Chapter 2

Bridging a Resilient Post-Pandemic Recovery through Digital Health Transformation

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A. Introduction

The digital revolution in health and the economy is a pivotal approach to post-pandemic recovery (European Public Health Alliance, 2022). Even before the pandemic came, the Government of Indonesia had already implemented digital health implementations such as Makassar's 24-hour-homecare/telemedicine and tele-radiology, National Health Insurance – Healthy Indonesia (BPJS) Mobile, BPJS Digital Claim Verification, digital Acquired Immune Deficiency Syndrome (AIDS) application, TeleECG and Teleradiology, P-Care BPJS, and application for Online Outpatient Registration. Private sectors like Alodokter, Go-Med, Homedika, and others also already contribute to the digital transformation journey in the health sector in Indonesia

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(Deloitte Indonesia, 2019). Digital health is critical in enhancing health system efficacy and increasing access to health services while keeping healthcare costs low, which will bring health systems closer to Universal Health Coverage (UHC). Digital health can contribute to UHC in various ways, such as improving patient access through digital intervention (WHO, 2019). However, current challenges lurking in the health systems like accountability, supply, demand, quality, and affordability, as these factors still become obstacles to maximizing digital health contribution in UHC.

Digital health intervention (DHI) is tightly related to the economy. Their interplay draws on and connects several businesses, including manufacturing, medical technology, medical devices, biotechnology, and pharmaceuticals (ANDHealth, 2019). Telehealth is an excellent example of this orchestration. During the pandemic, telehealth globally attained 65% more consumers, where 57% preferred telehealth services (Betheny et al., 2021). In the United States (U.S.), McKinsey & Co. reported impressive trillion-dollar revenues from telehealth in the third quarter of 2021 and predicted that $250 billion of U.S healthcare spending could go to virtual-based care. According to Rock Health, the total venture capital investment activity in telehealth at the end of quartile 2 was $14.7 billion, and the total revenue of the top 60 virtual care players experienced an increase of 83% per annum from 2019/2020. It means digital health contributes to the economy's improvement (Market et al., 2022). Although DHI classified by WHO does not specifically mention part of pharmaceuticals, pharmaceuticals got the advantage from clinical trials (Gomes et al., 2022) to data sharing (IBM, 2019; WIPRO, 2019; McKinsey & Co., 2021). This suggests digital health can be the key to bridging health and economic recovery post-pandemic.

Currently, Indonesia has progressed relatively well in the development and transition into digital health, evident by establishing telemedicine, PeduliLindungi, and 40 other digital platforms that serve as a synchronized database and information source (Sehat Negeriku, 2021). Furthermore, with 199.2 million smartphone owners, Indonesia

holds enormous opportunities to access digital health for inclusive healthcare services. The target market is predicted to achieve 60% of the total population by 2025, with a future revenue of more than 3 million USD for digital fitness and e-health players in Indonesia (Statista, 2022). Nevertheless, there are still many things to learn and challenges to be tackled, such as uneven distribution of healthcare quality, an uneducated market, and a lack of interoperability between healthcare systems and innovations (Wira, 2021; Jakarta Globe, 2021). User hesitancy can also stem from the accessibility limit, lack of technological knowledge or knowledge of technology, lack of integration to current EMR, lack of financial incentives, and increased overtime demands (Mohammed et al., 2021; Mogessie et al., 2021).

According to the World Health Organization (WHO), digital health belongs to the field of science, and its practice is mainly concerned with developing and applying digital technology to enhance health. It involves digital users and several comprehensive ranges of smart and connected devices, including the Internet of Things, advanced computing, big data analytics, artificial intelligence, machine learning, and robotics as applications of digital technology for health (WHO, 2021).

The WHO generally divides digital health interventions (DHI) into four categories depending on the principal user: clients, health workers, health system managers, and data services. Interaction between these principal users is crucial in conducting DHI to solve health system challenges (Table 2.1). Clients are members of the general public who are either potential or current consumers of health services and might benefit from innovations such as client-to-client communication, personal health tracking, citizen-based reports, or on-demand information services. Health professionals can benefit from innovations such as client identification and registration, client health records, health worker decision assistance, telemedicine, and referral coordination. Other advances that can help health system administrators include human resource management, supply chain management, and public health event notification. Finally, cross-cutting

capabilities to enable a wide variety of data collecting, administration, and usage; data coding; location mapping; and data interchange and interoperability are all included in data services initiatives (Healthcare Information for All, 2022).

