



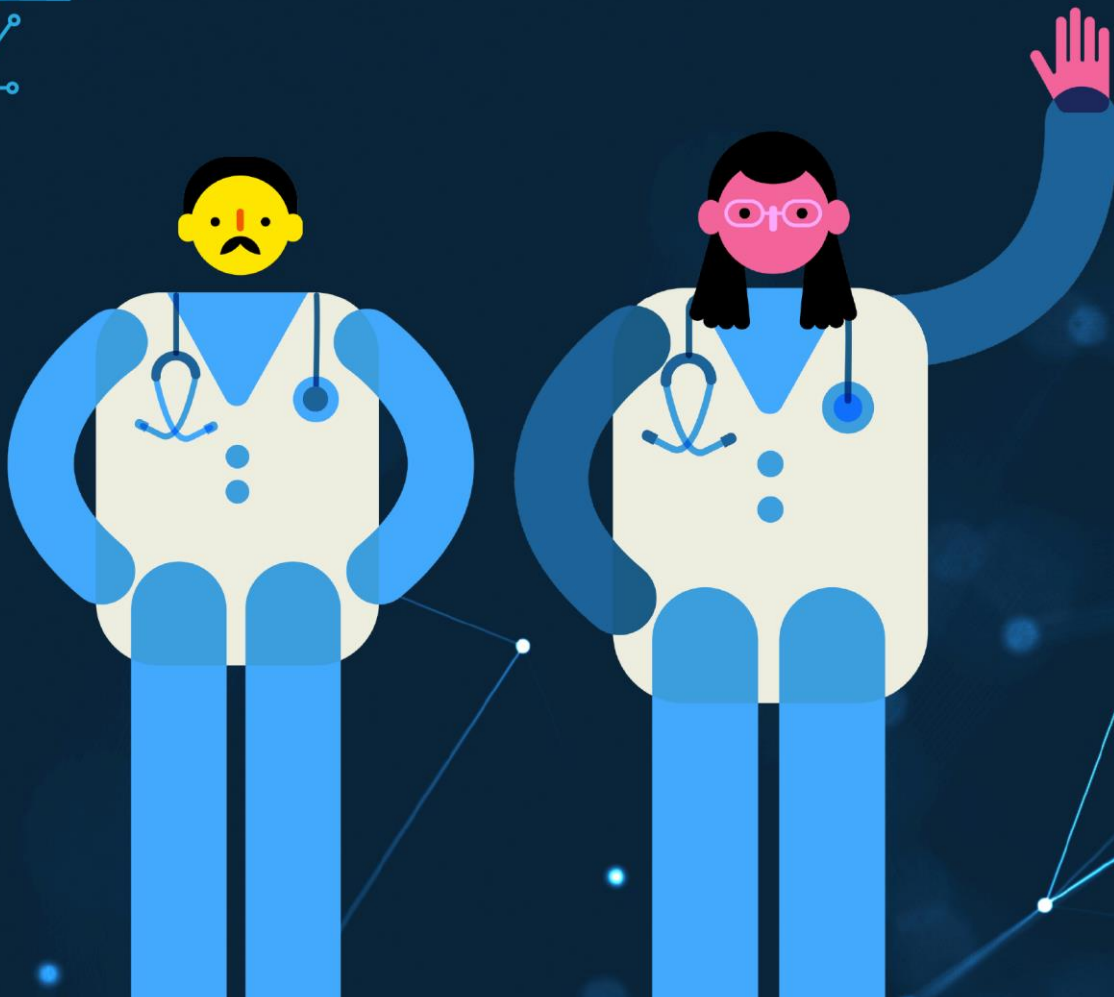
HEALTH INFORMATICS
RESEARCH CLUSTER
FAKULTAS KESEHATAN MASYARAKAT



**Transform
Health
INDONESIA**



ANALYSIS OF DIGITAL HEALTH READINESS OF PRIMARY HEALTH CARE IN INDONESIA



2023

HIRC FKM UI RESEARCH TEAM

Prof. Dr. Kemal N. Siregar (FKM UI)

Dr. Martya Rahmaniati M. (FKM UI)

Dr. Artha Prabawa (FKM UI)

Dr. Dewi Nirmala Sari (Health Polytechnic Jakarta 3)

Dr. Delmaifanis (Health Polytechnic Jakarta 3)

Dr. Rikawarastuti (Health Polytechnic Jakarta 3)

Bangga Agung Satrya, M.K.M. (FKM UI)

Nayaka Nayottama Pamadi, S.K.M. (FKM UI)

Nurul Fadhilah, M.Si. (FKM UI)

Wayan Wahyu Apriliantika, S.K.M (FKM UI)

ACKNOWLEDGEMENT

We extend our sincere gratitude to the dedicated team at Transform Health Indonesia and the Health Informatic Research Cluster (HIRC), guided by the invaluable expertise of Transform Health Global, for their unwavering commitment to advancing digital health transformation in Puskesmas across Indonesia. This report stands as a reflection of the collaborative efforts of esteemed individuals whose expertise and dedication have propelled this initiative forward.

