

Review

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A scoping review of digital health interventions for cardiovascular diseases in the WHO South-East Asia region

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Abstract

Digital health interventions for managing Non-Communicable Diseases, specifically cardiovascular diseases, are gaining momentum in Low-Middle-Income countries (LMICs), notably in the South-East Asia region. The effective implementation of these interventions hinges on their ability to effectively cater to user needs within the healthcare system. Our objective is to examine the usage of digital health approaches or modalities. A scoping review was conducted using PUBMED and SCOPUS databases, and the findings were synthesized narratively using the WHO's Digital Health Intervention (DHI) framework. The initial search yielded 1,505 articles, of which 51 met our inclusion criteria. In terms of the target users for digital health applications, providers remain the major focus, while other stakeholders such as data managers and health system managers remain neglected. Even within "provider-focused" applications, telemedicine dominates in the functionality aspect. Further, few applications addressed client issues such as client-to-client communication, personal health tracking, and the client's financial transactions. Few applications address the needs of data managers and health system managers. Moving forward, member countries in South-East Asia would benefit from digital health applications that specifically target data services and health system managers. For clients, functionalities such as personal health tracking, active data capture, citizen-based reporting, on-demand information services, and peer groups are required. For healthcare



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providers, features such as access to longitudinal client health records, decision support systems, referral coordination, prescription, and medication management, as well as laboratory and diagnostic imaging management, should be seamlessly integrated into existing digital health applications.

Keywords: Digital health interventions, telehealth, cardiovascular diseases, telemedicine, South-East Asia

INTRODUCTION

The South-East Asian (SEA) region is grappling with a dual burden of disease, encompassing infectious diseases and Non-Communicable Diseases (NCDs). Cardiovascular diseases account for 3.9 million deaths annually in the region, which equates to 43% of deaths caused by NCDs (9 million deaths) based on the 2019 WHO SEA region estimates for cardiovascular diseases^[1,2]. In 2019, 38% of the 17 million premature deaths attributed to non-communicable diseases were linked to cardiovascular diseases (CVD) in India^[3]. In Indonesia, a third of reported deaths were due to CVD^[4]; further to the west, Nepal has experienced a significant surge in CVD-related deaths, with all-age mortality rates rising from 111.1 deaths per 100,000 population in 1990 to 152.8 deaths per 100,000 population in 2019^[5].

Ensuring timely access to healthcare is pivotal for effective healthcare service delivery to individuals with cardiovascular diseases^[6,7]. Geographical and economic disparities hinder timely healthcare services^[8]. Moreover, the uneven distribution of healthcare specialists impacts care quality in rural, underserved areas^[9]. Given the constraints exacerbated by events like the COVID-19 pandemic, it is vital to adopt innovative, sustainable, and equitable health interventions^[10].

In a recent evaluation of digital healthcare advancements for managing non-communicable diseases (NCDs) amid the COVID-19 pandemic, it was found that telemedicine emerged as the most widely employed digital health innovation for NCD management, with a usage rate of 93%^[11]. In this context, digital health applications have gained global traction for education, treatment support, remote data collection, and diagnostics^[12,13]. Telehealth encompasses the "delivery and facilitation of health services via telecommunications and digital communication technologies," including live video conferencing, mobile health apps, and remote patient monitoring (RPM)^[13]. Remote monitoring in Telehealth can be asynchronous or synchronous, utilizing mediums such as video, telephone, emails, AI-based chatbots, and wearable devices that gather patient data accessed by physicians^[14].

The relevance and impact of a Digital health application are influenced by enabling environmental factors such as attitudes, governance, finances, policies, regulations, sociocultural considerations, and the ICT ecosystem comprising hardware and software tools^[15]. Such an enabling environment would optimize the benefits that digital tools and interventions could potentially facilitate. Amidst increasing interest in digital health, digital health interventions are implemented as "quick-fix" solutions in the absence of sufficient evidence^[16-18]. Healthcare providers and patients face difficulties in using digital health technologies due to insufficient training and technical assistance. Furthermore, the lack of adaptation due to cultural factors makes these interventions less accessible for local communities^[19].

