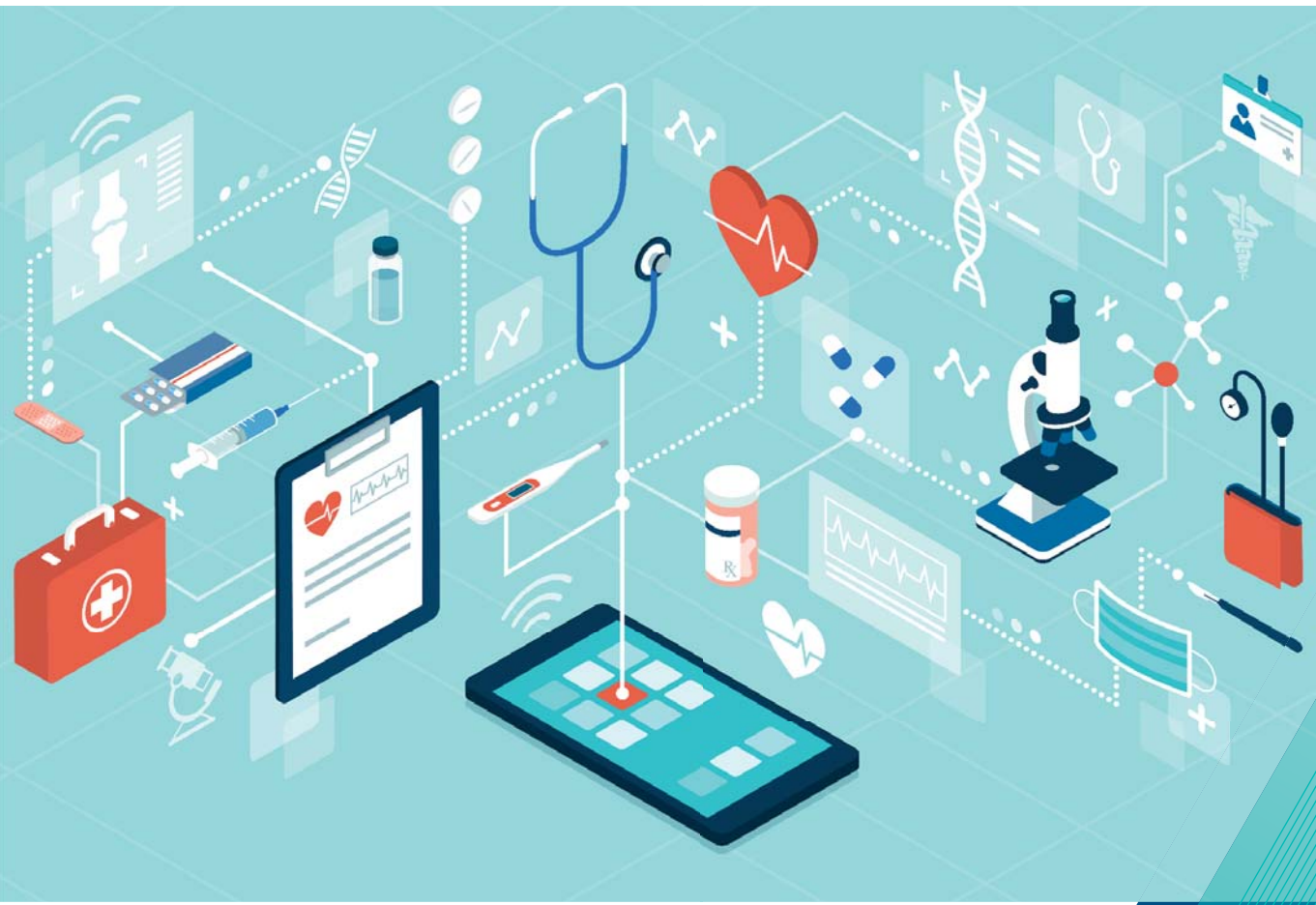
KONRAD ADENAUER STIFTUNG

E-health Development in Asia and Europe



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PANORAMA

Insights into Asian and European Affairs

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Preface

Dear readers,

In recent years, the integration of digital technologies into healthcare, known as e-health, has revolutionised how we manage and deliver medical services. From electronic patient records to telemedicine and electronic prescriptions, e-health encompasses a wide array of innovations aimed at improving healthcare accessibility, efficiency, and patient outcomes.

The publication "**E-health Development in Asia and Europe,"** published by the Regional Programme Political Dialogue Asia (KAS PDA), delves into this rapidly evolving field, offering a comprehensive exploration of digital healthcare initiatives across two continents.

As editors, we have curated a collection of chapters that examine various aspects of e-health, comparing strategies and experiences from diverse countries and regions. As such, we provide a starting point for readers and interested parties to explore how to draw on best practices in e-health developments in both Asia and Europe, and how to advance our healthcare systems respectively for the benefit of our patients and society as a whole, in the spirit of mutual learning between the two regions.

It has become evident that the COVID-19 pandemic underscored the importance of digital health solutions, such as in the field of contact tracing, checking of vaccine status and telemedicine consultations. It specifically accelerated the adoption of telehealth services, remote patient monitoring, and digital communication tools in healthcare settings globally. These advancements not only facilitated continuity of care during lockdowns but also highlighted the potential of e-health to transform healthcare delivery beyond the crisis. Most of the technologies adopted during COVID-19 – as we witnessed and as we will learn in the chapters below – are here to stay.

"*Digital Healthcare Advancements in Germany and Europe: Boosting Competitiveness in the Global Pharmaceutical Market?*" looks at Europe's role as a pioneer in leveraging digital innovations to enhance healthcare outcomes and its attempt to maintain its status as a primary location for pharmaceutical companies (especially in Research & Development) within the global market. The author argues that the use of secondary healthcare data in a fully-integrated European Health Data Space can boost Europe's pharmaceutical sector and ultimately its economy. Meanwhile, "*Addressing Challenges in mHealth Implementation: Comparative Analysis of ASEAN and EU Approaches*" provides a comparative lens on mobile health strategies, highlighting regional nuances and best practices. Some of the case studies are highly

context-specific and might not necessarily constitute a template, but they provide a general direction and idea.

Regulatory frameworks play a crucial role in shaping digital health adoption, as explored in "*Digital Health Regulatory Framework in Southeast Asia*." Additionally, "*Factors Influencing E-health Development in Asian Countries: A Comparative Analysis and Policy Implications*" sheds light on the socio-economic factors influencing e-health adoption in diverse Asian settings.

It goes without saying that inclusive and collaborative approaches are essential for sustainable e-health development and for gaining patients' trust, as evidenced by the insights from "*Building Inclusive and Collaborative Digital Health Development in Southeast Asia: A Comparative Analysis of Vietnam and Indonesia*." The potential of artificial intelligence in healthcare crisis management is further explored in *"AI in Health: How Technology Can Prevent Future Health Emergencies,"* which makes explicit references to the currently discussed ideas of a pandemic treaty or an update of the International Health Regulations (IHR).

Lastly, privacy concerns and policy readiness are crucial considerations, as highlighted in "*Privacy, Policy, and Preparedness and the Road Towards India's Digital Health Ecosystem.*" Localised efforts, such as those examined in "*Bridging Digital Divides for Inclusive Healthcare in Bangladesh*" and "*Fall Prevention for Thai Older Adults: A Community-Based Policy Plan Leveraging Technology,*" add to the broader picture and improve our understanding of how sometimes tailored strategies that were first experimented with and implemented at the subnational level have the potential to become more widely adopted and agreed upon.

This publication therefore serves as a resource for policymakers, healthcare professionals, researchers, and stakeholders interested in the transformative potential of e-health.

We are grateful to our contributors, whose expertise has enriched this collection, and we invite our readers to explore these insights, envision future possibilities, and contribute to the ongoing evolution of e-health across continents.

Andreas Klein
Director
Regional Programme Political Dialogue Asia

Digital Healthcare Advancements in Germany and Europe: Boosting Competitiveness in the Global Pharmaceutical Market?

Moritz Fink

BACKGROUND

This paper provides an overview of the status quo of e-health developments in Germany and Europe, addressing the paramount flaws (confusion between actors, lack of cross-boundary data sharing, missing interoperability) within the domestic and European contexts and linking those to the promising establishment of the European Health Data Space (EHDS).

The EHDS is set to become a vital tool to increase cross-boundary exchange of healthcare data between member states, to spur research and development into new medicines thanks to the available secondary healthcare data and to further improve health literacy among patients. In a time when Europe's competitiveness is a reason for concern and debate, the EHDS can contribute to more attractive conditions for pharmaceutical companies to increase their investments; and for Europe to ultimately remain in the top-tier for innovative medical manufacturing sites.

For its successful implementation, beyond European co-legislation, technical features, such as ensuring the cybersecurity of the infrastructure, but also legal features, such as a precise definition of the scope of the secondary use, are crucial to gain patients' support and backing.

INTRODUCTION

Digital healthcare tools and apps such as electronic patient records, electronic medication plans, a symptom tracker, or the cross-boundary processing of healthcare data and patients' medical histories in the German and European context have been at the centre of many discussions in the past years; however, their respective implementation to yield tangible benefits for patients is a different story. Some attribute this to the decentralised nature (federal structure) within the German

context, where each state has its own Data Officer or even the lengthy political decision-making processes and disagreements between the various actors in the German healthcare sector. In particular, the question as to whether the industry (pharmaceutical companies) should be given the right to access anonymised secondary healthcare data to conduct research for innovative medicines was a contentious issue that now seems to have been addressed adequately. With the European Commission's legislative proposal for the "European Health Data Space" in 2022 and subsequent German policies enacted in the past year, a direct link between Germany's digitalisation efforts and the European Union's Health Union is on its way.

For Germany these digitalisation efforts refer to the establishment of secure networking in the healthcare system (telematics infrastructure, TI), the introduction of the electronic health card (eGK) with its applications, the introduction of the electronic patient file (ePA) and the electronic prescription (e-prescription), the new range of digital health applications (DiGA) and digital care applications (DiPA) for insured persons as well as telemedicine services allowing for the instant issuance of electronic certificates of medical leave.

For the European Union (EU), the European Health Data Space (EHDS) fits into the broader picture of building a "European Health Union", where interlinkages between the EHDS and the EU's pharmaceutical strategy or its newly established Health Emergency and Response Authority (HERA) are created, banking extensively on the availability and use of healthcare data.

GERMANY – COVID-19 AS A REMINDER OF THE SLOW PROGRESS ON DIGITALISATION

The coronavirus pandemic has revealed a number of deficits and flaws in the German healthcare system, most notably: a poor data situation, unclear competences between the actors in a federal system (federal, state, municipal, district), a lack of coordination, inadequate communication, little intersection across medical disciplines and an unequal distribution of risks and burdens within the population.

Take the delayed reporting of new COVID-19 infections to the Robert Koch Institute (Germany's version of a public health institute) or the slow contact tracing as examples. Former Federal Minister of Health Jens Spahn initiated a number of far-reaching projects during his time as minister, such as the electronic prescription and the electronic patient record, which are now gradually becoming a centrepiece of the German healthcare system. However, this should not obscure the fact that Germany's healthcare system and structures require further digitalisation. Among

other things, interoperability for the "Telematikinfrastruktur" (telematics infrastructure for safe and interoperable communication) between various players in the healthcare sector (doctors, pharmacists, health insurance providers) needs to run smoother and become better established as well as accepted.

With the new coalition coming into power, the three parties (Social-Democrats, Greens and Liberals) have agreed to "advance" the digitalisation of Germany, not only in the healthcare sector but also in the sphere of public administration (government services). At the beginning of his term of office, Federal Health Minister Karl Lauterbach (Social Democratic Party of Germany, SPD) promised a "new start in digitalisation".[1] In addition to the already agreed e-prescription model, he advocated for a new edition/overhaul of the electronic patient file (ePA), which is to be introduced in 2025. The proposed "Digital and Health Data Utilisation Act" adopted an "opt-out" approach, whereby individuals covered by statutory and private health insurance will automatically receive an electronic patient file unless they choose not to.

Since January 2024, prescriptions must be issued electronically, meaning a transition from paper-based drug prescription to an electronic format. According to the recent "E-Health Monitor" by McKinsey, every second prescription is currently issued electronically.[2] Furthermore, the figures from the federal telematics organisation Gematik show that patients have received 49.8 million e-prescriptions as of the 28th of January.[3]

During the pandemic, there was a lot of misinformation circulating on online platforms such as YouTube. Within its digitalisation initiatives, Germany is also trying to increase the "health literacy" of its citizens by providing crucial health information on its National Health Portal, where scientifically sound, neutral and easy-to-understand information on selected health topics, clinical pictures and treatment options can be found. This serves as an enabler to making informed decisions. Through the National Health Portal a direct contribution to a patient's journey (from diagnosis, to treatment to recovery and secondary prevention) and patient sovereignty (considering more available information, weighing treatment options, ability to make informed decisions) could be created. In addition to information on illnesses, care services and patient rights, the portal also explains digital

1. (https://www.handelsblatt.com/politik/deutschland/e-rezept-wie-gut-klappt-die-digitalisierung-im-gesundheitswesen/100008222.html).

2. Ibid.

3. (https://www.faz.net/aktuell/wirtschaft/e-rezept-was-apotheken-von-dem-neuen-system-halten-19480392.html).

healthcare services such as the aforementioned ePA, DiGAs and telemedicine. The Health Portal therefore facilitates the people's understanding of digital healthcare tools and services vis-à-vis showing the benefits of those innovations.[4]

PRIMARY VERSUS SECONDARY HEALTH DATA

Every day, vast amounts of health data are generated, processed and stored, when a patient undergoes medical consultations, blood collection, magnetic resonance imaging (MRI) tests and medicine prescription. Ideally, this data (results, treatment options, medications) would be stored on his personal electronic patient record so that it can be used during his next medical consultation at home or abroad. Possessing an electronic file of the patient's journey could therefore avoid duplicate tests, reduce the necessity to recall the medical history and give doctors a solid overview of the patient's status quo, helping pharmacists to rule out the side-effects of poly-medications and so on. In a nutshell: time and efficiency gains. Yet it often remains difficult for citizens to access their own health data electronically as different institutes (e.g., hospitals, clinics) have stored the results locally, or the electronic file is simply not available yet. By extension, researchers at university hospitals or in public health institutes also share an interest to use the samples of health data to improve diagnosis and treatments. For further debates and understanding, below is a brief summary of the differences between primary and secondary health data.

Primary health data refers to the data that is collected during a patient's medical journey, such as in the above-mentioned scenario (check-ups, consultations, patient's journey, MRI scans). The patient owns the information and can make his health data available to a health professional of their choice, including when abroad and ideally in the same language of the health professional. Needless to say, the patient can decide what information to share and with whom. In the case of psychological treatment, the patient may not share this information with another health practitioner, let alone his health insurance provider. There are debates on whether "opt-out" (it is presumed that patients want their electronic patient file issued, issuance by default) or "opt-in" (patients actively need to give their consent for the issuance) should apply in creating the electronic patient file. In Germany, the former approach is adopted.

4. (https://www.bundesgesundheitsministerium.de/themen/digitalisierung/digitalisierung-im-gesundheitswesen.html).

All these primary health data, once generated, processed and stored, could then be used as **secondary health** data for research purposes on rare diseases, development of new medicines and enhancing patient safety (e.g., comparison of similar treatment cases, as in same chronic disease with a similar patient population). For that matter, the personalised primary health data will have to be made anonymous so that patients' personal information (name, address, occupancy, etc.) is not traceable. Usually this is done by a "trustee" or a "data steward" responsible for pseudonymising and anonymising primary health data. In Germany there is a dedicated "Forschungsdatenzentrum" responsible for that task, where interested parties can request to obtain these anonymised data for research purposes or public health policies. There are discrepancies in policymaking regarding who should be allowed to access the secondary health data and for what purpose.

The European Commission in its proposal sums up the differences insightfully: primary use of health data relates to "electronic health data in the context of healthcare" while the use of secondary health data "would benefit the society such as research, innovation, policy-making, patient safety, personalised medicine, official statistics or regulatory activities".[5] The following is an overview of how Germany and the EU approach the use of health data.

DIGITAL HEALTH TO BECOME A CENTREPIECE IN GERMANY'S HEALTHCARE SYSTEM

The acceleration of Germany's digitalisation efforts can in part be explained by the dissatisfaction of large pharmaceutical companies conducting research and development (R&D). Notwithstanding the high degree of persistent bureaucracy, the difficulty in accessing secondary health data (anonymised and pseudonymised) especially has been a major complaint in relation to hindrance of their R&D activities and innovation. German pharmaceutical giant Bayer's announcements in early 2023 of its intention to shift the focus of its pharmaceutical business more towards the United States (US) and China in the future and BioNTech's decision to establish a R&D centre for cancer therapy and personalised mRNA immunotherapies in the United Kingdom (UK) instead of Germany have put the perception of Germany as

5. (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0197) and (https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en).

a seemingly attractive location for innovation and investment into question.[6] With that in mind, the "Health Data Utilisation Act" (GDNG) was approved by the German parliament in December 2023, aiming to enhance the use of health data for research purposes. According to the Ministry of Health, the establishment of a central data access and coordination centre for the use of health data will reduce bureaucratic hurdles and facilitate access to research data.[7] Approval is no longer determined by who is applying (formerly only universities are allowed but not the pharmaceutical industry), but for what purpose. The decisive factor is hence the purposes of use in the public interest. The Research Data Centre can link pseudonymised data with data from legally regulated medical registers if this is necessary for the research purpose in accordance with the application and only if the interests of the insured persons are sufficiently protected.

With the GDNG in effect, the pharmaceutical industry will now have comprehensive access to (secondary) health data; while at the same time the policy establishes the foundation for a connection to the European Health Data Space.

THE OVERARCHING FRAMEWORK – THE EUROPEAN HEALTH DATA SPACE (EHDS)

Extending beyond Germany, Europe's competitiveness in the pharmaceutical sector also does not remain unchallenged. The European Health Data Space (EHDS) aims to ensure Europe remains a prime location for pharmaceutical companies and innovation centres. The EHDS in particular addresses the limited use of digital health data in the EU, a situation that arises due to different standards among member states; in other words: improving the currently limited interoperability. The EHDS therefore provides a much-needed regulation for information-sharing between member states, providing rules and guidelines on the usage of primary and secondary healthcare data by setting out a common framework for the whole bloc.[8]

The EHDS within the wider framework of the European Health Union, initiated by Commission President Ursula von der Leyen in September 2020, intends

6. (https://www.tagesschau.de/wirtschaft/pharmaindustrie-forschung-biontech-101.html) and (https://www.manager-magazin.de/unternehmen/bayer-verlagert-pharma-fokus-in-usa-und-nach-china-europa-ist-innovations-unfreundlich-a-79cb82fa-bf06-4387-9263-4f94c814c7b1).

7. (https://www.bundesgesundheitsministerium.de/themen/digitalisierung/digitalisierung-im-gesundheitswesen.html).

8. For more, see: (https://www.european-health-data-space.com/).

to address the deficits resulting from the experiences of the COVID-19 pandemic (lack of member states coordination with regard to COVID-19 policies at first, border closures, slow contract-tracing, low stock of certain medical equipment and medicines) to now "improve protection, prevention, preparedness, and response to human health hazards at EU level".[9] The EHDS can play an important role here, as representatives at the Konrad-Adenauer-Stiftung's EU Data Summit in December 2022 unequivocally confirmed.[10]

Access to research data (secondary health data) for the industry in Germany and Europe is currently still poor, let alone sufficient in terms of available datasets, although research data on tumour diseases, rare diseases, personalised medicine, clinical studies, new drug therapies and generally for R&D reveal enormous potential.[11] As aforementioned, in Germany, this was previously due to research companies' ineligibility to apply to the research data centre established for this purpose on the one hand, and to a still inadequate digitalisation of the public healthcare system (ePA, ePrescription), on the other – which is still to some extent valid.[12]

Whether the EHDS will become operational from 2025 as planned by the EU Commission is to be seen. It is more likely to be a learning system that is gradually improved. At its core, the EHDS enshrines that digitalisation will be essential for the future of healthcare. Over 810 million euros will be funded for the implementation of the EHDS, bringing together the health data of 430 million citizens, which, according to Health Commissioner Stella Kyriakides, could "mak[e] the EU a global leader in data-driven technologies".[13]

9. (https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/promoting-our-european-way-life/european-health-union_de).

10. (https://www.youtube.com/watch?v=D66dDropRuE) (from minute 1:20:27 - Keynote: The EHDS Proposal).

11. (https://www.encepp.eu/events/documents/Discussionpaper.pdf), (https://theodi2022.wpengine.com/wp-content/uploads/2021/09/Secondary-use-of-Health-Data-In-Europe-ODI-Roche-Report-2021-5.pdf) and (https://www.mdpi.com/2227-9032/10/9/1629).

12. The Research Data Centre makes it possible to access the billing data of all people with statutory health insurance in Germany.

13. (https://ec.europa.eu/commission/presscorner/detail/fr/speech_23_4947) and (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52022DC0196).

LEVEL OF MEMBER STATES READINESS IN THE EHDS

The healthcare systems of the member states already generate, process, and store a large volume of data. Yet, access to health data (digital patient record, e-medication plan) is still not guaranteed for many EU citizens.[14] An immediate priority for the Commission is therefore to address the inconsistent level of digitalisation across member states and to harmonise patient information systems. Such systems can vary significantly at both the state and regional levels, complicating agreements on common standards.[15]

The success of the EHDS relies on member states' levels of interoperability and ultimately readiness. Not surprisingly, the European Commission resorted to a regulation, hence "a legal act of the European Union that becomes immediately enforceable as law in all member states simultaneously".[16]

According to a recent Surfshark survey, within Europe, the Nordic countries lead while Eastern Europe lags behind in terms of healthcare sector digitalisation and readiness (e.g., patient files, electronic prescriptions, booking of doctor's consultations). Not all member states have set up systems to exchange electronic health records and there are significant deficiencies in the interoperability of the systems. Patient summaries and e-prescription services exist in two-thirds of all member states and are most frequently accessed via an online portal, but only in a few member states can they be sent or received across borders. Furthermore, eleven member states are still using paper printouts for prescriptions. Only ten member states support access to patient summaries or e-prescriptions via MyHealth@EU.[17]

Based on *the Assessment of the EU Member States' rules on health data in the light of the GDPR*, some 81 per cent consider that the use of different GDPR legal basis makes it difficult to share health data. Even if data processing is allowed due to GDPR, the doubts, misunderstandings, and fears of the consequences create altogether an invisible blockage impacting the overall acceptance for opening up the

14. (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52022DC0196).

15. In addition, a large divergence in the digitalisation of healthcare systems between the EU member states is evident – this is also mentioned several times in the legislative proposal on the EU Health Data Space. (https://prod.ucwe.capgemini.com/wp-content/uploads/2022/07/eGovernment-Benchmark-2022-1.-Insight-Report.pdf).

16. (https://commission.europa.eu/law/law-making-process/types-eu-law_en -:~:text=Regulations%20are%20legal%20acts%20that,be%20transposed%20into%20national%20law).

17. (https://health.ec.europa.eu/system/files/2021-02/ms_rules_health-data_en_0.pdf).

data for secondary use.[18] For instance, when a research centre wanted to access and process data, it was required to send requests to all individual data controllers.

The uneven implementation and interpretation of the GDPR by member states creates considerable legal uncertainties, resulting in barriers to secondary use of electronic health data.

USE OF SECONDARY HEALTH DATA IN THE EHDS

Even for research in the second step, after health-related data has been anonymised or pseudonymised, it is difficult to harness this data to improve diagnosis and treatment.

The EU Commission describes this fact in its legislative proposal as follows: "EU health sector is rich in data, but poor in making it work for people and science".[19]

According to the Commission, the new legal framework would enable stakeholders such as researchers, decision-makers, and member states to access electronic health data so as to promote better diagnosis, treatment, and patient well-being, as well as attaining an optimised and well-defined policy. What is more, the EHDS aims to drive the harmonisation of provisions on an internal market basis for digital health products and services, thus increasing the efficiency of healthcare systems.[20] It is in Europe's interest and against the background of the far-reaching GDPR to also become something like a global standard setter for digital health.

In this context, there is much talk about European digital sovereignty, which entails processing the anonymised and pseudonymised data of EU citizens to develop new innovative approaches in the pharmaceutical sector. This, in turn, means that data or AI-based solutions from China or the US could be renounced, hence increasing European independence in the use of secondary healthcare data, providing a boost to its own research activities in personal medicine or innovative drugs altogether.

In the meantime, the European Parliament has adopted the Commission's proposal to create the EHDS, "aimed at improving access to personal health data

18. Ibid.

19. IMMC.COM%282022%29196%20final.ENG.xhtml.1_EN_ACT_part1_v8.docx (europa.eu).

20. Ibid.

across EU states and bolstering secure data sharing for research".[21] Now it will be between the European Council and the Parliament to form the final legislation.[22]

In contrast to the Commission's proposal, the Parliament proposed an opt-out system for secondary data use and mandatory explicit consent for sensitive data like genetic information. Furthermore, the Parliament seeks to broaden the ban on secondary uses in sectors like labour and finance, highlighting the need to get patients' trust and backing of the far-reaching regulation before enactment.

POSITIVE SPILL-OVER EFFECTS INTO R&D ACTIVITIES IN EUROPE

Positive examples of interactions between the EHDS and other EU-led initiatives include, for instance, the European Plan to Combat Cancer and the EU-wide "Beyond 1 Million Genomes" project.[23] The development and expansion of data registers (tumour register, spine register, prostate cancer register) is also being promoted.[24] This can improve understanding as well as early detection, diagnosis, treatment, and monitoring of cancer by enabling health service providers in the EU to access and share health data across borders. The more high-quality data can be used, the greater the benefit for research and development as well as diagnosis.[25] This would appear logical as accessing data from a wide patient pool is essential for comprehensive insights into therapy and drug tolerability. The establishment of the EHDS is therefore vital for strengthening Europe's position as a pharmaceutical location and its research innovative landscape, which would also benefit Germany subsequently.[26]

In the global competition to attract foreign direct investment (FDI) or multinational companies or simply to safeguard their own supply chains, innovative

21. EU Parliament agrees position on digitalising health data – Euractiv.

22. Check the status of the EHDS regulation in the legislative train: Carriages preview | Legislative Train Schedule (europa.eu).

23. (https://b1mg-project.eu/ see also: https://www.kas.de/de/web/die-politische-meinung/artikel/detail/-/content/gene-und-genome-1 and https://www.kas.de/de/einzeltitel/-/content/genomsequenzierung).

24. Michaela Hempel. 2021. Strategy for the industrial healthcare sector: Anchor in times of crisis and growth driver of the future. In Federation of German Industries.

25. Ibid. and (https://www.tagesschau.de/wissen/forschung/medikamentenentwicklung-101.html).

26. (https://www.kas.de/documents/252038/22161843/Europe+as+a+Pharmaceutical+Location+%E2%80%93+Strengthening+Resilience+and+Competitiveness.pdf/f5e9c4bd-a0d4-8644-c550-923b98ccee4b?version=1.4&t=1685461444085).

biopharmaceuticals, such as cancer treatments, are still being primarily produced in Europe and North America. But China is catching up in the race. To this end, the European Chamber of Commerce in China writes: "China finds itself at a critical juncture, as the country is currently transforming from a generic drugs manufacturer to a supplier of primary drugs."[27] Strengthening the industrial healthcare sector and Europe's competitiveness as a scientific and research location thus largely depends on access to research data as part of the EHDS. For this reason, it is necessary to establish quality-assured databases, such as for patient data, including genomic data. This requires adequate funding and standardisation, as well as statutory regulations for data protection-compliant access that is research- and application-friendly at the same time.

By the same token, it is also noteworthy to look into R&D efforts in the EU, which are not only linked to the EHDS but also facilitated through the new framework: Pharmaceutical research into new and innovative drugs is growing rapidly, especially in China (from imitator to innovator) and to a smaller extent in other emerging markets such as India, while the gap with the EU and the US is narrowing.[28] Between 2017 and 2020, R&D spending on pharmaceuticals in China increased by an average of 12.9 per cent per year, compared to just 8.5 per cent in the US and only 4 per cent in Europe.[29] Of the 95 new substances launched on the global drug market in 2021, 35 came from the US, 19 from Europe and 18 from China. This means that China will not only continue to be an important supplier of pharmaceutical raw materials and inexpensive drugs in the future, but also a serious competitor in the pharmaceutical high-tech segment with growing R&D performance and effective implementation in new products, taking a lead on data-driven healthcare technologies.[30]

In general, pharmaceutical R&D in Europe benefits from a good research infrastructure and an efficient science and university system which produces well-trained scientists for the labour market and is available as a cooperation partner for research companies. Regarding the pharmaceutical industry, there is a division of labour between publicly funded research at universities and research institu-

27. (https://www.euractiv.de/section/gesundheit-und-verbraucherschutz/news/europas-abhaengigkeit-von-medikamenten-importen/ and https://www.handelsblatt.com/unternehmen/industrie/arzneimittel-pharmabranche-warnt-vor-abhaengigkeit-von-fernost-eu-will-mit-neuer-arzneistrategie-reagieren/28363374.html).

28. (https://economictimes.indiatimes.com/small-biz/sme-sector/budget-2023-pharmacy-of-the-world-has-a-chinese-achillean-heel/articleshow/97046291.cms?from=mdr).

29. (https://pharma-fakten.de/grafiken/pharmazeutische-forschung-und-entwicklung-in-europa-oder-anderswo/).

30. Ibid.

tions and companies. Publicly funded institutes mainly conduct basic research, for example, identifying basic substances that could have a useful pharmaceutical effect. The pharmaceutical industry often takes these results from basic research, develops them further and, in positive cases, ultimately incorporates them into clinical research.[31]

New regulations,[32] with the introduction of the Clinical Trials Information System (CTIS),[33] under the pharmaceutical strategy are also improving the clinical testing of new drugs in Europe. For instance, organisations that intend to carry out clinical trial assessments in several EU countries now only need to submit a single Clinical Trial Application (CTA) application that is then valid in up to 30 European Economic Area countries. So, for example, if a company wants to conduct a clinical trial within six member countries, they can do so with a single CTA. The new regulation helps to further streamline the clinical trial process and data sharing within Europe.[34]

The Horizon 2020 Framework Programme for Research and Innovation lists 2,347 research projects in the field of pharmacology and pharmacy that have been carried out in recent years.[35] The new Horizon Europe funding programme also provides intensive support for health-related research, notably for digital healthcare, digital tools, and health apps. A total of 8.2 billion euros has been earmarked.[36] The urgent need for research into diagnostics, vaccines, antibiotics and pharmaceuticals is emphasised.[37]

The pharmaceutical strategy for Europe also focuses on promoting research and development of "high-quality, safe, effective and environmentally friendly

31. (https://www.kas.de/documents/252038/22161843/Europe+as+a+Pharmaceutical+Location+%E2%80%93+Strengthening+Resilience+and+Competitiveness.pdf/f5e9c4bd-a0d4-8644-c550-923b98ccee4b?version=1.4&t=1685461444085).

32. (https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32014R0536&from=EN).

33. (https://www.ema.europa.eu/en/human-regulatory/research-development/clinical-trials/clinical-trials-information-system).

34. (arkivum.com/what-is-ctis-and-what-are-its-benefits/).