We express our deepest appreciation to Prof. Dr. Kemal N. Siregar, Dr. Martya Rahmaniati M., Dr. Artha Prabawa, Bangga Agung Satrya, M.K.M., Nayaka Nayottama Pamadi, S.K.M., Nurul Fadhilah, M.Si., and Wayan Wahyu Apriliantika, S.K.M. from the Faculty of Public Health (FKM UI) for their invaluable contributions. Additionally, we extend our heartfelt thanks to Dr. Dewi Nirmala Sari, Dr. Delmaifanis, and Dr. Rikawarastuti from the Health Polytechnic of the Ministry of Health Jakarta III and Jakarta I, respectively, for their expertise and collaboration in shaping the trajectory of this endeavour.

Their collective dedication, expertise, and unwavering support have been instrumental in driving progress and fostering positive change in the realm of healthcare systems in Indonesia. We are deeply grateful for their contributions and partnership in this transformative journey.

About Transform Health

Transform Health is a global coalition of organisations, individuals and institutions committed to achieving universal health coverage through the use of digital technologies and data. To learn more about Transform Health visit www.transformhealthcoalition.org.

GLOSSARY

Access – the availability of telecommunication devices and services for use by any member of the household at any time. In its broadest sense, it considers the economic, sociological and psychological factors that influence persons' opportunities to use technologies (gender, race, age, place of residence, etc.).

Connectivity – the various physical means to connect people and machines to the internet or other communication networks. It usually requires either a fixed-line or a wireless solution via a broadband or dial-up service.

Data – information, usually in the form of facts or statistics, that can be analysed and used in decision-making.

Data Application – using data for analysis, decision-making, problem-solving, and process improvement.

Digital health – the field of knowledge and practice associated with the development and use of digital technologies to improve health. Digital health expands the concept of e-health to include digital consumers, with a wider range of smart devices and connected equipment.

Digital literacy – the skills, knowledge and attitudes necessary to successfully use digital solutions and effectively understand and utilise data outputs from such solutions as well as actively participate in the digital information society

Digital technologies – the application of organised knowledge and skills in the form of electronic, mobile and frontier data-driven technologies to solve health issues and improve quality of life. Digital technologies for health care encompass definitions, components and systems included in digital health, e-health, m-health (and related terminology). Some examples include electronic medical records, telemedicine and health management information system.

Digital transformation – the multiple processes of integration of digital technology and data into all areas of everyday life and the resulting changes that they bring.

Information and communication technologies – the set of technologies developed to store, send and receive information from one place to another.

Interoperability – the ability of different applications to access, exchange, integrate and cooperatively use data in a coordinated manner through the use of shared application interfaces and standards, within and across organisational, regional and national boundaries, to provide timely and seamless portability of information and optimise health outcomes.

Personal data – any information that relates to an identified or identifiable living individual.

Primary health care – a whole-of-society approach to health and well-being centred on the needs and preferences of individuals, families and communities. It provides whole person

care for health needs throughout the lifespan, not just for specific diseases, ranging from promotion and prevention to treatment, rehabilitation and palliative care.

Technical guidelines - are instructions or recommendations for effectively implementing technology, covering areas like software development, cybersecurity, and data management. They ensure efficiency, security, and consistency in technology usage.

Telehealth – the use of mobile and telecommunications to deliver health services outside of traditional health care facilities. Telehealth refers to clinical and remote non-clinical services, including providing training and continued medical education for practitioners.

Telemedicine – a subset of telehealth that refers solely to remote clinical services.

Universal access – reasonable telecommunication access for all persons. It includes universal service for those who can afford individual telephone service and widespread provision of public telephones within a reasonable distance of others

Universal health coverage – all individuals and communities receive the health services they need without suffering financial hardship. It includes the full spectrum of essential, quality health services, from health promotion to prevention, treatment, rehabilitation and palliative care across the life course.

SUMMARY

The future of the healthcare system in the digital era, known as digital health, can create a responsive and sustainable healthcare system. However, there are several challenges in the process of digital healthcare transformation in Indonesia, including issues related to the readiness of healthcare facilities, including community health centres (Puskesmas).

The purpose of this research is to determine the extent of the gaps in the dimensions of organisation, resources, technology, and performance in the digital transformation process taking place in Puskesmas in Indonesia. This research aims to determine the extent of the gaps in organisational, resource, technology and performance dimensions in the digital transformation process in Community Health Centers in Indonesia. The size of this gap is used to see the readiness of community health centres in Indonesia to implement digital transformation. Community health centres' readiness level is vital for the Indonesian government in preparing digital health development plans based on needs and available resources.

The research method was carried out in two stages: a narrative review followed by a purposive analysis to assess the gaps. This research was conducted from December 2022 to August 2023 in North Lampung Regency, Lampung Province, Semarang City, Central Java Province, and Barru Regency, South Sulawesi Province. In each city/regency, three districts with three Puskesmas each were selected, making a total of 27 Puskesmas studied out of more than 10,000 Puskesmas across the country.

A total of 106 informants from 27 Puskesmas in three cities/regencies, namely North Lampung, Semarang City, and Barru Regency, were included in the study. The readiness of digital healthcare, based on resources, technology, organisation, and performance, falls into the category of fairly prepared (5.58 – 19.56)¹ out of a out of a maximum average score of 20. Performance is strongly correlated with digital healthcare readiness ($r=0.800$) and has a positive relationship. Organisation and performance also exhibit a strong positive correlation ($r=0.691$), as do resources and performance ($r=0.684$). Technology in Puskesmas is rated as fairly good, with an average score of 2.7 out of a maximum average score of 5.

