconomic status (SES), age, and sex.

Some studies suggest that Meta-Analysis can be particularly helpful for addressing research question in e-Health [8, 9]. E-Health is typically information intensive, and Meta-Analysis afford researchers the ability to conveniently addressing research questions. Andersson and Cuijpers [8] concluded from the meta-analysis that Internet and other computerized treatments hold promise as potentially evidence-based treatments of depression. And Andrews, Cuijpers [10] reviewed evidence through a meta-analysis that computerized CBT for the anxiety and depressive disorders is acceptable to patients and effective in the short and longer term.

Table 1. High centrality research.

Centrality	Year	Authors	Article Title
0.32	2010	Holden, R. J., & Karsh, B. T.	The technology acceptance model: its past and its future in health care
0.22	2010	Webb, T., Joseph, J., Yardley, L., & Michie, S.	Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy
0.03	2009	Andersson, G., & Cuijpers, P.	Internet-Based and Other Computerized Psychological Treatments for Adult Depression: A Meta-Analysis
0.19	2008	Kummervold, P., Chronaki, C., Lausen, B., Prokosch, H. U., Rasmussen, J., Santana, S., ... & Wangberg, S.	eHealth trends in Europe 2005-2007: a population-based survey
0.13	2014	Kontos, E., Blake, K. D., Chou, W. Y. S., & Prestin, A.	Predictors of eHealth usage: insights on the digital divide from the Health Information National Trends Survey 2012
0.04	2013	Ricciardi, L., Mostashari, F., Murphy, J., Daniel, J. G., & Siminerio, E. P.	A national action plan to support consumer engagement via e-health
0.07	2011	Eysenbach, G., & Consort-EHEALTH Group.	CONSORT-EHEALTH: improving and standardizing evaluation reports of Web-based and mobile health interventions
0.24	2011	Dedding, C., Van Doorn, R., Winkler, L., & Reis, R.	How will e-health affect patient participation in the clinic? A review of e-health studies and the current evidence for changes in the relationship between medical professionals and patients
0.07	2007	Andreassen, H. K., Bujnowska-Fedak, M. M., Chronaki, C. E., Dumitru, R. C., Pudule, I., Santana, S., ... & Wynn, R.	European citizens' use of E-health services: a study of seven countries
0.03	2014	Andersson, G., Cuijpers, P., Carlbring, P., Riper, H., & Hedman, E.	Guided Internet-based vs. face-to-face cognitive behavior therapy for psychiatric and somatic disorders: a systematic review and meta-analysis
0.05	2010	Andrews, G., Cuijpers, P., Craske, M. G., McEvoy, P., & Titov, N.	Computer therapy for the anxiety and depressive disorders is effective, acceptable and practical health care: a meta-analysis