Telemedicine services will benefit those who have experienced heart failure, systemic hypertension, and arrhythmia^[11]. Additionally, they have been used in the management of heart failure, myocardial infarction, and coronary artery disease^[20]. Telehealth-based cardiac rehabilitation is considered an alternative mechanism vis a vis facility-based cardiac rehabilitation in low- or moderate-risk patients^[21]. Digital health interventions are applicable in the management of Cardiovascular diseases (CVDs) for various purposes

such as medication adherence^[22], remote monitoring of lab tests and vital signs by physicians, facilitating behavioral changes such as physical activity and a better diet^[20]. M-health tools have improved medication adherence in patients with CVDs^[23]. In primary care, Digital health effectively reduces costs, assists patient management, and minimizes travel to health centers^[23]. However, access to internet services and digital communication tools like mobile phones is still a challenge and contributes to the existing digital divide in South Asian regions^[24,25].

Given the existing global evidence on telehealth digital health applications, it is imperative to examine the local digital health landscape in South-East Asian WHO regions, namely India, Indonesia, Nepal, Myanmar, Bangladesh, Thailand, Bhutan, Maldives, Sri Lanka, Timor Leste, Democratic People's Republic of Korea^[26]. In 2015, the United Nations Agenda for Sustainable Developmental Goals No. 17.6 to 17.8 highlighted the promotion of development, transfer, dissemination, and diffusion of environmentally sound technologies^[27]. Thereafter, the global digital health strategy (2020-2025) was developed in consultation with various stakeholders and endorsed by the 73rd World Health Assembly in 2020 for strengthening health systems through the application of technologies for various users, i.e., healthcare providers, consumers, and industry^[28].

Examining the evidence base of existing interventions specifically for cardiovascular diseases is crucial, considering timely service provision is one of the important recommendations for the management of cardiovascular diseases^[29]. Digital healthcare delivery models are expanding worldwide, including in the countries of the SEA region. A recent review found that the implementation of integrated telehealth is effective in lowering cardiovascular disease (CVD)-related hospitalization rates, reducing rehospitalizations, and decreasing mortality rates among older adults with multiple chronic conditions when delivered in primary care settings^[30]. However, little is known about the current practice of using digital health for combating NCDs in the SEA region. Furthermore, the implementation of digital health interventions needs to be guided by how effectively they can address the user needs in a health system^[31]. The WHO guidance document on digital health interventions specifically caters to this by providing a simplified framework to categorize the different interventions based on how these interventions support health system needs and thereby facilitate dialogue between multiple stakeholders in digital health^[32]. Scoping the usage of these interventions in the SEA region to understand how these digital health interventions achieve health system objectives can greatly guide future investments in digital health.

Therefore, the objective of this review is to scope the usage of digital health approaches/modalities for addressing the burden of cardiovascular diseases in the SEA region.

METHODS

A scoping review was conducted using the Arksey & O'Malley framework^[33]. We systematically searched peer-reviewed literature in PubMed and SCOPUS electronic databases from 2010 to 2021. The last search was done in February 2022. The year 2010 was used as a starting point, given digital health interventions gained momentum only after 2010 in developing countries^[34]. We included the following outcome variables, namely target users and types of digital health functionalities.

Search strategy

A search was performed using keywords, Medical Subject Headings, and database-specific subject headings. Our search terms were derived from three core concepts and their related terms:

- (1) Digital health.
- (2) Cardiovascular diseases.
- (3) SEARO regional countries (South-East Asia, India, Bangladesh, Nepal, Myanmar, DPR Korea, Bhutan, Indonesia, Timor-Leste, Thailand, Sri Lanka).

Eligibility criteria

The inclusion criteria selected for peer-reviewed articles published in English described the use of a digital health intervention to address Cardiovascular diseases in SEA member countries. We included publications examining any aspect of digital health intended for the general population, patients and caregivers, healthcare providers, and health system and data managers. There was no restriction on study designs included in the review.

Exclusion criteria: Publications in any language other than English, those for which the full text was not available, pilot interventions, and digital health interventions outside SEA member countries.