¹ This research has adopted the measurement of the standards developed above, referring to Michael Gregg's work in Que-CISA in 2007. In this study, an instrument was developed that includes a set of questions to measure digital readiness supported by the organisation, resources, technology, and performance (Gregg, 2007)

The conclusion is Puskesmas in general are **not yet fully** prepared for digital health implementation.

Given the non-representative nature of our research sample, we analysed 27 Puskesmas out of more than 10,000 units nationwide. Therefore these findings may not represent the overall situation in Indonesia. This highlights a significant gap in our analysis, emphasising the need for a more comprehensive and inclusive approach to scale up this assessment tool.

Currently, Puskesmas is the first level of health care facility for the community and digital health is only implemented in hospitals. The Government of Indonesia is preparing a policy on digital health for Puskesmas, to then be operationalized into guidelines so that Puskesmas can implement digital health in their services. Guidelines are needed for the implementation of digital healthcare transformation tailored to the conditions of Puskesmas. These research findings on readiness and gaps in Puskesmas can aid in the development and tailoring of these guidelines.

Keywords: Gap analysis; Puskesmas; healthcare workers; digital technology; digital health.

TABLE OF CONTENTS

ACKNOWLEDGEMENT	ii
GLOSSARY	iii
SUMMARY.....	iv
TABLE OF CONTENTS.....	vi
INTRODUCTION	1
1.1 BACKGROUND.....	1
1.2 OBJECTIVES.....	2
LITERATURE REVIEW	3
2.1 DIGITAL HEALTH TRANSFORMATION.....	3
2.2 PUSKESMAS.....	5
2.3 GAP ANALYSIS.....	5
2.4 NOVELTY.....	6
RESEARCH METHOD	7
3.1 RESEARCH LOCATION.....	9
3.2 RESEARCH AREA	10
3.3 DATA COLLECTION.....	10
3.4 DATA COLLECTION METHOD	10
3.5 ACTIVITIES.....	11
RESEARCH RESULTS.....	12
4.1 SAMPLE OBTAINED.....	12
4.2 DETERMINATION OF READINESS MEASURE.....	13
4.3 OVERALL DIMENSIONAL READINESS ANALYSIS.....	15
4.3.1 ORGANISATIONAL DIMENSIONS	15
4.3.2 RESOURCE DIMENSIONS.....	16
4.3.3 TECHNOLOGICAL DIMENSIONS.....	16
4.3.4 PERFORMANCE DIMENSIONS.....	17
4.3.5 DIGITAL HEALTH READINESS.....	18
4.4 GENERAL DESCRIPTION OF HEALTH CENTRE READINESS FOR DIGITAL HEALTH TRANSFORMATION.....	19
4.5 OVERVIEW OF EACH DIMENSION.....	21
	vi

CONCLUSION	24
RECOMMENDATIONS	29
5.1 ORGANISATIONAL READINESS AND GAPS IN DIGITAL TRANSFORMATION.....	31
5.2 READINESS AND GAPS BETWEEN RESOURCES AND DIGITAL TRANSFORMATION	31
5.3 READINESS AND GAPS BETWEEN TECHNOLOGY AND DIGITAL TRANSFORMATION	33
5.4 READINESS AND GAPS BETWEEN PERFORMANCE AND DIGITAL TRANSFORMATION	34
NEXT STEP.....	34
REFERENCES	40
APPENDIX	43
1. DIVISION OF RESEARCH PERSONNEL TASKS:.....	43
2. TABLE OF THE PLANNED AND ACTUAL DATA RELATED TO THE SAMPLE IN THE FIELD:	44
2.1 SEMARANG CITY, CENTRAL JAVA PROVINCE	44
2.2 NORTH LAMPUNG REGENCY, LAMPUNG PROVINCE.....	45
2.3 BARRU REGENCY, SOUTH SULAWESI PROVINCE.....	46
3. TABLE OVERVIEW OF DIGITAL HEALTH TRANSFORMATION READINESS BY DIMENSION IN EACH PROVINCE.....	47
4. TABLE OVERVIEW OF DIGITAL HEALTH TRANSFORMATION READINESS BY DIMENSION AT EACH HEALTH CENTRE.....	47
5. BIVARIATE ANALYSIS	53

INTRODUCTION

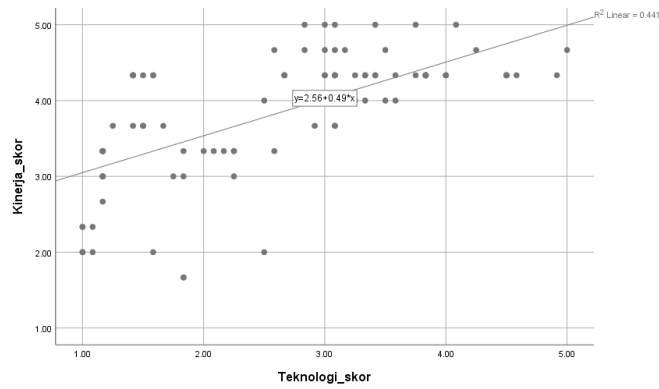
1.1 BACKGROUND

The global COVID-19 pandemic has disrupted all aspects of life, including the economy, society, and healthcare. The rapid development of digital transformation, which has proven highly beneficial in addressing the COVID-19 pandemic, has prompted Indonesia to embark on a national healthcare transformation. Healthcare transformation in Indonesia consists of six pillars, two of which are primary care transformation and digital health transformation (Ministry of Health of the Republic of Indonesia, 2021a).