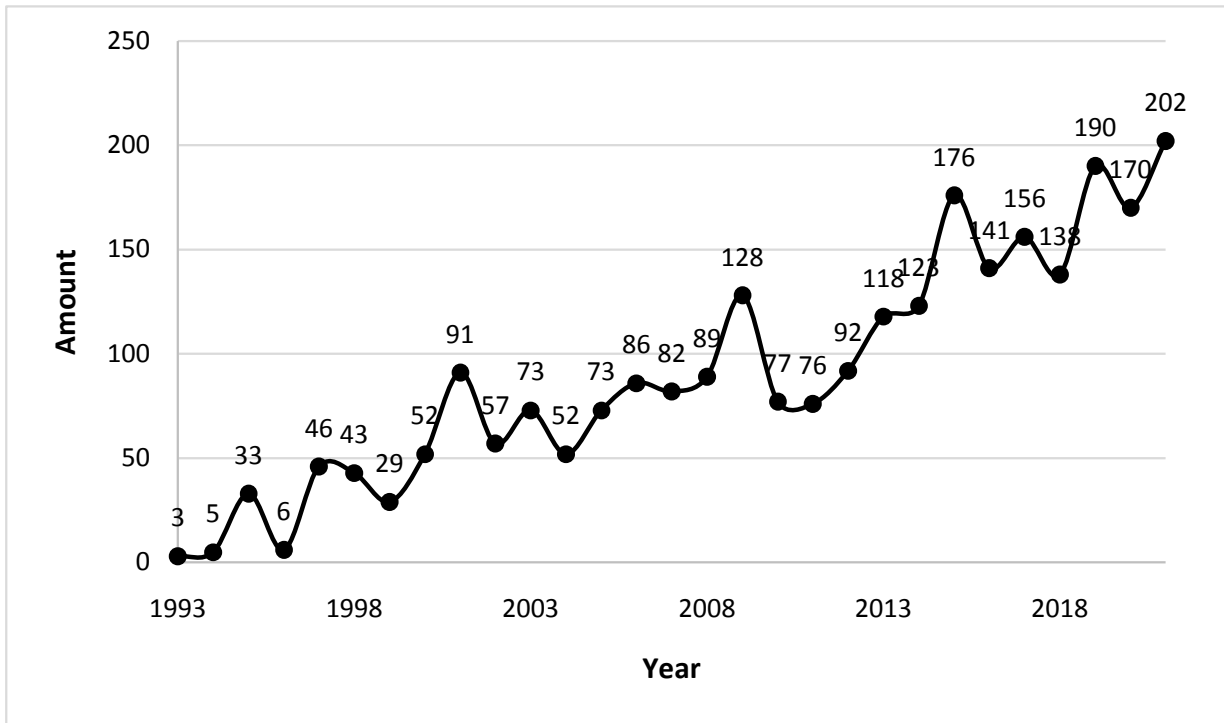


Figure 1. An illustration of relevant papers number over time. Source: Web of Science Core Database.

3.3. The Most Cited Research before 2017

Articles with any data deficiencies were excluded. After the careful screening of article content, we found 10 most cited articles that appeared relevant. They are listed by cited times in [Table 2](#) and are summarized the research themes.

“IT adoption” and “Technology Acceptance” were the most prominent themes studied until 2017 [11, 12], its research objective continues to be the improvement of the user experience on e-Health platforms. In this sense, these studies and another group of studies focusing on “Patients’ experiences” could both be labelled as “e-Health promoting” research. For example, [12] explored which factors influence the level of use of various types of technology by older adults and to describe these factors in a qualitative field study. Similar research objectives are also featured in [13], they describe the mission of the “e-Health” study as: to increase patient engagement, improve individual health, and achieve broader health care system improvements.

Research in this period has featured a number of innovations. For example, in addition to qualitative and quantitative methods, randomized controlled experimental methods have also gain prominence [14]. Some attention has also been paid to emerging technologies such as Wearable Sensor [14], cloud computing [15] and minority issues [16]. Overall, the research during this period laid the foundations of e-Health and signalled the future path of the discipline.

3.4. The Most Cited Research in Recent 5 Years

In recent 5 years, e-Health research has been further carried forward and developed. We list the most 8 cited literature in [Table 3](#).

The most common research topics remain well received [17]. TAM keeps acting as a channel for e-Health adoption research can enhance the explanatory of patients’ decision-making mechanism in exchange of clinical information.

Table 2. The most cited research before 2017.

Authors	Year	Article Title	Times Cited	Theme
Andreassen, HK; Bujnowska-Fedak, MM; Chronaki, CE; Dumitru, RC; Pudule, I; Santana, S; Voss, H; Wynn, R	2007	European citizens' use of E-health services: A study of seven countries	383	Internet use; Survey;
Ziebland, S; Wyke, S	2012	Health and Illness in a Connected World: How Might Sharing Experiences on the Internet Affect People's Health?	279	Patients' experiences; Review;
Tung, FC; Chang, SC; Chou, CM	2008	An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS non the medical industry	234	IT adoption; TAM; Trust; Perceived financial cost;
Wilson, EV; Lankton, NK	2004	Modeling patients' acceptance of provider-delivered e-health	195	IT adoption; TAM; Modeling;
Ricciardi, L; Mostashari, F; Murphy, J; Daniel, JG; Siminerio, EP	2013	A National Action Plan To Support Consumer Engagement Via E-Health	184	Patient engagement; Consumer e-health;
Peek, STM; Luijkx, KG; Rijnaard, MD; Nieboer, ME; van der Voort, CS; Aarts, S; van Hoof, J; Vrijhoef, HJM; Wouters, EJM	2016	Older Adults' Reasons for Using Technology while Aging in Place	163	Older people; Technology acceptance;
Riper, H; Spek, V; Boon, B; Conijn, B; Kramer, J; Martin-Abello, K; Smit, F	2011	Effectiveness of E-Self-help Interventions for Curbing Adult Problem Drinking: A Meta-analysis	160	eHealth interventions; Bibulosity;
Sultan, N	2014	Making use of cloud computing for healthcare provision: Opportunities and challenges	156	Cloud computing; Case study;
Wang, JB; Cadmus-Bertram, LA; Natarajan, L; White, MM; Madanat, H; Nichols, JF; Ayala, GX; Pierce, JP	2015	Wearable Sensor/Device (Fitbit One) and SMS Text-Messaging Prompts to Increase Physical Activity in Overweight and Obese Adults: A Randomized Controlled Trial	153	Sensor technology; Obese; Randomized controlled;
van der Vaart, R; van Deursen, AJAM; Drossaert, CHC; Taal, E; van Dijk, JAMG; van de Laar, MAFJ	2011	Does the eHealth Literacy Scale (eHEALS) Measure What it Intends to Measure? Validation of a Dutch Version of the eHEALS in Two Adult Populations	149	eHealth Measurement; Validation;