Data extraction

Articles identified by our search strategy were imported into Rayyan^[35], the online systematic review software, and duplicates were removed. Two researchers independently assessed the titles and abstracts of search results against the inclusion criteria. Any uncertainties or differences in opinion were discussed, and if unresolved by discussion, the full article was taken forward to full-text review. Subsequently, both researchers independently conducted a full-text screening of the articles, excluding publications that did not meet the eligibility criteria or where full text was unavailable. We developed a standardized template for data extraction to tabulate specific information from the included studies, such as journal title, article title, publication type and date, country of focus, disease or condition in focus, target population, description of digital health intervention, and its purpose and outcome. Additionally, we categorized digital health interventions based on the WHO Digital Health Intervention (DHI) classification of digital health interventions^[32].

RESULTS

Study selection

The initial search yielded 1,550 (PUBMED = 746 articles and SCOPUS = 804 articles). After eliminating duplicates and reviewing titles and abstracts, 63 articles were considered for full-text review. Upon full-text review, 51 papers were eligible for inclusion, of which 43 were unique digital health applications. The detailed process of study selection is shown in [Figure 1](#). For details of the included articles, please refer to [[Supplementary file 1](#)].

Trends in digital health - year-wise and country-wise

The year-wise distribution of the reviewed studies is shown in [Figure 2](#). The number of published articles has increased over the years 2010-2021, with a declining trend after 2020, as seen in the two-period moving average trendline. 14 articles were published in 2020, which was the highest among all the years in the timeline 2010-2021.

[Figure 3](#) provides a country-wise distribution of included study records. 74% ($n = 38$) of the total identified study records ($n = 51$) were reported from India. Indonesia and Bangladesh accounted for 8% ($n = 4$) and 6% ($n = 3$) of the records, respectively, while Nepal accounted for 2% ($n = 1$) and Thailand for 10% ($n = 5$) of

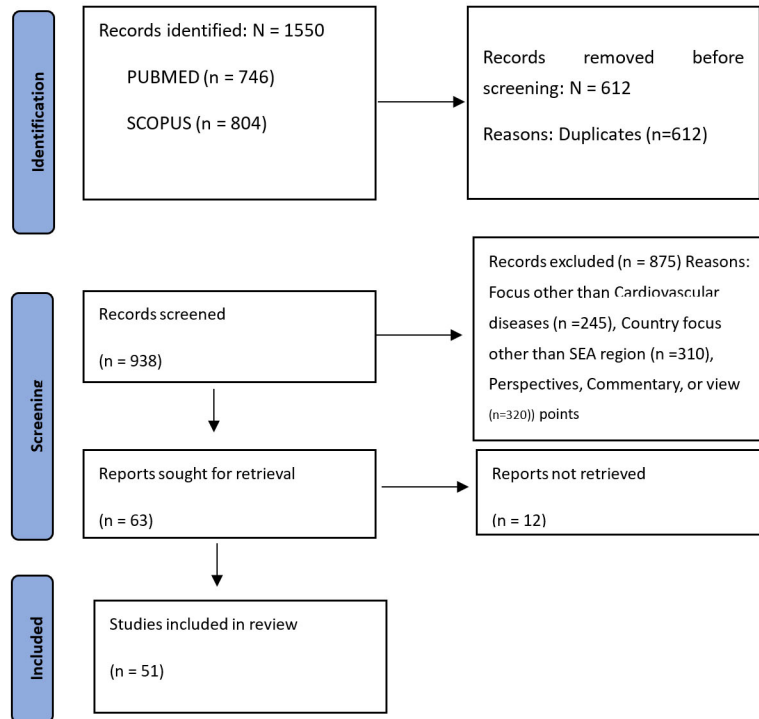


Figure 1. Prisma flow-diagram for the scoping review.