Digital technology is beneficial for improving the effectiveness, efficiency, and quality of healthcare services. The Ministry of Health of the Republic of Indonesia has launched the One Health Data Application, which includes disease data, healthcare facility data, healthcare human resources data, and funding data. One health data manages healthcare data as big data for future policies. The basic principle of one health data is a unified data and standardised metadata portal. Puskesmas as first-level healthcare facilities, are spread across almost all regions of Indonesia and have begun to enhance their services through the digitization of primary care (Ministry of Health of the Republic of Indonesia, 2021a).

In the context described above, there are several issues that pose challenges in the process of digital healthcare transformation in Indonesia. These challenges include the following ((Wibowo et al., 2020; Nugraha and Aknuranda, 2017; and Sunjaya, 2019 in Tsabita & Sugandi, 2022); Ministry of Health of the Republic of Indonesia, 2021a):

1. Misconceptions, that digital implementation will replace manual work processes. Perceptions like these are particularly prevalent among healthcare service providers in healthcare centres. This results from a lack of digital literacy, especially amongst health workers about the process and benefits of digital health. They think that all work will be replaced by tools or run by IT officers.
2. The readiness of healthcare facilities, including infrastructure availability, related policies, and healthcare personnel competencies, is a critical issue that must be addressed promptly to enable digital transformation in the healthcare sector.



Based on the conditions above, this research aims to conduct a gap analysis to assess the extent to which digital transformation has occurred in the front-line healthcare facilities, namely Puskesmas, within the community.

1.2 OBJECTIVES

The objectives of this research are to determine the extent of the gaps (disparities) between organisation, resources, technology, and performance in the digital transformation of Puskesmas services in Indonesia.

The specific objectives of this research are as follows:

1. Identify the digital healthcare standards for Puskesmas.
2. Identify the factors influencing digital transformation in Puskesmas services based on the dimensions of organisation, resources, technology, and performance.
 - Determine the magnitude of the gap in the organisational dimension.
 - Determine the magnitude of the gap in the resource dimension.
 - Determine the magnitude of the gap in the technology dimension.
 - Determine the magnitude of the gap in the performance dimension.
3. Provide evidence for advocacy. The size of these gaps serves as essential data for improving conditions in each of these dimensions, providing evidence for advocacy for changes in policy and implementation.

LITERATURE REVIEW

2.1 DIGITAL HEALTH TRANSFORMATION

Digital health refers to the use of digital, mobile, and wireless technology to support health objectives. Digital health encompasses the use of Information and Communication Technology (ICT) for health, including mHealth and eHealth (WHO, 2016). The Sustainable Development Agenda 2030 emphasises that the global utilisation of digital technology has significant potential to accelerate human progress. Digital transformation in healthcare can bring about changes such as the use of the Internet of Things, virtual care, remote monitoring, artificial intelligence, big data analytics, blockchain, smart wearables, platforms, and tools that facilitate data exchange and storage, as well as data sharing (WHO, 2021).

According to the World Health Organization (WHO), there are four strategic objectives for global digital health transformation: 1) Promote global collaboration and advance knowledge transfer in digital health, 2) Advance the implementation of national digital health strategies, 3) Strengthen the governance of digital health at the global, regional, and national levels, and 4) Advocate for a community-centred health system enabled by digital health (World Health Organization, 2021). According to the CDC, digital health transformation needs to consider five aspects: technology, knowledge, leadership, access, and collaboration (Centers for Disease Control and Prevention, 2022).

The Ministry of Health of the Republic of Indonesia is currently preparing for digital transformation in the healthcare sector as a long-term strategy to combat COVID-19. This digital transformation strategy focuses on the healthcare ecosystem, service efficiency, and data integration for data-driven policies (Ministry of Health of the Republic of Indonesia, 2021a, 2021c). The Ministry of Health of Indonesia, in collaboration with the United Nations Development Programme (UNDP), has launched the blueprint for the 2021-2024. Health Digital Transformation Strategy. This transformation strategy shifts the focus of healthcare services from reporting to officials to serving the community (Ministry of Health of the Republic of Indonesia, 2021b).

Currently, the Ministry of Health of the Republic of Indonesia is developing the Indonesia Health Services Platform (IHS), which provides data connectivity, analysis, and services to support and integrate various healthcare applications in Indonesia. Digital Health Transformation in Indonesia focuses on three priority activities: 1) Integration and development of health data systems, 2) Integration

and development of healthcare service application systems, and 3) Development of the healthcare technology ecosystem (Ministry of Health of the Republic of Indonesia, 2021a).