Table 2.1 The Relationships between Health System Challenges, Digital Health Interventions, and Digital Health System Categories

Challenges in the Healthcare System	Digital Health Intervention	Digital Health System Categories
Insufficient commodity supply	a. Oversee the inventory and distribution of health-related products. b. Keep track of health-related stock levels.	Information System for Logistics Management
Healthcare professionals' failure to follow clinical guidelines	a. Provide protocol-compliant prompts and notifications. b. Provide a checklist by the protocol. c. Communication with a healthcare provider and performance feedback (s) Schedule the actions of the healthcare practitioner.	a. Telemedicine systems b. Decision support systems
Lack of access to data or information	a. Data collection and management for health indicators regularly b. Storage and aggregation of data	a. Information System for Health Management (HMIS) b. Medical Records in an Electronic Format c. Identification registries and directories
Clients are not being followed up on as much as they should be.	a. Send customized notifications and reminders to clients (s) b. Send the client tailored notifications and reminders (s)	a. System for client communication b. Medical Records in an Electronic Format

Source: Adopted from Classification of Digital Health Interventions v 1.0 Figure 1. Linkages across Health System Challenges, Digital Health Interventions, and System Categories (hifa.org)

In addition, the WHO identified four critical components in implementing digital health interventions. First and foremost, health content and information must be appropriate, accurate, and in line with industry best practices. Second, digital health treatments must have discrete digital functionality to achieve specific health objectives. Third, text messaging, software, and information and communications technology (ICT) systems are software and communication channels that help offer digital interventions with health content. Finally, ICT and enabling environments include governance, infrastructure, legislation and regulations, workforce, interoperability, and digital architecture (WHO, 2019). Digital health had a tremendous impact during the outbreak since it was first recommended by WHO to reduce physical transmission of the virus. Interventions included telemedicine, monitoring surveillance systems, virtual hospitals, tracing and tracking activities, and even outbreak prediction models (Fagherazzi et al., 2020). As presented in Table 2.2, the four areas of digital health support during COVID-19 include the follows:

1) Public communication and information: disseminating information about the epidemic; preventing the spread of incorrect information
2) Monitoring and surveillance: modifying current systems to facilitate monitoring, surveillance, and contact tracking; genetic data applications; mobile health
3) Artificial intelligence is assisting in the delivery of health care
4) Apps that track vaccinations, immunity, and pharmacovigilance (Swayamsiddha et al., 2021; WHO, 2021)

Table 2.2 Type of Support of Digital Health Tools during COVID-19

Area	Type of Support
Communication and Information	Getting the word out to the public about COVID-19 Combating COVID-19 falsehoods
Monitoring and Surveillance	Existing tools are being adapted to help with monitoring, surveillance, and contact tracking. Modelling COVID-19 diffusion using mobility data Detecting and tracking novel variations using genomic data Using data from public databases and social media to aid surveillance and monitoring Contact tracing with the use of mobile applications Supporting symptom monitoring and self-diagnosis with mobile and web-based apps Self-isolation and quarantine are supported or enforced via applications.
Supporting the Delivery of Health-Care Services	Using remote consultations to assist in the delivery of critical care Using digital tools to manage hospital capacity Using AI to identify infections and potential treatments
Vaccination, Immunity, and Pharmacovigilance	Identifying individuals eligible for vaccination Combating vaccine hesitancy Monitoring of adverse reactions Using immunity certificates to support the reopening of economies

Source: Adopted from POLICY BRIEF 42: Use of digital health tools in Europe before, during, and after COVID-19. European Observatory on Health Systems and Policies, a partnership hosted by WHO. Editor: Nick Fahy and Anna Sagan. 2021

Subsequently, this chapter examines challenges in digital health intervention in global, developed countries (United States, Australia, Japan, South Korea, Taiwan), developing countries (Egypt, Thailand) and explore how their digital health tools and strategies in tackling the COVID-19 outbreak, as well as how the tools and strategies can be applied in Indonesia that has a large market.

In the end, this chapter formulates a recovery strategy to assist recovery in the post-pandemic time through digital health transformation.

B. Digital Health Innovations, Comparison with Other Countries

In this DHI comparison, we took examples of developed countries (Australia, South Korea, Japan, Taiwan, and the United States and developing countries (Egypt and Thailand), as well as Indonesia, to participate in a series of questions regarding battling the pandemic through the digital health system. We asked Indonesian students that are currently residing in the countries who are willing to participate (Australia, Taiwan, Egypt, and Thailand) to share their experiences on whether DHI—particularly mobile health applications as one of the required tools that should be used by the Indonesian students in overseas as regulated by each government—is considered helpful for them to get through and recover from the pandemic in the representative countries.

1. Australia

The first COVID-19 case in Australia was recorded on January 25, 2020 (Chen & Assefa, 2021). The aim of the public health policy in Australia during the pandemic has been to 'flatten the curve'- reducing the rate of COVID-19 spread among communities, minimizing the number of deaths, and helping health care facilities to cope. Telemedicine or telehealth is now an important approach in Australia, and Medicare (Australia's UHC scheme) has fully supported telehealth sessions through the permanent Medicare Benefits Schedule (MBS) since March 2020 (Davenport et al., 2020). Collaborations were also made with other countries to develop real-time transmission tracking, quarantine, and peer-to-peer consultation apps. One example is the Australian tracing app COVIDSafe, launched on April 14, 2020, and its use is highly encouraged by the government (Yang et al., 2020). Other health informatics systems used include patient triage, registration, COVID-19 screening clinic operations, electronic ordering, prescribing and documentation, reporting, analytics, and research (Cheng et al., 2021).