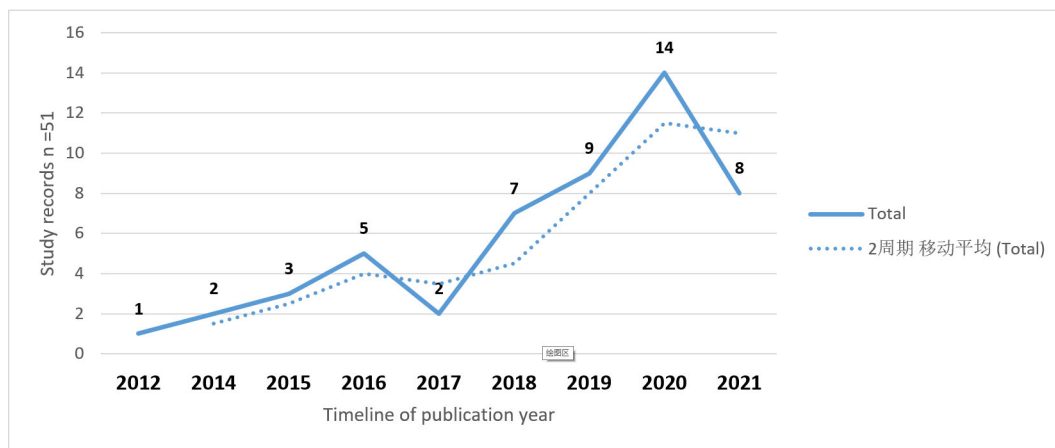


Figure 2. Year-wise distribution of included study records (n = 51).

the total identified study records during the period 2010-2021. The remaining single article was reported from Nepal. No articles were identified from the other countries in the South-East Asian region of WHO,

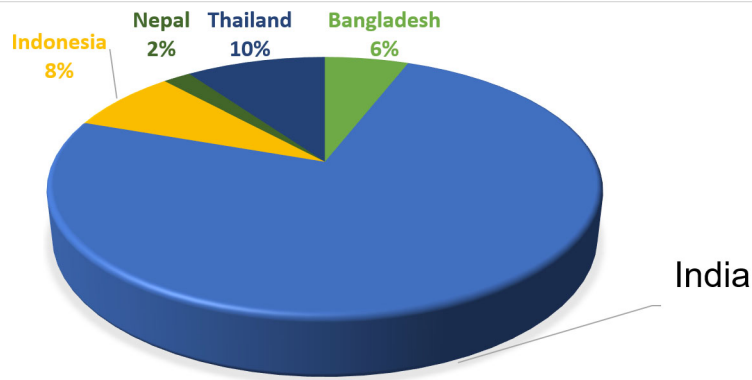


Figure 3. Country-wise distribution of included study records ($n = 51$).

including Bhutan, Maldives, DPR Korea, Timor-Leste, Sri Lanka, and Maldives during this time period.

All the identified articles reported the use of Digital health interventions for non-communicable diseases, specifically cardiovascular diseases. We looked at studies published from 2010 to 2021 and divided this timeline into time frames to see how research events were spread out. To compare the charts across multiple time periods, we used the period-over-period chart.

The first two parts cover five-year periods before the COVID-19 pandemic, and we used average values because the third part (during the pandemic) only had two years of data due to our criteria.

In [Table 1](#), you can see the average numbers of studies published in these three time segments: 2010-2014, 2015-2019, and 2020-2021. [Table 1](#) displays the values representing the average number of research studies published each year in different countries during three distinct time frames: 2010-14, 2015-19, and 2020-21. The three distinct time frames were selected to depict the time trend for digital health application publications pre- (until 2019) and post-COVID-19 pandemic (2020-21). Since the last time frame encompassed only two years, we used the mean value of the observations in each time frame. The first two time frames take into consideration a period of 5 years each. Overall, all the countries showed an increasing trend for digital health applications during the study period (2010-2021). The countries that experienced a major push after the pandemic include India, Bangladesh, Nepal, and Thailand.

Digital health interventions for target users

A total of 67 digital health interventions were reported in the 51 articles we identified. In 2018, the first version of the World Health Organization (WHO) classification of Digital Health interventions was released for use by stakeholders from diverse backgrounds. The framework was designed to make the requirements and features of digital health accessible to individuals without a technical background^[32]. The interventions reported in the identified included articles were classified based on these WHO guidelines that give specific guidance for organizing interventions into overarching groupings based on primary users of the digital health interventions^[32].