35. (https://cordis.europa.eu/search?q=%2Fproject%2Frelations%2Fcategories%2FeuroSciVoc%2Fcode%3D%27%2F21%2F35%2F159%27&p=1&num=10&srt=/project/contentUpdateDate:decreasing).

36. (https://op.europa.eu/en/publication-detail/-/publication/1f107d76-acbe-11eb-9767-01aa75ed71a1).

37. (https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/3c6ffd74-8ac3-11eb-b85c-01aa75ed71a1), p. 35.

medicines".[38] Many other funding programmes, such as for cancer[39] or coronavirus research,[40] are aligned with EHDS, making Europe an interesting research location for the pharmaceutical industry. The European Medicines Agency (EMA)[41] performs key tasks at the interface between R&D and commercial use. Further harmonisation of the approval of new pharmaceuticals, including orphan drugs (drugs for rare diseases where the patient population is small, like diseases affecting 1 in 100,000 people)[42], would make Europe even more attractive as a pharmaceutical location. The European Health Emergency Preparedness and Response Authority (HERA) is also developing research activities with a view to future pandemic situations, which will benefit the pharmaceutical industry, while concurrently and most importantly relying on available healthcare data on infection clusters (e.g., prevalence of the flu) or the quantity of prescribed medicine in Europe to navigate demand.[43]

OUTLOOK

The COVID-19 pandemic has revealed the urgent need and the high potential for interoperability and harmonisation. Germany looked repeatedly at other states with much more pronounced data collection experience, such as Israel, Denmark or the UK, when it came to public policies (e.g., school closing, lockdowns, transmission ways). Even though digitalisation in Germany has long been a subject of debate, its implementation due to the decentralised structure has always proven to be difficult. Germany is at times too occupied with its attention and debate to even the smallest details, delaying important policies altogether in this regard (instead of opting for a learning and gradually improving system), while at the same time confusion arises between the different actors (health insurance providers, doctors, patients, pharmacists) on how to best approach digital innovations. Another

38. (https://health.ec.europa.eu/medicinal-products/pharmaceutical-strategy-europe_de).

39. (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/eu-mission-cancer_en).

40. (https://research-and-innovation.ec.europa.eu/research-area/health/coronavirus_en, https://research-and-innovation.ec.europa.eu/system/files/2020-04/ec_rtd_era-vs-corona.pdf).

41. (https://www.ema.europa.eu/en).

42. To learn more about Orphan Drugs and Rare diseases, refer to: (https://www.ema.europa.eu/en/human-regulatory-overview/orphan-designation-overview#ema-inpage-item-11930). Orphan drugs come with high treatment costs for patients as the R&D efforts and expenses must be recouped from a small number of patients.

43. (https://health.ec.europa.eu/system/files/2021-09/hera_2021_comm_en_0.pdf).

factor is the diverging views between the Federal Data Protection Commissioner and the 17 state authorities towards the design and implementation of certain policies, whenever it concerns data protection, data safety or data use. With two new policies and the strong start of the e-prescription project this year, the digitalisation initiative finally seems to have gained some steam in Germany. At the EU level, the "Digital and Health Data Utilisation Act" is also an important step forward in connecting the overarching European Health Data Space that was put forward by the EU Commission in May 2022. Once this regulation is approved by the Parliament and Council, it will be fully applied across the European Union.

The proposal intends to address the limited use of digital health data in the EU due to different standards among member states and the limited interoperability. The EHDS provides a much-needed regulation to harmonise and spur information-sharing between member states. As the European Union only has a "supporting competency" in the healthcare sector, a full-fledged European Health Data Space within the European Health Union will certainly spark debates as to whether it interferes with national competencies.

A fact that should not be overlooked in Germany's and the EU's policies is the people's trust in bringing together healthcare data and their willingness to share data in the first place. Therefore, not only technical features, such as ensuring the cybersecurity of the infrastructure, but also legal features, such as a precise definition of the scope of the secondary use, need to be fleshed out and implemented. Ideally, digital literacy should be enhanced to allow the empowerment of EU citizens, as regards the use of their own health data.[44]

In order for Europe to maintain a leading position in the global pharmaceutical competition, research and development for new and high-quality pharmaceuticals must be promoted. One major building block to accomplish this constitutes the European Health Data Space and, deriving from that, the digital framework condition within EU member states.

44. (https://www.europarl.europa.eu/legislative-train/spotlight-JD22/file-european-health-data-space?sid=6801).

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Addressing Challenges in mHealth Implementation: Comparative Analysis of ASEAN and EU Approaches

Zekiye Gürün

1. INTRODUCTION

E-health, in its broadest sense, encapsulates an array of Information and Communication Technologies (ICTs) employed within the healthcare sector. This includes electronic health records (EHRs), telemedicine, health analytics, and notably, mobile health (mHealth) applications. These technologies are poised to significantly impact healthcare delivery, potentially increasing efficiency and reducing costs. They can streamline care coordination, empower patients through improved access to health data, facilitate remote patient monitoring, reduce medical errors, and foster cost-effectiveness[1].

As digital technologies continue to permeate various sectors, healthcare has emerged as a prominent field at the forefront of this transformation. The integration of electronic health, or e-health, signifies a paradigm shift in healthcare delivery, promising enhanced patient outcomes and optimised healthcare management[2]. Within the e-health area, mHealth stands out due to its direct patient interaction and role in making healthcare more widely available, particularly in resource-constrained regions. However, this potential does not come without challenges. Similar to e-health solutions, the path to successful mHealth implementation is paved with obstacles, necessitating a deep understanding of these issues, especially given the

1. Chan, Janet, AHIP, RN, MLIS. 2021. Exploring Digital Health Care: eHealth, mHealth, and Librarian Opportunities. J Med Libr Assoc 109, no.3: 376–381. DOI: (https://doi.org/10.5195/jmla.2021.1180).

2. Eysenbach, Gunther. 2001. What is e-health? Journal of Medical Internet Research 3, no. 2: e20. DOI: (https://doi.org/10.2196/jmir.3.2.e20).

distinct socio-cultural, economic, and technological settings that distinguish various locations and demand tailored solutions[3].

Transitioning from the broader context of e-health, it becomes clear that the success of mHealth is contingent upon navigating these regional nuances. This paper will focus on the difficulties and approaches related to mHealth, taking into account its distinct place in the e-health spectrum. It recognises that the implementation of mHealth solutions is not uniform. Consequently, this paper undertakes a comparative analysis of mHealth implementation between two markedly different geopolitical entities: the European Union (EU) and the Association of Southeast Asian Nations (ASEAN), each with its distinctive challenges and strategies. The selection of the EU and the ASEAN for this comparative study is particularly pertinent due to their contrasting approaches to health policy, economic development, and digital infrastructure, which can provide valuable insights into the scalable models of mHealth. These regions, with their unique healthcare landscapes shaped by distinct cultural and economic factors, provide a rich tapestry for comparison. By juxtaposing their experiences, this paper seeks to answer the critical question: "What are the key challenges and strategies in mHealth implementation across the EU and the ASEAN, and how do these approaches compare in addressing the diverse obstacles presented by each region's unique healthcare landscape?"

The core of this study revolves around three pivotal areas: policy and governance, the potential and pitfalls of mHealth, and global challenges. Each domain is critical to the widespread adoption and success of mHealth projects.

The aim of this analysis is to examine the use of mHealth in the EU and ASEAN, identify challenges and illustrate recommendations based on existing research. The focus is on understanding how mHealth can be better implemented in these regions.

2. POLICY AND GOVERNANCE FRAMEWORKS: INFLUENCES AND IMPACTS

The governance and policy frameworks in place can have a significant impact on the development and implementation of e-health and mHealth solutions. These

3. Tadesse, Melaku, et al. 2023. Facilitators and Barriers to the Sustainable Use of eHealth Solutions in Low-and Middle-Income Countries: A Qualitative Descriptive Exploratory Study. JMIR Medical Informatics 10, no. 2: e10221492. DOI: (https://doi.org/10.2196/10221492).

frameworks have an impact on how widely e-health is accepted and used in health-care systems, in addition to providing the essential regulatory rules[4].

2.1. ASEAN Perspective: Varied Approaches and Governance

ASEAN's policy and governance frameworks in e-health and mHealth are evolving at different rates. In Singapore, the Ministry of Health's establishment of National Telemedicine Guidelines and online courses for doctors underscores its advanced approach[5]. Local primary care clinics have introduced teleconsultations, reflecting telemedicine's growing importance in managing non-communicable diseases (NCDs) like type-2 diabetes, especially given Singapore's ageing population[6]. Struggling with problems such as overpopulation and environmental pollution, Indonesia is still developing in e-health[7]. In contrast to ASEAN countries, India's digital health initiatives, like the National Digital Health Mission (NDHM), provide a unique benchmark due to their scale and comprehensive approach. These efforts aim to build a unified digital health infrastructure, enhancing workforce capacity and system efficiency. India's ambitious strategy offers valuable contrasts to ASEAN's varied e-health development stages, highlighting diverse global approaches and potentially adaptable best practices for similar challenges.[8]

In the ASEAN region, the development and harmonisation of e-health and mHealth policies are marked by significant diversity in regulatory tactics. This divergence among member states not only presents barriers to the creation of a unified Asian mHealth ecosystem but also reflects the complex balance between

4. Lefevre, Arthur, Chamberlain, Sara and Singh, Natasha S., et al. 2021. Avoiding the Road to Nowhere: Policy Insights on Scaling up and Sustaining Digital Health. Global Policy 12, no. 2: 225-235. DOI: (https://doi.org/10.1111/1758-5899.12909).

5. Ministry of Health, Singapore. Licensing Experimentation and Adaptation Program (LEAP) – A MOH Regulatory Sandbox. Retrieved from (https://www.moh.gov.sg/home/our-healthcare-system/licensing-experimentation-and-adaptation-programme-(leap)---a-moh-regulatory-sandbox).

6. Tan, Mui Suan, et al. 2023. Patients' Perspectives on Video Consultation for Noncommunicable Diseases: Qualitative Study in Singapore. BJGP Open, DOI: (https://doi.org/10.3399/BJGPO.2023.0103).

7. Archer, Norman, Cynthia Lokker, Maryam Ghasemaghaei, and Deborah DiLiberto. 2021. eHealth Implementation Issues in Low-Resource Countries: Model, Survey, and Analysis of User Experience. Journal of Medical Internet Research 23, no. 6: e23715. (https://doi.org/10.2196/23715).

8. Gudi, Nachiket, Theophilus Lakiang, Sanjay Pattanshetty, Suptendra Nath Sarbadhikari, and Oommen John. 2021. Challenges and Prospects in India's Digital Health Journey. Indian Journal of Public Health 65, no. 2: 209-212. (https://doi.org/10.4103/ijph.IJPH_1446_20).

national healthcare priorities and the emerging needs of a globalised health context. The stark contrast in healthcare policies across the ASEAN countries, ranging from advanced systems in places like Singapore to evolving frameworks in nations like Indonesia[9], highlights the challenges of regional integration.

Notably, in the face of global health crises such as pandemics, the necessity for integrated e-health and mHealth policies becomes more pronounced. The need for a collaborative and coordinated approach is no longer just a regional preference but a global imperative. This is where ASEAN's collective efforts come into play[10]. ASEAN meetings have become platforms where member states discuss and strategise on strengthening their regional health architecture. These discussions aim not just at pandemic preparedness and response but also at building a resilient healthcare infrastructure that can withstand and adapt to future health emergencies[11].

These efforts are exemplified by initiatives such as the Asia e-health Information Network (AeHIN) and its "Mind the GAPS, Fill the GAPS" framework. This initiative is a testament to ASEAN's commitment to enhancing healthcare cooperation. By focusing on key areas like Governance, Architecture, People and Programme Management, and Standards and Interoperability, AeHIN seeks to create a more cohesive and standardised digital health landscape across ASEAN countries[12]. The framework's holistic approach underscores the importance of multifaceted cooperation in healthcare, encouraging not just inter-country collaboration but also cross-sectoral partnerships.

However, the realisation of these objectives should focus on regional rather than country-centred strategies. This is because the individual approach, while addressing specific national needs, often overlooks the potential benefits of regional co-operation, particularly in terms of economies of scale. For example, the development of mHealth infrastructure and solutions can be more cost-effective and innovative when approached from a regional perspective. Benefiting from shared

9. Tan, Mui Suan, et al. 2023. Patients' Perspectives on Video Consultation for Noncommunicable Diseases: Qualitative Study in Singapore. BJGP Open, DOI: (https://doi.org/10.3399/BJGPO.2023.0103).

10. Agoramoorthy, Govindasamy. 2017. Legal and Health Dilemmas Challenging India's E-Cigarette Endorsement. Cancer 23, no.16:3197. DOI: (https://doi.org/10.1002/cncr.30836).

11. ANTARA. 24 August 2023. ASEAN Ministers Discuss Strengthening Regional Health Architecture. Retrieved from (https://en.antaranews.com/news/291954/asean-ministers-discuss-strengthening-regional-health-architecture).

12. The ASEAN. 7 December 2022. Digital Infrastructure for Universal Health Care in ASEAN. Retrieved from (https://theaseanmagazine.asean.org/article/digital-infrastructure-for-universal-health-care-in-asean/).

resources, knowledge and technologies can lead to more efficient health solutions that benefit the entire region[13].

2.2. European Perspective: Striving for Coherent E-health Integration

The European Union's vision for e-health is ambitious, seeking to transcend national boundaries and create a unified digital healthcare ecosystem. This vision is encapsulated in the EU Commission's Communication on the digital transformation of health and care, which sets forth three critical priorities: secure cross-border access to citizens' health data, fostering personalised medicine through a shared data infrastructure, and empowering citizens with digital tools for health management and interaction with healthcare providers. The Communication outlines actionable steps to achieve these goals, reflecting a commitment to advancing healthcare through digital innovation[14].

The EU's mHealth policy reflects this broader objective, intending to use mobile technologies to improve healthcare delivery and patient outcomes. The creation of the EU mHealth Hub demonstrates this commitment by fostering research, innovation, patient safety, and data protection while aiming for interoperability across the continent's health systems[15]. This vision is deeply embedded in the European Health Data Space (EHDS), which aims to facilitate the accessibility, exchange, and secure handling of health data within the EU. EHDS is focused on empowering individuals in managing their health data, supporting the usage of health data for enhancing healthcare services, and fostering a collaborative environment for health-related research and policy-making[16].

Recent legislative measures in Germany, including the Digital Act and the Health Data Use Act, are emblematic of efforts within individual EU countries to align with the EHDS. These laws aim to digitise health records and introduce e-prescriptions by 2024, bolstering Germany's contribution to the EU's digital healthcare harmo-

13. Stoumpos, Angelos I., Fotis Kitsios, and Michael A. Talias. 2023. Digital Transformation in Healthcare: Technology Acceptance and Its Applications. International Journal of Environmental Research and Public Health 20, no. 4: 3407. DOI: (https://doi.org/10.3390/ijerph20043407).

14. European Commission. Shaping Europe's Digital Future - eHealth. Retrieved from (https://digital-strategy.ec.europa.eu/en/policies/ehealth).

15. CORDIS EU Research Result. 2022. Health for All: European Mobile Health Hub. Retrieved from (https://cordis.europa.eu/article/id/441971-health-for-all-european-mobile-health-hub).

16. EU Commission. European Health Data Space. Retrieved from (https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en).

nisation efforts. Furthermore, the Hospital Transparency Act will enable German patients to access comprehensive information about hospital services, echoing the EU's dedication to transparent and patient-focused healthcare[17].

These legislative developments in Germany are part of a larger narrative within the EU, where varying levels of digital adoption and the need for standardisation across borders present ongoing challenges. The push for an integrated e-health and mHealth ecosystem within the EU faces obstacles such as disparate technological adoption rates, regulatory discrepancies, and the complexities of cross-border data exchange. To address these problems, the EU seeks to improve the coherence of digital health initiatives, emphasising the need of improving patient care through digital transformation. This journey is marked by collaborative efforts to harmonise legislative frameworks, promote technical interoperability, and ensure equal distribution of digital health benefits across all member states[18].

3. MOBILE HEALTH: BALANCING OPPORTUNITIES AND RISKS

Certain technologies stand out for their potential influence as the digital transformation of healthcare develops. Among these, mHealth stands out as a particularly significant achievement. While e-health encompasses a wide spectrum of digital health projects, mHealth focuses on taking advantage of mobile devices' accessibility and flexibility. As the global use of mobile devices has increased, it is easier to reach patients directly through their smartphones and tablets. Given the potential for direct patient interaction and the issues that mobile platforms present, it is critical to look more into the worldwide effect and challenges of mHealth, which has the potential to enhance health outcomes and minimise healthcare expenses[19].

17. Jennings, Jordan. 2023. Germany's Gearing up for European Health Data Space (EHDS) Compliance. Taft Privacy & Data Security Insights, Retrieved from (https://www.privacyanddatasecurityinsight.com/2023/10/germanys-gearing-up-for-european-health-data-space-ehds-compliance/#page=1).

18. European Commission. Shaping Europe's Digital Future - eHealth. Retrieved from (https://digital-strategy.ec.europa.eu/en/policies/ehealth).

19. Ni, Zhao, Martini, S., and Spaulding, Erin M., et al. 2023. Editorial: Future Trends and Directions of Using mHealth Strategies to Prevent and Treat Cardiovascular Diseases. Frontiers in Public Health. DOI: (https://doi.org/10.3389/fpubh.2023.1246918).

However, in addition to this potential, mHealth introduces new obstacles and hazards that must be carefully controlled[20].

3.1. ASEAN Perspective: Addressing the Digital Divide with Measured Optimism

In the ASEAN region, mHealth initiatives offer promising avenues for bridging healthcare gaps. While smartphone penetration rates and mobile internet connectivity are burgeoning, leading to optimistic projections, there remains a notable digital divide across and within countries. For instance, Singapore's HealthHub app is a pioneering example, providing a one-stop portal for personal health records and information[21]. However, initiatives like these are contrasted by the challenges in countries like Myanmar, where mobile network access and health infrastructure are limited[22]. The health system in Myanmar has been severely disrupted by civil unrest and military attacks. This has led many internally displaced people to seek medical assistance in neighbouring countries due to limited access to health services and supplies in Myanmar[23]. Telemedicine programmes in the Philippines targeting distant populations[24] and Indonesia's mobile maternal healthcare are two examples of mHealth's impact in ASEAN[25]. Despite these advances, efforts must continue to assure fair access and address the severe digital divide, which, if not addressed, has the potential to worsen health inequities.

20. Moreno-Ligero, Marta, Lucena-Anton, D., and Salazar, A., et al. 2023. mHealth Impact on Gait and Dynamic Balance Outcomes in Neurorehabilitation: Systematic Review and Meta-analysis. Journal of Medical Systems.

21. Smart Nation Singapore. HealthHub. Retrieved from (https://www.smartnation.gov.sg/initiatives/health/healthhub/#:~:text=HealthHub%20is%20a%20Singaporeans%E2%80%99%20%E2%80%9Cdigital,take%20control%20of%20their%20health).

22. Kyaw, Hnin Kalyar, Kyu Kyu Than, Karin Diaconu, and Sophie Witter. 2023. Community Stressors and Coping Mechanisms in Accessing the Health System During a Double Crisis: A Qualitative Case Study from Yangon Region, Myanmar. International Journal for Equity in Health 22, 39. DOI: (https://doi.org/10.1186/s12939-023-01851-4).

23. Chen, Wei-Ti, Chengshi Shiu, Franco R Lee, Saiyud Moolphate, and Myo Nyein Aung. 2023. Infrastructure Collapsed, Health Care Access Disrupted, Myanmar People with Chronic Diseases Are in Danger. Journal of Global Health. DOI: (https://doi.org/10.7189/jogh.13.03002).

24. Macariola, Aitana Dy, and Theara Mae Capacion Santarin, et al. 2021. Breaking Barriers Amid the Pandemic: The Status of Telehealth in Southeast Asia and its Potential as a Mode of Healthcare Delivery in the Philippines. Frontiers in Pharmacology 12. Retrieved from (https://doi.org/10.3389/fphar.2021.754011).

25. Asian Development Bank. 2022. Care for Mothers and Their Children. Project Result / Case Study, September 16. Retrieved from (https://www.adb.org/results/indonesia-private-sector-improving-health-care-mothers-and-their-children-0).

The Asian Development Bank's reports on digital technology in healthcare provide insight into these disparities, highlighting the need for continued investment[26] and strategic policy-making[27]. However, the road to mHealth in ASEAN is filled with difficulties. As a result, there is a risk that, in the absence of effective treatments, mHealth will unwittingly increase health disparities[28].

Despite the challenges, mHealth in ASEAN holds significant promise for improving healthcare access and outcomes. To capitalise on this potential, a concerted effort is needed from governments, the private sector, and the international community to bridge the digital divide. Strategic investments and policies tailored to the unique needs of each ASEAN country can drive forward a more inclusive and equitable healthcare future, ensuring that technological advancements in healthcare serve everyone, not just the few.

3.2. EU Perspective: Regulatory Innovation and Equity

In the European Union, mHealth is recognised as an innovative complement to traditional healthcare systems, aiming to enhance the quality and accessibility of care. The EU's dedication to health innovation is evident through initiatives that seek to harmonise the integration of mHealth across member states, acknowledging the diverse landscape of healthcare needs and digital capabilities[29].

Nevertheless, the uptake of mHealth across the EU is not uniform, with adoption rates varying significantly.[30] For example, while northern EU countries may exhibit higher engagement with mHealth apps, southern and eastern regions are slower in adoption, often due to both regulatory hurdles and infrastructural limitations. Policy harmonisation is imperative to address the disparate mHealth adoption rates, aligning the regulatory frameworks to foster a more cohesive e-health eco-

26. Asian Development Bank. Digital Technology. Retrieved from (https://www.adb.org/what-we-do/topics/digital-technology/overview).

27. Asian Development Bank. Health in Asia and the Pacific. Retrieved from (https://www.adb.org/what-we-do/topics/health).

28. Duine, Maaike. 2023. Summary Report APE 2023, 10–12 January, Berlin, Germany Berlin Re-Visited: Building Technological Support for Scholarship and Scientific Publishing. Information Services & Use.

29. European Commission. 2023. Digital Health: Commission and WHO Launch Landmark Digital Health Initiative to Strengthen Global Health Security. Press release, June 5. Retrieved from (https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3043).

30. European Commission. 2019. eHealth Adoption in Primary Healthcare in the EU is on the Rise. Report/Study, June 18. (https://digital-strategy.ec.europa.eu/en/library/ehealth-adoption-primary-healthcare-eu-rise).

system across the EU. Engaging stakeholders from various sectors – healthcare providers, technology firms, and patient advocacy groups – is essential for navigating the regulatory and infrastructural challenges impeding mHealth adoption. Furthermore, investment in digital infrastructure, particularly in regions lagging behind, could enable more equitable access and adoption of mHealth services. Data from the European Commission's e-health benchmarking reports could help to clarify these adoption patterns and identify areas for targeted improvement[31].

Despite the existing barriers, mHealth has the capacity to significantly transform healthcare in the EU. The task for legislators, business executives and medical professionals is to collaboratively overcome these barriers to mHealth adoption and maximise its benefits for all residents of the EU.

4. GLOBAL CHALLENGES AND THE WAY FORWARD

The ascent of mHealth is a global phenomenon, yet its adoption is fraught with challenges that transcend regional boundaries. The digital divide is a global issue that poses a substantial obstacle to the efficient implementation of mHealth.

Regulatory issues are a global problem as well. The incorporation of mHealth into healthcare systems necessitates the development of clear and effective regulatory frameworks. These frameworks must address a wide range of challenges, from mHealth application approval to data security and privacy[32].

Furthermore, the global spread of mHealth creates significant ethical concerns. How can we ensure that mHealth solutions are accessible and beneficial to all, rather than aggravating health disparities? In an increasingly digital environment, how can we ensure patient privacy and security? In this regard, mHealth has enormous potential to improve healthcare delivery and outcomes[33]. Realising this promise, however, necessitates resolving the tremendous problems that come with it[34].

Addressing these global challenges requires a concerted effort to devise clear, harmonised regulatory frameworks that can accommodate the rapid evolution of

31. European Commission. 2018. "Benchmarking Deployment of eHealth among General Practitioners Final Report." DOI: (https://doi.org/10.2759/511610).

32. Sleimann, Madelaine and Balcerek., et al. 2023. Health Care Utilization of Adolescent and Young Adult Survivors of Pediatric Hematologic Malignancies in Germany. European Journal of Cancer Care. DOI: (https://doi.org/10.1007/s00432-023-05145-8).

33. Adibi, Sasan. 2015. Mobile Health: A Technology Road Map. Springer International Publishing. DOI: (https://doi.org/10.1007/978-3-319-12817-7).

34. Terry, Nicolas P. 2017. Mobile health: assessing the barriers. Chest 151(2): 356-361. DOI: (https://doi.org/10.1378/chest.14-2459).

mobile technologies while safeguarding patient data. Additionally, strategies must be developed to enhance digital literacy and infrastructure to ensure that mHealth benefits all societal segments.

5. CONCLUSION

The digital revolution in healthcare, spearheaded by e-health and mHealth, heralds a transformative era for medical services, underlining the importance of efficiency and patient engagement. This paper has explored the multifaceted nature of mHealth deployment across two distinct regions: the European Union (EU) and the Association of Southeast Asian Nations (ASEAN), each facing unique challenges within their healthcare frameworks.

In the European Union, significant progress has been made in integrating digital health within its varied healthcare systems. However, challenges in achieving uniform adoption and integration of mHealth across its member states persist. The EU's efforts are mainly focused on creating a unified digital healthcare ecosystem, emphasising the need for regulatory harmonisation and equitable access to digital health services. Comparatively, in ASEAN, the approach to digital health is marked by a wide spectrum of legislative developments. Countries like Singapore exhibit advanced mHealth systems, whereas others face challenges in establishing fundamental digital healthcare frameworks, reflecting diverse socio-economic and technological landscapes. This diversity, although presenting challenges, also offers a rich ground for innovation and context-specific solutions that could inform global mHealth strategies.

In conclusion, the advancement of e-health necessitates tailored strategies sensitive to the socio-cultural, economic, and technological contexts of each region. It calls for robust policy frameworks, a steadfast commitment to data security, strategic mHealth adoption, and inclusive stakeholder involvement. The experiences and lessons learned from both the EU and ASEAN serve as valuable references for global stakeholders aiming to develop effective e-health policies. Although the journey toward comprehensive e-health is intricate, the promise it holds for global healthcare is immense and warrants concerted collaboration and strategic vision. Moving forward, the global health community must embrace the lessons from these regions to foster a more connected, efficient, and equitable healthcare future.

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Digital Health Regulatory Framework in Southeast Asia

Catherine Setiawan

I. BACKGROUND

This is the era where the world's population is connected to one another because information, communication, and technologies (ICT) are important and integral to our daily lives. Like a blessing in disguise, the COVID-19 pandemic has again reminded us of the benefits of digitally enabling sectors and activities.[1] ASEAN (Association of Southeast Asia Nations) is no exception. The countries in the region have increased their use of digital services by between 10 and 50 per cent on e-education, e-shopping, e-banking, and e-health, especially during the COVID-19 pandemic,[2] and this effect is likely to persist in the long term.

ICT played a big role during the pandemic across all ranges of sectors, but especially in health.[3] E-health or digital health, as defined by the World Health Organisation (WHO), is the use of ICT in improving health.[4] It encompasses a broad range of technologies, from mobile health apps to telemedicine. Digital health is important as it can reduce healthcare costs to families, improve equitable access to quality services, efficiently link health systems with social protection programmes, and increase accountability and sustainability of health service delivery.[5] Digital health can also promote healthy lives and wellbeing for everyone and everywhere,

1. EU-ASEAN Business Council. Webinar - Fit-For-Purpose Regulatory Frameworks for Digital Health Post Covid-19: Opportunities for ASEAN. 3 May 2022 .

2. ASEAN. 2021. ASEAN Digital Masterplan 2025, p. 10.

3. Accessed 10 August 2023. (https://datareportal.com/reports/digital-2022-global-overview-report).

4. Accessed 2 August 2023. (https://www.who.int/health-topics/digital-health#tab=tab_1).

5. Ibid.

as it creates efficient and sustainable health systems, enabling the delivery of high-quality, affordable and equitable healthcare.[6]

Mr. Ekkaphab Phanthavong, ASEAN Deputy Secretary-General for the ASEAN Socio-Cultural Community, said: "ASEAN has experienced first-hand how digitalisation enabled ASEAN Member States to be nimbler and more adaptive to the COVID-19 pandemic".[7] He further encouraged the use of digital technologies for social welfare and reducing inequalities, especially in finding solutions to some of ASEAN's public digital health challenges, namely in optimising the technology skill sets of health practitioners and users, eliminating regulatory barriers, improving digital and health infrastructure and some other issues like privacy, safety, and ethical considerations.

This paper will provide an overview of the development of digital health in Southeast Asia, especially the regulatory framework. Some best practices from the WHO and the European Union's E-health policies will also be provided as comparison. In the end, the paper hopes to improve the digital health regulatory framework in Southeast Asia.

II. DIGITAL HEALTH IN SOUTHEAST ASIA

As mentioned previously, digital health uses ICT in improving health. Digital health has transformed the health ecosystem in the Southeast Asian region, including via telemedicine and digital health applications, digital system and big data analytics, and artificial intelligence (AI). Various websites and mobile applications have been established for telemedicine with the coverage ranging from urban to rural areas. Some examples of digital health applications are Indonesia's "halodoc"[8] and Malaysia's "Doctor2U" and "Doc2Us".[9]

The ASEAN BioDiaspora Virtual Centre[10] stands as a testament to leveraging digital systems and big data analytics to effectively tackle public health emergencies (PHE) within the ASEAN region. Notably, Brunei Darussalam has embraced the

6. Ibid.

7. Accessed 15 August 2023. (https://asean.org/regional-cooperation-multi-stakeholder-partnerships-key-to-aseans-digital-health-transformation/).

8. Halodoc. (https://www.halodoc.com/).

9. Doctor2U. (https://doctor2u.my/); Doc2Us. (https://doc2us.com/).

10. ASEAN BioDiospora Virtual Center. Accessed 19 December 2023. (https://asean-phe.org/phe-mechanism/asean-biodiaspora-virtual-centre-abvc/).

"One Patient One Record" initiative through its BRU-HIMS system.[11] This innovative platform consolidates medical data from various sources, including government hospitals, outpatient services, treatment centres, and clinics, into a unified electronic medical record, streamlining healthcare delivery and enhancing patient care.

AI's roles include monitoring and diagnostic systems, robotic services, and treatment through advanced technology. However, the adoption of AI is still in the early stages. Only a few systems are in the advanced stages of AI implementation; for example, Singapore utilises AI to support several services like pathology and medicine delivery.[12] Some other applications using AI-powered diagnostic and predictive systems to diagnose patients through chat include OneNUHS App and OneNUHS Health Chatbox.[13] AI is also used to help in the rapid diagnosis and early detection of high-risk patients. An Indonesian start-up named CekMata[14] used AI for detecting cataracts. In Thailand, IBM Watson supercomputer analytics[15] has been integrated into the oncology department at Bumrungrad International Hospital to advise doctors on the best treatment plans for cancer patients.