2. Egypt

As one of the first countries to monitor infectious disease through a national surveillance system, with an Acute Respiratory Infection plan that was developed in 2007 (Abu El Sood et al., 2021), a national task force for coronavirus was promptly established in Egypt's first case on February 14, 2020 (Beschel Jr., 2021) The government immediately launched a website to enable public access to case and mortality information on COVID-19 (Ghannam & Sebae, 2021); established a 24-hour counseling hotline; and an app with a map of local hospitals, proximity alerts, and self-reporting mechanism (Megahed, 2020). The Egypt Health Passport app provides Egyptian citizens with a COVID-19 vaccination tracker, dosage information, and a "vaccination certificate".

3. South Korea

Digital health in South Korea ranges from surveillance, testing, contact tracing, and strict quarantine (Whitelaw et al., 2020), and its use helped alleviate overload in tertiary hospitals (Kim et al., 2021). The use of big data in South Korea was implemented by using credit cards, GPS, and CCTV data to track people's movements (OECD, 2022) and the adoption of gadgets such as wristbands (Yonhap, 2020).

"My Healthy Way" app is the Korean Government initiative to integrate medical check-up data (from National Health Insurance records), prescription data (from the Health Insurance Review and Assessment Service), and immunization history (from the Disease Control and Prevention Agency) in a single system. In 2022, interoperability issues in My Healthy Way are planned to be solved, while in 2023, the integration hopefully will expand to personal financial and administrative data (Jung, 2021).

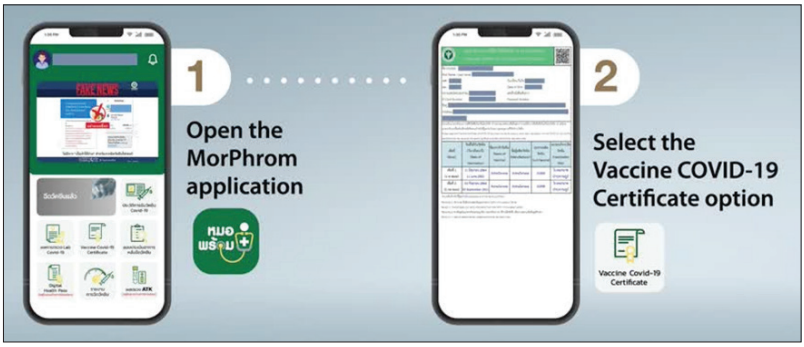
4. Japan

Robots in hotels and hospitals were instructed to take care of non-critical patients and those who need to stay-at-home to minimize human contact. In addition, the COCOA app was launched to trace

people contacted with positive test result citizens, with a decentralized framework to ensure tracking without requesting personal information (Sayeed & Hossain, 2020; Nakamoto et al., 2020). However, low connectivity persists in rural Japan, causing delayed data sharing.

5. Thailand

Digital methods and technologies are becoming more and more important in tourism-dependent Thailand (Bangkok Post, 2021). The Mor Prom application (Figure 2.1), launched by the Ministry of Health of Thailand, provides residents with access to vaccination services such as vaccine booking and tracking and up-to-date information on COVID-19. It also includes checking for side effects by monitoring after vaccination (Bangkok Hospital, 2022).



Source: Bangkok Hospital, 2022

Figure 2.1 MorPhrom App

The Phuket Sandbox Program allows foreign t to visit Phuket Province without being quarantined. Before traveling anywhere in Phuket for leisure activities, the RTPCR test result must be negative. This program is very important for Thailand as a country that depends on the tourism sector (Thai Embassy, 2022).

6. Taiwan

Taiwan became the first country to screen and implement 14-day quarantine with phone monitoring for all passengers from Wuhan when the first case was confirmed in December 2019. Along with establishing notifiable disease reporting and laboratory surveillance of SARS-COV2 within Central Epidemic Command Centers (CECC) (Jian et al., 2020; Han et al., 2020); every Taiwanese and foreigner can connect with Taiwan's single-payer national health insurance (NHI) (Han et al., 2020). Quick Response (QR) Code was also implemented since the beginning of the pandemic (Han et al., 2020) by locating designated traveling and contact history with a VPN query and face mask-rationing policy where the purchases of masks can be tracked by name. Other innovations include an entry quarantine system; a home quarantine tracking system by using LINE chatbot; a digital fencing system; Taiwan Social Distancing exposure notification app; QR-Code connected to free-of-charge SMS (that is still functional within low internet connectivity) as well as a user-friendly layout (Lo et al., 2021; Garrett et al., 2021).