Out of the 67 interventions, most of them ($n = 42$, 62.7%) were identified to be targeted for use by healthcare providers. 38.7% ($n = 22$) of the interventions were targeted for use by clients. Two interventions were reported to be used for data services. Only one intervention was reported to be used for health system

Table 1. Country-wise and year-wise distribution of published study records

Timeframes	Country of origin	Grand total	average studies published per year
2010-2014	India	3	0.6
2015-2019	Bangladesh	1	0.2
	India	19	3.8
	Indonesia	3	0.6
	Thailand	3	0.6
2020-2021	Bangladesh	2	1
	India	16	8
	Indonesia	1	0.5
	Nepal	1	0.5
	Thailand	2	1

managers.

Figure 4 shows the country-wise distribution of DHIs based on target primary users. This figure shows that in the identified category of Interventions for healthcare providers, 46.3% ($n = 31$) of the total identified interventions were reported from India, while both Thailand and Indonesia each reported 6% ($n = 4$) of the total interventions. In the category of interventions for clients, 23.9% ($n = 16$) of the total identified interventions were reported from India, while 4.5% ($n = 3$) of the interventions were reported in Thailand. We found just one study record that reported an intervention for health system managers from India. For data services, we found two study records reported from India and Bangladesh.

Figure 5 gives the year-wise distribution of DHIs based on target primary users. Up until 2019, DHIs mainly targeted healthcare providers. However, in 2021, there was a shift and clients became the primary users of DHIs, surpassing healthcare providers.

Digital health functionalities

In addition to the overarching groupings of DHIs for primary users, the WHO guidelines also provide guidance on specific digital health functionalities that address various challenges in the health system^[32]. The various digital health interventions identified from the articles included in this review have been organized based on these digital health functionalities. In the overall distribution of digital health functionalities, 32.8% ($n = 22$) of the 67 interventions identified in our review were categorized under Telemedicine. 25.4% ($n = 17$) comprised Targeted client information, while Untargeted client information comprised only 1.5% ($n = 1$) of the total interventions. 10.4% ($n = 7$) comprised HCP (Healthcare provider) decision support. Client financial transactions also comprised only 1.5% ($n = 1$) of the total interventions.

Figure 6 shows the country-wise distribution of identified DHI functionalities. In the category of Telemedicine, out of 22 interventions, 20.9% ($n = 14$) were reported from India, followed by Thailand ($n = 4$, 6%). Bangladesh and Indonesia each comprised only 3% ($n = 2$) of the intervention functionalities in Telemedicine. In the category of targeted client information, out of 17 interventions, 19.4% ($n = 13$) were reported from India, while the other countries, namely Indonesia, Thailand, Nepal, and Bangladesh, each comprised only 1.5% ($n = 1$) of the intervention functionalities in targeted client information functionality. In the category of HCP decision support, out of the total 7 interventions, 9% ($n = 6$) were reported from India and 1.5% ($n = 1$) from Indonesia. In the lab and diagnostic imaging management category, all 5 interventions were reported from India. In the category of personal health tracking, one intervention was reported from India and the other from Thailand. Likewise, in the category of Data collection, management,

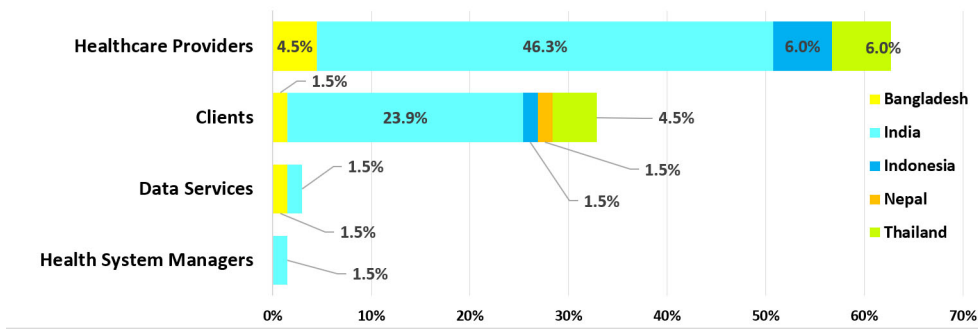


Figure 4. Country-wise distribution of DHI based on target primary users.