Indonesia has demonstrated the crucial role of technology in supporting and accelerating the response to the COVID-19 pandemic. The growth of the digital health ecosystem provides optimism for Indonesia to address the pandemic and epidemics, particularly COVID-19 (Ministry of Health of the Republic of Indonesia, 2021a). The Head of the Communication and Information Department of East Java Province emphasised that "digital literacy is currently needed, and the speed of information technology has not yet balanced with human resources' capabilities. Building technology is easier than building the people. Therefore, there must be an acceleration in developing human resources to keep pace with technological advancements" (Ministry of Communication and Information of the Republic of Indonesia, 2022).

The Director General of Resources and Equipment for Post and Informatics at the Ministry of Communication and Information stressed, "There are many important things in preparing for the digital transformation era, and I would like to emphasise the need to prepare for this agenda. But the most important and urgent thing is human resource competence," and encouraged the preparation of highly competent human resources to embrace the digital transformation era (Ministry of Communication and Information of the Republic of Indonesia, 2021). The proportion of Internet users in Indonesia, according to the Association of Indonesian Internet Service Providers (2017), shows the largest percentage, 91%, among those aged 15-19, who fall into the category of digital natives. Digital natives are those who were born in the digital era. However, the majority of healthcare service providers in Indonesia belong to the millennial generation and below, where digital technology development is still limited. This is undoubtedly one of the predisposing factors for the occurrence of a digital literacy gap among healthcare professionals themselves (Association of Indonesian Internet Service Providers, 2017, as cited in Tsabita.R., and Sugandi M.S., 2021).

The utilisation of digital technology in various aspects of life, including healthcare, is currently tending to be concentrated in major cities on the island of Java. This is primarily due to the better network infrastructure available in these areas. Some cities such as Jakarta, Bandung, and Surabaya have high contributions to Internet users in Java (Association of Indonesian Internet Service Providers, 2017, as cited in Tsabita.R. and Sugandi M.S., 2021).

The implementation of digital health requires collaboration between health industry players. Therefore, there is a need to develop a digital health technology ecosystem to ensure that digital health technology relies on human resources

who actively participate, not passive technology users.

2.2 PUSKESMAS

Puskesmas are primary healthcare facilities that emphasise promotive and preventive efforts within their operational areas (Minister of Health Regulation No. 45 of 2019). Each district must have at least one Puskesmas, but the establishment of more than one Puskesmas in a district can be done considering service needs, population size, and accessibility. The Blueprint of the Digital Health Transformation Strategy published by the Digital Transformation Office of the Indonesian Ministry of Health, identifies one of the issues facing Puskesmas and other healthcare facilities as the fragmentation of data due to the variety of information systems, data banks, and different data quality standards. The report also mentions that to date, more than four hundred health applications have been developed by central and regional governments. Another hindrance is the continued manual input of data (Onofrei et al., 2021).

Furthermore, the report explains that the digital transformation process is also limited by inadequate regulations regarding digital data, such as data storage, protection, and healthcare data standardisation. Interoperability is highly needed to integrate all information systems into a single application. Health policies should also be based on comprehensive data, and their implementation is still not effectively enforced. on-standardised data quality can lead to poor decision-making, reputational damage, and limited opportunities for analysis (Government Data Quality Hub, 2021; Onofrei et al., 2021).

2.3 GAP ANALYSIS

The first step in building this digital health technology ecosystem is to understand the resource gaps in the current digitalization of health services, especially the resources available at community health centres and primary health facilities with the broadest coverage in various regions of Indonesia. Puskesmas also emphasises promotive and preventive service efforts that involve the active participation of the community and health workers.

This study aims to reveal gaps in digital transformation in Puskesmas services based on the dimensions of organisation, resources, technology, and performance, in order to reveal areas that can be improved in each dimension to achieve universal health outcomes so that public health status improves. Interviews with key stakeholders during the literature review helped to inform

the development of the assessment, based on the major gaps cited.

Surdi Sudiana's, the Head of Resources at the Health Office in Sumedang District provided the following interpretation of the readiness of the Sumedang District Health Office in facing digital health transformation is as follows (Sudiana, 2022). This is the result of a literature review. Sumedang is one of the regions that can illustrate the situation of regional readiness in digital health transformation.

- 1) Human Resources:** IT professionals are especially limited in healthcare institutions. Most of the workforce has specialised healthcare competencies, such as doctors, midwives, nurses, and public health professionals. There is still a shortage of healthcare competent professionals in some regions of Indonesia. Human resources, especially healthcare providers, face significant challenges, including a change in mindset, not just a change in equipment or infrastructure for service delivery.
- 2) Budgetary Support:** The implementation of digital health transformation needs adequate funding to meet the requirements for the procurement and maintenance of infrastructure, competency training, and more. This poses a significant challenge for most Puskesmas.
- 3) Infrastructure Availability:** The availability of infrastructure and facilities is crucial and must be met by healthcare service institutions for the implementation of health digitization.
- 4) Regulation:** Regulations are essential guidelines in the implementation of health digitization to ensure standardised practices.

2.4 NOVELTY

The novelty of this research lies in obtaining an overview of the gaps in digital transformation in Puskesmas services based on the dimensions of organisation, resources, technology, and performance, with the desired expectation of supporting the implementation of Puskesmas through digital technology utilisation.