7. United States of America

Despite its public health benefits, privacy groups in the US have raised concerns about how personal data would be secured, maintained, and deidentified (Cho et al., 2020; Valentino-DeVries et al., 2020). COVID-19 Exposure Notification App that Google-Apple backed up works well, at least in Alabama, Colorado, Connecticut, Louisiana, Minnesota, Nevada, North Carolina, Pennsylvania, Utah, Virginia, and Washington. Still, some states like Oklahoma, Texas, and Idaho do not deploy the app due to limited mobile phone service in remote locations or conflicting objectives such as vaccine distribution initiatives (U.S. Government Accountability Office, 2021).

C. COVID-19 and Digital Health in Indonesia

1. Digital Health during COVID-19 in Indonesia

UNDP supports national efforts to meet the 2030 SDG indicator 3.8.1 and the national priority in Rencana Pembangunan Jangka Menengah Nasional (RPJMN) 2020–2024 to increase access and quality of health services through the Health Governance Cluster. Work on health technology, financial management of Aids, Tuberculosis, Malaria programs, and waste management are among the initiatives' projects (UNVP, 2022). Since the beginning of telemedicine practice during the COVID-19 pandemic, simple digital health intervention has been deployed by both government and private sectors, such as digital learning packages based on web and mobile health for training; cloud and mobile-based for self-care; QR Code based/wearable systems for real-time transmission; intelligent systems for early detection, screening, and triage; and social media for burden analysis (Niakan et al., 2021). It involves digital users and a more comprehensive range of smart and connected devices, the Internet of Things, advanced computing, big data analytics, artificial intelligence, machine learning, and robotics service as applications of digital technology for health.

To combat the COVID-19 pandemic, the Indonesian government has made extensive utilization of digital information technology for (1) testing, (2) tracking, and (3) treating COVID-19. Consequently, the positive rate has dropped to 0.88% by early 2022, and COVID-19 cases dropped to 58% within two weeks after the height of the second wave in July 2021 (Widyawati. 2021). Based on the four important factors of surge capacity: staff (healthcare professionals), things (supply), structure (hospital beds and medical waste treatment), and system, Mahendradhata et al. (2021) investigated the potency of Indonesia's healthcare system to respond to COVID-19 (referral and essential health services). Indonesia's limited healthcare system capacity should motivate the government to implement numerous DHI. A virtual monitoring and assessment of vital health services and a digital triage system to complement the existing referral system (Lai et al., 2020)

were advocated to allow early identification of service interruptions (Mahendradhata et al., 2021).

A study by Widyawati (2021) showed that the Indonesian government reinforced a few digital health projects during the COVID-19 outbreak. During COVID-19 testing, a New All Record (NAR) database was created as an integrated system to record COVID-19 test results and link them to the national civil registration system, known as SILACAK. Another breakthrough was a test result tracking app, which was also developed using information technology through collaboration amongst health officials, TNI and Polri, and volunteers for its implementation. In less than six weeks, this innovation raised the tracing ratio by 1,000%. The Ministry of Health has created a telemedicine service to help COVID-19 patients who were self-isolating at home and to cope with the limited capacity of health professionals to meet patient in-person for the high demand of consultation, especially in mid of 2022. This service offers automated WhatsApp messaging for free remote consultations and drug delivery from pharmacies, thanks to a collaboration with 15 telemedicine companies and WhatsApp as a part of the Meta company. The Ministry of Health has also employed an integrated COVID-19 Big Data system to assess the COVID-19 status at all levels, from city/district to province. It has made the data available to be open and accountable to the public. The Ministry of Health was working on a long-term strategy to cope with COVID-19 by focusing on the health ecosystem, service efficiency, and data integration for data-driven policies (Widyawati, 2021).

From the private sector, one of the most prominent telemedicine platforms in Indonesia is Halodoc. The number of Halodoc app downloads has doubled since the pandemic, in line with the Ministry of Health's appeal to reduce in-person hospital visits (Uly, 2021). Meanwhile, from the government sector, the government's requirement for the public to use the services of applications provided by the government is becoming increasingly crucial. PeduliLindungi, for example, is an application designed to assist relevant government

entities in tracking and preventing the spread of Coronavirus Disease (COVID-19). This application has several advantages: (1) giving warnings to users, (2) surveillance, (3) downloading vaccination certificates, (4) obtaining information on COVID-19 test results, and (5) as evidence for accessing public services (Satuan Tugas Penanganan COVID-19, 2021). Introducing various unknown performance flaws or difficulties is a hurdle in designing smartphone apps; thus, users must be informed and pushed to update the apps frequently.