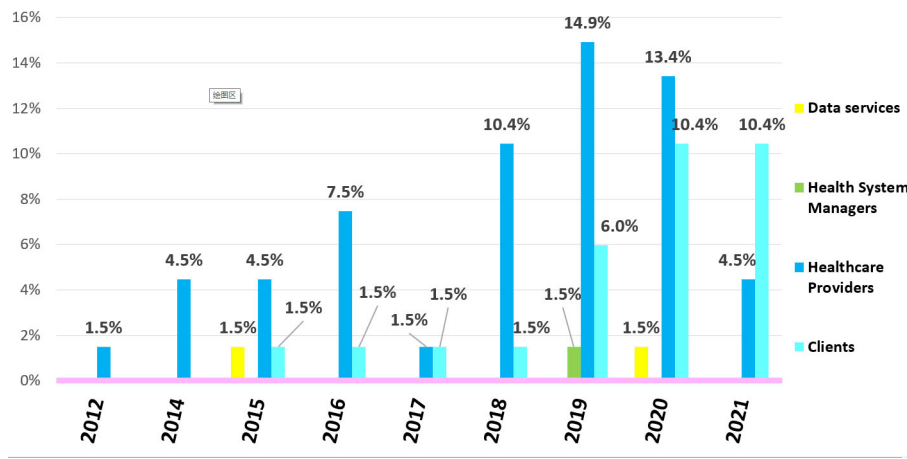


Figure 5. Country-wise and year-wise distribution of DHIs (n = 67) based on target primary users.

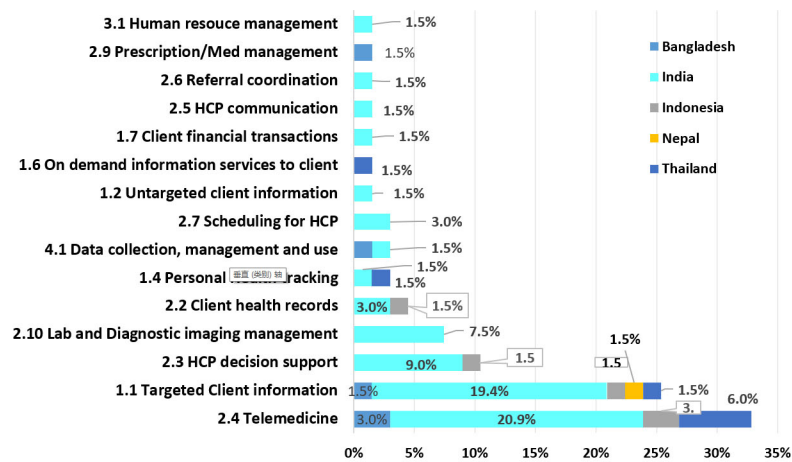


Figure 6. Country-wise Distribution of identified Digital health functionalities (n = 67).

and use, one intervention was reported from India and the other from Bangladesh. Remaining digital health functionalities, including untargeted client information, On-demand information services to clients, HCP communication, Referral coordination, Prescription/Med management, and Human resource management, each comprised only one or two interventions within their respective categories.

DISCUSSION

This paper takes stock of the existing digital health applications addressing cardiovascular diseases in the SEA region. We use the WHO's Digital Health Intervention (DHI) framework to categorize these applications based on their target users and conduct an in-depth analysis of their functional focus. The findings from this review aim to guide the future development of applications, focusing on both target users and design considerations.

India leads in the focus on digital health applications for cardiovascular diseases, followed by Bangladesh, Indonesia, and Thailand during our study period (2010-2021). India shows a consistently increasing trend in adopting digital health to address the burden of cardiovascular disease even before COVID-19. The number of published articles in the SEA region has increased from 2010-2021. However, a declining trend was observed after 2020, as seen in the two-period moving average trendline. A similar trend was noted in other published secondary studies on digital health interventions^[36,37]. Beyond doubt, the experience of COVID-19 pushed for digital health in the SEA region; however, the declining trend for the year 2021 is perhaps indicative of declining interest in digital health in the SEA region after the pandemic. This requires further exploration.