Table 3. The most cited research in recent 5 years.

Authors	Year	Article Title	Times Cited	Theme
Wind, TR; Rijkeboer, M; Andersson, G; Ripper, H	2020	The COVID-19 pandemic: The “black swan” for mental health care and a turning point for e-health	246	Mental health; Internet interventions;
Yildirim, O; San Tan, R; Acharya, UR	2018	An efficient compression of ECG signals using deep convolutional autoencoders	81	Neural networks; Data transfer;
Bol, N; Helberger, N; Weert, JCM	2018	Differences in mobile health app use: A source of new digital inequalities?	77	Digital inequalities; User characteristics analysis;
Hoque, MR; Bao, YK; Sorwarb, G	2017	Investigating factors influencing the adoption of e-Health in developing countries: A patient’s perspective	68	IT adoption; TAM; Patient
Walker, DM; Hefner, JL; Fareed, N; Huerta, TR; McAlearney, AS	2020	Exploring the Digital Divide: Age and Race Disparities in Use of an Inpatient Portal	54	Digital inequalities; Race and Age;
Bygstad, B	2017	Generative innovation: a comparison of lightweight and heavyweight IT	51	Generative innovation; Case study;
Rexhepi, H; Ahlfeldt, RM; Cajander, A; Huvila, I	2018	Cancer patients’ attitudes and experiences of online access to their electronic medical records: A qualitative study	45	IT adoption; EMR; Case study;
van der Meij, E; Anema, JR; Leclercq, WKG; Bongers, MY; Consten, ECJ; Koops, SES; van de Ven, PM; Terwee, CB; van Dongen, JM; Schaafsma, FG; Meijerink, WJHJ; Bonjer, HJ; Huirne, JAF	2018	Personalised perioperative care by e-health after intermediate-grade abdominal surgery: a multicentre, single-blind, randomised, placebo-controlled trial	42	Recovery; Randomised controlled trial;

Yet, while IT adoption and Technology acceptance still dominating, previously rare research topics, such as digital inequality, have been moving into vogue. For instance, Bol, Helberger [18] found systematic differences in mobile health app users and non-users. Specifically, mobile health app users were generally younger, higher educated, and had higher levels of e-health literacy skills than non-users. [19] showed solicitude for race disparities. They found African American patients used e-Health portal less than White patients and suggested additional intervention may be needed to close the digital divide.

Other rising themes include the far-reaching COVID-19 in recent years, with scholars highly concerned about its impact on social structures and psychology [20]. Their research also pays attention to mental health, which is another increasingly familiar research topic in the field of e-Health.

4. CONCLUSIONS

This systematic analysis of the relevant literature in e-Health leads us three instructive findings.

1) IT adoption is the most important research topic in this field. TAM is the most widely practiced research model and a large number of studies have been conducted based on it. This topic is expected to remain active as technology continues to change and innovate.

2) Research methods are growing in diversity. Quantitative research exclusively leads the field, while exploratory qualitative research is increasingly emerging as more scholars embrace interpretivism. The two constitute the main methods to research in e-Health, but tools such as randomized controlled experiments and machine learning techniques lend more flexibility to research depending on the research question.

3) Research topics are reasonably differentiated. There is a proliferation of different online health communities with different focuses. e-Health involves many disciplines and there are knowledge barriers between each other's research, posing a challenge to the formation of a scientific community of e-Health research.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

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