2. The Opportunities in Digital Health in Indonesia

Indonesia owns a large market for digital innovation. There are 170 million web clients in Indonesia (64.8% of the overall population), with a youthful populace of 110 million, 90% of whom utilize the internet (APJII, 2019). Over 96% of Indonesians access the internet through smartphones, while 15% do so through a home desktop (United Nations, 2019). Furthermore, Indonesia has also demonstrated potency for computerized commerce, including computerized digital health businesses (United Nations, 2019). Given that Indonesia is the biggest ($54 billion) and quickest developing internet economy in Southeast Asia, it is estimated that Indonesia's internet economy will reach $174 billion by 2025 at a compounded yearly development rate of over 40% (e-Conomy SEA, 2019).

Other key players include pharmaceutical companies, healthcare companies, and open and private health centers. Two of Indonesia's biggest pharmaceutical companies, Kalbe Farma and Dexa Group, support digital health platforms KlikDokter (Kalbe Farma) and GoApotek (Dexa Group), along with non-profit companies (Deloitte Indonesia, 2019). There are currently over 318,000 health apps accessible on the Google Play and Apple app stores in 2017, with over 200 well-being apps being included daily (IQVIA, 2017; Startup Health, 2019).

During the pandemic, healthcare startups learned how to cope with the situation in Indonesia (Reuters, 2020). Two upcoming Indonesian digital startups can be proposed as case studies. First, HELFA offers electronic kiosks for hospitals that are integrated with

mobile applications, where patients can utilize brokers or stand-ins for the long queues and administrative procedures in the hospital until the patient's turn has arrived. This innovation has begun to clear clinic waiting rooms and diminish persistent wait times, and HELFA is currently planning an expansion outside Jakarta. However, as with many application developments, there are still many performance problems and bugs. Privacy and security of health data are also challenges that arise (Pardede & Hakim, 2021). In the U.S., for example, privacy and security are already regulated for all solutions by Health Insurance Portability and Accountability Act (HIPAA) and Health Information Technology for Economic and Clinical Health (HITECH) Act (SGR Law, 2019). Another case study involves Sehati/TeleCTG. Sehati (Sehati, 2022) while TeleCTG (TeleCTG, 2022). This innovation reduces maternal and newborn mortality and is currently accessible in six of Indonesia's territories. An essential portion of TeleCTG's computesrized health solution is a simple transducer gadget that can detect fetal pulse and uterine contractions; transmits the results to a midwife's smartphone and a specialist obstetrician-gynecologist.

However, the Indonesian government has yet to regulate digital health applications, leaving a grey area where digital health applications operate in silos—between existing (but separate) health and technology regulations. Indonesian digital health companies are taking full advantage of the regulatory grey area like data privacy and security, where for example, the law is still limited only to telehealth and online distribution medicine (Pardede & Hakim, 2021), but are aware of the impact that government intervention and regulation may have in the future, and engaging the government to be involved in the process of four giant tech unicorns in Indonesia (Gojek, Tokopedia, Traveloka, and Bukalapak) that has created momentum for other startups to penetrate the Indonesian market, with 70–600% percent increase in the development of online travel, ride-hailing, and e-commerce in 2015–2018 alone. Disruptions to healthcare may follow the wide-scale disruptions seen in other businesses in Indonesia, such as transport (with the arrival of Gojek, Get, and Uber) and E-commerce (with

Bukalapak and Tokopedia). In addition, the Indonesian government has strived to find another tech unicorn, with a yearly summit called Nexticorn (Another Indonesian Unicorn) for up-and-coming startups (Timorria, 2018). The government is extending web infiltration to inaccessible zones through the Palapa Ring Venture, which aims to bring the broadband web to Indonesia's populace with over 36,000 km of fiber-optic cable. (Kominfo, 2018) With this market, advanced digital health incomes are anticipated to expand in Indonesia from $85 million in 2017 to $973 million in 2022, at a compounded yearly development rate of over 60% (Consultancy Asia, 2018; Pardede & Hakim, 2021).

As stated in the Digital Economy Working Group of the G-20 presidency of Indonesia, for reducing the digital Blue and Green Economy (G20, 2022b), the Minister of Information and Communication suggested that there are four opportunities for f in Indonesia that can be addressed:

1) A shift to electronic health records
2) Partnership with stakeholders to build global cooperatives for health technology
3) The business-to-business partnership between G20 countries
4) Providing e-health issue customization on each G20 country according to their necessities (Hayati, 2022).