In terms of target users, existing digital health applications focus on healthcare providers. This has shifted to clients after COVID-19. The major functionalities of the existing digital health applications targeting providers were telemedicine, while other components required for effective usage of digital health applications by the providers, namely, client identification and registration, decision support system, client health records, referral coordination, prescription and medication management, laboratory and diagnostic imaging management^[38] were hardly available.

Thailand, Bangladesh and Nepal made a major push for client- (patient-) oriented digital health applications after COVID-19. For client-focused applications, the DHI functionality commonly observed was targeted client communication in India, Bangladesh, Indonesia, Thailand, and Nepal. Few applications addressed client issues such as client-to-client communication, personal health tracking, and client financial transactions. The existing literature suggests that for effective management of CVDs, remote monitoring is critical, wherein continuous streams of information along with machine learning algorithms can support timely intervention^[39]. Further, prescription and medicine delivery management integrated into digital health applications can help close the loop from monitoring to treatment. As highlighted in our review, the existing digital health applications in the SEA region fall short in these critical elements. For applications targeted at clients, the management of CVD would be effective when functionalities such as personal health tracking, active data capture, citizen-based reporting, on-demand information services to clients, and peer group for clients are integrated into client-targeted digital health applications. Similarly, for providers, functionalities such as access to longitudinal clients' health records, decision support systems, referral coordination, prescription and medication management, and laboratory and diagnostic imaging management need to be integrated into existing digital health applications. Thus, future designs must consider these components to ensure efficient and effective treatment via digital health in SEA member countries.

Health system managers and data managers are a key group neglected in digital health applications. Before the onset of COVID-19, digital health applications for data services were reported only from Bangladesh. However, following the pandemic, India has also seen the emergence of a number of digital health applications for data services, albeit in limited numbers. Given the significance of data management for ensuring integrated care models via technology^[40,41], there is a need for SEA member countries to design and

develop digital health applications for data management. Similarly, there are very few applications addressing the needs of health system managers. Our review found only a few such applications and they were limited to India. Ideally, digital health interventions (DHIs) that target health system managers include human resource management, supply chain management, civil registration and vital statistics, health financing, facility management, and equipment and asset management. Systems collecting Civil Registration and Vital Statistics (CRVS) data are critical not only for empowering citizens and ensuring access to services, but also for designing, implementing, and monitoring public policies^[42]. A recent review study of CRVS from 25 countries, including SEA countries, found that, except Thailand, all other SEA countries were facing challenges in ensuring the timely registration of births and deaths. Digital health interventions have been found to be effective in ensuring timely civil registries and maintaining records for public service provision. Thus, future DHIs in SEA member countries must focus on facilitating CRVS.

This review included only published literature in English language; thus, there is a possibility that there are applications addressing data issues and needs of health system managers or applications from countries such as Myanmar, DPR Korea, Indonesia, and Maldives that exist but were not covered in our review. Further, many small-scale applications do exist in SEA member countries that fail to document their progress in academic literature, and thus, we acknowledge the limitation of reporting (publication) bias in our results.

CONCLUSION

The COVID-19 pandemic accelerated the adoption of digital health applications in SEA member countries. However, the sustainability in the push beyond the pandemic needs to be further researched. The focus of digital health applications in terms of target users was more orientated towards healthcare providers before COVID-19, but after the pandemic, clients (or patients) have become the focus of digital health applications in SEA member countries, though provider-targeted applications still dominate. In terms of functionality of provider-targeted applications, a majority of applications facilitate telemedicine, but fail to ensure an integrated delivery model since other functionalities, such as prescription and medication management, laboratory and diagnostic imaging management, referral coordination, decision support system, and client health records, are lacking. There is a dearth of applications addressing the needs of data managers and health system managers. Going forward, SEA member countries would benefit from digital health applications that target data services and health system managers. This review highlighted the need to work towards designing and delivering integrated care models for effective CVD management in the SEA region.

DECLARATIONS

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Authors' contributions

Conceptualized the study objectives and research design: Singh V, John O

Performed data acquisition and report writing: Singh V

Performed data analysis and report writing: Singh V, Johnson KR

Reviewed the manuscript and finalized it: Jacob AG, John O

Availability of data and materials

All the data related to the review are presented in the supplementary file.

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Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate.

Not applicable.

Consent for publication

Not applicable.

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