III. DIGITAL HEALTH REGULATORY FRAMEWORK IN SOUTHEAST ASIA

Digital health development in Southeast Asia has also been supported by national policies and frameworks.[16] As we can see in Table 1, some countries in Southeast Asia have already taken a further step towards digital health transformation through the implementation of digital health strategies, policies, or blueprints.

11. BRU-HIMS. (https://www.moh.gov.bn/SitePages/Bru-HIMS.aspx).

12. ASCC. 2023. Transforming the Digital Health Initiative in ASEAN. (https://asean.org/wp-content/uploads/2023/02/ASCC_Policy-Brief_Issue_6_Jan2023.pdf).

13. OneNUHS App. (https://www.nuhs.edu.sg/For-Patients-Visitors/OneNUHS-App/Pages/default.aspx).

14. CekMata. (https://www.instagram.com/cekmata_ai/).

15. IBM Watson supercomputer analytics. (https://www.ibm.com/watson).

16. ASCC. 2023. Transforming the Digital Health Initiative in ASEAN. (https://asean.org/wp-content/uploads/2023/02/ASCC_Policy-Brief_Issue_6_Jan2023.pdf).

Table 1. Digital Health Strategy in Southeast Asia.

Countries	E-health Policies or Strategies
Cambodia	Cambodia Health Tech Roadmap (2022)[17]
Indonesia	Indonesia Digital Health Transformation Strategy 2024[18]
Lao PDR	Lao PDR Digital Health Strategy for 2023-2027 (in progress)
Singapore	Singapore Smart Health Initiative[19]
Thailand	Thailand Digital Health Strategy, Ministry of Public Health 2021-2025[20]
The Philippines	Philippines E-health strategic framework and Plan 2014-20*
Viet Nam	Viet Nam's Ministry of Health Decision No. 5316, 2020[21]

Source: Multiple (2023).
Note: * no information on the update.

The Cambodia Health Technology Roadmap[22] was endorsed by the National Council of Science, Technology & Innovation (NCSTI) on 8 July 2021. The roadmap is based on three interrelated and reinforcing visions, namely an integrated one health approach, multidisciplinary policy and governance and strengthening research and knowledge-sharing capacity. Cambodia's target for digital health is divided into three phases. In the short term, Cambodia may consider focusing investment on ensuring nationwide internet access and developing cloud computing facilities to support the increased digitisation of the health sector. In the medium term, targeted development of blockchain medical records and advanced telemedicine infrastructure will build on earlier technological upgrading to enhance service provision. The long-term ambition in 2030 is to create a health sector characterised by knowledge sharing and embodying the principles of One Health. This

17. National Council of Science, Technology and Innovation. 2022. Cambodia Health Tech Roadmap. (https://www.misti.gov.kh/public/file/202206301656579483.pdf).

18. Ministry of Health Indonesia. 2021. 2024 Digital Health Transformation Strategy. (https://dto.kemkes.go.id/ENG-Blueprint-for-Digital-Health-Transformation-Strategy-Indonesia%202024.pdf).

19. Smart Nation Singapore. 2023. Singapore Smart Health Initiative. (https://www.smartnation.gov.sg/initiatives/health/).

20. Thailand Ministry of Public Health. Digital Health Strategy. (https://ict.moph.go.th/upload_file/files/263bec94c161efb9d61d3b1116dee9a4.pdf).

21. Viet Nam's Ministry of Health Decision No. 5316, 2020. (https://vanbanphapluat.co/decision-5316-qd-byt-2020-medical-digitalization-program-until-2025-and-orientation-to-2030).

22. General Department of Science, Technology, and Innovation. 2023. Cambodia Health Technology Roadmap. LinkedIn. (https://www.linkedin.com/pulse/cambodias-health-technology-roadmap-/).

objective will be achievable through the adoption of crucial technologies. Cambodia has recognised the interlinked relationships between health, social and economic outcomes, and is thus committed to improving health with the support of technologies as part of its future prosperity and economic development.

The Indonesian Ministry of Health formulated the 2024 Digital Health Transformation Strategy, a blueprint which is based on the spirit of creating an *"Indonesia Sehat"* collaboratively with the entire ecosystem of health industry players in a *SATUSEHAT* platform (Indonesia Health Services). The Indonesia digital health blueprint focuses on the Indonesian digital health situation and challenges, digital technology transformation (technology, ecosystem, data, and governance), and health platform and architecture. The Ministry of Health is currently preparing the Digital Health Transformation Strategy (DHTS) 2025-2029 as a continuation of the health technology transformation being conducted from 2021 to 2024. The goal of the DHTS 2025-2029 is to ensure that the programme or the movement is sustained and continues to achieve its ultimate goal, namely improving public health.[23]

Previously, the Lao People's Democratic Republic (Lao PDR) had formulated an E-health strategy spanning from 2017 to 2021, but it did not receive endorsement from the Ministry of Health (MOH) of Lao PDR. Subsequently, the MOH sought assistance from the World Health Organisation (WHO) to revise this strategy to align with current needs and circumstances, engaging relevant stakeholders in the process. In January 2022, the MOH conducted a Dissemination Workshop on its Digital Health Strategy for 2023-2027. The workshop served to scrutinise key elements of the strategy, involve stakeholders, and disseminate it in both printed and digital formats to national and international audiences.[24] At present, there are no updates available regarding the progress of the digital health strategy development.

Singapore is at the forefront of embracing key digital health technologies, with notable advancements in artificial intelligence (AI), telemedicine, mobile health, data analytics, and integrated healthcare systems. Central to these efforts is the Singapore Smart Health Initiative, which aims to empower individuals with the knowledge and tools necessary to manage their health effectively, leveraging technology and robotics in healthcare delivery. Supporting this initiative are various digital health programmes and policies, including the Singapore one-stop health

23. Muhamad Sean, Raka Adji. 2023. Ministry Prepares Digital Health Transformation Strategy for 2025-2029. Antara News. Accessed 18 December 2023. (https://en.antaranews.com/news/298719/ministry-prepares-digital-health-transformation-strategy-for-2025-2029).

24. AeHIN. 2023. Lao PDR holds Digital Health Strategy (2023-2027) Dissemination Workshop, 13 February 2023.

portal known as HealthHub, the National Steps Challenge™ & Healthy 365 App, Project Pensive, aimed at early detection of dementia through technology, and telehealth services designed to bring healthcare directly to homes. These initiatives underscore the Singaporean government's commitment to revolutionising healthcare through digital innovation.

Thailand has demonstrated a steadfast commitment to advancing digital health, continuously striving to expedite and expand its digital health transformation to effectively tackle the challenges and capitalise on the opportunities presented by healthcare in the 21st century. The Thailand Digital Health Strategy serves as a pivotal mechanism for enhancing the national health system, encompassing a paradigm shift, restructuring digital technology operations, and fostering health innovation across all sectors. This strategic approach underscores Thailand's dedication to modernising healthcare delivery and improving health outcomes through digital innovation.

Drawing from the Philippines eHealth Strategic Framework and Plan 2014-20, the Philippines aimed to foster extensive access to healthcare services, health information dissemination, and secure sharing and exchange of client data. This initiative aimed to bolster the provision of safer, high-quality healthcare, fostering a more equitable and responsive health system for all Filipino citizens. The overarching goal was to revolutionise the utilisation of information in planning, managing, delivering, and monitoring health services. While there is no explicit update on the plan for the upcoming years, continuity from the previous agenda is expected, reflecting the nation's commitment to advancing healthcare through digital innovation.

Viet Nam's Ministry of Health Decision No. 5316, 2020 approves the healthcare digital transformation scheme until 2025 and orientation to 2030, promoting the implementation of information technology and digital technology in all aspects of healthcare activities. The four key areas addressed in this scheme are state administration, cashless payment and telehealth, disease prevention and primary care, and healthcare. Furthermore, Viet Nam's Ministry of Health is also focusing on three objectives in transforming healthcare, namely e-health infrastructure, electronic medical records, and an online one-stop public health service system.

Despite the existence of national guidelines for digital health policy, Southeast Asian countries do not have any regional guidelines and standards. Although the health vision was indeed stated in the background for the ASEAN Digital Masterplan (ADM) 2025 creation and the health focus stated under desired outcome 1, the Masterplan was designed only to address COVID-19 pandemic-related global health

issues and the measures required to control it.[25] The ADM 2025, unfortunately, does not provide a clear strategy or outcomes that are specifically connected to the segment of digital health in the broad context.

Having a regional framework for digital health is important, especially in standardising and aligning data, harmonising digital systems, and improving interoperability, as it will leverage the potential for efficiently gaining electronic medical health records. For example, public and private hospitals in Southeast Asia (as part of ASEAN member states) may use different platforms and formats to encode medical data, which also come in different data formats, in recording a patient's medical history. Having the same data formats will allow all patients within Southeast Asia to easily share medical records in all hospitals within the region. In addition, patients need to feel safe and confident that the digital health services will be stored, used, and shared in a responsible manner. That said, hospitals and medical facilities in Southeast Asia must also comply with a set of standards and guidelines as provided at the ASEAN level to ensure that patient data records are safe and secure in whichever hospital they are going to within the region.

IV. INTERNATIONAL STANDARD AND BEST PRACTICES

World Health Organisation

The WHO[26] has four strategic objectives for digital health (Table 2 below). The four strategic objectives are intended to provide guidance and coordination on global digital health transformation and to strengthen synergies between initiatives and stakeholders to improve health outcomes and mitigate associated risks at all levels: "Promoting global collaboration and advance the transfer of knowledge on digital health, Advancing the implementation of national digital health strategies, Strengthening governance for digital health at global, regional, and national levels, Advocating people-centred health systems that are enabled by digital health."

25. Ibid, p. 8.

26. WHO. Global Strategy for Digital Health 2020-2025. (https://apps.who.int/iris/bitstream/handle/10665/344249/9789240020924-eng.pdf).

Table 2. WHO Strategic Objectives for Digital Health 2020-2025.

Strategic Objectives	Outputs
1. Promote global collaboration and advance the transfer of knowledge on digital health	1) digital health is prioritised and integrated into health systems at global, regional, and national levels through dedicated bodies and mechanisms for governance. 2) multi-stakeholder groups are convened on a regular basis to support the appropriate use and scaling up of digital health and innovation to accelerate progress towards the health-related Sustainable Development Goals. 3) information centres for disease surveillance are established or strengthened at national, regional, and global levels.
2. Advance the implementation of national digital health strategies	1) a national digital health strategy or equivalent strategic framework exists, is integrated in the national health strategy, and is actively used to guide development and accelerate progress towards the health-related targets of the Sustainable Development Goals and in the context of digital transformation of health systems; and 2) a dynamic digital health maturity model assessment to guide prioritisation of national investment in digital health is made in support of primary health care and universal health coverage.
3. Strengthen governance for digital health at global, regional and national levels	1) governance exists, in accordance with Secretariat-led development of regulatory framework, to agree on global appropriate use of health data and on concepts such as health data as a global public good and to outline principles of equitable data-sharing principles for research, consistent metadata and definitions, artificial intelligence and data analytics, and primary and secondary use of data. 2) a voluntary guideline on global interoperability standards for digital health is developed in collaboration with stakeholders and adopted, that: a) tries to build upon results already broadly achieved, b) includes a list of commonly agreed use cases for the public health care sector, its functional requirements and a set of functional and technical specifications, standards, semantics and profiles derived thereof, c) defines requirements for a sound legal and regulatory framework with clearly defined roles for data governance and d) encompasses political leadership regarding public investment, procurement and standardisation to create an interoperable digital health ecosystem at the national and international levels; 3) global guidance on planning, development and use of digital hospitals, digital clinical trials and digital therapeutics is developed; and 4) a set of recommendations is developed for pseudonymisation and anonymisation of health data.
4. Advocate people-centred health systems that are enabled by digital health	1) improved digital health literacy in using and understanding digital health technologies and systems as well as health data is prioritised, and the validated tools are accessible by all populations. 2) a framework allowing individual feedback in validating the performance of digital health tools and services, diffusion of increasing digital health demand is implemented and used. 3) global minimum health data standards for prioritised digital health technologies and processes are established, adopted, and applied at national level; and 4) global guidance on personalised medicine is developed.

Source: WHO (2020).

In addition to the four strategic objectives for digital health, the World Health Organisation together with the International Telecommunications Union (ITU) released the National eHealth Strategy Toolkit.[27] The toolkit is a practical guide that provides governments, their ministries and stakeholders with a solid foundation and method for the development and implementation of a national eHealth vision, action plan and monitoring framework.

Table 3. WHO-ITU eHealth components.

<table>
<tr><td colspan="4">Leadership and Governance</td></tr>
<tr><td rowspan="3">Strategy and Investment</td><td>Services and applications</td><td rowspan="3">Legislation, Policy and Compliance</td><td rowspan="3">Workforce</td></tr>
<tr><td>Standards and interoperability</td></tr>
<tr><td>Infrastructure</td></tr>
</table>

Source: WHO-ITU National eHealth Strategy Toolkit (2012).

The most critical part in the toolkit is **leadership and governance** because adequate governance is important for encouraging the growth of the digital health industry. It will direct and coordinate national-level digital health, as well as multi-sector engagement and specification of roles. The next component in this toolkit is **strategy and investment**, which entails responsive strategy, planning, and financing for the digital health environment. These include identifying financing needs and sources, such as from the government, private sector, and donors. The **legislation, policy and compliance** component is described as the development and adoption of national policies and legislation aiming to establish trust and protection for digital health consumers and the industry, and includes: ensuring adequate service quality, data privacy, and reimbursement. Compliance to these regulations should be prioritised through periodic accreditation of digital health products and services. Furthermore, due to the digital divide across a country, ICT **infrastructure** represents another challenge in implementing telemedicine. The internet can be very costly due to the absence of competition. It is important to ensure service quality and to keep prices low by promoting competition. The **workforce** component entails the improvement of digital skills and literacy through education, technical cooperation, establishing relevant networks, and collaborations with the private sector. Digital literacy for the public is the aim and main focus of this component. It is also crucial to introduce **standards** that allow for accurate

27. WHO-ITU National eHealth Strategy Toolkit. 2012. Available at: (https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-E_HEALTH.05-2012-PDF-E.pdf).

and consistent data collection to exchange information across systems, so as to effectively transform the digital health landscape. The last component, **services and application,** involves brainstorming and working sessions to develop digital health products that can solve health issues.

European Union

The European Union (EU), as another regional organisation, has also been working to provide its citizens with access to safe and top-quality digital services in health and care.[28] The European Union's digital transformation of health and care centres on three core priorities. First, it focuses on ensuring citizens' secure access to their health data, both within their own countries and across borders, facilitating seamless access to health information throughout the EU. Second, it aims to advance personalised medicine by establishing a shared European data infrastructure, enabling collaboration among researchers and healthcare professionals across member states. Third, the EU prioritises citizen empowerment through digital tools, promoting person-centred care and fostering active engagement between individuals and healthcare providers.

The European Union's dedication to leveraging digital technologies to empower individuals, enhance healthcare services, and foster cross-border cooperation in the health and care sector is evident through its prioritised initiatives. With a focus on ensuring secure data access, establishing shared data infrastructure, and enabling citizen empowerment through digital tools, the EU aims to cultivate a more integrated and responsive healthcare ecosystem. This approach aims to meet the diverse needs of EU citizens while fostering a culture of innovation and collaboration among member states. Central to these efforts is the EU's unwavering commitment to prioritising the sharing of health data across borders. By facilitating seamless access to health information for EU citizens regardless of their location within the region, the EU seeks to promote continuity of care and facilitate informed decision-making. This commitment underscores the EU's vision of creating a unified healthcare landscape that utilises digital technologies to improve accessibility, efficiency, and quality of care while promoting greater cooperation and solidarity among member states.

28. EU. 2023. Shaping Europe's Digital Future. (https://digital-strategy.ec.europa.eu/en/policies/ehealth); EU. 2023. (https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en).

To realise the full potential of the health data, the European Commission presented a proposal to enact a regulation to set up the European health data space.[29] This proposal advocates for empowering individuals to manage their health data autonomously, facilitating greater autonomy and agency in personal healthcare decisions. Additionally, it advocates for leveraging health data to enhance healthcare delivery, spur research advancements, foster innovation, and inform policy-making processes. By promoting the safe and secure exchange, utilisation, and reuse of health data, this initiative positions the EU to fully capitalise on the potential inherent in harnessing health data for the collective benefit of its citizens and the advancement of healthcare systems.

V. CONCLUSION AND RECOMMENDATIONS

ASEAN member states have made significant strides towards digital health transformation at the national level, with many countries having already established their own comprehensive strategies, policies, and blueprints. Examples include Cambodia's Health Tech Roadmap (2022), Indonesia's Digital Health Transformation Strategy 2024, and Singapore's Smart Health Initiative, among others. However, while countries like Laos are in the process of developing their digital health strategies, there remains a lack of uniformity in the current landscape of digital health readiness across ASEAN member states. Despite individual efforts, the ASEAN Digital Masterplan 2025 (ADM 2025) currently lacks a clear strategy or outcomes specifically linked to digital health. This highlights the need for a regional framework that standardises and aligns data, harmonises digital systems, and improves interoperability. Such a framework would facilitate efficient access to electronic medical health records and enhance the overall effectiveness of digital health initiatives across the ASEAN region. By addressing these challenges collectively, ASEAN can leverage the full potential of digital technologies to improve healthcare delivery and outcomes for all its citizens.

Aligned with the WHO Digital Health Framework, digital health policies across Southeast Asian countries underscore a commitment to collaboration and knowledge sharing, aiming to propel the effective implementation of digital health strategies. Furthermore, within ASEAN, member states collectively prioritise enhancing governance structures at both national and regional levels. Leveraging

29. European Commission. 2022. Regulation of the European Parliament and of the Council on the European Health Data Space. (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022PC0197).

resources such as the WHO and ITU's National eHealth Strategy Toolkit, ASEAN can systematically evaluate and gauge the readiness of countries in embracing digital health initiatives. This comprehensive approach serves as a guiding framework to identify areas for improvement and to advance all facets of digital health within each member state. By adopting a holistic perspective, ASEAN stands poised to optimise the potential of digital health technologies, fostering innovation and enhancing healthcare delivery across the region. Through collaborative efforts and informed governance, member states can leverage shared resources and best practices to bolster their digital health infrastructure. This collective approach not only facilitates the assessment and enhancement of digital health readiness but also fosters a conducive environment for sustainable progress and equitable access to healthcare services throughout Southeast Asia.

Looking beyond the ASEAN region, the European Commission's proposal to establish a regulation for the European health data space offers valuable insights for ASEAN countries as they develop their own regional digital health service framework. This EU initiative, which focuses on standardising a digital health framework within Europe, emphasises the safe and secure exchange, utilisation, and reuse of health data to maximise its potential benefits for citizens and healthcare systems. The promotion of such practices can serve as an encouraging example for ASEAN to explore opportunities for exchanging health data across the region.

In drafting a regional framework for digital health services, ASEAN can draw inspiration from the European Commission's approach while considering the unique needs and challenges within the ASEAN context. By prioritising data security, interoperability, and collaboration among member states, ASEAN can create a robust framework that facilitates seamless exchange and utilisation of health data for the betterment of healthcare delivery and outcomes across the region. Additionally, leveraging lessons learned from the EU's efforts can help ASEAN navigate the complexities of digital health governance and foster greater trust and cooperation among member states.

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Factors Influencing E-health Development in Asian Countries: A Comparative Analysis and Policy Implications

Dmitry Erokhin

INTRODUCTION

In recent years, the field of digital health has witnessed significant growth and transformation, revolutionising healthcare delivery systems worldwide (Cummins and Schuller 2020). Among the various aspects of digital health, e-health, which encompasses the use of information and communication technologies (ICTs) in healthcare, has emerged as a vital tool for improving access, quality, and efficiency of healthcare services (Al-Shorbaji 2021). With the potential to overcome geographical barriers, enhance healthcare delivery, and empower patients, e-health has garnered attention as a promising avenue for healthcare advancement.

Understanding the factors that contribute to the development of e-health is crucial for policymakers and healthcare professionals aiming to leverage its benefits effectively. While the adoption and progress of e-health vary across countries, this research paper focuses specifically on Asian nations to investigate the factors influencing e-health development in this region. By utilising the Global Digital Health Monitor as a comprehensive dataset, this study aims to analyse a wide range of variables related to e-health performance, providing insights into the determinants of successful e-health implementation.

The paper's primary objective is to conduct a comparative analysis of e-health development among Asian countries, shedding light on the factors that explain variations in their performance. By examining the diverse approaches and strategies adopted by these nations, valuable insights can be gained to inform policymakers and stakeholders about the key drivers of successful e-health implementation. Such knowledge will enable them to make informed decisions and foster improved e-health outcomes in their respective countries.

The Global Digital Health Monitor dataset serves as a robust foundation for this study, offering a comprehensive view of e-health development across multiple

dimensions. The dataset includes various indicators, such as e-health infrastructure, policy frameworks, health information systems, telemedicine services, and electronic health records, among others. By leveraging this extensive dataset, the research delves into the specific factors that contribute to successful e-health implementation, elucidating the pathways towards improved healthcare delivery in the Asian context.

Asia presents a diverse and dynamic environment for e-health implementation, with significant variations in economic, social, and technological factors across its nations (Lwin et al. 2023; Chongsuvivatwong et al. 2011). In recent years, Asian countries have witnessed significant advancements in e-health implementation (Pengput and Schwartz 2022). The region's unique blend of economic growth, technological innovation, and increasing healthcare demands has created fertile ground for the adoption of digital health solutions. Several Asian nations have made notable strides in implementing e-health strategies, resulting in improved healthcare access, enhanced patient outcomes, and more efficient healthcare systems.

E-health development in Asian countries is influenced by a combination of factors that span economic, social, technological, and policy dimensions. One key driver of e-health adoption in the region is the rapid advancement of ICT infrastructure (Amboala 2021). Countries such as Singapore, South Korea, and Japan have invested heavily in building robust telecommunications networks, broadband connectivity, and mobile penetration rates (Pradhan et al. 2017), creating a solid foundation for e-health initiatives. These countries have capitalised on their technological capabilities to develop and implement comprehensive e-health systems that facilitate telemedicine, health information exchange, electronic health records, and remote patient monitoring.

Furthermore, the rising prevalence of chronic diseases and the growing elderly population in Asia have necessitated the adoption of innovative healthcare solutions (Sukkird and Shirahada 2015). E-health technologies offer opportunities for early detection, remote monitoring, and personalised care, which can significantly improve the management of chronic conditions. In countries like China and India, where the burden of chronic diseases is substantial, e-health solutions have the potential to bridge the gaps in healthcare access, particularly in rural and remote areas (Banbury et al. 2014; Bloom et al. 2014).

Policy and regulatory frameworks play a crucial role in shaping e-health development in Asian countries (Kusumasari et al. 2018). Governments across the region have recognised the importance of e-health and have taken steps to create an enabling environment for its implementation. Policy initiatives that promote interoperability, data privacy and security, and standards harmonisation are critical

for ensuring the seamless exchange of health information and the integration of e-health solutions into existing healthcare systems.

In addition to policy support, successful e-health implementation in Asia relies on strong public-private partnerships (Qureshi et al. 2013). Collaboration between governments, healthcare providers, technology companies, and academic institutions is essential for driving innovation, sharing best practices, and mobilising resources. Public-private partnerships facilitate the development of scalable e-health solutions, encourage knowledge transfer, and help overcome financial and technical barriers.

While several Asian countries have made remarkable progress in e-health implementation, challenges and barriers persist (Dornan et al. 2019). Limited interoperability among different healthcare systems, resistance to change, inadequate healthcare infrastructure in rural areas, and concerns related to data privacy and security are some of the challenges that need to be addressed. Additionally, cultural and social factors may influence the acceptance and adoption of e-health technologies, highlighting the importance of considering local context and tailoring strategies accordingly.

Understanding the variations in e-health development among Asian countries and identifying the factors that contribute to their success or hinder their progress is crucial for policymakers and healthcare professionals aiming to improve healthcare outcomes. Comparative analyses of e-health implementation in different countries provide valuable insights into the strategies, policies, and best practices that can be adopted or adapted to suit specific contexts. By identifying the drivers of successful e-health initiatives and the barriers faced by less developed countries, policymakers can make informed decisions, allocate resources effectively, and design targeted interventions to foster improved e-health outcomes.

DATA AND METHODOLOGY

Data

In the study, the overall indicator of the Global Digital Health Monitor (GDHM)[1] is utilised as the dependent variable. The GDHM serves as an interactive web-based resource designed to track, monitor, and assess the enabling environment for digital health globally. It consists of 23 indicators covering various dimensions of digital

1. (https://digitalhealthmonitor.org/).

health, such as leadership and governance, strategy and investment, legislation, policy and compliance, workforce, standards and interoperability, infrastructure, services and applications, and cross-cutting issues.

By utilising the overall indicator of the GDHM as the dependent variable, the study aims to evaluate and analyse the progress and quality of digital health interventions and enablers at the country level. The GDHM's comprehensive set of indicators provides a holistic view of the digital health landscape, allowing for the monitoring of advancements in different areas of digital health implementation.

The study utilises the GDHM's overall indicator as a measure to assess the effectiveness and impact of digital health initiatives, track the development of comprehensive digital health systems, identify funding and technical assistance needs, encourage alignment among stakeholders, and highlight potential areas of risk for investment.

The state of digital health in a country can be assessed through various World Bank variables, which serve as proxies for measuring digital health readiness and progress. These variables are crucial for understanding the digital health landscape and its relationship with broader socioeconomic factors. Here are the key variables and their significance:

1. Information and Communication Technology (ICT) Infrastructure: Variables such as broadband and mobile subscriptions per 100 inhabitants, and internet users (percentage of population) reflect the technological infrastructure available in a country. Robust ICT infrastructure is essential for the development, implementation, and accessibility of digital health solutions (Lennon et al. 2017).

2. Health Expenditure and Financing: Health expenditure as a percentage of Gross Domestic Product (GDP), government expenditure on health, and out-of-pocket health expenditure as a percentage of private expenditure on health indicate the financial investment in healthcare. Sufficient health financing is vital for supporting digital health initiatives, including the development of infrastructure, technology adoption, and the sustainability of digital health services (Labrique et al. 2018).

3. Government Policies and Regulations: The regulatory quality index and ease of doing business index reflect the policy environment for digital health. Favourable policies and regulations facilitate innovation, investment, and implementation of digital health solutions, while ensuring privacy, security, and interoperability of health data (Fernandes and Chaltikyan 2020).

Additionally, economic indicators like GDP, GDP per capita, inflation rate, unemployment rate, and foreign direct investment (FDI) inflows provide insights into the socioeconomic context within which digital health operates. They help in the understanding of the economic conditions, resource allocation, and the potential for investment in digital health infrastructure and services.

By considering these variables collectively, policymakers, researchers, and stakeholders can gain a comprehensive understanding of a country's digital health landscape, identify areas for improvement, and make informed decisions to advance digital health for better healthcare delivery, accessibility, and outcomes.

Methodology

Given that the dependent variable in this analysis takes on values from 2 to 5, an ordered logistic regression model (ologit) was employed. The ologit model is suitable for analysing ordinal or ranked dependent variables, where the categories have a meaningful order. The empirical analysis focuses on the whole world.

To improve the distributional properties of certain variables, a logarithmic transformation was applied. Specifically, the variables GDP, GDP per capita, and FDI were logarithmised. This transformation is useful when the variable exhibits a highly skewed distribution or when there is a substantial range of values. By taking the logarithm, we reduce the effect of extreme values and achieve a more symmetrical distribution, which can enhance the validity of statistical analyses. Other variables in the dataset, such as share, per cent, or index variables, were not logarithmised. These variables often represent proportions, percentages, or relative values that do not require logarithmic transformation.

RESULTS

Figure 1 illustrates the global distribution of Global Digital Health Monitor overall indicator. The performance is evaluated on a scale ranging from 2 to 5, with 5 indicating the highest level of achievement, signifying that a particular country has reached an advanced stage in digital health development. On the other hand, a rating of 2 suggests that while the country is making some efforts, they remain limited in their digital health endeavours. We see that the best-performing countries are primarily located in Europe, North America, Australia, and select Asian nations. Meanwhile, Africa and certain Pacific Islands generally exhibit lower levels of performance among countries. Table 1 summarises the results by various indicators for the Asian countries.

Figure 1. Global Digital Health Monitor overall indicator (constructed by the author based on the GDHM data).

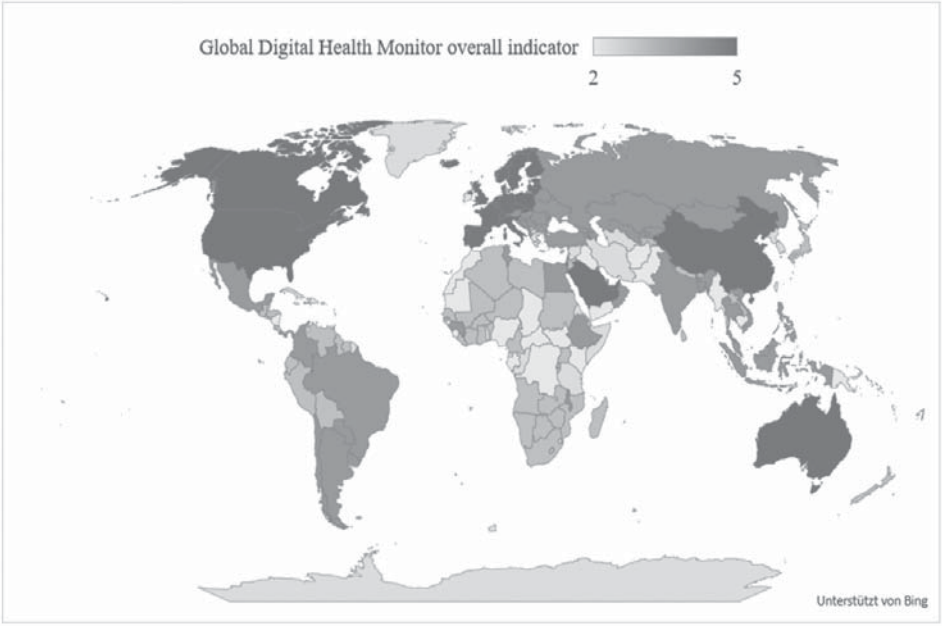

Table 1. Global Digital Health Monitor in Asian countries (GDHM database).[2, 3]

Country Name	Leadership & governance	Strategy & investment	Legislation, policy, & compliance	Workforce	Standards & interoperability	Infrastructure	Services & applications	Overall Phase
China	Phase 5	NA	Phase 4	NA	NA	Phase 4	NA	Phase 5
Israel	Phase 4	NA	Phase 5	NA	NA	Phase 4	NA	Phase 5
Saudi Arabia	Phase 5	Phase 5	Phase 5	Phase 5	Phase 5	Phase 5	Phase 5	Phase 5
Singapore	Phase 5	NA	Phase 5	NA	NA	Phase 5	NA	Phase 5
United Arab Emirates	Phase 5	Phase 5	Phase 5	Phase 4	Phase 5	Phase 5	Phase 4	Phase 5
Armenia	Phase 3	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Azerbaijan	Phase 3	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Bahrain	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Bangladesh	Phase 5	Phase 4	Phase 2	Phase 3	Phase 2	Phase 4	Phase 5	Phase 4
Brunei Darussalam	NA	NA	Phase 3	NA	NA	Phase 4	NA	Phase 4
Cyprus	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Egypt	Phase 4	NA	Phase 4	NA	NA	Phase 3	NA	Phase 4
Georgia	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
India	Phase 3	NA	Phase 4	NA	NA	Phase 3	NA	Phase 4
Indonesia	Phase 4	Phase 3	Phase 4	Phase 3	Phase 3	Phase 4	Phase 4	Phase 4

2. For more details about each particular phase, please visit (https://monitor.digitalhealthmonitor.org/indicators_info).

