## **E-Health in Southeast Asia**

#### Subjects: Management

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eHealth or digital health innovations expanded tremendously during the COVID-19 pandemic. Innovation and digitalization offer creative solutions to build up a healthy society. The eHealth technologies are quickly taken up by Southeast Asia countries and continue to flourish to alleviate the burden of healthcare challenges.

e-health bibliometric review electronic health

### 1. Introduction

In the contemporary era, the world has been disrupted by digital technologies. With no exception in the healthcare industry, innovation and digitalization deliver promising solutions to build up a healthy society by fostering equitable, affordable, and universally accessible healthcare <sup>[1][2]</sup>. Since 2005, the World Health Organization has encouraged nations to use digital health strategies in their health system <sup>[3]</sup>. With the proper implementation, digital health technologies can escalate the progress toward Universal Health Coverage and health-related Sustainable Development Goals <sup>[2][4]</sup>.

The term "eHealth" denotes the digital health technologies or the use of emerging information and communication technologies (e.g., Internet, artificial intelligence, big data, mobile device) to improve health and the healthcare system <sup>[5][6][7]</sup>. There are several subdomains under its broad scope, including telehealth, telemedicine, mHealth, wearable healthcare devices, health information technologies, and robotic and personalized medicine <sup>[8][9]</sup>. These technologies have significantly dominated the health system by connecting patients, families, and healthcare providers and enhancing patient-centered care delivery. The world is also receiving help from eHealth to solve the increasing healthcare demand by the aging global population.

Moreover, the recent COVID-19 pandemic highlighted the benefits of telemedicine and other forms of e-medical care <sup>[10][11]</sup>. Given the rapid spread of the coronavirus from person to person during the COVID-19 pandemic, hospitals are overwhelmed with virus-infected patients. Governments imposed large-scale lockdowns across the countries to reduce social contact and further spread the virus. However, the news reported that these extensive lockdown measures inflicted the health system as patients cannot easily and timely access the healthcare providers. Thereby, eHealth technologies are mushrooming as they can alleviate the tremendous burden on medical resources and minimize the amount of person-to-person contact required for treatment <sup>[12][13][14]</sup>.

In Southeast Asia, the enhancement of the eHealth strategy was designated as one of the significant public service priorities by the ASEAN Digital Master Plan 2025 <sup>[15]</sup>. Southeast Asian countries are increasingly taking up eHealth

services. Furthermore, eHealth's implementation fulfills consumers' rising demand for better healthcare services, especially amid the COVID-19 pandemic [16][17][18][19].

# 2. Intellectual Structure of the eHealth Literature in Southeast Asia

Co-citation analysis measures the similarity between authors, documents, or journals in the field of study. It refers to the frequency with which two units are cited together. The fundamental assumption underlying this analysis is that the more two items are co-cited, the more likely their content is related <sup>[20][21]</sup>. By using VOSviewer software, this bibliometric review conducted author co-citation analysis (ACA) to identify the intellectual structure of eHealth in Southeast Asia.

**Table 1** presents the highly co-cited authors in the eHealth in Southeast Asia literature. In addition, **Figure 1** illustrates the ACA map by using the VOSviewer setting at a threshold of at least 23 author co-citations, which yielded a display of 86 scholars on the co-citation map. The size of the bubbles indicates the co-citation frequency. The larger the bubble means, the greater the scholars' influence in the field of eHealth in Southeast Asia. The colored clusters represent schools of thought, which are the collection of items with similar theoretical perspectives and research interests. There are four distinct, coherent schools of thought in the literature on eHealth in Southeast Asia: "technology for healthcare and disease management" (red cluster with 39 items), "analysis and adoption of hospital information system/eHealth records" (green cluster with 22 items), "user intention and acceptance of information technology" (blue cluster with 15 items), and "m-Health" (yellow cluster with ten items).



**Figure 1.** Four clusters representing the intellectual structure of eHealth in Southeast Asia (Threshold 23, Display 86 Authors).