RESEARCH METHOD

To achieve the research objectives, two phases of activities are carried out as outlined below.

Phase One: Narrative Review.

The purpose of this phase is to identify the digital health standards for Puskesmas and the factors influencing digital transformation in Puskesmas services based on the dimensions of organisation, resources, technology, and performance.

The steps involved in this phase are based on the guidelines for writing a narrative review and are as follows (Gasparyan et al., 2011; Green et al., 2006):

1. Topic selection, scoping, and building the narrative review title. This step is done with input from experienced colleagues and experts.
2. Defining objectives, importance, and novelty.
3. Literature search through library catalogues and databases using keywords. The keywords used include: Gap analysis; healthcare professionals; digital technology; primary care; and Growth Pole. Scientific journals used are open access and available in both Indonesian and English.
4. Data synthesis.
5. Drawing conclusions and establishing evidence-based points related to gap analysis.

Phase Two: Gap Analysis

The purpose of the second phase is to determine the extent of the gaps in the dimensions of organisation, resources, technology, and performance in the digital transformation of Puskesmas.

The steps involved in this phase are as follows:

1. Establishment of digital health standards for Puskesmas.
2. Development of research instruments.
3. Data collection and presentation in quantitative and qualitative formats.
4. Data analysis.
5. Preparation of recommendations.

According to the WHO, the implementation of digital health in primary health care requires at least seven functioning components. These components include (a) leadership and governance, (b) strategy and investment, (c) services and applications, (d) infrastructure, (e) standards and interoperability, (f) legislation, policy, and compliance, and (g) workforce (World Health Organization, 2012). These seven components are crucial as a standard, and all of them are accommodated in this research.

The focus of these components is on the input and process of the system being studied. This research complements the output component of the system, which concerns the system's performance. In fact, the performance component is already indicated in the leadership and governance aspect of the WHO framework mentioned above, which states that the functioning of these components results in digital health performance, reporting, monitoring, and evaluation. The components examined in this research are organised comprehensively, covering the input, process, and output of a system. This research adds a performance dimension, resulting in four dimensions: (a) organisation, (b) resources, (c) technology, and (d) performance. Thus, the standards built in this research encompass all four dimensions, along with the factors and all variables derived from these four dimensions.

Tabel 5.1 shows the functional relationship between the implementation of digital health in primary health care according to WHO and the assessment of digital health readiness in Puskesmas in this research.

WHO		Penelitian Ini (2023)
Leadership and governance		Organizational Dimension
Strategy and investment		
Services and applications		Resource Dimension
Infrastructure		
Standards and interoperability		Technology Dimension
Legislation, policy, and compliance		
Workforce		Performance Dimension

This research has adopted the measurement of the standards developed above, referring to Michael Gregg's work in Que-CISA in 2007. In this study, an instrument was developed that includes a set of questions to measure digital readiness supported by the organisation, resources, technology, and performance (Gregg, 2007). The developed instrument covers measurements of the seven components mentioned by WHO above.

The questionnaire was developed using the Que CISA (Questionnaire for Certified Information System Accredited) standards. Apart from that, the policy regarding the application of digital technology in Indonesia is also a consideration. Each question item is modified to explore and collect data and information regarding PKM's readiness to implement digital health. After the questionnaire was compiled, it was tested randomly on approximately 25 respondents to see its validity and reliability as a measuring tool for the research object. The trial results were carried out using the Cronbach Alpha test, which helps obtain question items that have appropriate validity and reliability as a measuring instrument. The feasibility is seen from the Cronbach Alpha coefficient value, which must reach 0.6 and above. So, from the developed questionnaires, questions were deleted because the Cronbach alpha coefficient value was less than 0.6. In this study, testing was carried out using statistical software considering the questionnaire's large number of question items. Question items with a Cronbach Alpha coefficient of less than 0.6 will be deleted automatically.

3.1 RESEARCH LOCATION

The Puskesmas locations are divided into three zones: Full, Medium, and Poor in terms of signal strength. The selection of Puskesmas locations is based on the Theory of Growth Poles (Growth Pole and Central Place) both economically and technologically. Location selection is done using an application to measure the digital signal strength in the chosen areas using the SPEEDTEST CLI application supported by Ookla. The median speed set by Ookla in Indonesia in SPEEDTEST is as follows (influenced by the provider). The following is a reference for internet speed based on speedtest.net:

No	Provider	Speed (Mbps)
1	Telkomsel	30,49
2	IM3	25,68
3	XL	23,93
4	3	15,52

3.2 RESEARCH AREA

Based on the above study, the proposed research area is as follows:

No	Province	City/District/ Regency	Total Sub-district	Total Puskesmas Per Sub-district	Total Puskesmas
1	Lampung	North Lampung	3	3	9
2	Central Java	Semarang	3	3	9
3	South Sulawesi	Barru	3	3	9
		Total			9

In each region, a Contact Person will be designated to act as the regional coordinator responsible for coordinating research activities with the local Health Department both administratively and operationally. They will also coordinate the data collection and information gathering team in their respective areas. The selection of regions may result in an overestimate if the selection is made in areas that are already growth hubs, such as Jakarta, Bandung, and Surabaya.