3. One of the clear limitations of the database is the lack of data for some of the indicators. For example, 4 out of 7 indicators for China are NA but it is still considered the best-performing country. Also, some of the countries in the database are missing, in particular, the Republic of Korea.

Country Name	Leadership & governance	Strategy & investment	Legislation, policy, & compliance	Workforce	Standards & interoperability	Infrastructure	Services & applications	Overall Phase
Iran	Phase 4	NA	Phase 3	NA	NA	Phase 4	NA	Phase 4
Kazakhstan	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Kuwait	Phase 4	NA	Phase 3	NA	NA	Phase 4	NA	Phase 4
Kyrgyzstan	Phase 4	NA	Phase 3	NA	NA	Phase 3	NA	Phase 4
Malaysia	Phase 5	Phase 4	Phase 5	Phase 4	Phase 3	Phase 4	Phase 4	Phase 4
Mongolia	Phase 4	NA	Phase 3	NA	NA	Phase 3	NA	Phase 4
Oman	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Philippines	Phase 2	Phase 4	Phase 4	Phase 2	Phase 4	Phase 4	Phase 4	Phase 4
Qatar	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Russian Federation	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Thailand	Phase 5	Phase 4	Phase 5	Phase 4	Phase 3	Phase 3	Phase 5	Phase 4
Turkey	Phase 4	NA	Phase 4	NA	NA	Phase 4	NA	Phase 4
Uzbekistan	NA	NA	Phase 4	NA	NA	Phase 3	NA	Phase 4
Viet Nam	Phase 4	Phase 3	Phase 4	Phase 3	Phase 3	Phase 4	Phase 4	Phase 4
Bhutan	NA	NA	Phase 1	NA	NA	Phase 4	NA	Phase 3
Japan	Phase 3	Phase 2	Phase 3	Phase 2	Phase 3	Phase 3	Phase 2	Phase 3
Jordan	Phase 3	Phase 2	Phase 3	Phase 3	Phase 2	Phase 3	Phase 4	Phase 3
Laos	Phase 4	Phase 3	Phase 3	Phase 2	Phase 3	Phase 4	Phase 3	Phase 3
Lebanon	Phase 3	NA	Phase 2	NA	NA	Phase 4	NA	Phase 3
Nepal	Phase 2	Phase 2	Phase 2	Phase 3	Phase 2	Phase 3	Phase 3	Phase 3
Sri Lanka	Phase 3	Phase 2	Phase 3	Phase 3	Phase 3	Phase 3	Phase 3	Phase 3
Tajikistan	Phase 3	NA	Phase 2	NA	NA	Phase 3	NA	Phase 3
Afghanistan	Phase 3	Phase 1	Phase 1	Phase 1	Phase 2	Phase 1	Phase 2	Phase 2
Cambodia	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 2	Phase 2	Phase 2

Country Name	Leadership & governance	Strategy & investment	Legislation, policy, & compliance	Workforce	Standards & interoperability	Infrastructure	Services & applications	Overall Phase
Iraq	Phase 2	Phase 1	Phase 2	Phase 1	Phase 1	Phase 1	Phase 2	Phase 2
Maldives	Phase 3	Phase 2	Phase 1	Phase 2	Phase 1	Phase 1	Phase 2	Phase 2
Myanmar	Phase 3	Phase 4	Phase 1	Phase 1	Phase 2	Phase 2	Phase 3	Phase 2
Pakistan	Phase 2	Phase 2	Phase 2	Phase 2	Phase 2	Phase 2	Phase 2	Phase 2
Timor-Leste	NA	NA	Phase 1	NA	NA	Phase 3	NA	Phase 2
Yemen	NA	NA	Phase 1	NA	NA	Phase 2	NA	Phase 2

Table 2 summarises the regression results. The coefficients (without brackets) signify the estimated impact of a predictor, while the standard errors (in brackets) gauge their uncertainty. Stars denote significance – more stars imply greater significance. Pseudo R-squared measures model fit. In ordered logit (ologit) regression, cuts are thresholds separating ordered categories, and coefficients predict cut effects. We find that fixed broadband subscriptions, regulatory quality, and GDP have a positive and significant effect on digital health outcomes (i.e., the higher these variables are, the more advanced is the digital health development), whereas domestic general government health expenditures and GDP per capita show a negative and significant effect. We find that other explanatory variables are not significant. We provide a detailed discussion of the results in the Discussion section below.

Table 2. Regression results.

VARIABLES	Global Digital Health Monitor
Positive and significant relationship	
Fixed broadband subscriptions	0.160***
	(0.0339)
Regulatory quality estimate	1.467**
	(0.576)
Logarithmised GDP	0.533***
	(0.131)
Negative and significant relationship	
Domestic general government health expenditure	-0.115*
	(0.0657)
Logarithmised GDP per capita	-1.204**
	(0.541)
Non-significant relationship	
Current health expenditure	0.0172
	(0.107)
Mobile cellular subscriptions	-0.00152
	(0.00727)

VARIABLES	Global Digital Health Monitor
Individuals using the Internet	0.0307
	(0.0196)
Out of pocket expenditure	-0.0190
	(0.0138)
Ease of doing business score	0.0113
	(0.0322)
Inflation	0.00345
	(0.00336)
Unemployment	-0.0466
	(0.0358)
lnFDI	-0.0358
	(0.0253)
/cut1	1.524
	(4.213)
/cut2	4.298
	(4.227)
/cut3	8.571**
	(4.297)
Pseudo R2	0.4069
Number of countries observed	149

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.

DISCUSSION

The Asian landscape of digital health development has witnessed remarkable progress, with several countries standing out for their impressive achievements in this field. Among the leading nations driving digital health advancements are China and Singapore. These countries have made substantial investments and implemented innovative strategies, positioning themselves at the forefront of digital health technologies and services. Their commitment to leveraging technology for healthcare has yielded substantial benefits, improving patient care, access to healthcare services, and overall healthcare outcomes.

China has emerged as a pioneer in digital health development, utilising advanced technologies like artificial intelligence, telemedicine, and health information systems (Ye et al. 2020). The country has launched large-scale initiatives to enhance healthcare accessibility and efficiency, with digital platforms facilitating remote consultations, health monitoring, and personalised care (Sun and Martin Buijsen 2022) (e.g., internet hospitals, electronic health records and universal electronic health codes for every resident as well as private platforms like Ping An Good Doctor, AliHealth or WeDoctor).

Singapore has established itself as a global hub for digital health, emphasising the integration of technology into its healthcare system[4]. The country's Smart Nation initiative promotes the use of digital platforms for telehealth, remote patient monitoring, and electronic health records (Laurent et al. 2021). Singapore's robust infrastructure and strong government support have fostered a thriving digital health ecosystem, attracting global collaborations and investments (Liew 2015).

On the other end of the spectrum, several Asian countries face significant challenges in advancing digital health capabilities. Afghanistan, Cambodia, Maldives, Myanmar, Pakistan, and Timor-Leste are among the nations grappling with limited resources, infrastructure, and technological advancements in the healthcare sector. These countries often struggle to implement digital health solutions effectively, which hampers healthcare access, data management, and overall healthcare outcomes.

It is important to note that digital health development is a complex and multifaceted process, influenced by various socio-economic factors. While some countries have made remarkable progress, others face significant barriers that impede their digital health advancements. International collaboration, investment, and knowledge sharing can play a crucial role in supporting nations with limited resources and promoting equitable digital health development worldwide.

As for the factors related to digital health performance, five were identified as being significant.

Fixed Broadband Subscriptions: The effect of fixed broadband subscriptions on digital health is positive. An increase in the number of fixed broadband subscriptions is associated with positive outcomes in digital health. Fixed broadband subscriptions provide a reliable and high-speed internet connection, enabling better access to digital health services, telemedicine, remote patient monitoring, and health information exchange. This increased accessibility and connectivity contribute to improved digital health outcomes.

4 (https://globalventuring.com/university/digital-health-ecosystem-in-singapore/).

Domestic General Government Health Expenditures: The effect of domestic general government health expenditures on digital health is negative. Higher levels of government spending on healthcare may lead to worsened digital health outcomes. This negative effect may be influenced by factors such as inefficient resource allocation, lack of technological infrastructure, or ineffective implementation of digital health initiatives within the healthcare system. Additionally, wealthier countries with higher government health expenditures may rely more on conventional medical services rather than digital health solutions, which can impact digital health outcomes.

Regulatory Quality: The effect of regulatory quality on digital health is positive. Regulatory quality refers to the effectiveness and efficiency of regulations governing the healthcare and digital health sectors. Higher regulatory quality implies well-designed and implemented regulations that promote digital health initiatives, ensure data privacy and security, and facilitate innovation in healthcare technologies. Positive regulatory quality encourages the growth and adoption of digital health solutions, leading to improved digital health outcomes.

GDP: The effect of GDP on digital health is positive. A higher GDP generally indicates a stronger economy with more resources available for investment in digital health infrastructure, research, and development. Increased economic activity and financial resources positively impact the growth and adoption of digital health technologies and services, ultimately improving digital health outcomes.

GDP per capita: The effect of GDP per capita on digital health is negative. Higher GDP per capita may lead to worsened digital health outcomes. Factors such as accessibility to digital health services, health literacy, and equitable distribution of healthcare resources can influence the impact of GDP per capita on digital health. In wealthier countries with higher GDP per capita, there may be a greater reliance on traditional healthcare services, which can contribute to the negative correlation between GDP per capita and digital health outcomes. An example from the GDHM is Japan, which has a high GDP per capita but is only in Phase 3 according to the GDHM.

In summary, while fixed broadband subscriptions, regulatory quality, and GDP have a positive effect on digital health outcomes, domestic general government health expenditures and GDP per capita show a negative effect. The negative effect of higher government health expenditures and GDP per capita could be attributed to wealthier countries relying more on conventional medical services rather than digital health solutions. Other factors such as resource allocation, technological infrastructure, and healthcare practices can also influence these relationships.

CONCLUSION

In conclusion, the development of e-health in Asian countries has gained significant momentum in recent years. The unique combination of economic growth, technological advancements, increasing healthcare demands, and supportive policy environments has created opportunities for leveraging e-health solutions to enhance healthcare delivery. This comparative analysis of e-health development in Asian countries has shed light on the factors that contribute to variations in their performance and provides valuable insights for policymakers and healthcare professionals.

The findings of this research paper have important policy implications for Asian countries. Policymakers can utilise the insights gained from the analysis to craft evidence-based policies that promote the development and implementation of e-health strategies. This includes investing in robust ICT infrastructure such as broadband connectivity to create a solid foundation for e-health initiatives. Governments can also focus on addressing challenges related to interoperability, data privacy, and security to ensure the seamless exchange of health information and the integration of e-health solutions into existing healthcare systems.

Moreover, policymakers should consider the specific healthcare needs of their populations, particularly in addressing the rising burden of chronic diseases and the needs of the elderly population. E-health technologies offer opportunities for early detection, remote monitoring, and personalised care, which can significantly improve the management of chronic conditions. By tailoring e-health strategies to address these specific healthcare challenges, policymakers can bridge the gaps in healthcare access, particularly in rural and remote areas.

Public-private partnerships play a crucial role in successful e-health implementation. Collaboration between governments, healthcare providers, technology companies, and academic institutions can drive innovation, enable the sharing of best practices, and mobilise resources. Policymakers should encourage and facilitate such partnerships to develop scalable e-health solutions, promote knowledge transfer, and overcome financial and technical barriers.

While significant progress has been made, challenges and barriers still exist in e-health implementation in Asian countries. Limited interoperability among different healthcare systems, resistance to change, inadequate healthcare infrastructure in rural areas, and concerns related to data privacy and security need to be addressed. Policymakers should work towards creating an enabling environment that addresses these challenges and fosters the acceptance and adoption of e-health technologies. This includes addressing cultural and social factors that may

influence the acceptance of e-health solutions, ensuring local context considerations are taken into account.

In summary, this research provides valuable insights into the factors influencing e-health development in Asian countries. By understanding these factors and their interplay, policymakers and healthcare professionals can make informed decisions, allocate resources effectively, and design targeted interventions to foster improved e-health outcomes. The successful implementation of e-health strategies has the potential to enhance healthcare access, quality, and efficiency in Asian countries, ultimately leading to improved healthcare delivery and patient outcomes.

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Building Inclusive and Collaborative Digital Health Development in Southeast Asia: A Comparative Analysis of Vietnam and Indonesia

Dang Dao Nguyen

INTRODUCTION

The rising demand for high-quality healthcare services and rising healthcare expenses in the Association of Southeast Asian Nations (ASEAN) may be addressed via e-health development. The ASEAN Member States (AMS) have progressed in their transition to digital health. Although there are numerous legal products, requirements for online products, infrastructure readiness, and digital literacy, there is still no uniformity in today's e-health readiness in the region.[1]

The study and practice of using digital technology to advance health are defined as "digital health" or "e-health" by the World Health Organisation (WHO). A greater variety of smart devices and linked equipment are being used in digital health, broadening e-health's definition to include digital consumers. Artificial intelligence, big data, blockchains, health data, health information systems, the infodemic, the Internet of Things, interoperability, and telemedicine are typically recognised as components of digital health.

E-health programmes in Southeast Asia are more frequently private sector-driven; therefore, to comprehensively evaluate the landscape of digital health in the region, this paper uses the WHO e-health Components framework, which is summarised in the table below:

1. The Resilience Development Initiative. 2023. Transforming the digital health landscape in ASEAN. ASEAN Socio-Cultural Community Policy Brief. Accessed 10 August 2023. (https://asean.org/wp-content/uploads/2023/02/ASCC_Policy-Brief_Issue_6_Jan2023.pdf).

Table 1. WHO Digital Health Components.

Component	Content
Leadership, Governance and Multi-sector engagement	• Oversee and manage e-health; guarantee congruence with health goals and national interest; build awareness; and integrate stakeholders. • Utilise tools, knowledge, collaboration, and partnerships to create or implement other digital health components.
Strategy and Investment	• Ensure that the strategy and plan are suitable for the e-health environment. • Manage and allocate financial resources aligned with national goals and interests.
Legislation, Policy and Compliance	• Establish regulations and laws in key sectors; evaluate sectoral policies for coherence and accuracy; and institute regular policy assessments.
Infrastructure	• Develop the physical infrastructure, including networks, core services, and applications for digital health.
Standard and Interoperability	• Develop guidelines that allow health information to be collected and exchanged across systems and services with accuracy and consistency.
Services and Applications	• Access, sharing, and control of information and content should be made possible via concrete mechanisms.
Workforce	• Digital health knowledge and abilities should be made accessible through knowledge, technological collaboration, or the commercial sector; create digital health education and training programmes to improve the capability of the healthcare staff.

Source: World Health Organisation. 2012. National e-health Strategy Toolkit. Accessed 10 August 2023. (https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-E_HEALTH.05-2012-PDF-E.pdf).

Within ASEAN, Singapore has the overall highest scores, with exceptional scores on strategy and investment, infrastructure, and workforce, all standing at around 90 per cent. Malaysia and Brunei Darussalam also had high scores among AMS, followed by Vietnam and Indonesia. In general, both countries have comprehensive strategies and investments when it comes to national digital health development and sufficient infrastructure to further develop digitalisation in this sector.[2] Given the similarities in their scores as well as their important role in developing regional digital health, this article will first examine the national landscapes of Indonesia and Vietnam through a comparative lens. Following that, the paper explores possible ways to improve the inclusive and sustainable development of e-health

2. The Resilience Development Initiative. 2023. Transforming the digital health landscape in ASEAN. ASEAN Socio-Cultural Community Policy Brief. Accessed 10 August 2023. (https://asean.org/wp-content/uploads/2023/02/ASCC_Policy-Brief_Issue_6_Jan2023.pdf).

collaboration in pan-Southeast Asia by strengthening multi-sectoral partnerships, public-private partnerships, and partnerships with the European Union (EU) and European countries.

1. VIETNAM'S NATIONAL DIGITAL HEALTH LANDSCAPE

Vietnam has made commendable progress over the course of the last two decades on important measures of quality of life, including life expectancy, infant mortality, and access to inexpensive medicines. The government's concerted efforts to update the healthcare system and provide access to affordable care have been successful.

In general, among all WHO e-health Components, Vietnam has been doing relatively well, except for the *Workforce* component. Regarding the *Leadership and Governance* and *Legislation, and Policy and Compliance* components, the Vietnamese Ministry of Health (VMoH) has announced a variety of rules to create a legal foundation for the growth of digital health. Until now, the most overarching document issued by the VMoH has been the document issued in 2020 – Health Digital Transformation Program (NDTP) by 2025 with an orientation to 2030 (Decision No. 5316/QD - BYT/2020), which aims to promote the application of science and digital technology in health activities. The table below summaries the targets of the VMoH in digital health transformation:[3]

3. Vietnam Ministry of Health. 2020. Approving the health digital transformation program to 2025, with a vision to 2030 [Phê duyệt chương trình chuyển đổi số y tế đến năm 2025, định hướng đến năm 2030]. Accessed 10 August 2023. (https://luatvietnam.vn/y-te/quyet-dinh-5316-qd-196039-d1.html).

Table 2. Targets of the Decision of the approval of the healthcare digital conversion programme until 2025, with the orientation towards 2030.

Focus	2020-2025	2025-2030
Develop digital governance in the health sector	• Maintain 100 per cent of online public services, of which 80 per cent of online public services are provided on many different access means, including mobile devices; • 80 per cent of medical information systems that require sharing and connecting information are connected and interconnected through an integrated platform to share medical data; information of people and businesses is digitised and stored in the national health database,	• 100 per cent of online public services are provided on many different access means, including mobile devices; • 100 per cent of work records at the Ministry of Health, Department of Health; 90 per cent of work records of the district health department are processed online (except for work records that are national secrets); • 100 per cent of medical information systems that require sharing and connecting information are connected and interconnected through an integrated platform to share medical data; information of people and businesses that has been digitised and stored in the national health database does not have to be provided again.
Develop a digital society in the health sector	• 100 per cent of medical facilities deploy non-cash electronic payments; • 100 per cent of medical examination and treatment facilities deploy remote medical examination and treatment consultation; • 100 per cent of medical examination and treatment facilities deploy online medical examination and treatment registration; • 100 per cent of health sector officials and employees participate in the Vietnam medical connection network.	Maintain the development of digital society in healthcare according to the targets achieved in the period 2021-2025.
Digital transformation in disease prevention and people's health care	• 100 per cent of people are medically identified; • 100 per cent of medical staff, including doctors, pharmacists, officials, civil servants, and health sector employees, are identified; • 90 per cent of people have electronic health records; • 100 per cent of communes deploy commune health station management software with full functions according to regulations of the Ministry of Health.	• Maintaining targets in disease prevention and people's healthcare achieved in the 2021-2025 period; • 95 per cent of people have electronic health records.

Focus	2020-2025	2025-2030
Digital transformation in medical examination and treatment	15 per cent (about 210) of hospitals nationwide have successfully converted digitally, deployed electronic medical records without using paper medical records, and accepted electronic payment of hospital fees.	50 per cent (about 700) of hospitals nationwide have successfully converted digitally, deployed electronic medical records without using paper medical records, and accepted non-cash electronic payment of hospital fees.

Source: Law Library. 2020. Decision of the approval of the healthcare digital conversion program until 2025, with the orientation towards 2030 [Quyết định phê duyệt chương trình chuyển đổ số y tế đến năm 2015, định hướng đến năm 2030]. Accessed 10 November 2023. (https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyet-dinh-5316-QD-BYT-2020-phe-duyet-chuong-trinh-chuyen-doi-so-y-te-den-2025-460152.aspx).

Furthermore, the Decision to Approve the Project on Information Technology Application at Communal Health Care Facilities in the Period of 2018–2020 (Decision No. 6111/QD-BYT) is an example of such a policy. In order to manage professional activities, finances, human resources, and other issues for healthcare institutions in communes, wards, and townships more efficiently and effectively, this project supports the use of information technology. The strategy also ensures data correctness and the ability to connect commune health stations with the higher levels of health stations, including the city level, regional level, and national level, and social insurance, all of which enhance management work generally.[4] Most recently, on 20 April 2023, Decision 1923/Q-BYT approved the Vietnam 2023 Electronic Health Record Platform Implementation Plan[5]. According to this strategy, the infrastructure must be in place by 1 June 2023. It is also necessary to set up an information system that will link and identify digital Fast Healthcare Interoperability Resources (FHIR) on core medical information, build an e-health record database for the VMoH that includes a selection of fundamental medical data, and provide a software module with features to help create and update personal health record information

4. Nguyen, Ba Dat. 2021. Digital Health in Vietnam – Opportunities and Challenges. In Country Report - Vietnam, No 3, 2021: Vietnam as a Digital Society. Vietnam: Thanh Nien Publishing House.

5. Vietnam Ministry of Health. 2023. Approving the plan to deploy the electronic health record platform in 2023 [Phê duyệt kế hoạch triển khai nền tảng hồ sơ sức khoẻ điện tử năm 2023]. Accessed 10 August 2023. (https://thuvienphapluat.vn/van-ban/Cong-nghe-thong-tin/Quyet-dinh-1923-QD-BYT-2023-Ke-hoach-trien-khai-Nen-tang-Ho-so-suc-khoe-dien-tu-564088.aspx).

and reporting data for use by the Ministry of Health, district health centres, and commune health centres.

Regarding the *Strategy and Investment Strategy* component of the Vietnamese government in terms of identifying and diversifying financial resources for national digital health development, former Minister of Health Nguyen Thi Kim Tien in 2019 shared: "Together with the achievements made over recent years, Vietnam continues the reform of the healthcare system. And we want to learn from countries in the development of the healthcare sector and encourage private investment in this path."[6] Although digital health is still in its infancy in Vietnam, start-ups and multinational corporations, including notable telecommunications firms such as FPT, VNPT, and Viettel, have shown interest in participating. Through real-time data, digital signature integration, and solutions for digital medical records, these businesses in Vietnam offer end-to-end solutions with the aim of helping hospitals manage daily operations. Furthermore, there are market participants from other countries. Examples include the use of Microsoft and its cloud services by hospitals and modern drugstore chains, as well as the use of IBM's Watson for oncology by local businesses.[7]

Thirdly, Vietnamese digital health *Infrastructure* has a strong advantage as internet coverage and the percentage of smartphone users in the country are both high. Vietnam is one of the nations with the highest percentage of internet users in the Asia-Pacific region. As of 2021, there were around 69 million internet users out of a total population of over 96 million.[8] Internet consumption in Vietnam is mostly mobile-based due to the high smartphone penetration rate. Therefore, Vietnam's continued investment in its telecommunications infrastructure puts the country in a better position to embrace digital health solutions. A solid foundation will serve as the first step to improve the national information, communications and technology (ICT) infrastructure to facilitate future expansion in telemedicine, consumer health electronics, and electronic health records.[9]

6. Bich, Thuy. 2019. Hospitals leap on the digital bandwagon. Vietnam Investment Review, August 19. Accessed 10 August 2023. (https://vir.com.vn/hospitals-leap-on-the-digital-bandwagon-70630.html).

7. PMG. 2020. Digital Health in Vietnam: Market Intelligence Report. Accessed 10 August 2023. (https://kpmg.com/vn/en/home/insights/2021/01/future-of-digital-health-in-vietnam.html).

8. Nguyen, Minh-Ngoc. 2022. Internet usage in Vietnam - statistics & facts. Statista. Accessed 10 August 2023. (https://www.statista.com/topics/6231/internet-usage-in-vietnam/).

9. KPMG. 2020. Digital Health in Vietnam: Market Intelligence Report. Accessed 10 August 2023. (https://kpmg.com/vn/en/home/insights/2021/01/future-of-digital-health-in-vietnam.html).

As a result, *Services and Applications* are increasingly being developed and applied at both local and national levels. Healthcare big data and products and services based on Artificial Intelligence (AI), telemedicine, consumer health electronics, and health information technology are the four main categories of the Vietnamese digital health market; however, they still remain underdeveloped or are at the beginning stage due to the lack of the necessary software, facilities, support applications and technical know-how related to big data and AI. For example, the majority of Vietnam's healthcare facilities continuing to utilise paper-based medical records for patients tracking and illnesses tracking are two major factors influencing the Vietnamese market for digital health.

In particular, telemedicine emerged as one of the examples of the use of cutting-edge technology for healthcare services in Vietnam during the COVID-19 outbreak. By implementing a national digital transformation programme, the Vietnamese MoH established Project 2628/Quyet dinh-Bo y te, which authorised a plan for remote medical inspections and treatments throughout the period of 2020-2025. The goal was to promptly stop the spread of the COVID-19 pandemic. The initiative aims to connect 1,000 hospitals and enhance the calibre of medical care by using the expertise of central hospitals to serve rural areas through provincial hospitals.[10]

Even though Vietnam has not made significant progress in AI applications in healthcare yet, the NDTP aims to make Vietnam one of the top 50 ICT nations, and AI is an important pillar to achieve this goal.[11] In 2023, Microsoft signed its first contract for AI healthcare in Vietnam, covering three areas: data exchange, cross-product validation, and research and development. The cooperation states that DrAid, a group of AI-powered pathology tools that can recognise 21 illness indicators in the bone, heart, and lungs, will be used by VinBrain. The US FDA-licensed platform is used by more than 100 institutions and 2,000 professionals in Vietnam[12].

10. Nguyen, Ngoc Huy, An Quang Nguyen, Van Thi Bich Ha, Phuong Xuan Duong, and Thong Van Nguyen. 2021. Using emerging telehealth technology as a future model in Vietnam during the COVID-19 pandemic: practical experience from Phutho General Hospital. JMIR Formative Research 5, no. 6 (2021): e27968.

11. Tran, Mai Chi. 2023. AI in Vietnam: Opportunities and Challenges for Foreign Investors. Vietnam Briefing, August 2. Accessed 10 August 2023. (https://www.vietnam-briefing.com/news/ai-in-vietnam-opportunities-and-challenges.html/).

12. Ang, Adam. 2023. Microsoft signs first AI healthcare partnership in Vietnam. Healthcare IT News, January 31. Accessed 10 August 2023. (https://www.healthcareitnews.com/news/asia/microsoft-signs-first-ai-healthcare-partnership-vietnam).

Last but not least, the Vietnamese *workforce* has received the government's attention. The NDTP aims to increase awareness among state agencies, organisations, and business leaders about the necessity of accelerating digital transformation, guaranteeing that all stakeholders have access to digital skills, and enhancing the effectiveness of workforce development programmes for digital transformation in each industry, region, and community. The government additionally intends to create incentive programmes for information technology (IT) officials and initiatives to draw skilled IT personnel to the healthcare industry. However, there have been no specific and comprehensive statistics or data on the number of ICT experts or the digital readiness of the workforce in the healthcare industry until now. The research conducted by Swiss Business Hub ASEAN (2021) is among a few research studies pointing out that the existing number of Vietnamese healthcare staff is insufficient to meet the demands of the population. For instance, since the majority of highly qualified doctors and nurses work at provincial and central-level institutions, there are less qualified staff in the rural areas.[13]

2. INDONESIA'S NATIONAL DIGITAL HEALTH LANDSCAPE

In general, the use of digital technology for public health is strongly supported and encouraged by the Indonesian government. According to the Indonesian Minister of Health, Budi G. Sadikin, the transformation of the health system is built on six pillars: primary care, secondary care, system resilience, financing, talent and culture in the field of health, and digital and technological advancements[14].

Regarding *Leadership and Governance*, together with all health industry stakeholders, the Indonesian Ministry of Health (IMoH) created the Blueprint for Digital Health Transformation Strategy 2024 under the Indonesia Health Services (IHS) Platform, which supports and integrates many health applications in Indonesia and provides data connection, analysis, and services. The goal of the digital health blueprint is to lay the foundation for developing Indonesia's business architecture for health technology. It is supported by important pillars, including the digital integration of patient and healthcare provider health information and

13. Swiss Business Hub ASEAN. Opportunities in the Digital Health Industry in Vietnam. Accessed 5 September 2023. (https://www.s-ge.com/en/publication/industry-report/20213-c3-vietnam-digital-health-medt2?ct).

14. East Ventures. 2022. Indonesian Health System Transformation. Accessed 10 August 2023. (https://east.vc/insights/indonesian-health-system-transformation/).

the integrated development of digital health infrastructure. The blueprint will also help the Indonesian government utilise digital technologies to advance its national objective of offering universal, cheap, egalitarian, and high-quality healthcare to all Indonesians[15].

Prior to that, the IMoH's DTO (Digital Transformation Office) was founded in March 2021 with a focus on three key areas: digital medical records, streamlining health service applications, and regulatory guidance for the ecosystem of e-health innovation. Six months later, in December 2021, Indonesia presented its first digital health strategy, laying the groundwork to digitise its healthcare systems in order to provide its 270 million residents with more comprehensive healthcare coverage.[16]

In terms of *Legislation, Policy and Compliance*, similar to Vietnam, patient privacy, data standardisation, and data protection are not adequately regulated in the healthcare industry; thus, health policies are not supported effectively by data.[17]

Regarding *Strategy and Investment*, based on Article 170 in Law No. 36 of 2009 concerning health, health financing in Indonesia "aims to provide health financing continuously with the sufficient amount, fair allocation, and efficient and effective utilisation to ensure the realisation of high-quality public health development."[18] Activating funding sources, allocating the national health budget, and using the funds are three main responsibilities of the government to realise the aims for healthcare financing.[19] In the 2010s, investment in health innovation expanded quickly in Indonesia, from $1.6 billion in 2010 to $19.6 billion in 2018.[20] Furthermore, increasing private sector participation in e-health investment has been fostered since the Blueprint on Digital Health was established with the United Nations

15. UNDP. 2021. Indonesia launches a blueprint on digital health to expand inclusive health care coverage. Accessed 10 August 2023. (https://www.undp.org/indonesia/press-releases/indonesia-launches-blueprint-digital-health-expand-inclusive-health-care-coverage).

16. Accessed 10 August 2023. (https://transformhealthcoalition.org/indonesia/).

17. Ministry of Health of the Republic of Indonesia. 2021. Blueprint of Digital Health Transformation Strategy 2023. Accessed 10 August 2023. (https://dto.kemkes.go.id/ENG-Blueprint-for-Digital-Health-Transformation-Strategy-Indonesia%202024.pdf).

18. The President Republic of Indonesia. 2009. Law of Republic of Indonesia, Number 36, year 2009, p. 75.

19. International Labour Organisation. 2009. Indonesia Law on Health (Law No. 36/2009). Accessed 10 August 2023. (http://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=91185&p_country=IDN&p_count=611).

20. Cheung, Ruby and Elvina Tio. 2021. Indonesia's digital health boom and the opportunities for Australian healthcare providers. WilliamBuck. Accessed 10 August 2023. (https://williambuck.com/nz/news/gr/health/indonesias-digital-health-boom-and-the-opportunities-for-australian-healthcare-providers/).