**Table 1.** Highly co-cited authors in eHealth in Southeast Asia.

Rank	Author	Nation	<b>Co-Citation</b>	Topical Focus
1	Davis, F.D.	United States	112	User intention and acceptance of IT
2	Venkatesh, V.	United States	75	User intention and acceptance of IT
3	Li, Y.C.	Taiwan	70	Technology for healthcare and disease management
4	Lee, J.Y.	United States	58	Technology for healthcare and disease management
5	Free, C.	United Kingdom	53	m-Health
6	Ajzen, I.	United States	50	User intention and acceptance of IT
7	Hair, J.F.	United States	46	Analysis and adoption of hospital information system
8	Ringle, C.M.	Germany	45	Analysis and adoption of hospital information system
9	Bates, D.W.	United States	44	Analysis and adoption of hospital information system
10	Lee, S.H.	United Kingdom	44	Technology for healthcare and disease management
11	Wang, Y.	Canada	44	Technology for healthcare and disease management
12	Wang, J.	United States	42	Technology for healthcare and disease management
13	Wang, W.	Singapore	41	Technology for healthcare and disease management
14	Zhang, Y.	China	41	Technology for healthcare and disease management
15	Delone, W.H.	United States	US	Analysis and adoption of hospital information system
16	Sarstedt, M.	Germany	39	Analysis and adoption of hospital information system
17	Zhang, J.	Singapore	38	Technology for healthcare and disease management
18	Li, H.	Finland	36	Technology for healthcare and disease management
19	Li, J.	Australia	36	Technology for healthcare and disease management
20	Zaidan, A.A.	Malaysia	36	Analysis and adoption of hospital information system

The red cluster represents the technology for healthcare and disease management. Scholars associated with this school of thought investigated the factors related to the adoption and management of computer science and technology for health, physical activities, and disease management <sup>[22][23][24][25][26][27]</sup>. This is the biggest cluster, and many top co-cited authors (such as Li, Y.C., Lee, J.Y., Lee, S.H., Wang, Y., Wang, J., Wang, W., Zhang, Y., Zhang, J., Li, H., and Li, J.) are involved in this cluster. Studies of authors in this cluster highlighted that adopting eHealth technologies needs financial support and trust, organization structural support, leadership, and knowledge-sharing capacity <sup>[22][23][26][27]</sup>. These findings provide valuable implications for practitioners and researchers interested in adopting eHealth technologies.

The green cluster researches the "analysis and adoption of hospital information system/eHealth records". Scholars working within this school of thought have studied frameworks for decision-making and adopting the hospital information system (HIS) at the organizational level <sup>[28][29][30][31]</sup>. Popular theories by these authors are the DeLone and McLean Model of information systems success <sup>[30]</sup> and the Technology–Organization–Environment–Human framework <sup>[28]</sup>. These theories were foundations for adopting hospital information systems research in Southeast Asia. In addition, Hair et al., who introduced multivariate data analysis <sup>[32]</sup>, are also included in this cluster. Due to the centrality of his node position in the cluster, it may be interpreted that scholars frequently adopt this quantitative method in empirical research of hospital information system adoption.

The blue cluster studies "the user intention and acceptance of information technology", included scholars such as Davis, Venkatesh, Ajzen, Agarwal, and Fishbein <sup>[33][34][35][36][37]</sup>. These scholars were linked because their research examines individual users' attitudes, perceptions, and acceptance of IT adoption. Davis and Venkatesh, located in this cluster, were the top two co-cited authors in **Table 1**. Davis is the pioneer in developing the user acceptance of technology theory <sup>[35]</sup>. Venkatech collaborated with Davis and colleagues to build the UTAUT model, which is very useful for scholars, policymakers, and technology developers to determine the user acceptance of IT <sup>[37]</sup>. The findings of the top-cited document also suggested that the UTAUT model could be applied to health technology in Thailand <sup>[38]</sup>.