3.3 DATA COLLECTION

The total number of informants is 108 individuals, consisting of:

1. Head of Health Centers
2. Administrative Staff
3. Doctors/Midwives/Nurses
4. IT Staff

3.4 DATA COLLECTION METHOD

Data collection is carried out primarily by enumerators who have received training on questionnaires. Enumerators come from the research area to avoid miscommunication due to regional language limitations.

Data collection is carried out using the following methods:

1. Conducting surveys by filling out questionnaires.
2. Conducting In-Depth Interviews with informants.

3. Performing observations using checklists and multimedia tools.

The questionnaire types will be divided into four dimensions: organisation, resources, technology, and performance. The types of questions used will be both closed-ended and open-ended.

3.5 ACTIVITIES

No	Activities	Date
1	Research contract	December 2022
2	Inception report	January 2023
3	Narrative review	January 2023
4	Review by THI (The Health Institute)	January 2023
5	Instrument development	January 2023
6	Ethical review	January 2023
9	Research location permits	February 2023
10	Enumerator training	March 2023
11	Data collection	March– April 2023
12	Progress report	April 2023
13	Data analysis	April – May 2023
14	Preparation of the final report	May – June 2023
15	Manuscript preparation	June – July 2023
16	Submission of the final report to THI	July 2023
17	Review of the report by THI	August 2023
18	Finalisation of the final report	August 2023
19	Manuscript submission	March 2024

RESEARCH RESULTS

4.1 SAMPLE OBTAINED

The sample obtained was nearly 100% of what was planned. This research obtained sample data from three locations in three provinces: Semarang City in Central Java Province, North Lampung in Lampung Province, and Barru in South Sulawesi Province, covering a total of 20 sub-districts and 36 Puskesmas. Out of the planned 108 informants, which included Heads of Health Centers, Administrative Staff, Doctors/Midwives/Nurses, and IT Staff, data were successfully collected from 106 informants. This was because there was seven Health Centers that did not have IT staff, namely Puskesmas Kalibalangan (North Lampung), Puskesmas Ralla (Barru), Puskesmas Pujananting (Barru), Puskesmas Pallaka (Barru), Puskesmas Mangkoso (Barru), Puskesmas Madello (Barru), and Puskesmas Bojo Baru (Barru). The data were obtained through in-depth interviews with informants and observations to complete the instruments that had been prepared beforehand.

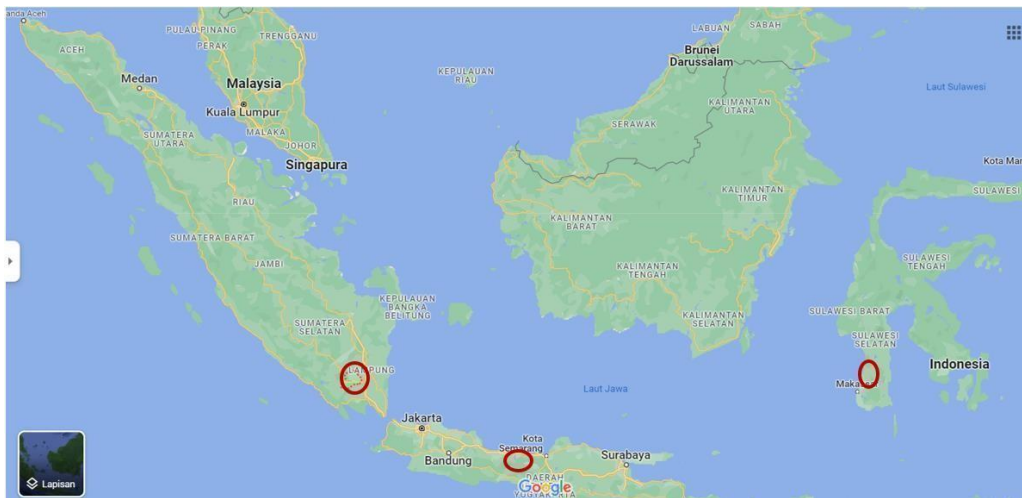


Figure 3. 1 Map of the three cities/districts where the samples were taken

4.2 DETERMINATION OF READINESS MEASURE

Puskesmas readiness is measured using a Digital Health transformation readiness measurement instrument, which consists of 4 dimensions (organisation, resources, technological, and performance dimensions) with 27 variables. The following is a table of these dimensions