Development Programme (UNDP) in 2021.[21] Nevertheless, only 2 per cent of healthcare spending at the time was made by the private sector, indicating a great possibility for public-private partnerships. After the COVID-19 pandemic, acknowledging the importance of ICT in the health sector, the Indonesian Chief Operating Officer of the Digital Transformation Office, Ministry of Health, Daniel Oscar Baskoro, reported in 2023 that the nation was successful in boosting health investment. While government health spending increased by 124.5 per cent between 2013 and 2021, expanding at a compound annual rate of 10.4 per cent, health spending per person increased by 23 per cent between 2015 and 2019, from $97 to $120.[22]

Regarding *Infrastructure*, 77 per cent of the country's population had access to mobile phones, yet only 53 per cent had access to the internet.[23] Furthermore, the construction of upstream infrastructure, a national data centre (PDN), and the Telecommunications Equipment Testing Centre (BBPPT) are intended to be finished by 2023 by the Ministry of Communication and Informatics to enhance digital infrastructure and technology. Among all government agencies, the IMoH utilises cloud technology the most, accounting for 24.1 per cent.[24] Furthermore, the digital gap in Indonesia will also be addressed through the development of the digital infrastructure and support for the 47 per cent of the population without internet access. They are marginalised populations in rural regions, especially children and women in undeveloped areas who need healthcare the most. Therefore providing patients living in locations without appropriate medical facilities with access to healthcare is a key task for Indonesia's digital infrastructure. To extend network access to outlying locations, the Ministry of Information and Communications has been collaborating with numerous telecommunications companies. For instance, the Palapa Ring project involves building a 36,000 km-long fibre optic network to connect 440

21. UNDP. 2021. Digitalizing Indonesia's health sector, a critical step towards SDGs achievement. Accessed 10 August 2023. (https://www.undp.org/indonesia/news/digitalizing-indonesia%E2%80%99s-health-sector-critical-step-towards-sdgs-achievement).

22. PwC. 2023. How can technology accelerate the digitisation of the Indonesian healthcare sector? Accessed 10 August 2023. (https://www.pwc.com/id/en/media-centre/press-release/2023/english/how-can-technology-accelerate-the-digitisation-of-the-indonesian-healthcare-sector.html).

23. Antara News. 25 February 2023. Indonesia progressed in digital infrastructure development: Minister. Accessed 10 August 2023. (https://en.antaranews.com/news/273876/indonesia-progressed-in-digital-infrastructure-development-minister).

24. Santhika, Eka. 2023. Indonesia's Three Digital Development Focus Areas in 2023. Open Gov. Accessed 10 August 2023. (https://opengovasia.com/indonesias-three-digital-development-focus-areas-in-2023/).

cities and districts to the 4G network.[25] The major obstacle to Indonesia's national e-health growth, however, remains inclusive digital infrastructure given the country's wide geography and unequal population distribution.

Regarding *Services and Applications*, digital health data in Indonesia is dispersed because of the many apps and low restrictions on standardisation and data exchange. The national and municipal governments have produced 400 health applications, according to the IMoH's most recent mapping data. This situation shows that there is still room for progress in the health policy based on completely comprehensive data and raises questions about the efficacy of health services. The IMoH created the 2024 Digital Health Transformation Strategy, a roadmap built on the concept of creating an "Indonesia Sehat" in conjunction with the whole ecosystem of players in the health sector on the *SATUSEHAT* platform (Indonesia Health Services). *SATUSEHAT* is a platform that supports and integrates various health resources and applications through data communication, analysis, and services[26]. Moreover, there are now more than 60,000 healthcare institutions. The integration of all of these capabilities with *SATUSEHAT* is required by Regulation No. 24 on Electronic Medical Records, which was published in 2022. It provided Indonesia with a fantastic opportunity to standardise, incorporate, and digitalise its health applications.[27]

Indonesia has been moving slightly faster than Vietnam regarding telemedicine and AI applications in e-health. In particular, for example, an AI system has been installed at the Mayapada Hospital in Jakarta to analyse medical pictures and aid in the diagnosis of illnesses. A different Surabaya hospital has used an AI system to forecast patient health outcomes and help doctors create personalised treatment regimens. Despite the country still being in the early stages of accepting and implementing AI in healthcare, the usage of AI in healthcare in Indonesia is anticipated to increase over the next few years as more healthcare professionals invest in the

25. Deloitte. 2022. Digitising Indonesia's Health Care Sector. Accessed 10 August 2023. (https://www2.deloitte.com/id/en/pages/life-sciences-and-healthcare/articles/id-tmt-lshc-digitalhealth-2022.html).

26. PwC. 2023. How can technology accelerate the digitisation of the Indonesian healthcare sector? Accessed 10 August 2023. (https://www.pwc.com/id/en/media-centre/press-release/2023/english/how-can-technology-accelerate-the-digitisation-of-the-indonesian-healthcare-sector.html).

27. Azhar, Mochamad. 2023. Indonesia makes health data available at one's fingertips. Gov Insider. Accessed 10 August 2023. (https://govinsider.asia/intl-en/article/Indonesia-makes-health-data-available-at-ones-fingertips).

technology and become knowledgeable about it.[28] Moreover, in the Blueprint for Digital Health document, Telemedicine Technology Expansion is one of the core components. The use of telemedicine has considerably expanded as a result of the COVID-19 pandemic. The government's goal of achieving Universal Health Coverage (UHC) for at least 95 per cent of the population, or as many as 257.5 million people, by 2020 is linked to the use of telemedicine. The lack of human resources and inadequate healthcare facilities that restrict the general public's access to healthcare services may also be resolved with the use of this telemedicine technology.[29]

Lastly, speaking of the workforce in the digital health sector, the healthcare sector is struggling to find qualified employees. In contrast to other surrounding economies like Singapore (2.3 medical professionals per 1,000 people) and Malaysia (1.9 medical professionals per 1,000 people), Indonesia only has roughly 0.4 medical professionals per 1,000 people. The demand for specific skills to operate in the field of digital health draws attention to the talent deficit.[30] The World Bank also predicts that Indonesia will need to add 9 million digital talents by 2030 to support its technological development because the competition for talent in the field of e-health is expected to intensify and the industry will need to compete with several other sectors searching for individuals with a similar technological skill set.[31]

Indeed, Indonesia needs more than 160,000 physicians, according to the IMoH. The 2020-2024 Digital Transformation Strategy prioritises healthcare and seeks to change the healthcare system into one that is more effective, efficient, and patient-centred, as stated by Minister of Health Budi Gunadi Sadikin. To support and enhance healthcare talents, the IMoH has financed health education through a number of scholarship programmes. These initiatives encourage an equitable distribution of healthcare professionals. The government projects that basic

28. Upadhyay, Vidhi. 2022. Market Research Report: Digital Health. Accessed 10 August 2023. (https://www.insights10.com/report/indonesia-artificial-intelligence-ai-in-healthcare-market-analysis/).

29. Ministry of Health of the Republic of Indonesia. 2021. Blueprint of Digital Health Transformation Strategy 2023. Accessed 10 August 2023. (https://dto.kemkes.go.id/ENG-Blueprint-for-Digital-Health-Transformation-Strategy-Indonesia%202024.pdf).

30. Deloitte. 2022. Digitising Indonesia's Health Care Sector. Accessed 10 August 2023. (https://www2.deloitte.com/id/en/pages/life-sciences-and-healthcare/articles/id-tmt-lshc-digitalhealth-2022.html).

31. Deloitte. 2022. Digitising Indonesia's Health Care Sector. Accessed 10 August 2023. (https://www2.deloitte.com/id/en/pages/life-sciences-and-healthcare/articles/id-tmt-lshc-digitalhealth-2022.html).

healthcare services, like heart disease treatments, will be available nationwide in Indonesia by 2024.[32]

3. POLICY RECOMMENDATIONS

3.1. Collaboration between ASEAN Member States

Leadership and regional governance are the breakthrough points for more integrated and sustainable digital health development. AMS should develop a unified digital health growth roadmap along with a coordination framework that is understood by every stakeholder. Even though Singapore has developed into a centre for medical services and technological innovation in the region, there are still significant health disparities in many other ASEAN nations. In fact, hospital bed density in ASEAN is lower than the global average, except for the more industrialised nations such as Brunei, Singapore, and Malaysia. ASEAN countries also lag behind the global average in terms of physicians per population. As de facto leaders of ASEAN with their development stages positioned in the middle among AMS, both Indonesia and Vietnam should take the lead to enhance regional collaboration in e-health. While having the means and opportunity to significantly enhance their digital health capabilities and catch up with the most advanced AMS, Indonesia and Vietnam are aware of the challenges faced by the least developed nations, such as Laos, Cambodia, and Myanmar. Currently, ASEAN does not have an official and comprehensive strategy for digital health that can serve as the prerequisite for a more coordinated and coherent partnership scheme. Nevertheless, in the ASEAN Digital Masterplan, health is identified as one of the four essential industry sectors along with finance, education, and government: "ASEAN should build trust by developing trust and security frameworks for these industries. With the cooperation of industry stakeholders in the region, ASEAN could support the development of best practises and aim for a unified certification approach to trust and security in these industries."[33] It particularly mentioned "cross-border e-health services as the key to improving cohesive e-services across Southeast Asia".[34]

32. Cuaca, Willson. 2023. How Digital Transformation Strategy could transform Indonesia's healthcare system for the better? BioSpectrum Asia Edition. Accessed 10 August 2023. (https://www.biospectrumasia.com/opinion/46/22517/how-digital-transformation-strategy-could-transform-indonesias-healthcare-system-for-the-better.html).

33. ASEAN. 2021. ASEAN Digital Master Plan, p. 72.

34. ASEAN. 2021. ASEAN Digital Master Plan.

When it comes to *Strategy and Investment*, multi-sectoral coordination and public-private partnerships also play a crucial role since several areas in e-health are driven by the private sector. This is particularly true amid the global pandemic. For instance, the Indonesian Ministry of Health collaborated with the telemedicine company Halodoc and the ride-hailing company Gojek to offer rapid COVID-19 diagnoses in remote locations. Additionally, by collaborating with the digital health platforms Alodokter and Halodoc, the IMoH can provide COVID-19 patients across the nation with moderate symptoms free access to teleconsultation and medicine delivery services. In Vietnam, the government worked together with Viettel Group, the country's major telecommunication service provider, to create the Viettel Telehealth platform. The platform facilitates technology transfer, training, and remote medical and surgical consultations. Therefore, to foster multi-stakeholder partnerships at the regional level, in 2022, the ASEAN Secretariat organised for the first time a webinar on "Transforming ASEAN's Digital Health Landscape to Improve Regional Health". Dr. Alvin B. Marcelo from the Asia eHealth Information Network (AeHIN) pointed out during the webinar that the success of the adoption of digital healthcare depends on coordinated and collaborative efforts, efficient information technology use, and general good governance. In the post-COVID-19 world, the private sector accounted for 53 per cent of Southeast Asia's healthcare market, valued at US$420 billion. Due to the economic recession and the resulting reduction in tax revenues, governments do not have sufficient budgets to maintain the effective provision of healthcare services to the population. Therefore, the private sector plays an important role in complementing the efforts of the government in providing healthcare to its citizens.[35]

Legislation, Policy, and Compliance might be the hardest components to harmonise given the variety in national legislations, health policies, and development stages of the ten ASEAN member states. According to the Global Digital Health Index, numerous AMS have lax privacy and telemedicine legislations, especially when it comes to consistent legal enforcement.[36]

Southeast Asia's digital health infrastructure has been developing, with Vietnam and Singapore taking the initiative. The ministries of health of AMS are

35. ASEAN BAC Malaysia. 2022. Public-Private Partnerships (PPP) in healthcare is critical for the post-pandemic recovery. Accessed 10 August 2023. (http://aseanbac.com.my/public-private-partnerships-ppp-in-healthcare-is-critical-for-the-post-pandemic-recovery/).

36. The Resilience Development Initiative. 2023. Transforming the digital health landscape in ASEAN. ASEAN Socio-Cultural Community Policy Brief. Accessed 10 August 2023. (https://asean.org/wp-content/uploads/2023/02/ASCC_Policy-Brief_Issue_6_Jan2023.pdf).

encouraged to manage infrastructure initiatives, such as free Wi-Fi and internet access, under the Mind the GAPS[37], Fill the GAPS framework.[38] While Fill the GAPS suggests potential solutions based on the assessment's results, Mind the GAPS evaluates the present capabilities of the respective ministries of health. The critical task is to prioritise equal access to affordable, high-quality internet services by encouraging investment from the private sector and using government resources to fill the network gaps via targeted wireless services. "All AMS, except Singapore, often face challenges with internet and mobile phone access, similar to what Indonesia encounters."

Next, *Services and Applications*: AI applications can serve as the driving force for digital health development. However, Nguyen et al. (2023) pointed out that ASEAN is still unable to fully use AI technologies to accomplish sustainable development, including e-health, due to its inadequate levels of AI resilience and preparation, notably in the business and technology sectors. The government sector's impaired vision, insufficient digital capacity, and the inability of both the business and government sectors to adapt and develop AI technologies are some of the challenges faced by the AMS. Therefore, collaborating with countries and partners that are more advanced might serve as a solution.[39]

Last but not least, the need to equip the workforce in the health sector with the necessary digital skills is placed highly on ASEAN's digital agenda. In cooperation with the ministries of education, the private sector, and other pertinent players, the respective ministries of health should deliver appropriate digital health literacy training and education. To create cutting-edge models of digital education, training, and skills development, ASEAN policymakers must work with experts from academia, civil society, and the private sector. They must first reform curricula to consider the evolving needs of the e-health workforce and then form partnerships with the private sector to create fresh approaches to digital upskilling that can be used throughout the region.[40]

37. GAPS refers to Governance, Architecture, People and Program Management, and Standards and Interoperability.

38. Marcelo, Alvin. 2022. Digital Infrastructure for Universal Health Care in ASEAN. The ASEAN Magazine, 7 December. Accessed 10 August 2023. (https://theaseanmagazine.asean.org/article/digital-infrastructure-for-universal-health-care-in-asean/).

39. Dao, Nguyen Dang, Upalat Korwatanasakul, and Suonvisal Seth. Artificial Intelligence and the Sustainable Development Goals in ASEAN. Dialogues on Connectivity between Europe and Asia: 169.

40. Karr, John, Benjamin Lokshin, and Katherine Loh. 2020. The Future of Work Across ASEAN Policy Prerequisites for the Fourth Industrial Revolution Recommendations and Country Studies. The ASEAN Foundation.

3.2. Collaboration between ASEAN and the EU on digital health development

Until 2022, the third-largest commercial partner of ASEAN, the EU, accounted for around 10.6 per cent of ASEAN trade. The EU's third-largest economic partner outside of Europe is ASEAN, with bilateral commerce in goods and services bilateral commerce in goods and services reaching around €189 billion in 2020. Furthermore, the EU is one of the main investors in AMS, as its stocks of foreign direct investment (FDI) into ASEAN were €313.6 billion in 2019.[41] Therefore, the EU has been one of the main investors and partners in terms of regional digitalisation and digital health development in Southeast Asia. However, when it comes to e-health, the partnership between the two sides remains limited compared to other digital fields, leaving ample room for growth.

The Directorate-General for Communication Networks, Content, and Technology of the European Commission met with top ASEAN representatives in October 2019 in Laos to examine ways to improve connectivity and collaboration in the digital economy between the two areas. Best practices from the EU's Digital Single Market policy, which also includes topics of shared interest to ASEAN, were shared during the event.[42] Furthermore, since 2022, the EU and ASEAN have been researching digitalising health insurance across Southeast Asia. In particular, the EU-ASEAN Business Council Insurance Group examines how a regulatory framework may assist with long-term insurance fund investments and how European insurers can commit to implementing digital solutions to improve Southeast Asian consumers' access to insurance while addressing data privacy and governance issues and harmonising regional laws to maximise the free flow of data securely across borders.[43] This project can serve as a good practice for ASEAN, the EU, and their businesses to foster further collaboration on improving different WHO e-health components.

41. Delegation of the European Union to ASEAN. 2022. The European Union and ASEAN: A Strategic Partnership. Accessed 10 August 2023. (https://www.eeas.europa.eu/asean/european-union-and-asean_en?s=47).

42. Delegation of the European Union to ASEAN. N.d. Working Towards a Sustainable and Secure Digital Economy. Accessed 10 August 2023. (https://euinasean.eu/working-towards-a-sustainable-and-secure-digital-economy/).

43. EU-ASEAN Business Council. 2020. Inclusive Insurance Ecosystem: Long-term Investment, Digital Innovation and Sustainable Healthcare. Accessed 10 August 2023. (https://www.eu-asean.eu/wp-content/uploads/2022/02/Inclusive-Insurance-Ecosystem-Long-term-Investment-Digital-Innovation-and-Sustainable-Healthcare-2020.pdf).

Most recently, in 2023, through the Enhanced Regional EU-ASEAN Dialogue Instrument (E-READI), the EU supported the ASEAN Employment Outlook by analysing digital labour platforms and platform workers and proposing practical solutions to ensure that platform workers receive sufficient protection and assistance in line with labour regulations and requirements for decent work.[44] Based on E-READI and the EU Global Health Strategy, ASEAN and the EU can collaborate in various fields, particularly in terms of equipping the necessary skills for the workforce, more cohesively linking and coordinating policies and measures among AMS, and joint research to develop information and communications technology applications on health.[45]

44. ASEAN. 2023. ASEAN and EU support well-being of online platform workers in growing digital economy. Accessed 10 August 2023. (https://asean.org/asean-and-eu-support-well-being-of-online-platform-workers-in-growing-digital-economy/).

45. European Union. 2022. EU Global Health Strategy.

CONCLUSION

In general, the developments of digital health in Vietnam and Indonesia share several difficulties and opportunities that are summarised in the table below:

Table 3. National Digital Health Landscape in Vietnam and Indonesia.

E-health component	Vietnam	Indonesia
Key Policies and Initiatives	• - Circular No. 53, 2014: Indicate the provision of digital health services • - Directive No.16, 2017: Establish the fundamental guidelines for regulating digital health • - Circular No. 54, 2017: Regulate the use of technology in medical facilities • - Circular No. 49, 2017: Outline services that are permitted in telemedicine • - Decision No. 4888, 2019: Adopt the smart health information technology and industry 4.0 growth goals • - Decision No. 5316/QD - BYT/2020: Approve the health digital transformation programme to 2025, with a vision to 2030 • - Decision 1923/Q-BYT/2023: Approve the plan to deploy the electronic health record platform in 2023	• - Blueprint of Digital Health Transformation 2024 • - MOH Regulation No. 21 of 2020 on the MOH Strategic Plan for 2020-2024 about the use of technology through telemedicine for direct medical care between patients and doctors • - MOH Regulation No. 90 of 2015 on the Implementation of Health Services in Health Services Facilities in Remote Areas and Very Remote Areas
Leadership, Governance and Multi-sector engagement	Constantly improve the capacity in management, develop digital health capacity and engage stakeholders	Same with Vietnam
Investment Strategy	Diversify various financial resources; collaborate with private sectors	Develop a national investment strategy and collaborate with various stakeholders; increase health expenditures yearly
Legislation, Policy and Compliance	Adopt updated legislation and national strategy to develop e-health	Develop a national blueprint for e-health development
Infrastructure	Wide internet coverage across the country and 69 million smartphone users (out of 96 million people) in 2021	77 per cent of the population has access to mobile phones but unequal internet access remains a challenge due to geographical factors
Standard and Interoperability	Lack of clear guidelines with accurate data management system	Same as Vietnam

E-health component	Vietnam	Indonesia
Services and Applications	Focus on healthcare big data and AI-based goods and services, telemedicine, consumer health electronics, and health information technology; slow progress on AI health applications	Have several applications but not well-managed, yet more advanced in AI and telemedicine
Workforce	Pay more attention to upskilling the health workers but still far from addressing the actual needs of the society	Possess a strong demand for more highly qualified health workers and finance more scholarships and training

Source: Author, 2022.

The noticeable worldwide need for digital health goods and services will drive future growth in the ASEAN digital health industry. Each AMS is working to develop the healthcare sector, making healthcare services more affordable and accessible, especially for the people on the margins. This is in response to growing public demand and understanding of the significance of digitisation in the healthcare system. All member states are on the same road to improving health by making use of new technologies despite differences in pace. Countries in the region can learn and benefit greatly from one another. At each level of the medical system, every stakeholder involved, from healthcare providers to policymakers, can improve the digitalisation of the industry by fostering know-how transfer and sharing good practices to sustain, accelerate, and innovate the respective national and regional health systems, thus paving the way to developing a more inclusive and collaborative digital health ecosystem in ASEAN.

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AI in Health: How Technology Can Prevent Future Health Emergencies

Arya Marganda Simanjuntak and Silvi Angelia May Purba

A. INTRODUCTION

After experiencing the COVID-19 pandemic, the world began to realise the importance of information and technology development to adapting to global pandemics. Marked with the transition from offline meetings to online meetings, all aspects of social interaction have changed significantly. Yet technology development is not only beneficial to facilitating social transitions, but also for accelerating global health emergency mitigation. Countries with pre-existing digital health technology adapted quicker towards data tracing and testing. Those with strong digital regulations also adapted better to health education and handling of misinformation. With technological advancement in all aspects of health, we are left to wonder whether technology could also aid us in future scenarios: predicting the probability of future health emergencies and quicker data-and-pathogen sharing.

On declaring that COVID-19 was no longer a global health emergency, Dr. Tedros Adhanom Ghebreyesus said: "The threat of another variant emerging that causes new surges of disease and death remains, and the threat of another pathogen emerging with even deadlier potential remains". In retrospect, the COVID-19 pandemic reminds us of the importance of the One Health agenda to preventing future health emergencies. Many infectious diseases (such as Anthrax, COVID-19, and MERS-CoV) can be transmitted through animals, and the One Health approach will allow multi-sectoral cooperation in humans, animals, and the environment in disease prevention. The World Health Organisation (WHO) has encouraged risk surveillance through the Health Emergency Preparedness, Response and Resilience (HEPR) framework. However, currently there is no platform that can objectively combine those inter-sectoral knowledge into corporeal preventative measures for infectious diseases.

Machine learning technology for predictive and generative purposes has been closely explored using *Artificial Intelligence (AI)*. AI has been used commercially, perhaps with the most famous example being ChatGPT. It has also been used extensively in other domains, from answering miscellaneous questions, to tailoring recommendations based on preferences. If AI can predict scenarios based on certain sets of data, then is it possible to implement a similar concept in the realm of global healthcare?

We value the scientific ability that can navigate the development of a disease and also its transmission. With the development of AI, we would like to measure its capability in early prediction of health threats before they manifest into emergencies that can take a toll on collective resources (financially, economically, socially). But the question is: Is it feasible? Can AI see patterns in infectious disease epidemiologic data and utilise them in dealing with other emerging diseases?

B. CURRENT IMPLEMENTATION OF AI IN HEALTHCARE

Artificial Intelligence (AI) is an umbrella term for a generic machine or a system that responds to data stimuli, and modifies its operation to maximise a performance index. Machine Learning (ML) is a branch of AI that utilises training a program with a set of data, and that conjures a certain desired output to its maximum performance coefficient.[1] ML has been implemented in pilot projects on several diseases, as summarised in Table 1. AI was designed to improve the accuracy of diagnosis, screening, therapy, and prognosis, as an effort to boost the quality of health services.

1. Kurt Benke and Geza Benke. 2018. Artificial Intelligence and Big Data in Public Health. International Journal of Environmental Research and Public Health 15, no. 12 (2018): 2796. (https://doi.org/10.3390/ijerph15122796).

Table 1. Overview of Current Implementation of AI in Healthcare.

Author, Year	Research Objectives	Outcome
Arun et al., 2018[2] Graham et al., 2019[3]	AI implementation on mental disorder diagnosis	High-accuracy AI has great potential in mental healthcare. A model using XGBoost has excellent accuracy (98 per cent), which makes it possible to determine a person's level of depression.
Grzybowski et al., 2020[4]	State-of-the-art Diabetic Retinopathy (DR) screening technologies	Comparing several deep learning Artificial Intelligence (AI) algorithms for diabetic retinopathy screening using funduscopy pictures, for it may be crucial in preventing diabetes-related blindness.
Wang, et al., 2021[5] Zoabi, et al., 2021[6]	AI on monitoring COVID-19 diagnostic and progression with clinical data	AI can monitor COVID-19 progression using serial CT images. Clinical and demographic data can also be used on COVID-19 testing.
Sahu et al., 2022[7]	Summarise AI potential in Drugs and Pharmaceuticals	AI may play a significant role in identifying target proteins, improving drug design success rates, reducing the health risks associated with preclinical trials, significantly lowering costs, data mining, and many other things.
Ranka et al., 2021[8]	Application of AI in cardiovascular medicine	This is where AI may be really helpful. It can analyse head CT scans for acute strokes, suspect acute coronary syndrome, interpret electrocardiograms, assist imaging decisions, and many other things.

2. Vanishri Arun et al., 2018. A Boosted Machine Learning Approach For Detection of Depression. In 2018 IEEE Symposium Series on Computational Intelligence (SSCI) (IEEE, 2018), pp. 41-47. (https://doi.org/10.1109/SSCI.2018.8628945).

3. Sarah Graham et al. 2019. Artificial Intelligence for Mental Health and Mental Illnesses: An Overview. Current Psychiatry Reports 21, no. 11 (28 July 2019): 116. (https://doi.org/10.1007/s11920-019-1094-0).

4. Andrzej Grzybowski et al. 2020. Artificial Intelligence for Diabetic Retinopathy Screening: A Review. Eye (London, England) 34, no. 3 (2020): 451–60. (https://doi.org/10.1038/s41433-019-0566-0).

5. Robin Wang et al. Artificial Intelligence for Prediction of COVID-19 Progression Using CT Imaging and Clinical Data. European Radiology, n.d., 1–8. (https://doi.org/https://doi.org/10.1007/s00330-021-08049-8).

6. Yazeed Zoabi, Shira Deri-Rozov, and Noam Shomron. 2021. Machine Learning Based Prediction of COVID-19 Diagnosis Based on Symptoms. NPJ Digital Medicine 3 (2021): 1–5.

7. Adarsh Sahu, Jyotika Mishra, and Namrata Kushwaha. 2022. Artificial Intelligence (AI) in Drugs and Pharmaceuticals. Combinatorial Chemistry & High Throughput Screening 25, no. 11 (August 1, 2022): 1818–37. (https://doi.org/10.2174/1386207325666211207153943).

8. Sagar Ranka, Madhu Reddy, and Amit Noheria. 2021. Artificial Intelligence in Cardiovascular Medicine. Current Opinion in Cardiology 36, no. 1 (August 1, 2021): 26–35. (https://doi.org/10.1097/HCO.0000000000000812).

Author, Year	Research Objectives	Outcome
Park et al., 2021[9]	Developing new ML algorithm to screen 39 diseases	Utilising Deep Neural Network (DNN) with LightGBM and XGBoost to aid disease diagnosis. ML shows promising results in connecting medical data to certain clinical diagnosis.

In general, these models are implemented as diagnostic tools for non-communicable diseases, but are not yet in the epidemiologic field. But regardless, these models set the foundation for medical determinants usability in machine-learning technology. Diagnostic models feed medical data (risk factors, biomarkers, medical images) into artificial neural network models and are trained to determine whether one individual is classified for a specific disease diagnostic or not. As parameters are fed into the deep learning models, the model will navigate patterns of functions which determine the end result.[10]

AI usage in disease analysis can have several advantages. Unlike human-navigated screening, AI does not experience fatigue. As a result, screening using AI algorithms can enable the consistent screening of thousands of sets of data without subjective skewing.[11] This quality will be valuable for analysing disease data, which has a preference for an accurate method that can screen a multitude of data in the shortest period of time.

Regarding the validity of data, deep machine learning is able to find patterns from various sources of data by repeating numerous trial-and-error series. This quality can help minimise potential issues, including data duplication, falsification, and incompletion. The Least Absolute Shrinkage and Selection Operator (LASSO) regression model can also be used to reduce a high variation of data coefficients (regularisation).[12]

9. Dong Jin Park et al. 2021. Development of Machine Learning Model for Diagnostic Disease Prediction Based on Laboratory Test. Scientific Reports 11, no. 7567 (2021): 1–11.

10. B. Acs, M. Rantalainen, and J. Hartman. 2020. Artificial Intelligence as the next Step towards Precision Pathology. Journal of Internal Medicine 288, no. 1 (July 28, 2020): 62–81. (https://doi.org/10.1111/joim.13030).

11. Grzybowski et al. 2020. Artificial Intelligence for Diabetic Retinopathy Screening: A Review.

12. Carmela Comito and Clara Pizzuti. 2022. Artificial Intelligence for Forecasting and Diagnosing COVID-19 Pandemic: A Focused Review. Artificial Intelligence in Medicine 128, no. 102286 (2022): 1–25.

AI can also learn complicated patterns that surpass human ability. AI in radiation therapy, for example, can learn subtle patterns consistently, as opposed to the high intra-operator variability of human appraisal.[13]

C. CHALLENGES DURING HEALTH EMERGENCIES

The World Health Organisation (WHO) launched One Health as an integrated strategy with the goal of promoting optimal health for people, animals, and the environment. In order to attain global health security, One Health can aid in achieving a deeper understanding of how to control illnesses using a wide range of strategies, including prevention, detection, preparation, reaction, and case management. But due to interdependence, all three factors cannot be isolated from one another and should be equally involved. To attain sustainability and to manage the many health challenges associated with these connections (including zoonotic illnesses, antibiotic resistance, food safety, and others), the One Health concept is unquestionably crucial.[14] For the purpose of pandemic prevention, preparedness, and response, a platform that can incorporate actions from all actors is highly desirable to increasing One Health cooperation.

During and after the COVID-19 pandemic, all countries realised that the current health system in the world is not sufficiently prepared to respond to a virulent disease. Diseases that are thought to be isolated in animals can be transmitted to humans (zoonotic diseases), with explanations that are currently still difficult to elaborate. Dividing human resources to studying both microbiology and disease prevention at the same time can be challenging. Healthcare flexibility to manage known diseases and to prepare for unknown diseases is desirable to creating global health security.

This challenge is certainly tough, particularly in this era of global mobility and international supply chains. A disease can be transmitted from one area to another, even during the latent phase, which can be activated by various variables. For

13. Issam El Naqa and Martin J Murphy. What Is Machine Learning? In Machine Learning in Radiation Oncology: Theory and Application, n.d.; Lian Wang et al. Artificial Intelligence for COVID-19: A Systematic Review. Frontiers in Medicine 8 (n.d.): 1–15.

14. J. R. Sinclair. 2019. Importance of a One Health Approach in Advancing Global Health Security and the Sustainable Development Goals: -EN- -FR- Importance de l'approche Une Seule Santé Pour Améliorer La Sécurité Sanitaire Mondiale et Atteindre Les Objectifs de Développement Durable -ES- Importancia de La Noción de Una Sola Salud Para Promover La Seguridad Sanitaria Mundial y Los Objetivos de Desarrollo Sostenible. *Revue Scientifique et Technique de l'OIE* 38, no. 1 (1 August 2019): 145–54. (https://doi.org/10.20506/rst.38.1.2949).