Currently, some of these recommendations are being developed in Indonesia, as it's important part of health technology (G20, 2022a) and pandemic management (WHO, 2020), such as:

a. Mobile health/telemedicine

Patients' interactions are moving to a new model by using smartphones to communicate with health facilities, while practitioners use the new technology to accept consultations, monitor their health and

medicine consumption, and expedite administrative operations such as appointments, prescriptions, and billing.

b. Wearable and sensor devices

In diagnosis and treatment management, wearable devices measuring vital signs are utilized with audio and video technology. The 'Internet of Things (IoT) revolution is a significant component of this expected future in digital health. In the trend toward precision medicine, these devices offer individualized patient treatment increasingly.

c. Data science

In the healthcare industry, AI/machine learning reduces labor on regular back-office chores, such as using speech recognition technology to quickly transcribe the doctor's notes. Clinical data is also used alongside data science to facilitate the transition to personalized medicine for certain patients.

d. Cloud computing

Electronic health records are in the early stages of being transformed by cloud computing. This technology improves efficiency by minimizing silos and duplication in records management systems. It will also supply a large amount of aggregate data for studies. This is also a priority of the Digital Economy Working Group during Indonesia G20 Presidency in 2022.

e. Blockchain

In the healthcare industry, blockchain technology protects patient confidentiality while allowing for data aggregation that might be valuable for medical research and improving patient outcomes.

To compare digital health innovations in Indonesia, we further analyzed and compared the mobile health apps released by the government of each country, which consist of PeduliLindungi (Indonesia); Egypt Health Passport (Egypt); National Health Insurance, and Taiwan Social Distancing (Taiwan); Corona 100m, Self-Check, and Self Quarantine Safety Protection (South Korea); COCOA (Japan);

MorPhrom (Thailand); COVIDSafe (Australia); and some apps from U.S. Finally, we listed each feature of the apps on Table 2.3.

Table 2.3 Mobile Health Application from Government in Indonesia and Other Selected Countries that Supporting Combating COVID-19

Country	Mobile Health App Name	Features
Indonesia	PeduliLindungi	Digital Passport, Risk Zone Notification, Track and Tracing, QR Code, Integrated e-Haq Service, Teledoctor, COVID-19 Statistic
Egypt	Egypt Health Passport	Vaccination Status, Dosage Information, QR Code, Travel Document
Taiwan	National Health Insurance	Single-Payer System, Comprehensive Medical Coverage, Access to Healthcare, Medical Information, NHI e-referral system, Telemedicine, NHI MediCloud, Name-based Mask Distribution
	Taiwan Social Distancing	Exposure notification, QR Code connected to 1922 SMS, App introduction, Daily Summary, Upload Anonymous IDs, Privacy Policy and Terms of Use, Exposure Notification Setting, Help.
South Korea	Corona 100m	Contact Tracing
	Self-Check	Self-Diagnosis
	Self-Quarantine Safety Protection	Self-Diagnosis, Self Quarantine Information, Emergency Contact, Motion Detection
Japan	COVID-19 Contact-Confirming Application (COCOA)	Contact Information, Symptoms Checker
Thailand	Mor Phrom	Vaccine Reservation and Tracking, Post Vaccination Monitoring
Australia	COVIDSafe app	Bluetooth Notification

Country	Mobile Health App Name	Features
United States of America	GuideSafe Alabama	Exposure Detection, Complete Healthcheck, Share GuideSafe, Review Health Guidance
	COVID Watch Arizona	Exposure Notifications Alert, Add Test Result, How to Get a Vaccine
	COVID Alert Delaware	Updates, COVID-19 Alert, Exposure Notifications, Exposure Alert, Settings
	Aloha Safe Hawaii	Exposure notification, Exchange secure anonymous token (Exposure Alert), COVID-19 information and guidance.
	COVID Defense Louisiana	Exposure notification, Self quarantine information, Privacy protection information
	Michigan Covid Alert	Exposure alert by using Bluetooth Low Energy (BLE)), Exposure notification, Privacy protection information
	COVIDAware Minnesota	Exposure notifications, Exposure alert, Privacy protection information, COVID-19 information, and guidance
	COVID Alert New Jersey	Updates (latest information and statistics related to the COVID-19 pandemic; and survey), Exposure notification, COVID-19 Check-In (symptoms tracker and guidance), Settings, Public health representative contact
	COVID Alert New York	Exposure notification, New York COVID Data, My Health Log, MY COVID Analysis, AppSettings, Health Advisor call-back
	SlowCOVID North Carolina	Exposures (Exposure notifications), Notify Others (Exposure Alert), More Information (Privacy protection information; and COVID-19 information and guidance); How it Works, Stats.
	Care19 Alert North Dakota and Wyoming	Exposures, Notify Others, Affiliates, Info
	COVID Alert Pennsylvania	Updates, COVID-19 Check-In, Exposure Alert, Settings
	COVIDWISE Virginia	Exposures, Notify Others, Virtual Virginia Department Health, Share, Stats

Source: App Store (2021)

In the countries we analyzed, the mobile health solution for COVID-19 has been implemented in line with the increase in mobile device usage during the pandemic (Pandya & Lodha, 2021). In Taiwan, the QR code-based tracking system was connected to the phone provider through Short Message Service to improve connectivity with remote areas without downloading any other app. Egypt Health Passport data integrity could be updated and maintained without an internet connection. Since PeduliLindungi relies on internet connection, even for the "offline check-in" feature, there is a challenge to reach remote areas that cannot afford internet connections.