Finally, the yellow cluster can be termed "m-Health". This group is the smallest of the four schools of thought. However, it has a distinct character because this group of scholars has investigated the use of mobile health technologies or text messaging to deliver health promotion or control public health problems <sup>[39][40][41]</sup>. Along with the exponential increase in the number of mobile phone users in both high- and low-income countries, mobile phones are widely used in health information and healthcare delivery <sup>[42]</sup>. In Southeast Asia, m-Health has been used via text messaging or smartphone applications to remind health service appointments, to deliver messages for medication adherence, to prevent unhealthy activities such as smoking cessation, to assist in monitoring and self-management of chronic disorders such as hypertension and diabetes <sup>[42][43][44][45][46]</sup>.

To summarize, co-citation analysis revealed four major schools of thought involved in the literature on eHealth in Southeast Asia from 1975 to 2021. This result can be used to analyze the evolution of the academic field in future studies.

## 3. Topical Foci of the eHealth in Southeast Asia Knowledge Base

Keyword co-occurrence analysis, also called co-word analysis, identifies key themes and topics within the eHealth in Southeast Asia knowledge base. Co-word analysis frequently identifies co-occurring words in the titles, abstracts, and indexes of documents in the review database <sup>[20]</sup>. This analysis would offer insight into broad topical trends within the literature.

**Figure 2** shows the density map of the most frequently occurring keywords in the literature: healthcare delivery (316), telemedicine (308), health information system (243), medical information system (164), m-health (162), electronic health record (141), geographical information system (135), public health (124), hospital (120), elderly (115), organization and management (105), and covid-19 (100). These frequently occurring keywords offer insight into the subjects of studies that describe the eHealth in Southeast Asia knowledge base since its emergence in the past four decades.



Figure 2. Keyword density heat map of the eHealth in Southeast Asia literature, 1975–2021 (Threshold 25 Occurrences, Display 94 Keywords).

In the next step, a temporal co-word map was generated in VOSviewer using a threshold of at least 25 occurrences (**Figure 3**). It synthesizes the time distribution of keywords based on the document publication date. The difference in colors indicates the different timeframe. Purple/darker bubbles are associated with topics popular in the earlier periods. In contrast, yellow/lighter-shaded bubbles are associated with the most recent topics in this research database.



**Figure 3.** The temporal co-word map of the eHealth in Southeast Asia literature, 1975–2021 (Threshold 25 Occurrences, Display 94 Keywords).

The biggest bubbles, such as "healthcare delivery", "telemedicine", "health information system", have darker colors, meaning that they were popular keywords in the earlier periods. However, this temporal co-word map also presents recent topics in the eHealth literature. The term "m-Health" is shown in the lighter bubble, and it is a relatively new topic emerging after the year 2018. Recent topics of interest among scholars are keywords such as "mobile application", "social network", "covid-19", "pandemic", "patient referral", "follow up", "self-care", "quality of life", "psychology", "diabetes mellitus", and "hypertension". These findings, thus, confirm that the recent public health outbreak, the COVID-19 pandemic, accelerated the usage and application of new health technology in Southeast Asia, especially mobile health technology.

After the World Health Organization announced COVID-19 as a global pandemic in 2020, the world was alarmed by its rapid spread. Governments imposed large-scale lockdowns across the countries to reduce social contact and further spread the virus. The effect of this extensive lockdown is the acceleration of death by other diseases such as diabetes mellitus, hypertension, heart attack, and stroke because patients cannot easily and timely access healthcare providers. This issue highlighted the benefits of m-Health, telemedicine, and other forms of e-medical care to support and treat patients <sup>[10][11]</sup>. m-Health is defined as medical or public health practice supported by mobile devices <sup>[47]</sup>. m-Health is widely used to ensure patients connect with their healthcare providers virtually. They are integrated into medical treatment, such as daily monitoring of chronic diseases, psychological support for mental health, health promotion, enabling home care, and consequently enhancing the quality of life of people.

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