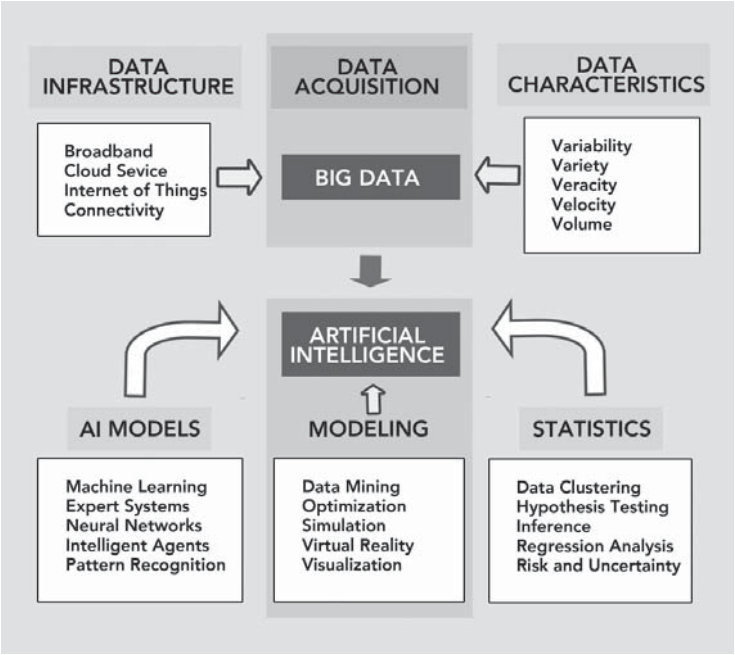
example, in the case of Tuberculosis (TB), latent TB screening has not been commonly practised to enable the detection of active TB cases. If a traveller comes to a TB endemic area, is exposed to TB, and then returns to their country of origin, they may cause the unpredicted emergence of tuberculosis in that area. The same risk can also apply to other infectious diseases. Therefore, preparation for an increase in cases and disease surveillance needs to be improved. The fact that an area is not endemic to certain diseases does not directly equate to disease immunity in that area. Many reports find an increase in the number of cases of a disease in areas that are not endemic, especially from patients that have a travel history to endemic areas. Hence, preparations for case spikes, such as recognising disease trends, what factors affect them, and how to determine the occurrence of significant cases, need to be closely monitored.

The aim of this hypothetical algorithm is to predict the possibilities of health emergencies based on clinical data. Although clinical knowledge can understand the progression of infectious diseases, it might be limited to predicting its trajectory in real-life dynamics. In theory, technology might be beneficial to translating empirical data into a framework, finding patterns of infectious diseases that might follow similar transmission patterns. Apart from that, mathematical modelling might give us a better understanding of pathogen heterogeneity, host variability, ecological dynamic, and other unknown factors.[15]

15. Anna Maria Niewiadomska et al. 2019. Population-Level Mathematical Modelling of Antimicrobial Resistance: A Systematic Review. BMC Medicine 17, no. 81 (2019): 1–20.

D. HYPOTHESIS OF DISEASE SURVEILLANCE USING AI

Figure 1. Artificial Intelligence (AI) and Data.[16]



Currently, we have survived several disease outbreaks in the Association of Southeast Asian Nations (ASEAN). Some known examples are explained in the table below. We are in possession of pre-outbreak data (demography, transmission route, virulence) and post-outbreak data (casualties, risk factors, management, time lapse). Retrospectively we now possess a better understanding of the transmission nature of some of these diseases, yet we are still not sure how the transmissions resulted in outbreaks.

16. Benke and Benke. Artificial Intelligence and Big Data in Public Health.

Table 2. Emerging Diseases in Southeast Asia, 2021.[17]

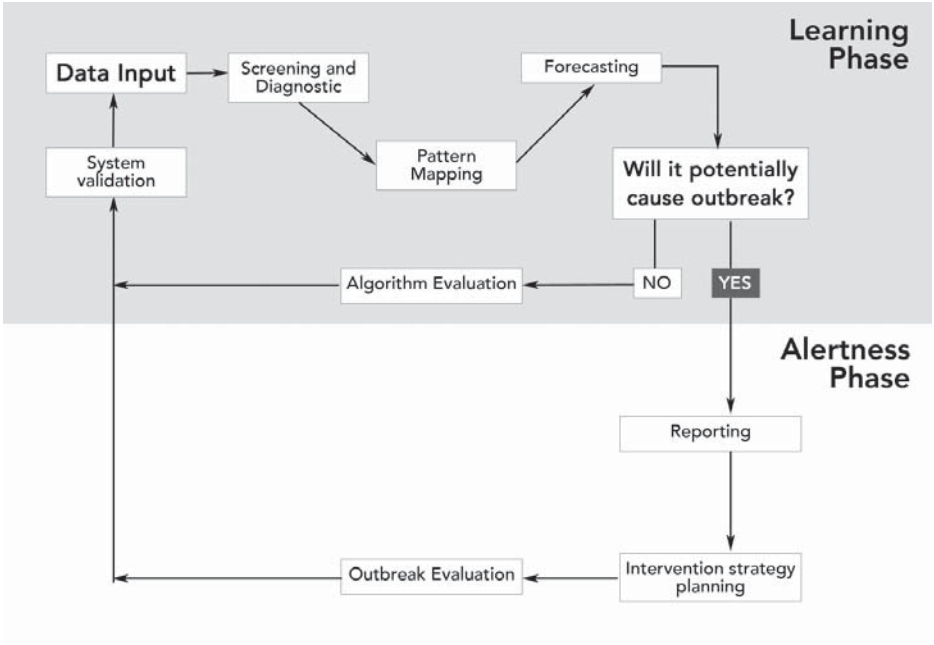
Disease Name	Description	Affected Countries
Highly Pathogenic Avian Influenza A (H5N1), 2014	First reported in Vietnam in 2003, affecting poultry and humans. ASEAN contributes 50 per cent of all cases	Thailand, Indonesia, Myanmar, Cambodia, Laos, Malaysia
Pandemic Influenza A (H1N1), 2009	Emerged from individuals with travel history to Mexico. Transmitted through human-to-human contact, found in 20 per cent of sampled pigs	Almost all Southeast Asian (SEA) countries
Coronavirus-19 Pandemic, 2019	Causing Severe Acute Respiratory Syndrome (SARS). Possibly involve animal reservoir but also transmit through human-to-human contact	All SEA countries
Tuberculosis	SEA was home to 43 per cent of all TB burden. Currently the global burden is also increased by drug-resistant TB, long TB, and co-infection	Indonesia, Thailand, Myanmar
Malaria	Spread through mosquitoes as vector. SEA holds the second highest burden of malaria globally. Thrives in tropical countries with access to water bodies	Indonesia, Thailand, Cambodia, Laos, Myanmar, Vietnam

There can be numerous factors that decide the infection rate, both intrinsic factors (age, lifestyle, genetic, nutrition) and extrinsic factors (prior infection, climate, occupation). To add to the challenge, some of the factors can be dynamic. Climate, for example, changed gradually in ASEAN due to global warming. Demographic composition can be influenced by birth rate, education, welfare, and other factors.

This hypothetical algorithm postulated the machine learning process to study the interdependence of each factor, and how it can contribute to disease outbreak. The idea is to compile medical data from these diseases, the outbreak timeline, and the end result of each outbreak. We then input the data into the system, and find the function that can yield the result that is most similar to the outbreak outcome. This process can take a lot of time, but it can give a better understanding of each disease. And in case of known similar factors within each disease, we can use the knowledge to test for new diseases, with the idea that infectious diseases may have similar influencing factors with one another. Hypothetically, we would need an ensemble of several algorithms to have a working outbreak alertness framework: screening algorithm, mapping algorithm, and forecasting algorithm.

17. ASEAN. 2021. ASEAN Strategy for Exotic, Emerging, and Re-Emerging Diseases and Animal Health Emergencies.

Figure 2. Hypothesised Screening Algorithm.



The screening and diagnostic algorithm is utilised to process medical data, then conclude whether someone can be diagnosed with a disease or not. This part of the ensemble is most likely to be successful, since a similar concept has been proven to be adaptable to various diseases. In this section, the inter-correlation of various data should be established, and used to validate a physician's diagnosis. Learning processes using XGBoost and LightGBM have been found to be the most accurate in several studies. However, each disease's algorithm might need to be developed separately, and similar factors can be concluded afterwards.

Positive data then needs to be inputted in the mapping algorithm. Each individual is marked on their respective domicile, and analysed for their transmission risk. Areas with high virulence risk (densely populated cities, transit cities, high mobilisation rates) should be marked with high risk. Once the number of cases approaches the normal threshold, monitoring should progress to predicting future cases.

A disease can be considered endemic if the number of cases at a certain given time surpasses the threshold of the common case number. So after achieving diagnostic data collection and mapping, we should forecast whether transmission of the respective infectious disease might increase in the future, and how fast it can progress. This phase has several benefits. First of all, it can detect unexpected disease outbreaks early, even before visible damage occurs, especially by eradicated

or new diseases. Second, we can predict the magnitude of the disease and the estimated time to preventing that from occurring. Lastly, it can be used as a reference for assigning targets for intervention efforts.[18]

During the COVID-19 pandemic, numerous studies have tried to utilise the ML model to forecast case numbers. One of the commonly used models is the Autoregressive Integrated Moving Average Model (ARIMA). ARIMA is a univariate regression model that can produce averages per successive time frame. This model allows comparisons between specific time frames that can be valuable in determining disease outbreaks. This model is created with supervised learning mechanisms. Retrospective epidemiologic data are fed to the system, training them to make a fitting equation. Through trial and error, we pick the algorithms that match our desired outcome. And to evaluate the accuracy, a new retrospective dataset that has never been introduced before will be fed to the algorithm.[19] And now prospective data at any given time can be inputted into the algorithm to forecast whether it carries the risk of a disease outbreak.

A good ensemble should be cross-checked with health professionals and real-life situations to validate the system. The development and evaluation phase should be performed repeatedly to improve the predictive quality. Adapted from research by Park, et al., several parameters need to be considered during performance evaluation: predictive power, confusion matrix, SHAP method, F1-score, accuracy, precision and recalling.[20] The Shapley additive explanation (SHAP) method, in particular, can leverage each factor's predictive value to various diseases. Finding parallel factors between diseases will increase the algorithm's interoperability, which hopefully will also apply to new-emerging diseases. Predictive power or optimal accuracy can be objectively measured. Comparison with a physician is used to compare the system's prediction with the physician's diagnosis.

18. Deepak Painuli et al. Forecast and Prediction of COVID-19 Using Machine Learning. In Data Science for COVID-19, 1st edition, vol. 1, n.d., pp. 381–97.

19. Painuli et al.; Said Agrebi and Anis Larbi. 2020. Use of Artificial Intelligence in Infectious Disease. In Artificial Intelligence in Health Care, 2020, pp. 415–38.

20. Park et al. Development of Machine Learning Model for Diagnostic Disease Prediction Based on Laboratory Test.

E. WAY FORWARD: REALISTIC STRATEGIES TO IMPLEMENT AI AS EPIDEMIOLOGIC GUIDE

ASEAN's commitment to regional health cooperation will play an important role in ensuring the success of this project's implementation. The region has already established the foundation for health cooperation, such as the ASEAN Portal for Public Health Emergencies, and ASEAN BioDiaspora. However, most discussions lean toward emergency responses, and have not extensively explored emergency prevention strategies. In line with the Health Emergency, Preparedness, Response, and Resilience (HEPR) architecture,[21] several considerations need to be discussed so as to improve ASEAN's health quality and prevent future endemics. Those considerations are as follows:

Although promising, AI in health should not be implemented unless supported with rigorous regulations. Our hypothesis to implement AI in epidemiological studies requires a huge amount of medical data (e.g., clinical records, outbreak history, mobility surveillance). A strong data safety regulation should be established first, to protect patients' privacy and assure researchers' ethical compliance. ASEAN member states have signed the ASEAN Strategic Framework for Public Health Emergencies for reporting and data sharing during health emergencies, in accordance with International Health Regulation (IHR) 2005 principles.[22] However, the corporeal strategies to implement the commitment should be discussed further in the ASEAN Health Ministers Meeting (AHMM).

Desirable regulations include but are not limited to: data safety, authorisation for dissemination, data privacy, digital consent, and data retaining.[23] Data anonymity can also be considered to protect privacy. As a reminder, citizens hold the rights to their medical data confidentiality, and policy makers are accountable should this right be violated. In addition, **the national health governing body should examine AI compatibility with national health practices, and legally determine the degree of acceptance in the medical field.** The ASEAN Guide on AI Governance and Ethics is at the developmental stage and is becoming the promising foundation of AI proliferation in the region.

There is a risk of insufficient or limited data eligibility for the analysis. Since not all ASEAN member states have fully implemented integrated digital health

21. Health Emergency, Preparedness, Response, and Resilience (HEPR) "Strengthening Health Emergency Prevention, Preparedness, Response and Resilience," 2023.

22. ASEAN Secretariat. 2020. ASEAN Strategic Framework for Public Health Emergencies.

23. Benke and Benke. Artificial Intelligence and Big Data in Public Health.

data, there are risks of incomplete data. Before input, all data should be screened for incompletion, duplication, or falsification. Indeed, AI can be trained separately to detect data duplication by teaching it examples of recurring phrase patterns. However, human vigilance to check individual data both as input and output is desirable for better reliability; not to mention that not all ASEAN member states have implemented Universal Health Coverage (UHC), raising risks of unrepresented cases, especially in the low-middle income communities. Therefore, regional transition towards better healthcare digitalisation and UHC will grant smoother integration of emergency risk surveillance with AI.

On the micro level, ensuring healthcare professionals' willingness to collaborate with novel technology is also important to ensuring its development. The majority of health workers are still apprehensive towards AI due to the fear of it competing with healthcare professionals. Although this scenario is very unlikely, it raises valid concerns for check-and-balance in ensuring that technology will operate only as an instrument for health workers. AI can indeed learn faster than humans, but humans still hold the executive advantage of empathy and reason. Health professionals are still very much needed to navigate data science, apply the results in communities, and observe the results. But in return, health workers should also willingly learn about AI. ASEAN should endorse capacity building regarding AI in health, encouraging its discourses in medical symposiums and medical curricula. Funded research will also increase data science attraction in health sectors.

Furthermore, introducing technology to healthcare also requires interprofessional collaboration with other sectors. Joint research between data scientists, clinical professionals, bioinformaticians, and epidemiologists should be encouraged. However, performing large-scale novel studies can be costly. Apart from professionals, these researches also require computational equipment, training programs, and technical and administrative assistants.[24] Funding schemes should be increased as a means to securing AI proliferation in health, especially in ASEAN. Funding opportunities from ASEAN partners (for example, HORIZON Europe or similar programmes) should also be considered to increase interest for AI development.

24. Grzybowski et al. Artificial Intelligence for Diabetic Retinopathy Screening: A Review.

F. CONCLUSION

The potential utilisation of AI to predict health emergencies should be considered to strengthen ASEAN's Health Emergency, Preparedness, Response, and Resilience (HEPR). A systematic ensemble that can forecast emergencies is vital, especially with the risk of climate-related health issues. Its implementation in ASEAN is not impossible. However, several aspects need to be solved in order to secure the safety and sustainability of this system. A regional commitment towards health emergency frameworks is needed to kick-start the implementation of AI in health for the betterment of ASEAN citizens.

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Privacy, Policy and Preparedness and the Road Towards India's Digital Health Ecosystem

Shweta Mohandas

INTRODUCTION

India has been in the process of implementing a digital health ecosystem over the last few years, and the government has set this in motion by launching health IDs, and publishing policies on health data management and insurance. While the ambition to have a health ID through the Ayushman Bharat Health Account number (ABHA number) and a digitally connected health ecosystem is well grounded, there are still some challenges that need to be addressed for this to benefit both providers and receivers of healthcare services. This article aims to shed light on three of the challenges that need to be taken into account.

While privacy was recognised as a fundamental right in 2017, the Digital Personal Data Protection Act was only passed in August 2023 after six years of deliberations. While this Act is a more succinct document compared to the earlier drafts, it is weaker in terms of the rights granted to the individual. For example, the Act does away with several protections that the earlier versions had granted to health data. In terms of policy, the National Health Authority has been publishing policies since 2017 that look at the framework and ecosystem and management of health data. However, these policies are scattered (some left as drafts) and oftentimes do not even refer to each other. The last requirement ties in with the capacity of both the healthcare industry as well as the government in terms of how prepared they are for undertaking and maintaining a digital health ecosystem. This paper will look at the three conditions of Privacy, Policy and Preparedness separately while looking at the key issues, and suggesting possible recommendations based on the identified issues.

PRIVACY

Background and Key Issues

One of the developments that stemmed from the Right to Privacy judgment[1] was the push towards creating data protection legislation. The first draft of the Personal Data Protection Bill was released in 2018, following which revised versions of the Bill were released in 2019, 2021, and 2022. On the ninth of August 2023, the Parliament passed the Digital Personal Data Protection (DPDP) Act 2023, the provisions of which will come into effect after the notification by the government.

It is pertinent to note that some of the most significant policy developments in healthcare, including the use of technological measures during the pandemic, happened in the absence of the DPDP Act. One example of this was the COVID Vaccination Intelligence Network (Co-WIN) created to facilitate booking of vaccination appointments. It was reported that many people had involuntarily created their ABHA number by linking their Aadhaar number (12 digit individual identification number) for vaccination.[2] While it is possible to delete the ABHA number there is very little information as to whether all the data related to it will also be deleted.[3] The Co-WIN website also did not have a privacy policy until six months after its launch, when the Delhi High Court issued a direction for it to do so. Even then, the privacy policy directed users to the Health Data Policy of the National Health Data Management Policy, 2020.[4]

While the Act is still not operationalised, there is still a need to look at how it fares in protecting health data and ensuring individual autonomy and privacy. At the outset, the Act does not differentiate between sensitive personal data and personal data. The DPDP Act leaves the categorisation for certain data fiduciaries as significant data fiduciaries based on the sensitivity of the data to a government no-

1. Protection of personal data: A legal perspective. Supreme Court Cases. Accessed 12 September 2023. (https://www.scconline.com/blog/post/2021/06/15/protection-of-personal-data/).

2. Mehab Qureshi. 2021. Govt Created Health IDs Without Consent, Say Vaccinated Indians. The Quint, 9 June 2021. (https://www.thequint.com/tech-and-auto/govt-created-uhid-without-consent-say-vaccinated-indians).

3. ABHA (Ayushman Bharat Health Account) Fundamentals. Ayushman Bharat Digital Mission. Accessed 12 September 2023. (https://healthid.ndhm.gov.in/).

4. Aman Nair, Pallavi Bedi. 2021. Pandemic technology takes its toll on data privacy. Deccan Herald, 13 June 2021. (https://www.deccanherald.com/specials/pandemic-technology-takes-its-toll-on-data-privacy-996870.html).

tification.[5] This differs from the 2018, 2019 and 2021 versions in which the definition of sensitive personal data included health data and genetic data.[6] The earlier versions also prescribed greater responsibility to data fiduciaries[7] processing sensitive personal data, including the requirement for explicit consent.[8]

Similarly, the earlier versions defined health data as "data related to the state of physical or mental health of the data principal and includes records regarding the past, present or future state of the health of such data principal, data collected in the course of registration for, or provision of health services, data associating the data principal to the provision of specific health services". This definition, though unclear in certain aspects, especially in the question of whether the health ID would be included,[9] was still a good guide to understanding what would be considered as health data. The inclusion of health data as a part of sensitive personal data also ensured that health data would have a greater level of protection right at the outset, compared to now, where there is a need for an executive notification for such inclusion.

A Separate Health Data Legislation?

With the definition of both sensitive personal data and health data removed from the DPDP Act, it might be time to explore the possibility of a separate legislation for health data. The idea of a separate legislation for health data is not new; in 2018 the government came out with the Digital Information Security in Healthcare Act (DISHA), which aimed to ensure data privacy, confidentiality, reliability and security of digital health data.[10] Reports suggest that the DISHA was subsumed into the

5. Section 10, The Digital Data Protection Act 2023.

6. Shweta Mohandas and Pallavi Bedi. 2023. CoWIN Breach: What Makes India's Health Data an Easy Target for Bad Actors? The Quint,19 June 2023. (https://www.thequint.com/opinion/cowin-data-breach-health-sensitive-details-policies-solution).

7. Section 9, Personal Data Protection Bill 2019.

8. Section 11, Personal Data Protection Bill 2019.

9. Shweta Mohandas and Pallavi Bedi. 2022. The Data Protection Bill 2021: A Missed Health Opportunity. Medianama, 22 February 2022. (https://www.medianama.com/2022/02/223-data-protection-bill-health-data-unique-id/).

10. Comments on Digital Information Security in Healthcare Act. Ministry of Health and Family Welfare. Accessed 15 August 2023. (https://main.mohfw.gov.in/newshighlights/comments-draft-digital-information-security-health-care-actdisha).

data protection legislation to avoid duplication of efforts; the DPDP Act has also left space for the possibility of a health data legislation.[11]

The health data policies are not as binding as legislation and the only way to ensure privacy and data protection is through existing legislation (either the DPDP Rules or as a new sectoral legislation, the framework of which exists in DISHA). As the DPDP Act deals with personal data as a whole, a much better option would be to draw inspiration from other jurisdictions that have a separate legislation for regulation of health data, and to take from existing policies and draft legislations like DISHA.

POLICY

Background and Key Issues

In 2017 the National Health Authority (NHA) came out with the National Health Policy, with a goal to work towards improving the existing healthcare system through measures including deployment of digital tools to provide access to inexpensive healthcare without compromising on quality.[12] The goal was also to establish a federated health information ecosystem linking data from both private and public hospitals and enabling the creation of Electronic Health Records.[13]

In order to materialise these goals the government came out with two other policies: the National Health Stack and the National Digital Health Blueprint. The National Health Stack published by the NITI Aayog (the public policy think tank of the Government of India), had two components, the National Health Electronic Registries, which was a registry of the health data of a person, and a Coverage and Claims platform for facilitating insurance coverage and conducting fraud detection. The National Digital Health Blueprint published in 2019 by the Ministry of Health and Family Welfare aimed at maintaining the data infrastructure required to create a seamless flow and exchange of health data as well as an easily accessible electronic health records system.

Following the Blueprint, the Ministry of Health and Family Welfare has been publishing Health Data Management Policies, which was revised three times; the

11. Data Transfer of Digital Health Records. Press Information Bureau Government of India Ministry of Health and Family Welfare. Accessed 12 September 2023. (https://pib.gov.in/Pressreleaseshare.aspx?PRID=1578929).

12. National Health Policy, Ministry of Health and Family Welfare.

13. National Health Policy, Ministry of Health and Family Welfare.

latest version was released in April 2022. The Health Data Management Policy aims to act as a guidance document across the National Digital Health Ecosystem and sets out the minimum standard for data privacy protection that should be followed by all stakeholders to comply with existing regulations and legislations.[14] In addition to this the Consultation Paper on the proposed Health Data Retention Policy released in April 2021 acted as a guidance for healthcare facilities to aid the implementation of record retention and compliance. Along with this, in 2022, the NHA released the NHA Data Sharing Guidelines for the Pradhan Mantri Jan Aarogya Yojana (PM-JAY), India's state health insurance policy. The PM-JAY aims to cover 100 million families that require financial assistance by providing coverage up to five hundred thousand Rupees per family each year for secondary and tertiary care. The most recent health policy that was released was the Consultation Paper on Unified Health Interface (UHI), released in March 2023. The UHI is envisioned as an interface that would connect health service providers and patients, by facilitating easy appointment booking, telehealth services and allied health services.[15]

Along with these policies the most rigorous implementation of the digital health system was the Co-WIN application to facilitate booking of vaccination appointments, which also became a way to register and assign a health ID to the people.

While we can see that there have been numerous documents that try and simplify the process of health data creation and management, these policies often do not refer to each other, creating issues of continuity and questions over which policy would take precedence over the others. At times policies create definitions and entities that clash with an existing policy. For example, the Health Data Management Policy in its section on the Governance structure consists of the Data Protection Officer ("Ayushman Bharat Digital Mission-Data Protection Officer or ABDM- DPO"), who functions as an intermediary between the regulator and different stakeholders, as well as a decision maker on matters concerning data; while the PM-JAY Data Sharing Guidelines in its governance structure includes a data protection committee along with the Data Protection Officer with similar responsibilities as the ABDM-DPO. The PM-JAY Data Sharing Guidelines also has a separate section on privacy and data management without referring to the existing health data management policy. To add to this, there are other government documents like the

14. Draft Health Data Management Policy April 2022, Version 02, National Health Authority, April 2022.

15. Consultation Paper on Operationalising Unified Health Interface (UHI) in India. National Health Authority India, 13 January 2023. (https://abdm.gov.in:8081/uploads/Consultation_Paper_on_Operationalising_Unified_Health_Interface_UHI_in_India_9b3a517a22.pdf).

Data Empowerment and Protection Architecture (DEPA), which tasks the National Digital Health Mission with piloting the DEPA for health data when the Health Data Management Policy was published.[16] It is also surprising to note that neither the recent Health Data Management Policy of 2022, nor the UHI mention the Co-WIN application.

Need for Comprehensive Policies

One of the most important things to note is that the actual implementers of the policy are health service providers who need to keep up with and implement these policies in addition to their existing work. According to a reply by the health ministry in the Parliament, as of February 2023, there was a shortage of 3,000 doctors and 21,000 nurses and support staff in thirty one of India's government hospitals.[17] This shortage, along with the added task of being in the loop about various health data policies, leads to a greater pressure on existing health service providers.

One way to address this issue could be to have a single document that encompasses all aspects of health data, taken from the existing documents to create an easily searchable compendium of India's health data ecosystem. Another possible way could be by having an accessible dashboard of policies which are in effect available to the general public in multiple Indian languages. The implementation and functioning of the policies could also be taught at medical colleges to equip the healthcare professionals with a better understanding of their roles and functions.

PREPAREDNESS

Background and Key Issues

While the government is concentrating its efforts on building digital health infrastructure, the investment in physical health infrastructure lags far behind. A recent World Health Organisation (WHO) Report stated that there are only 0.5 public hos-

16. The Centre for Internet and Society's comments and recommendations to the: Data Empowerment and Protection Architecture. The Centre for Internet and Society, 30 November 2020. (https://cis-india.org/depacomments).

17. Shivam Patel. 2023. India builds more India builds more hospitals as population surges but doctors in short supply. Reuters, 10 May 2023. (https://www.reuters.com/world/india/india-builds-more-hospitals-population-surges-doctors-short-supply-2023-05-10/).

pital beds for every 1000 people.[18] India is also way below the threshold of 44.5 doctors, nurses, and midwives per 10,000 people suggested by the WHO, with just 6.1 doctors and 10.6 nurses and midwives per 10,000 people.[19]

Yet another issue is that of internet infrastructure. Although it is growing in India, it is still not enough for an online-only system. Finally, there has been an increase in incidents of cyberattacks targeting hospitals, creating uncertainty on their capacity to keep the health data of millions of people protected.

Infrastructure and Personnel

The numbers of healthcare centres in the form of hospitals and nursing homes are disproportionately spread across Indian states, where in some states the ratio is as low as 1.8 hospitals available per 100,000 people.[20] It is important to note that while the policies are being published at the central level, health remains a State subject. This means that each State has to take it upon itself to ensure the creation and implementation of a digital health ecosystem. However, the capacity and budget vary across different States. For example, it was reported that the health budget of the State of Madhya Pradesh was not enough to cover the urgent need for public health services.[21] This is in addition to other factors such as existing infrastructure, geography and population. Hence it is unreasonable to expect that all the States would be able to budget for and implement health digitisation at the same pace. The public health sector, which is key in providing accessible and affordable healthcare, is severely underfunded, ranking sixth lowest worldwide in terms of the percentage of Gross Domestic Product (GDP) invested in health.[22] Experts at-

18. Aravindan Srinivasan. 2023. Health Infrastructure, Capacity Building & Investments: The focal points to improve healthcare in India. The Economic Times, 20 July 2023. (https://health.economictimes.indiatimes.com/news/industry/health-infrastructure-capacity-building-investments-the-focal-points-to-improve-healthcare-in-india/101970232).

19. Karan, Anup, Himanshu Negandhi, Suhaib Hussain, Tomas Zapata, Dilip Mairembam, Hilde De Graeve, James Buchan, and Sanjay Zodpey. 2021. Size, composition and distribution of health workforce in India: why, and where to invest? Human resources for health 19, no. 1 (2021): 1-14.

20. Garima Sadwani. 2023. CAG Report On PMJAY: 7.5 Lakh Beneficiaries Linked to One Invalid Phone Number. The Quint, 9 August 2023. (https://www.thequint.com/fit/ayushman-bharat-discrepancies-in-pmjay-scheme-cag-report).

21. TNN Updates, Madhya Pradesh budget needs to allocate more funds for health. The Times of India, 3 March 2023. (https://timesofindia.indiatimes.com/city/bhopal/state-budget-needs-to-allocate-more-funds-for-health/articleshow/98377955.cms?from=mdr).

22. Walton-Roberts, M., Runnels, V., Rajan, S.I. et al. Causes, consequences, and policy responses to the migration of health workers: key findings from India, 1:18.

tribute the low spending on public health infrastructure to the fact that historically, healthcare was not seen as a viable economic expenditure for the country, along with a lack of political will to invest in strengthening public health.[23] This continued underfunding problem has led to a compounding effect: the Ministry of Health and Family Welfare estimated that the present amount to uplift the healthcare infrastructure was close to five trillion Rupees, the bulk of which was just for primary healthcare.[24] However, the private health sector is growing steadily. As of 2020, there were 43,486 private hospitals in India. In contrast, there were only 25,778 public hospitals, indicating that India has a health system that favours people who can afford expensive healthcare.[25]

On the other hand, both public and private hospitals are already overburdened with patients, leaving very little time and energy to take on the administrative burden of digitisation. This is exasperated by the toll the pandemic took on both the Indian healthcare system and the medical professionals. India had some of the highest numbers of COVID cases worldwide, with multiple incidences of people not being able to secure hospital beds. The pandemic also led to the disruption of the treatment of non-communicable diseases, in which the health system, doctors and patients are trying to catch up on lost time.

In the context of the PM-JAY scheme, it was reported that there was a lack of initiative by medical teams, due to the paucity of human resources and staff already burdened by clinical work.[26] The time and resources needed to adapt to the new healthcare system added to their existing constraints.[27] In addition to this, cur-

23. Sumathi Bala. 2021. India's Covid crisis exposes deep-rooted problems in public health after years of neglect. CNBC, 19 May 2021. (https://www.cnbc.com/2021/05/18/india-covid-crisis-shows-public-health-neglect-problems-underinvestment.html).

24. Accumulation of Poor Health Infrastructure. Economic and Political Weekly, 01 May 2021. (https://www.epw.in/journal/2021/18/editorials/accumulation-poor-health-infrastructure.html).

25. Christophe Jaffrelot and Vihang Jumle. 2020. Private Healthcare in India: Boons and Banes. Institut Montaigne, 3 November 2020. (https://www.institutmontaigne.org/en/expressions/private-healthcare-india-boons-and-banes).