Japan's COCOA paid special attention to privacy issues, where no personally identifiable information was collected for contact tracing except for GPS location. COVIDSafe in Australia does not record its user location, and the encrypted information cannot be accessed by anyone, including the user (Australian Government Department of Health, 2021). User personal data in the PeduliLindungi app are stored for purposes that need to be communicated in detail to the public, even though the Minister of Information and Communication promised to delete user data after the pandemic (Wira, 2020).

My Healthy Way app from South Korea is a national-level, fully integrative, and interoperable Personal Health Record project fully supported by the national health system for health information exchange, which can be a goal for further developments of the PeduliLindungi App (Lee et al., 2021). Likewise, the MorChana app and Digital Health Pass in Thailand declared that the collected data would help the Ministry of Public Health of Thailand to assess the vaccine effectiveness and adverse event, which could also be followed by PeduliLindungi (Morchana, 2021).

According to Table. 2.3, most of U.S. Exposure Notification apps have at least four features so far (Exposure Notification, Exposure Alert, Privacy Protection Information, and How it Works). Information regarding the privacy protection information and how the system works are improvements that can be added to PeduliLindungi app updates since it's highly important to educate society regarding

their private information and digital literacy of COVID-19-related technology (Rothstein, 2020; Martinez-Alcalá et al., 2021).

D. Conclusion

From our findings, we conclude that mobile health solutions, as one example of DHI, have been well implemented in all the countries we searched so far, where the features in PeduliLindungi app as Indonesia's solution can be comparable with the existing solutions from other countries, and also the developers can adopting what has not yet adopted in the current version to fill the existing gaps to meet the implementation in its ideal condition. Even better, improving it's features for the untapped users in Indonesia. In all the countries we analyzed, digital health intervention was taken to foster the recovery from the pandemic and improve their countries' digital health initiatives. We believe the key to bouncing back post-pandemic by implementing digital health transformation is to stick with Global Strategy on Digital Health 2020–2024, in line with Strategy Transformasi Kesehatan Digital 2024. Engaging academic and researchers, public, private, and social sectors, and civil society is an unreplaceable element to foster the bounce back from the pandemic and accomplish all digital health transformation goals before 2024. Future steps may include mapping current DHIs and evaluating their impact, increasing collaboration with other stakeholders, and disseminating the use of DHI to the general public. It is crucial to keep improving existing solutions while improving infrastructure and building new solutions to reach even the unreachable population in Indonesia and to recover together, recover stronger.

E. Future Directions and Recommendations

As we mentioned in our findings where DHI example, mobile health solutions, has been implemented across the globe, including Indonesia with its PeduliLindungi app. Although the PeduliLindungi app is comparable with the other solutions, it's still needed some improvement. We strongly suggest that the Global Strategy on Digital Health

2020–2024 from WHO, and the blueprint Strategy Transformasi Kesehatan Digital 2024 from the Ministry of Health Indonesia, are several references that need to be considered improving for what's next, as it would also fill the gap for what hasn't been done or need to be done. As mobile health is just one example, the blueprint Strategy Transformasi Kesehatan Digital 2024 addresses larger DHI examples.

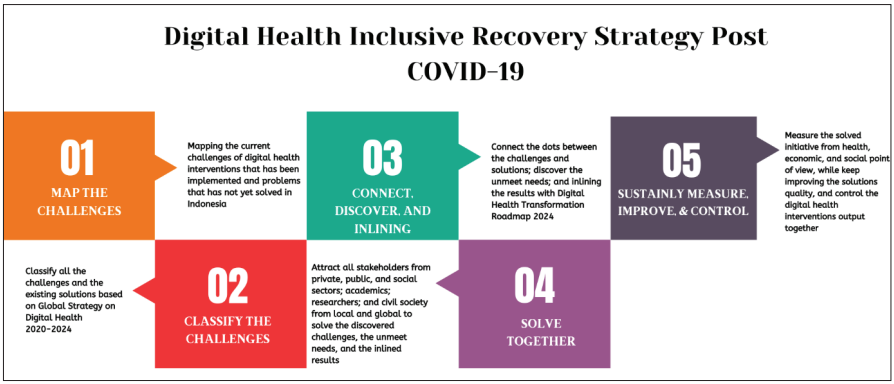
Previously, under the leadership of Minister of Health, Budi G. Sadikin, Strategi Transformasi Digital Kesehatan 2024's blueprint was made with support from United Nations Development Programme (UNDP) and Japan Government. As a result, more than 400 digital health application was developed by the country-level and local-level government. Three priority agendas on the blueprint cover the following: 1) widening telemedicine and implementing a regulatory sandbox for biotechnology-based innovation; 2) architecture design of integrated EHR, health system interopabilities, security, and infrastructure; and 3) ecosystem assessment and trials health regulatory sandbox.