26. Mita Choudhury, Nitya Chutani, and Vismay Basu. 2023. Ayushman Bharat expose: How to nudge India's public health infrastructure. The Indian Express, 28 July 2023. (https://indianexpress.com/article/opinion/columns/ayushman-bharat-expose-how-to-nudge-indias-public-health-infrastructure-8864104/).

27. Rapid Adoption of Electronic Health Records Path and Pitfalls. Centre for Policy Research, 15 June 2022. (https://cprindia.org/briefsreports/rapid-adoption-of-electronic-health-records-paths-and-pitfalls/).

rently smaller healthcare centres had to buy online storage and equipment to store patient data.[28]

The issues with personnel are not limited to doctors, but also the community health workers called Accredited Social Health Activists (ASHA) workers. While they are heralded as the backbone of India's public health system, ASHA workers, who are mostly women, are considered volunteers, which prevents them from exercising their labour rights, and from being covered by steady policies for payment, safety and social security.[29]

Strengthening Infrastructure and Capacity

A fully functioning digital health ecosystem can only be built on top of an existing robust healthcare system. The above sections shed light on the issues of funding and staffing of public health centres, indicating that India may need to look at creative ways to build infrastructure. One way could be through public-private partnerships and engaging with grassroots organisations, private hospitals as well as philanthropic institutions.[30] More resources could also be spent on strengthening the physical infrastructure before investing more on the digital health ecosystem.

The long-term benefits of a digital health system can only manifest when there is correct data entry. Incorrect or incomplete data could do more harm in the long term and lead to misdiagnosis. It is essential to provide support to healthcare professionals for maintaining health records. This could be in the form of training, financial and technical support from the government, and the creation of a simple and standardised system of data management. Moreover, support and assistance to the ASHA workers through training and work formalisation can help them perform their duties more effectively and efficiently. In addition, government agencies must provide them with the required tools, such as data collection devices with pre-paid internet connection.

28. Tabassum Barnagarwala. 2022. How India is creating digital health accounts of its citizens without their knowledge. Scroll, 27 August 2022. (https://scroll.in/article/1031157/how-india-is-creating-digital-health-accounts-of-its-citizens-without-their-knowledge).

29. Namrata Sidwani. 2022. Data hurdle: ASHA workers lose perks. The New Indian Express, 15 August 2022. (https://www.newindianexpress.com/cities/bengaluru/2022/aug/15/data-hurdle-asha-workers-lose-perks-2487643.html).

30. Srinivasan. Health Infrastructure, Capacity. The Economic Times.

Connectivity

While mobile connectivity in India has been increasing, especially in the rural areas, challenges beyond mobile phones remain. According to recent reports, there are 759 million active internet users (a person who accesses the internet through any device at least once a month) in India in 2022, of which 399 million are from rural areas and 360 million are from urban areas.[31] Nevertheless, this is still not enough to implement mobile-first measures in delivery of healthcare services. While almost-800 million internet users is a large number it is still just half of India's population, while the other half does not use or does not have access to the internet. In addition, at times a family shares one phone, which results in mixing of data based on the details of the family members.[32] A single mobile connection could also make it difficult to have multiple health IDs linked to a number.

Two attempts at a smartphone-first approach had been made during the pandemic, which revealed how it affected a number of people. One was India's contact tracing app Aarogya Setu that initially only worked on smartphones, but which later was made compatible with feature phones when people were not able to travel without the app installed on a smartphone.[33] Second, booking for vaccination was first made possible only through the Co-WIN application, which required not only an internet connection but also a smartphone as well as the ability to navigate the website and book an appointment. This issue was also flagged by the Supreme Court, which shed light on the digital divide and the accessibility of the portal.[34]

In addition, India has more internet shutdowns than any other country in the world. In 2022, India witnessed 84 cases of internet shutdowns. The blanket implementation of the shutdowns has consequences for healthcare facilities that rely on the internet to fill in and access health records. It was reported in 2020 that the

31. PTI. 2023. Over 50% Indians are active internet users now; base to reach 900 million by 2025: report. The Hindu, 24 May 2023. (https://www.thehindu.com/news/national/over-50-indians-are-active-internet-users-now-base-to-reach-900-million-by-2025-report/article66809522.ece).

32. Dr. Rajesh Tandon. 2020. One device households. Times of India, 17 July 2020. (https://timesofindia.indiatimes.com/blogs/voices/one-device-households/).

33. Shiv Nalapat. 2022. Aarogya Setu: Are India's non-smartphone users at risk of being left in the cold? Times Now News, 13 May 2022. (https://www.timesnownews.com/technology-science/article/aarogya-setu-are-india-s-non-smartphone-users-at-risk-of-being-left-in-the-cold/591350).

34. Radhika Roy. 2021. 'Digital Divide Will Have Serious Implications On Right To Equality & Health': Supreme Court On CoWIN Portal. Live Law, 2 June 2021. (https://www.livelaw.in/top-stories/supreme-court-cowin-portal-digital-divide-covid-vaccine-175103).

beneficiaries of the Ayushman Bharat, a health insurance scheme, were not able to access their records or avail the benefits of the scheme due to an internet blockade in Kashmir.[35]

Not Just Mobile-First Approach

Hence, looking at the ground reality of internet access and internet shutdowns, there is a need to take a step back and look at other ways to enable a functioning health ecosystem. This could be through offline modes, features compatible with landline and feature phones, as well as keeping the older analogue system as an option until everyone has access to a working internet connection.

Security

While the various policies facilitate data collection and retention, we should look at measures taken to ensure the security of the data. There have been two major breaches in health data that have been reported in the past two years. First, in 2022, a major ransomware attack on India's premier medical institution All India Institute of Medical Sciences (AIIMS) left millions of people's personal data vulnerable.[36] More recently, in June 2023, it was reported that a breach in the Co-WIN application had led to personal data being available on a Telegram bot.[37] It was reported that the Telegram bot was able to retrieve the information of citizens registered with Co-WIN, including names, Aadhaar and passport numbers upon entry of phone numbers.[38] There was also a breach in the Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH) portal as recently as September 2023,

35. Swagata Yadavar and Athar Parvaiz. 2019. In Jammu & Kashmir, the shutdown has brought Modi's pet health scheme to a grinding halt. Scroll, 7 September 2019. (https://scroll.in/article/936465/in-jammu-kashmir-the-shutdown-has-brought-modis-pet-health-scheme-to-a-grinding-halt).

36. Outlook Business Desk. 2022. Cyber Attack Derails AIIMS Delhi Services: How Data Of Patients Is In Danger. Outlook India, 29 November 2022. (https://www.outlookindia.com/business/aiims-ransomware-attack-cyber-attack-derails-aiims-delhi-services-how-data-of-patients-is-in-danger-news-241071).

37. John Xavier. 2023. Explained | What does the alleged CoWIN data leak reveal? The Hindu, 18 June 2023. (https://www.thehindu.com/sci-tech/technology/explained-what-does-the-alleged-cowin-data-leak-reveal/article66980831.ece).

38. Xavier. 2023. Explained | What does the alleged CoWIN data leak reveal? The Hindu.

which made the personal information of over three hundred thousand people vulnerable.[39]

Security Before Data Collection

These two instances show that it is necessary to look at data security both at the hospital level and at the central level. The issue of data security was also a cause for concern for medical professionals, who highlighted the importance of protecting the sensitive information of patients, such as HIV or mental health status.[40] In addition, the federated nature of the health ecosystem puts the responsibility on the health service provider to set up servers and hence maintain the security. The NHA also clarified that there would not be a central database of medical records. Instead, data would be fetched from the servers of the health service providers.[41] There should be more concerted efforts to ensure that the data that is being collected is stored securely, with appropriate cybersecurity measures, and personnel in place who are responsible for security. While health data leaks are not unique to India, India is in the position to establish a digital health ecosystem with a strengthened security practice. One of the approaches to ensure security would be to come up with data security protocols with respect to health data. The health service provider's staff would also need to be trained on the protocol as well as best practices for handling health data. This is important because the existing documents guiding data security, such as health data management policies and the DPDP Act, mention reasonable security safeguards but do not provide specific guidelines.

CONCLUSION

There is no doubt that it is necessary to bring forth a digital revolution in healthcare in India. The National Health Policy states that there is a need to ensure universal access to healthcare as well as a seamless way to share health data. A digitised healthcare system, including telehealth services and easy access to health data, will benefit most people in India.

39. Sarasvati NT. 2023. Jharkhand AYUSH Portal Reportedly Breached, Records Of 3.2 Lakh Patients Exposed. Medianama, 7 September 2023. (https://www.medianama.com/2023/09/223-jharkhand-ayush-portal-breached/).

40. Barnagarwala. How India is creating digital health accounts of its citizens without their knowledge. Scroll.

41. Barnagarwala. How India is creating digital health accounts of its citizens without their knowledge. Scroll.

Health data is a valuable data point for many companies. The law should ensure that this data is not misused/used to cause harm as well as ensure that the data does not go into the wrong hands through data breaches. A few changes in policy could ensure that the healthcare system is better adapted for a digital health ecosystem. At the outset, in order to protect health data, it needs to be defined clearly. This could be either through an addition in the existing DPDP Act or with a law governing health data. A law like DISHA would ideally be apt, as it would ensure a single place to look at the regulations governing health data. It could also bring about greater responsibility to the institutions collecting health data. While the legislation process takes time, the health data policies could be made clearer and more comprehensive with clear indication of which ones are currently in use in order to allow healthcare professionals and institutions to better adapt their practices and implement them. Finally, no policy can be fulfilled without on the ground implementation. For a completely functional digital health ecosystem, it is necessary to have a strong public health system, sufficient staff for both healthcare professionals and administrative departments, robust privacy regulations, as well as the strong online and physical infrastructure needed to support a digital system. These factors should be examined and addressed in order to create a system that provides not only easy access to health data, but also provides better and more inclusive healthcare services. While the road ahead for a digital healthcare ecosystem in India is difficult, one can hope that India will be on the right path to provide a good standard of healthcare to those that would benefit the most from universal healthcare.

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Bridging Digital Divides for Inclusive Healthcare in Bangladesh

Tanvir Quader and Khaled Md Saifullah

INTRODUCTION

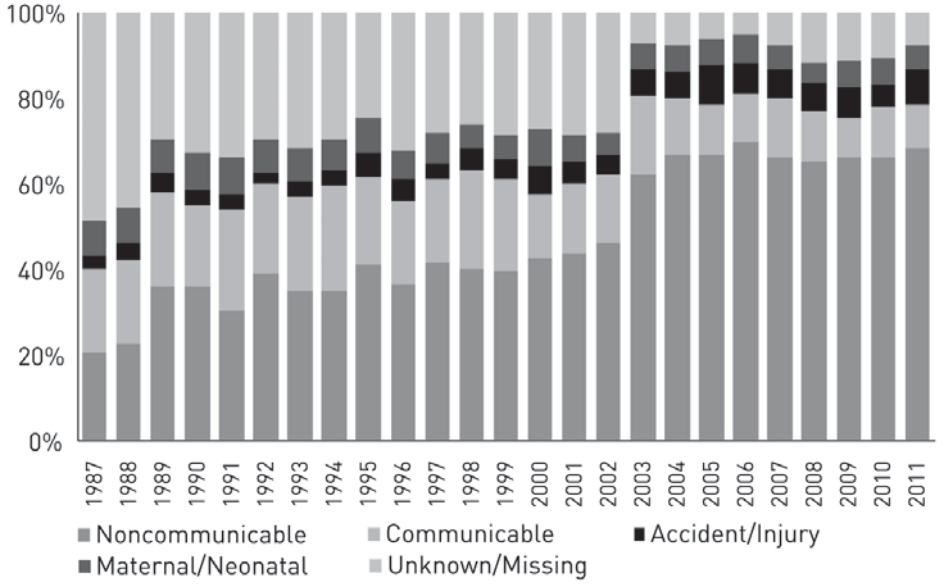
After its independence in 1971, the health system of Bangladesh has undergone a number of reforms and established an extensive health architecture in the public and private sectors. Bangladesh has accrued impressive improvements in its health status, achieving United Nations Millennium Development Goal 4 (MDG 4) by reducing child death rate and rapidly improving on other key indicators, including maternal death, immunisation coverage, and survival from infectious diseases such as malaria, tuberculosis, and diarrhoea. The emergence of digital health has aided significantly in the improvement of key health indicators since its independence. Need-based situations have led to the development of advanced technologies that have helped the health sector become more efficient over the years. Launched in 2015, the 16263 platform uses artificial intelligence (AI) voice response technology to ensure a seamless service workflow for patients. The 16263 platform was the national health call centre, which was operational 24/7 and provided free health services (Azad et al. 2019).

In 2020, when the coronavirus pandemic first hit Bangladesh, e-health services were in the initial stages of development. However, after two to three months, the pandemic catalysed health services and brought new transformations in e-health services. Telemedicine was one of the most popular services of all. Platforms like 333 aided citizens nationwide by providing free health services 24/7. The national helpline operated as a relief assistance to telemedicine services. Upon using the national network, the helpline has successfully connected 4,000 registered professionals who provided telemedicine services to over 350,000 people (United Nations Development Programme n.d.).

However, challenges for the health infrastructure remain significant even after the rapid improvements in the health sector. Along with the demographic

transition, Bangladesh is undergoing a health transition and manifesting a double burden of diseases (the combination of communicable and non-communicable diseases). Health and Demographic Surveillance Systems (HDSS) data suggests that in the period 1986-2006, the proportion of deaths due to non-communicable diseases (NCDs) increased nearly nine-fold, whereas deaths due to injuries (including suicide and homicide) remained stable at around 7 per cent, maternal and neonatal (including nutritional) deaths declined from 7 per cent to 4 per cent, and deaths due to unknown/unspecified causes declined from 7 per cent to 5 per cent. According to the World Health Organisation (WHO), over 59 per cent of all deaths in Bangladesh were estimated to be due to NCDs in 2012 (Ahmed, Syed Masud, Bushra Binte Alam and Iqbal Anwar et al. 2015).

Figure 1. Non-communicable disease mortality increases over time in rural Bangladesh, 1987-2011.



Source: (Ahmed, Syed Masud, Bushra Binte Alam and Iqbal Anwar et al. 2015).

OUT-OF-POCKET PAYMENTS

Health services in Bangladesh remained predominantly financed by households' out-of-pocket payments (OOP) during 1997-2007. OOP grew at 14 per cent annually, faster than the annual growth rate of total health expenditure (THE) (12.7 per cent) and gross domestic product (GDP) (10 per cent). The growing reliance on OOP

leaves the population at risk. Direct payment for the purchase of pharmaceuticals and medical goods is the predominant contributor to OOP, either through self-purchase or on the advice of a formal or informal healthcare provider. User charges and informal charges are relatively low (Ahmed, Syed Masud, Bushra Binte Alam and Iqbal Anwar et al. 2015).

Table 1 demonstrates that drug and medical retail outlets (notably pharmacies) were the main recipients of OOP over the period 1997-2007. Households spent money at pharmacies for several reasons:

1. to purchase medicines prescribed by healthcare providers at public facilities where those medicines were not available;
2. to buy medicines prescribed by private healthcare providers;
3. to buy medicines to self-treat; or
4. after consulting drug sellers (most of whom are not qualified healthcare providers) at pharmacies and buying recommended medicines from them.

Table 1. Households' OOP by different healthcare providers, 1997-2007.

Providers	Year										
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hospitals	4%	5%	6%	7%	8%	10%	11%	12%	15%	16%	16%
Drug and medical goods retail outlets	76%	74%	73%	72%	71%	70%	69%	68%	66%	66%	66%
Medical and diagnostic facilities	5%	6%	6%	7%	7%	6%	7%	7%	6%	6%	6%

Source: MOHFW, 2010

Spending at pharmacies grew on average by 13 per cent annually, although its share of OOP dropped from 74 per cent in 1997 to 63 per cent in 2007. During the same period, OOP at hospitals increased by 30 per cent per year, and the share of OOP increased fourfold (Table 2). This indicates a shift in OOP spending in favour of qualified healthcare providers.

An analysis of OOP by functions reveals that the share of OOP spending on medicines has decreased over the period 1997-2007 while the share spent on inpatient care has increased. In absolute terms, OOP spending on medicines increased by 13 per cent annually, while OOP spending on inpatient care grew by 26 per cent annually. Spending on inpatient care grew twice as fast as spending on outpatient care. The declining share of medicines and rising share of inpatient care in OOP can be explained by the fact that over the decade, the share of public spending

on medicines and medical supplies has more than doubled. Moreover, most of the medicines available at public facilities are provided to inpatients.

Table 2. Households' OOP by functions, 1997-2007.

Providers	Year										
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Inpatient care	4%	5%	5%	6%	7%	8%	9%	10%	10%	11%	11%
Outpatient care	14%	14%	14%	14%	14%	14%	14%	14%	13%	13%	12%
Ancillary services	5%	6%	6%	7%	7%	7%	7%	8%	7%	8%	7%
Medicines	74%	72%	71%	70%	69%	67%	66%	65%	64%	63%	63%
Medical goods	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
OOP	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: MOHFW, 2010

Figure 2. Disease-specific out-of-pocket expenditure on hospitalisation.

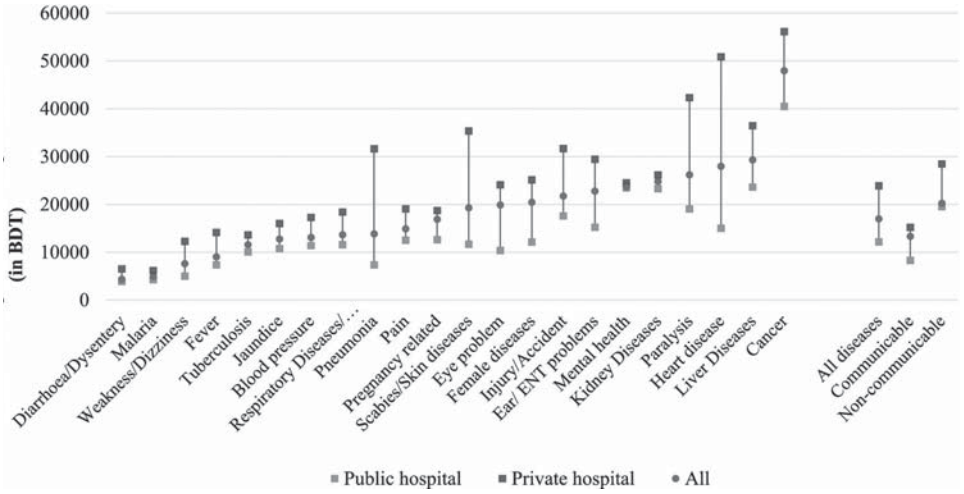


Figure 2 visually depicts the average expenses on hospitalisation segmented by diseases/causes. The analysis from the diagram shows that among all the diseases, private hospital OOP expenditures are high for all NCDs.

CHALLENGES

Over the years, impactful interventions and improvements have been made in the health sector. Despite the significant progress made, there is still room for improvement in addressing the challenges of communicable diseases, non-communicable

diseases, and maternal health. The health sector in Bangladesh faces several challenges that impact the delivery and quality of healthcare services. Some of the key challenges include:

- *Limited Access to Healthcare:* Accessibility to healthcare services remains a significant challenge, particularly for people in remote and underserved areas. There is a lack of healthcare facilities and skilled healthcare professionals in these regions, resulting in limited access to primary, secondary, and tertiary healthcare services.
- *Inadequate Infrastructure:* Insufficient healthcare infrastructure, including hospitals, clinics, and medical equipment, hinders the provision of quality healthcare. Many existing facilities are overcrowded, lack necessary equipment, and struggle to meet the growing demand for healthcare services.
- *Shortage of Healthcare Professionals:* Bangladesh faces a shortage of healthcare professionals, including doctors, nurses, and specialists, especially in rural areas. The concentration of medical professionals in urban centres further exacerbates the disparity in healthcare access between urban and rural populations.
- *Low Health Financing:* The healthcare sector in Bangladesh is plagued by low health financing. The country's healthcare expenditure as a percentage of GDP is relatively low, resulting in limited resources for infrastructure development, staffing, and service expansion. This affects the quality and availability of healthcare services across the country.
- *Health Disparities:* Health disparities persist in Bangladesh, with marginalised communities, women, children, and individuals living in poverty facing greater challenges in accessing healthcare. Addressing these disparities requires targeted interventions, improved healthcare infrastructure, and health promotion programmes tailored to the specific needs of these vulnerable populations.
- *Disease Burden and Emergencies:* Bangladesh faces a high burden of communicable diseases, such as tuberculosis, malaria, and waterborne illnesses, as well as non-communicable diseases like cardiovascular diseases and diabetes. Additionally, the country is susceptible to natural disasters and public health emergencies, which can strain the healthcare system and impact the delivery of healthcare services.

All the challenges mentioned above are linked to a single problem that is exacerbating all the bottlenecks in the health sector (Ahmed, Syed Masud, Bushra Binte Alam and Iqbal Anwar et al. 2015). The silo nature of the healthcare system restricts

transition to seamless processes in healthcare organisations. The pluralistic nature of the Bangladesh health system makes the key players work in silos without any interoperability and data exchange between the respective health information systems. Patients have to provide the same information again and again while applying for services in the same community clinic. It then becomes impossible for the public/private service providers to build complementary services because the data are locked away and siloed inside organisations. As a result, patients within reach of the healthcare system receive the same services from multiple sources (i.e., government, non-governmental organisations, and private healthcare organisations) while individuals from remote areas are left behind. This is the most entrenched challenge in healthcare, rooted in a lack of standardisation in data and data silos. Hence it leads to a coordination gap, ineffective governance, and lack of resource provision to tackle global health challenges among agencies.

PROPOSED SOLUTION

Interoperability amongst key healthcare players is a necessary component required to resolve the fragmented approach of health service provision. The proposed solution is to construct combined layers of the system that will ensure uninterrupted process flows throughout the whole health ecosystem serving the public and private stakeholders. The five layers – Access, Identity, Payments, Data, and Services Layers – will work together to provide citizens with access to essential health services.

- **Access Layer:** Bangladesh has numerous public and private healthcare centres available for people residing in rural areas. From ensuring primary healthcare to providing tertiary-level care, the government has established union health and family welfare centres, Upazila health complexes, community clinics, etc. However, the digital divide in rural areas is increasing with each passing day. That is why the penetration of digital services like telemedicine has not been able to reach the rural market fully. But the government is investing in expanding internet access and digital infrastructure in rural areas to ensure that everyone has access to e-health services. This will ensure the availability, affordability, and interoperability of services such as airtime, data, and SMS. This layer guarantees the accessibility of digital resources such as devices, making them available, reachable, and affordable. Apart from that, national call centres such as 333 are also available to aid citizens by providing healthcare services.

- **Identity Layer:** The identity layer will ensure the identification of every stakeholder in the health ecosystem, for instance, doctors, nurses, pharmacies, etc. Bangladesh has implemented a national digital identity system so that every citizen will be provided with a unique digital ID. Citizens above 18 years old will be under the "NID" system and citizens below the age of 18 will be under the "BRN" system. This will provide every citizen with a single, unified ID that they can use to access services and other financial benefits. The Identity Layer will provide a unique digital identity by setting up unique digital IDs, e-KYC (Know Your Consumer/Customer), digital signatures, and authentication. It will also ensure that all service providers and private sectors identify citizens using their unique digital ID, creating a "single point of truth".
- **Payments Layer:** Health coverage is a big challenge for people who live in poverty. The government and private sector organisations disburse huge amounts of donations but no impactful footprint is being created successfully. Over the years, the government has introduced several digital payment systems, including mobile banking and electronic fund transfer, to facilitate payments. The Payments Layer can facilitate digital transactions through interoperable digital payment systems, making it possible to transact across different types of banking and non-banking institutions. This layer will ensure the provision of a unique ID linked to the bank accounts of citizens that will ensure the health coverage of every deprived citizen in times of crisis.
- **Data Layer:** The Data Layer comprises the health registries (database), data services, and health information exchanges (HIE) that will enable a seamless ecosystem. The HIE function as an enabler to activate centre-state federated data interactions in a standardised and interoperable format between various public and private stakeholders. With the deployment of the open-source District Health Information Software 2 (DHIS2), Bangladesh now has a national public sector health data warehouse. Siloed information from the previously fragmented approach is now unified in a common data repository, enabling data exchange for health information systems and decision-making. An information exchange system will facilitate the authentication, authorisation, and transfer of standardised data from different databases or sources and will cater to different data requests.
- **Services Layer:** The Services Layer enables the market maturity of services across multiple departments, resulting in unified delivery of essential services at key moments of life. This layer will enable new health-centric use cases and types of services by integrating with the HIE layer. Upon the establishment of the national health stack, every health service provider or organisation will be able to provide healthcare service to any citizen anywhere. For instance, a

woman who is six months pregnant will be able to access healthcare services anywhere in Bangladesh, because her e-health record will be available everywhere at that time.

The development of the whole health ecosystem will bring in a new era of increased availability of high-quality, accessible, and relevant health services and make important progress towards health system targets. The existence of a national health architecture will ensure healthcare provision for all citizens. The development of a data analytics dashboard built on the foundation of the health data architecture will ensure a calculative approach by the decision-makers to tackle NCD-related issues. In addition, the diagnosis of a patient affected by a NCD will have a significant chance of being effective because of data accuracy and documentation.

IMPACT

Upon the establishment of a health information exchange system, the upgraded health ecosystem will ensure interoperability in designing public-facing services oriented around citizens' needs. The e-health journey will lead the government and private service providers to ensure healthcare services for last-mile citizens.

When Farzana, who is six months pregnant, moves to her parents' rural home to have her second child, she no longer needs to carry her medical files with her. By seamlessly and virtually combining her unique national identification number with the use of digital signatures and e-KYC services, which are part of the Bangla Stack, she will be able to access her medical records anytime, anywhere, and share them with the gynaecologist at the local sub-district health complex and later on, the district medical college hospital, in a secure and efficient manner, ensuring the privacy of her records. The above-mentioned challenges for Farzana will be resolved in the following ways:

- *Limited Access to Healthcare:* Farzana will now have access to healthcare services because the healthcare providers will be able to track her medical conditions and progress. When required, the healthcare providers will be able to communicate with her and give her the right treatment.
- *Inadequate Infrastructure:* Farzana will now be able to register in the community clinic before visiting. She will not have to face overcrowding and wait in line to get healthcare services.
- *Shortage of Healthcare Professionals:* After the establishment of the stack, the doctors will be able to take care of only selected patients like Farzana.

- *Low Health Financing:* The healthcare sector in Bangladesh is plagued by low health financing. But now Farzana will be able to claim health coverage by providing access to her data and e-health record to the government or other key stakeholders.
- *Health Disparities:* Addressing these disparities, the stack will provide access to healthcare services to everyone with targeted interventions and support an improved healthcare infrastructure tailored to the specific needs of these vulnerable populations, including people like Farzana.
- *Disease Burden and Emergencies:* The burden of diseases and emergencies will come to an end because the stack will enable the implementation of a national analytics dashboard for decision- and policy-makers. This will enable them to improve the health status of Bangladesh and take necessary decisions.

Tanvir Quader is a solution architect for the a2i program within the ICT Division and the Cabinet Division of the Government of Bangladesh, with invaluable support from the UNDP. With a wealth of experience spanning various nations, he specialises in developing innovative solutions and implementing Whole-of-Government (WoG) approaches. Tanvir's expertise encompasses a wide array of fields, including financial inclusion, health technology, agriculture technology, education technology, IP telephony, and government service delivery.

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Fall Prevention for Thai Older Adults: A Community-Based Policy Plan Leveraging Technology

Patchanee Tungjan and Riccardo Corrado

INTRODUCTION: THAILAND, AN AGING SOCIETY

The challenge of an aging society has emerged as a significant problem for numerous countries worldwide. According to the World Health Organisation (WHO), the global number of individuals aged 60 years and above is expected to rise substantially from 1 billion in 2020 to 1.4 billion in 2030. Furthermore, by 2050, the number of older individuals worldwide is projected to double to 2.1 billion[1]. While the aging society issue was initially prevalent in developed and high-income nations such as the United States, Germany, Italy, and Japan, it is now a concern faced by low- and middle-income countries as well. The WHO has forecasted that by 2050, 80 per cent of older adults will be living in low- and middle-income countries[2]. Thailand as well is facing this reality. In 2018 the Civil Service Commission in Thailand (OCSC) announced that Thailand had entered an aged society phase as the proportion of people aged 60 years and over had exceeded 10 per cent (following the definition of *aged society* by the OCSC). According to the OCSC, an aged society was considered to have been reached in the Thai ecosystem as[3] recent data showed that the proportion of Thai older people was about 19.21 per cent in 2022, equivalent to almost 13 million individuals[4]. Accounting for these numbers, Thailand is also expected to enter the super-aged society phase before 2040, which indicates that one in three people in the country will belong to the segment of the population considered older adults[5].

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2. WHO.
3. OCSC. Government sector and preparation for entering an aging society.
4. DOP. Statistics of older persons.
5. OCSC. Government sector and preparation for entering an aging society.

With these premises, one of the challenges in dealing with the rising ratio of older adults in society is associated with the consequences that this is bringing to the healthcare systems, and in this chapter, we will focus specifically on the risks associated with falling and its consequences, with specific attention on what can be done, particularly leveraging on technology, in terms of prevention. Specifically, one of the common issues associated with seniority is the increase in the risk of falling, with all the related consequences connected to it. Falls are defined by the WHO as "inadvertently coming to rest on the ground, floor, or other lower level, excluding intentional change in position to rest in furniture, wall, or other objectives"[6]. The level of injury from falling can range from moderate to severe, especially injuries affecting the skeletal and muscular systems[7]. The severe consequences can lead to mortality. According to the WHO, falls suffered by elderly people are usually related to four categories of risk factors, namely: (1) behavioural risk factors (medication usage, alcohol, lack of exercise, inappropriate footwear), (2) biological risk factors (age, chronic illnesses, physical and cognitive impairments), (3) socioeconomic risk factors (income, education level, access to health and social services, lack of community resources), and (4) environmental risk factors (building design, floors and stairs design, lighting, sidewalks and streets)[8]. Falls among older people are a significant problem in aged societies as well as in Thailand, a country that has experienced a growing number of such incidents over the past decade. The majority of older people (60 years and above) in the Kingdom belongs to the age group of 60-69 years, which represents 56.25 per cent of the total, followed by those aged 70-79 years (29.52 per cent) and those with an age of 80 years and above (14.23 per cent) (Figure 1).

More than three million Thai older people aged 60 and over experience falls each year, accounting for one in three of the older population[9], with over half of fall incidents in older people resulting in severe injuries requiring hospitalisation, leading to a loss of independence, post-anxiety syndrome, and physical and mental health problems[10]. This trend is not slowing down but rather increasing. Specifically,

6. World Health Organisation. WHO Global Report on Falls Prevention in Older Age.

7. Deeroop, Manopanjasiri, and Nethin. Falls prevention: Clinic Lerdsin Hospital.

8. World Health Organisation. WHO Global Report on Falls Prevention in Older Age.

9. DIP. Number and Rate of Out-Patient Department (OPD) Due to Fall (W00-W19) in Older People Aged 60 Years and Over.

10. DIP; Worapanwisit, Prabpai, and Rosenberg. Correlates of Falls among Community-Dwelling Elderly in Thailand; Rogerson and Emes. Fostering Resilience Within an Adult Day Support Program.

the rate of in-patient department admissions due to falls among older people has been increasing, from 442 per 100,100 people in 2015 to 555 per 100,000 people in 2020, as shown in Figure 2[11].

Figure 1. Percentage of Thai people aged 60 and over divided by age groups, 60-69, 70-79, and 80 and over (DOP 2022).

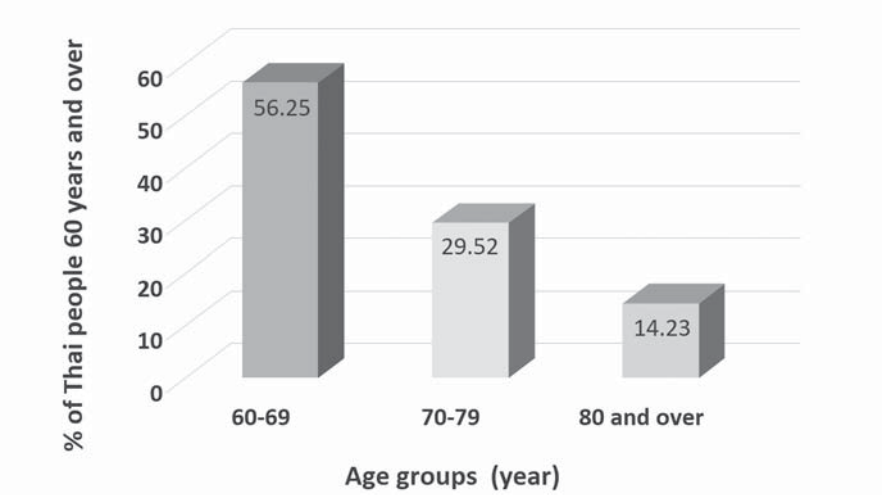
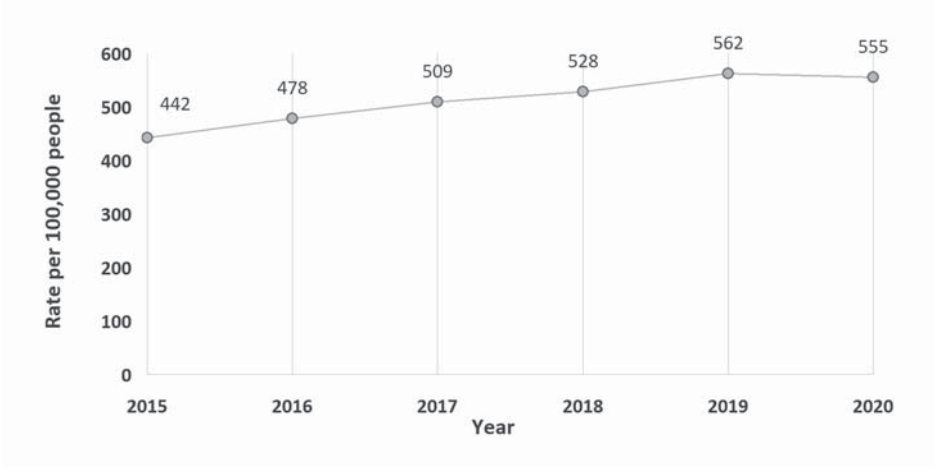


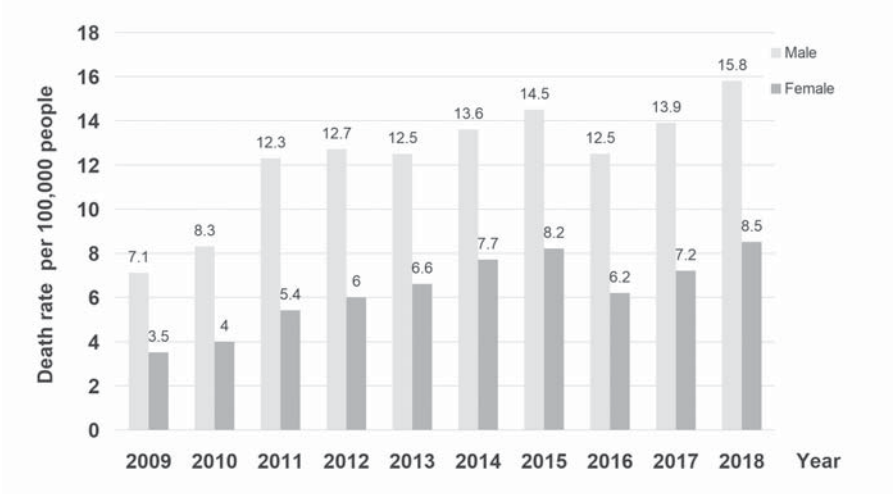
Figure 2. In-patient department (IPD) rate due to fall (W00-W19) in older people aged 60 and over per 100,000 people from the year 2015-2020 (DIP 2021).



11. DIP. Number and Rate of Out-Patient Department (OPD) Due to Fall (W00-W19) in Older People Aged 60 Years and Over.

Also, the number of outpatient department visits due to falls among older people has increased dramatically, from 54,145 in 2015 to 230,552 in 2021, representing more than four times the number of visits in 2015[12]. This increase may be related to the increasing number of elderly people in Thailand, with the slight reduction (between 2019 and 2020) most likely related to the limitations dictated by the pandemic in accessing healthcare facilities (and thus, not contributing to the growth in numbers of outpatients). The issue is also exacerbated by the connection between falls and death. Overall, in fact, "falls are the leading cause of unintentional-injury deaths and can result from multiple causes, either singly or in combination"[13]. Older people have a higher risk of mortality following falls than other age groups[14]. The majority of deaths due to falls among older people occur among males, with the death rate for males nearly twice that of females[15], as also visible in Figure 3. The increase in falls in the country is also increasing the financial burden on the healthcare sector, with the overall cost for fall injury intervention and treatment in older people in Thailand being estimated to be approximately 12,000 million Baht (roughly US$334,000) per year[16].

Figure 3. The death rate of falls in people aged 60 years and over per 100,000 people, divided by gender from 2009-2018 (DIP 2019).



12. DIP.

13. Worapanwisit, Prabpai, and Rosenberg. Correlates of Falls among Community-Dwelling Elderly in Thailand.

14. ThaiNCD. ข้อมูลจำนวนและอัตราการเสียชีวิตจากการพลัดตกหกล้มในผู้สูงอายุ ICD 10 (W00 - W19) ปี พ.ศ. 2561.

15. DIP, Fall in Elderly: Causes and Prevention.

16. DIP.

Accounting for these numbers, preventing falls represents an important focus area for Thailand, both in assuring the safety and well-being of its citizens, but also to avoid financial pressure on its healthcare system. It is worthwhile to highlight that in Thailand the total health expenditure in 2020 was reported to be equal to 4.4 per cent of the Gross Domestic Product (GDP) of the country, with 28.2 per cent of this representing the private expenditure as a share of total health expenditure[17]. The health expenditure as a share of Thai GDP experienced an increase from 3 per cent to 4.4 per cent between 2001 and 2020, an average annual rate of growth equivalent to 2.06 per cent[18]. The public coverage for citizens is represented by the Thailand Universal Health Coverage (UHC) scheme (also known among Thai people as the 30 Bath scheme).

THE IMPORTANCE OF FALL PREVENTION IN THAILAND

In the past, several fall prevention programmes for Thai older people in the community were actively implemented by different institutions. While not all communities in Thailand received these programmes, a spillover effect was a relative increase in awareness regarding fall prevention among older people. However, the effectiveness of such fall prevention programmes is not yet fully established, with some findings pointing out the ineffectiveness of some programmes in effectively reducing falls[19]. In general, it could be argued that these programmes did not reach the expected outcomes, as can be seen in Figures 2 and 3, where an increase in the rate of death and hospitalisation due to falls in the country in the recent past is visible. Arguably, these higher rates may be also one of the consequences of the lack of effectiveness or implementation of fall prevention programmes for Thai older people in the community.

Additionally, the Division of Injury Prevention (DIP), under the Department of Disease Control of the Thai Ministry of Public Health, has introduced a series of fall prevention plans and strategies[20]. However, upon analysing the plans and strategies provided by DIP, it appears that they are limited to older people who live in the community. Kespichayawattana, analysing fall prevention policies and

17. Knoema. Thailand - Total Health Expenditure as a Share of GDP.

18. Knoema.

19. Suttanon et al. Effectiveness of Falls Prevention Intervention Programme in Community-Dwelling Older People in Thailand.

20. DIP. Number and Rate of Out-Paitent Department (OPD) Due to Fall (W00-W19) in Older People Aged 60 Years and Over.

implementations in the country, suggested that fall prevention measures should be community-based but also proactive (Kespichayawattana 2021). Furthermore, it is important to highlight that falls have been commonly found in community-dwelling elderly people[21], and thus, the major focus should be specifically placed on this segment of the population. A study conducted in Thailand identified age, income, presence of congenital disease, and past fall history as the socioeconomic factors that affect fall risk levels[22]. In general, risk factors of falls can be classified into two main categories: intrinsic and extrinsic risk factors. Intrinsic risk factors "include a history of falls, walking and balance problems, less muscle strength, visual impairment, incontinence, receiving many medications, [and] cognitive problems", whereas extrinsic risk factors are referring to "environmental hazards such as a wet floor, slippery and uneven ground surface, inadequate lighting, and inappropriate clothing" (Maneeprom et al. 2019). Based on another study conducted in Thailand, the most common reason for falling was indoors hazardous environments[23]. Therefore, implementing fall prevention programmes and providing a safe environment in the community, both in the indoor environment, and outdoors, where actually the majority of cases happen[24], represent a crucial aspect to consider for Thai elderly people.

In Thailand, there have been only a limited number of studies of fall prevention interventions, with "little research evidence to guide fall prevention practices for Thai older people living in the community"[25]. It is thus essential to ensure that older people in the community receive the benefits of effective fall prevention programmes and thus live in a safe environment relatively free from the risk of falls in order to reduce the incidence rate of falls among Thai older people. In fact, as was pointed out in research work in the literature, if "it is utopian to believe fall-related injuries can be eradicated", at least "one can realistically hope to reduce fall incidence and prevalence, even as nations' populations age and, as they do, the

21. Ganz and Latham. Prevention of Falls in Community-Dwelling Older Adults.

22. Iamtrakul et al. The Association of Falls Risk in Older Adults and Their Living Environment.

23. Worapanwisit, Prabpai, and Rosenberg. Correlates of Falls among Community-Dwelling Elderly in Thailand.

24. Worapanwisit, Prabpai, and Rosenberg.

25. Suttanon et al. Effectiveness of Falls Prevention Intervention Programme in Community-Dwelling Older People in Thailand.

risk of falls increase"[26]. Fall prevention, in fact, is considered the best approach for reducing fall injuries[27].

Effective fall prevention exercise programmes, safe environments, and awareness among older people, family members, and caregivers in the community can all help reduce the risk of falls. In fact, there are two main components in a typical fall prevention programme: exercise training programmes and the creation of safe environments. The physical environment in which older people live and spend their time usually includes homes, roads, and vehicles, and thus, they all have to be considered in the discussion on how to improve their safety in regard to fall prevention. Such an improvement process cannot be achieved without cooperation between public institutions and local communities. But also, exercise is essential. Specifically, a study in Thailand found a beneficial improvement in physical strength and balance as a helpful factor in reducing fall risk within a short period of time[28]. Thus, fall prevention programmes should in fact be implemented at the community level with exercise programmes focusing on training an individual's gait, balance, and functional abilities.

To successfully achieve positive effects, close cooperation between government institutions and communities, involving all the related stakeholders holistically and with a multidisciplinary approach,[29] has emerged as a necessity, to ensure that older people in Thailand have the greatest opportunity to benefit from effective fall prevention programmes, thus enabling them to live in a safe environment free from risk of falls as much as possible while participating in exercise activities. Also, a strong focus should be placed on increasing the number of community-dwelling older adults who participate in fall prevention programmes, improving the quality and effectiveness of these programmes, including implementing measurable outcomes to gauge their effectiveness, increasing awareness and education around fall prevention, and finally, improving the safety of the environment where older adults live. As highlighted in the research in the literature, a fall prevention intervention

26. Worapanwisit, Prabpai, and Rosenberg. Correlates of Falls among Community-Dwelling Elderly in Thailand.

27. Suttanon et al. Effectiveness of Falls Prevention Intervention Programme in Community-Dwelling Older People in Thailand; Worapanwisit, Prabpai, and Rosenberg. Correlates of Falls among Community-Dwelling Elderly in Thailand.

28. Dejvajara et al. Effects of Home-Based Nine-Square Step Exercises for Fall Prevention in Thai Community-Dwelling Older Adults during a COVID-19 Lockdown.

29. Suttanon et al. Effectiveness of Falls Prevention Intervention Programme in Community-Dwelling Older People in Thailand.

for older adults should be designed as a multifactorial programme delivered by a multidisciplinary team of healthcare professionals[30].

For the successful implementation of fall prevention programmes for Thai older people in the community, many dimensions should also be considered, such as:

- Socioeconomic environments, including education and income statuses, which shape opportunities for and knowledge about safety.
- Gender, age, and cultural backgrounds, which influence choices that affect safety.
- Lifestyles and behaviours, which contribute to the risk of falls and are shaped by attitudes, knowledge, and environmental factors.
- Safety devices, such as safety shoes that have the right fit, tread, and weight, and possession of strong muscles that can reduce the severity of injury from falls.
- The availability of good retrieval, acute care, and rehabilitation services can increase the chances of survival, and speed and completeness of recovery in case of serious injury.

Finally, it is relevant to reiterate the important role that technology is increasingly playing in healthcare systems, including in the process of fall prevention[31]. In fact, several applications used in fall prevention deploy technology, "including predictive and prescriptive analytics using big data, video monitoring and alarm technology, wearable sensors, exergame and virtual reality, robotics in home environment assessment, and personal coaching"[32]. Accounting for the increasing opportunities offered by technology, and also considering the vision itself of the Royal Thai Government (RTG) to include more digital solutions in the healthcare system, it is essential to understand and discuss how technology can be leveraged for preventing falls among older adults in the country.

30. Suttanon et al.

31. Maneeprom et al. Effectiveness of Robotics Fall Prevention Program among Elderly in Senior Housings, Bangkok, Thailand; Morat et al. Evaluation of a Novel Technology-Supported Fall Prevention Intervention – Study Protocol of a Multi-Centre Randomised Controlled Trial in Older Adults at Increased Risk of Falls.

32. Oh-Park et al. Technology Utilization in Fall Prevention.

AN E-HEALTH APPROACH

In 2005, the WHO officially recognised the potential of e-Health contributions to strengthen health systems around the world through its ability to support the management and delivery of health systems[33]. The RTG has pushed many initiatives and measures to incorporate digital technology into the Thai healthcare system, in alignment with the Ministry of Public Health's eHealth Strategy 2017-2026, which also provides incentives for research in technology and innovation[34]. As Pattarawan (2022) wrote, "Given the increasing health care cost, all stakeholders across the health and wellness sectors, including health care providers, consumers, and the government, realise the benefit of keeping individuals healthy and shift more focus on preventive and self-management measures". Telehealth and remote care, digital health platforms, medical diagnosis, devices and monitoring systems, robots, digital transformations of hospitals to increase efficiency and improve operations, and also digitalisation of financial and insurance services all play important roles in promoting health and wellness, and fostering injury prevention in the Kingdom[35]. In addition, leveraging social media can be an important path to explore.

Specifically, social media and the internet in general can play an important role in health promotion. There is in the literature a large multidisciplinary examination "demonstrating that influencers are, indeed, influential", with influencer categories including "opinion leaders, celebrities, and micro-celebrities who have a large number of followers on social networking platforms"[36]. Celebrities "can have a tremendous influence on individuals' knowledge, attitudes, and decision-making behaviours, including those that affect health"[37]. Furthermore, as highlighted by Kostygina et al.[38], social media can also be integrated into interventions, including peer discussions, conversations between participants and health professionals, delivering information in texts, videos and infographics[39], and sharing achievements[40].

33. WHO. Fifty-Eighth World Health Assembly.

34. Pattarawan. Thailand's Digital Entrepreneurship and Digital Health and Wellness.

35. Pattarawan.

36. Kostygina et al. Boosting Health Campaign Reach and Engagement Through Use of Social Media Influencers and Memes.

37. Kostygina et al.

38. Kostygina et al.

39. Condran, Gahagan, and Isfeld-Kiely. A Scoping Review of Social Media as a Platform for Multi-Level Sexual Health Promotion Interventions.

40. Armin et al. Development of a Multi-Behavioral MHealth App for Women Smokers.

In addition, social media also enables users to "track and share their health statuses or activities and view those of others in the community" (Kostygina et al. 2020). As Schillinger et al.[41] wrote: "[T]o an unprecedented degree, the popularity and technical sophistication of social media platforms have translated into health discourse becoming more ubiquitous".

To understand if social media can also actually play an important role in Thailand, it is important to look at the actual statistics of the Thai ecosystem. In January 2023, according to a report from GSMA Intelligence, mobile connections in Thailand were equivalent to 141 per cent of the population, recording an increase of almost 6 per cent compared to the year before, with a total internet penetration of 85.3 per cent of the population, and with more than 52 million Thais using social media, a figure representing almost 73 per cent of the entire Thai population[42]. The median mobile internet connection speed was reported to be equivalent to 37.85 Mbps, with the fixed one standing at 205.63 Mbps, according to the data reported by Ookla[43], numbers representing an increase of 18.7 per cent and 20 per cent respectively, compared to the twelve months before[44]. Also, just accounting for Facebook, YouTube, and TikTok, the Ad-reach (the percentage of Thais reached by ads on these platforms) was equivalent to 78.6 per cent of the local internet user base (regardless of age) at the beginning of 2023 for Facebook (48.10 million users in Thailand at the beginning of 2023), 71.7 per cent of the total internet user base for YouTube (43.90 million users in Thailand at the beginning of 2023), and 65.8 per cent of the local internet user base (40.28 million users aged 18 and above in Thailand at the beginning of 2023) for TikTok[45].

41. Schillinger, Chittamuru, and Ramírez. From 'Infodemics' to Health Promotion.

42. Kemp. Digital 2023.

43. Ookla. Ookla® | Network Intelligence to Enable Modern Connectivity; Kemp. Digital 2023.

44. Kemp. Digital 2023.

45. Kemp.

Figure 4. Favourite Digital Platforms Among Thais (background picture retrieved from pixabay.com).

Furthermore, in accordance with Statista, in 2021, around 74.8 per cent of social media users in the country were in the segment of the population aged between 18 to 24 years, while only 0.9 per cent of users were 55 years and above[46]. Additionally, in terms of accounts that users follow, a survey by GWI showed that almost 50 per cent of accounts followed were belonging to people that the users know[47]. After this, TV shows and channels, actors and performers, brands, singers and musicians, foodies, and entertainment represented the typology of accounts followed by Thais[48]. In terms of platforms used, Facebook and Line are at the top of the rankings (over 90 per cent of internet users in the country), followed by Facebook Messenger (above 80 per cent), TikTok (almost 80 per cent), Instagram, and Twitter, all still above the 50 per cent mark.

From these numbers it can be seen that social media has become an integral part of the Thai market and the life of citizens, with platforms such as Facebook, YouTube, and also LINE playing an important role in offering information to Thais, while influencing their consumer decisions[49]. This has been seen also in terms of

46. Statista. Thailand.

47. OOSGA. Social Media in Thailand - 2023 Stats & Platform Trends.

48. OOSGA.

49. OOSGA.

health consciousness among Thai consumers, with an example being represented by a large increase in the popularity of vitamins and dietary supplements for maintaining a fit body[50]. Yet, one aspect to keep in consideration is that social media is mainly used by the younger generation, with the older generation instead being those more affected by the risk of falls. Yet, social media can still be used to raise awareness among caregivers and community dwellers to promote an environment free of risks, educate on exercise promotion and inform on signs of decline in mobility with a connected increase of risk of falling. Also, social media still plays an important role in social mobilisation[51]. In fact, since social media has the ability to reach varied stakeholders and a wide audience in Thai society, it also allows nongovernmental organisations to play an important role. Specifically, "nongovernmental health organisations can use social media to mobilise social resources" and examples can be seen already in the literature, with several studies pointing out how nongovernmental health organisations "leveraged social media to advocate for change in public policies related to health issues such as HIV/AIDS and mental health, raise funds for individual medical care and health-related research, and raise awareness and promote actions to address health problems"[52].

Finally, it is also important to consider technology adoption and integration into the existing Thai healthcare system. A recent study has pointed to the integration of different digital technologies into already existing healthcare systems as one of the major challenges[53]. When referring to the adoption of technologies by individuals, models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Model (TAM) are typically used as reference. These models offer frameworks for helping researchers and businesses to understand the reasons behind people's choice to use or not new technologies. These models aim to explain and predict the factors that influence technology adoption. But as highlighted by Scherer et al.[54], these models focus on tools that "can be voluntarily used by individual adopters", but in contrast, "most health care settings involve an organisational-level decision to roll out technologies that are made available to all staff". Besides, these models were not developed within a healthcare setting and

50. OOSGA.

51. Chen and Wang. Social Media Use for Health Purposes.

52. Chen and Wang.

53. Gold et al. Adoption of Social Determinants of Health EHR Tools by Community Health Centers.

54. Scherer, Siddiq, and Tondeur. The Technology Acceptance Model (TAM).

thus "overlook its organisational and regulatory complexity"[55]. The adoption of digital health technologies, in fact, is not simply a "technical process in healthcare systems, but a multi-dimensional process, where all stakeholders including clinicians, patients, and institutions need and requirements have to be considered for successful implementation"[56].

STAKEHOLDERS TO CONSIDER, AND CONSTRAINTS

In order to create policies and programmes that can be effective, but also properly implemented to obtain measurable results, it is essential to outline the stakeholders who should be involved in the process. In the first place, programmes should be designed for Thai older people aged 60 years and over and who live in the community, including older people who are still living independently in their own homes or with family members, as well as those who reside in senior living facilities or other forms of communal living arrangements. The focus should be on those who are at high risk of falling. They should be the direct beneficiaries of the fall prevention programmes and safe environments policies. Furthermore, local government agencies are also important stakeholders, as they can provide funding, resources, and regulatory support for fall prevention programmes and safe environments policies, and can also coordinate with other stakeholders to ensure that policies are implemented effectively. Examples of local government agencies are the Provincial Administrative Organisation (PAO), Tambon Administrative Organisation (TAO), and Subdistrict Municipality (SDM).

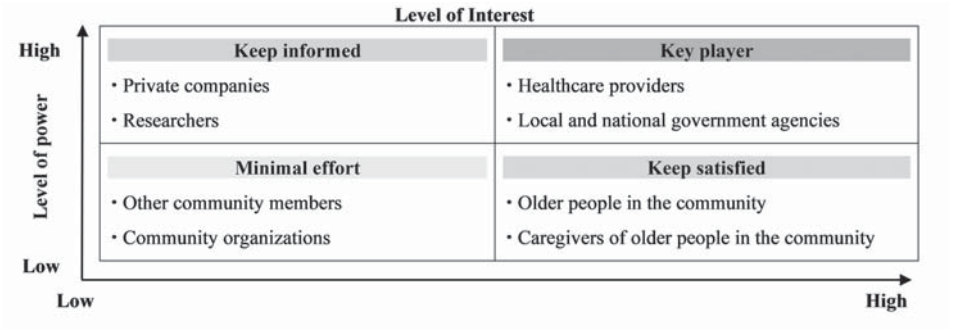
Another important stakeholder is represented by the national government agencies. They have a direct responsibility in implementing and funding fall prevention programmes for older people who live in the community in Thailand. Examples of national government agencies are the Thai Ministry of Public Health (MOPH), the Division of Injury Prevention (DIP), the National Health Security Office (NHSO), and the Ministry of Social Development and Human Security (MSDHS). These stakeholders have the ability and tools to establish wide social media campaigns capable of reaching Thai citizens. Besides the primary stakeholders, it is also important to consider those involved on a second level, including caregivers, community organisations, but also researchers, and the private sector. Specifically, caregivers

55. Scherer, Siddiq, and Tondeur.

56. Al-Rayes et al. Public Awareness and Use of Health Tools Provided by the Portal of the Ministry of Health of Saudi Arabia.

and family members of older people in the community can support older people and ensure their access to fall prevention programmes and a safe environment. As mentioned earlier, if it is true that in the Thai ecosystem (as in general), older people are those less involved in the usage of social media, caregivers and family members are not. They can be easily reached through social media campaigns, and overall positively influenced on supporting the creation of a risk-free environment in terms of falling. Also, their awareness about the importance of exercise for the older adults they are taking care of can be raised. Other community members can also provide valuable insights and perspectives on the needs and priorities of their community. Examples of other community members are local community leaders, volunteer groups, and community organisations. Specifically, the latter can help to raise awareness about fall prevention and provide support and resources while facilitating education and training on fall prevention strategies. Examples of community organisations are community health centres, senior centres, and non-profit organisations. But this is not all.

Figure 5. Classifies stakeholders by their level of power and interest using a power/interest matrix.



Researchers also play an important role in the design and implementation of effective programmes and policies. Researchers can provide evidence-based recommendations for designing and evaluating fall prevention programmes, safe environments policies, and social media campaigns. Finally, private sectors/companies can design, develop, and promote technologies and products/equipment, and supplies that support fall prevention and safe environments for older people. Examples of private companies that may play important roles include HomePro (Thailand) Co., Ltd. and Thai Safety Equipment Co., Ltd. Universities, schools, and companies with high visibility among the public can also play important roles. In Figure 5, a matrix with the level of interest for each stakeholder is reported.

A possible approach should consider an overall increase in funding for fall prevention programmes in communities with limited resources to ensure access for older people. More training and education for healthcare providers and community volunteers on evidence-based practices for fall prevention should be also offered. There is a need to leverage technology, such as mobile applications and telehealth, to increase access and education for older people, and, importantly, social media campaigns, mainly through the right influencers, in accordance to the targeted audiences, particularly the accounts most followed by them. But also, it would be essential to conduct research on the effectiveness of fall prevention programmes in different communities and populations and use these findings to tailor programmes to the specific needs of older people in Thailand. Finally, an essential aspect to focus on is collaboration. Specifically, seeking partnerships and collaboration with other government agencies, community organisations, and stakeholders to increase funding and resources for fall prevention programmes would be an essential aspect to consider, while involving communication agencies, well-known actors and singers, and highly followed social media account owners as key players in influencing and raising awareness on the importance of fall prevention, are key factors to take into account in order to implement effective fall prevention programmes properly in the communities.

Finally, it is also very important to consider the current limitations and constraints of such programmes. Specifically, one of the common limitations is posed by a shortfall in funding. Implementing an effective fall prevention programme for older people in the community may require significant financial resources. The government and relevant stakeholders may face constraints in securing sufficient funding to implement and sustain such a programme. Additionally, limited accessibility also represents a limitation to account for. Older people who live in rural areas may have limited access to fall prevention programmes and leveraging technology for awareness campaigns, monitoring, and data collection may even result in difficulties, mostly when dealing with that segment of the population that is less accustomed, prone, or even enabled by the currently available infrastructure in using technological tools. This, in turn, would limit awareness. In fact, despite previous efforts to raise awareness about fall prevention among older people in Thailand, some may still lack knowledge and understanding about the importance of fall prevention measures. This could hinder their participation in fall prevention programmes and lead to higher rates of falls in the community. Another aspect to consider is represented by the limited coordination among stakeholders. Coordination among various stakeholders, including government agencies, healthcare providers, and community organisations, may be necessary

to effectively implement a fall prevention programme. Lack of coordination and collaboration could result in duplication of efforts, inefficiencies, and gaps in coverage. Additionally, limited enforcement could directly affect policies and programmes on fall prevention. Without proper enforcement, policies and strategies may not be effective in reducing the incidence of falls among older people in the community. Finally, limited technology adoption represents the natural limitations of such an approach. The reliance on technology and the internet for some fall prevention programmes and awareness campaigns may limit the accessibility and utilisation of these programmes among older people who are not tech-savvy or who do not have access to the internet. This could lead to further disparities in fall prevention outcomes among different groups of older people.

CONCLUSIONS AND RECOMMENDATIONS

The importance of placing a major focus on fall prevention in Thailand has emerged as a rising priority in the Kingdom. Several prevention programmes have been carried out in the past but with limited or no effect in preventing or reducing falls and related injuries. In alignment with the increasing pervasiveness of technology in Thai society, social media may represent a viable tool to adopt to battle against falls in an aging Thai society. Awareness campaigns could play an important role in this battle, informing the elderly about important aspects of prevention and the public about easy-yet-effective guidelines that could prevent falls, with all the related consequences, by their loved ones. In this chapter we offered a discussion on the importance of fall prevention in Thailand, followed by a discussion on some ideas on how technology can be used to raise awareness, educate, and inform people in the country, in a direct manner, but also in a non-direct manner, focusing on reaching out, informing, and influencing those stakeholders who can promote a risk-free environment for Thai older people, while promoting exercise in communities. A list of stakeholders has been identified to better understand who policies should speak to and involve. Finally, a list of limitations and risks were laid out.

Accounting for these points, the following recommendations can be offered:

- **Increase community-based fall prevention programmes:** These programmes should be proactive, rather than reactive, and should focus on raising awareness, providing education, and promoting physical activity to reduce the risk of falls.
- **Improve accessibility and utilisation of fall prevention programmes:** Many older people in Thailand may not have access to technology or the internet, which limits their ability to participate in fall prevention programmes

that rely on these resources. Programmes should be designed to be accessible and user-friendly for all older people, including those with limited technology skills.

- **Collaborate with stakeholders:** Coordination and cooperation among stakeholders is pivotal in achieving effective programmes to reduce fall through prevention and education. Channels and events dedicated to support such communication and collaboration between stakeholders should be established, so as to help in ensuring the creation of well-designed, well-implemented, and sustainable-over-time programmes.
- **Pay more attention to data collection and analysis**: Strategies and policies that support fall prevention depend on data, which in turn requires a more comprehensive and regular data collection system for monitoring the effectiveness of fall prevention programmes and thus identifying areas for improvement. Regular data collection and analysis may also help to better identify emerging trends and risks related to falls among older people.
- **Increase public funding for fall prevention programmes**: Adequate funding is necessary to support the development, implementation, and evaluation of fall prevention programmes. More focus should be placed on the importance of fall prevention among the elderly, and prioritising such programmes through adequate budgets at the local and national levels should be considered. Increased funding could also support research on the most effective strategies for fall prevention among older people, while supporting a mechanism of feedback and improvement to achieve a reduction in the number of cases experienced in the past years.
- **Create social media campaigns**: In regards to reaching out to Thais, both older adults and the people involved with their care or who are close to them, leveraging social media would be a viable approach. Social media platforms are already extensively used by Thais, and thus leveraging them may be a great and effective path to follow to inform, increase awareness, and educate people on how to create risk-free environments both indoors and, more importantly, outdoors, with an eye to reducing and preventing the risk of falls in communities. Furthermore, the usage of specific influencers, actors and singers to disseminate information, while raising awareness, may be an effective approach to creating prevention programmes targeting both environment settings and exercise promotion.

These recommendations are specifically tailored to the Thai ecosystem, but may lead to the creation of effective policies and campaigns that could be used as an example for the neighbouring countries as well.

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