Meanwhile, according to Sumarsono (2020), fast broadband is required to connect healthcare practitioners and professionals with patients and their families via e-health infrastructure. Information fragmentation, lack of accessibility, disaggregation, and inequities in health care are present issues, but a solid health information system can bring answers. The Ministry of Health's initiatives can significantly impact by promoting and encouraging the adoption of national telehealth programs to boost national health plans. This process will be substantially accelerated by collaboration between health education and research institutions (or rather, all relevant government agencies), integration of research and teaching institutions in sophisticated academic networks, and academic-government-business alliances.

To accomplish this, the strategy should emphasize e-health components such as the electronic medical record (or electronic clinical history), telehealth (including telemedicine), mHealth (or health services delivered via mobile devices), e-learning (including training or distance education), ICT continuing education, and standardiza-

tion and interoperability between various software and application technologies. WHO has formulated a Global Digital Strategy on Digital Health to promote global collaboration and knowledge transfer in digital health. In the future, digital health governance must be strengthened at all levels, and its application must remain people-centered. This is a potential roadmap on how digital initiatives should be mapped in Indonesia (UNDP, 2021). Most importantly, integrating the current Digital Health Transformation Roadmap with WHO's Digital Strategy on Digital Health under the current digital health solution for combating COVID-19 will help researchers, innovators, policymakers, and stakeholders in every sector to prepare better for the upcoming health challenges and quickly recover from the current pandemic. We also propose several recovery strategies for helping Indonesia bounce back from the pandemic from the point of view of digital health (Figure 2.2), which consist of the following:

1) Mapping the current challenges of digital health interventions that have been implemented and problems that have not yet been solved in Indonesia.
2) Classify all the challenges and the existing solutions based on Global Strategy on Digital Health 2020–2024.
3) Connect the dots between the challenges and solutions; discover the unmet needs; and inlining the results with Digital Health Transformation Roadmap 2024
4) Attract all stakeholders from private, public, and social sectors; academics; researchers; and civil society from local and global to solve the discovered challenges, the unmet needs, and the inlined results
5) Measure the solved initiative from a health, economic, and social point of view while keep improving the quality of the solution and controlling the digital health interventions output together



Source: Authors

Figure 2.2 Digital Health Inclusive Recovery Strategy Post COVID-19

Following examples from Indonesia and the rest of the world, and considering Indonesia's current digital health landscape and possibilities for the future, Sumarsono (2020) proposes some recommendations:

1) National institutions (governments, universities, NGOs, and the private sector) and international organizations must strengthen and expand distance communication media to collect data from operational units, manage and implement the national health plan, and assess and recommend procedures.
2) National institutions (governments, universities, NGOs, and the private sector) and international organizations need to participate in advanced academic networks to gather data on formal and practical knowledge growth, suggest processes within the topic network, and help health managers, researchers, professors, residents, students, and professionals to be integrated into the networks.
3) National Telemedicine Programs should foster distant learning, collaborate on research, organize remote assistance, and monitor and assess their implementation and success.

4) Universities, teaching hospitals, and public and private research centers should share various models, progress, proposals, and projects with the Ministry of Health for the evaluation and consolidation of the academic-government-enterprise consortium, as well as their alignment with the government's priority theme areas (Sumarsono, 2020).

For specific stakeholders, we also recommend that academics and researchers map and evaluate the current DHI that help tackle the pandemic in Indonesia based on the Digital Health Transformation Roadmap 2024, in line with the WHO Digital Strategy on Digital Health 2020–2024; to keep providing recommendations and suggestions on Indonesia's recovering journey from the pandemic from the point of view of digital health intervention through international collaborations and to help educate civil society about the existing digital health intervention for combating COVID-19 in Indonesia along with the Digital Health Transformation Roadmap 2024 and WHO Digital Strategy on Digital Health 2020–2024.

For private sectors, we encourage to take the opportunity to collaborate with other stakeholders based on the Digital Health Transformation Roadmap 2024 that in line with the WHO Digital Strategy on Digital Health 2020–2024; and to provide additional solutions for the existing and not yet existing solutions of COVID-19 related digital health intervention in Indonesia.

For the public sector, we recommend evaluating the current COVID-19 related digital health intervention, along with Digital Health Transformation Roadmap 2024, and disseminating to disseminate in public any challenges and progress on Digital Health Transformation Roadmap 2024.

For the social sector, we encourage to look for the impact of existing COVID-19 digital health intervention in Indonesia on nonprofit sectors; and to take the opportunity to collaborate with other stakeholders based on Digital Health Transformation Roadmap 2024 together with WHO Digital Strategy on Digital Health 2020–2024.

For civil society, we recommend to support all stakeholders in the Digital Health Transformation Roadmap 2024; and to keep aware of, report, and evaluate any COVID-19 related digital health intervention from other stakeholders.

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