Dimensions			
Organisation	Resources	Technological	Performance
<p>Availability Factors Policy regarding the implementation of digital health from the Indonesian Health Service for Puskesmas Technical and Implementation Instructions SOP for Digital Health Unit' operations The SOP has been tested. Guidelines or references in the SOP creating process.</p> <p>Support Factors Socialisation² from the Indonesian health service regarding the implementation of Digital Health in Puskesmas Structure of digital health units/teams/sections at each level Decree³ for the digital health unit Training to prepare for the implementation of Digital Health at PKM</p>	<p>Human resource Factors Human Resource in the Digital Health Unit The Digital Health Unit has a person in charge Digital Health unit staff workload distribution Digital Health Unit performance Officer' Culture: a) Officer culture at the health centre b) Work ethic of officers at the health centre c) Habits of health centre staff d) Openness of health centre staff towards digital implementation at the health centre</p> <p>Facilities and infrastructure Factors Rooms that meet the needs of digital health units The electricity requirements used are appropriate Adequate computer network Adequate internet network Maintenance on the computer and Bandwidth</p>	<p>Availability of technology (hardware) Factors Availability of Local Area Network (LAN) computer networks Wide Area Network (WAN) computer network availability The health centre has a server</p> <p>Methods Factors Work structure in the digital health unit Work guidelines (SOPs) in the digital health unit</p> <p>Updates Factors Information technology updates</p> <p>Skills Factors HR with technology, hardware, and software skills in the digital health IT sector Routine and non-routine training</p>	<p>Coverage Factors Coverage of recording and reporting Level of monitoring and evaluation</p> <p>Load Factors Overall unit workload</p>

² Socialisation is the presentation and explanation of information policy makers provide to digital health implementers

³ An official letter of determination by the head of a formal organisation, such as a community health centre, for the appointment or determination of a team so that it can be accounted for.

Dimensions			
Organisation	Resources	Technological	Performance
	<p>Facilities Factors Condition of equipment and work support Updating the software on the computer Software and hardware maintenance</p> <p>Funding Factors Operational funds for the digital Health unit Sources of funding</p>	<p>Puskesmas representatives who take part in routine and non-routine training Sources of funding for routine and non-routine training</p> <p>Implementation Factors Outputs or products produced by the Digital Health unit Appropriateness of HR functions and responsibilities in digital health units</p>	

These four dimensions have a total of 27 variables that were asked of respondents. Respondents' answers are in the form of a score of one to five, indicating each variable's readiness. The score value for each respondent was searched for the average score value for each dimension. Then, the Interquartile Range (IQR) is calculated from each dimension to determine readiness. Then, the values Q1, Q2, and Q3 are obtained. Scores obtained from respondents below Q1 are categorised as not ready, scores obtained between Q1 and Q3 are categorised as less ready, and scores obtained from respondents who are more than Q3 are categorised as very prepared.

4.3 OVERALL DIMENSIONAL READINESS ANALYSIS

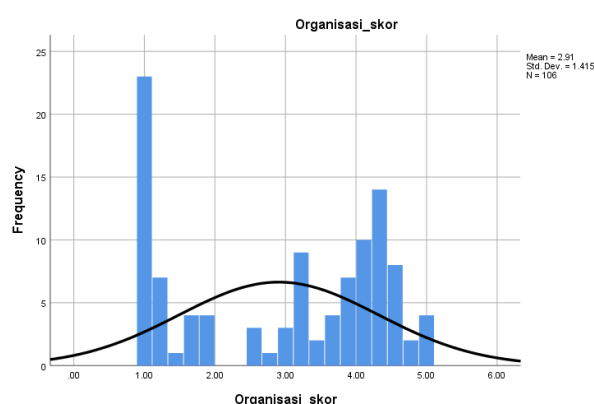
4.3.1 ORGANISATIONAL DIMENSIONS

The following is an overall readiness assessment for the organisational dimension, which is built from the sum of the variable scores for each respondent and then the value obtained is divided by 9. The value obtained is the organisational dimension readiness of a respondent. The results of the organisational assessment are divided into three categories, namely:

1. A score of <1.19 is in the not ready category
2. A score of 1.19 – 4.22 is in the less ready category
3. A score of >4.22 is in the very ready category

Variable	n	Mean	Median	Mode	Std. deviation	IQR	Min-Max	Readiness Assessment
Organisation	106	2.90	3.17	1	1.41	3.03	1-5	Less good

Gap Analysis: The organisation at the Puskesmas is in the Less ready category with an average score of 2.90 out of a maximum average score of 5. There are still quite a lot of gaps that exist.



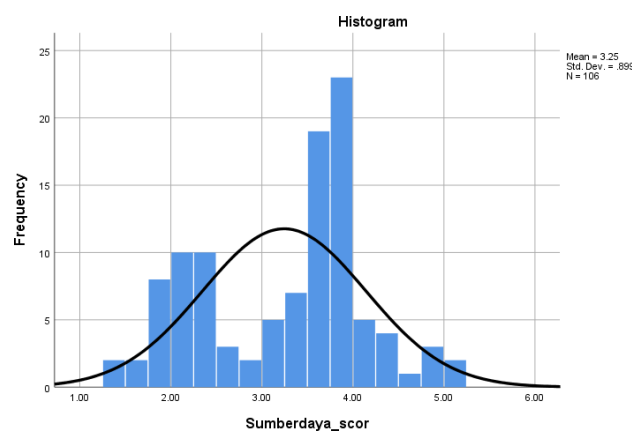
4.3.2 RESOURCE DIMENSIONS

The following is an overall readiness assessment for the resource dimension which is built from the sum of the variable scores for each respondent and then the value obtained is divided by 16. The value obtained is the readiness of the resource dimension of a respondent. The results of the resource assessment are divided into three categories, namely:

1. A score of <2.36 is in the not ready category
2. A score of $2.36 - 3.85$ is in the less ready category
3. A score of >3.85 is in the very ready category

Variable	n	Mean	Median	Mode	Std. deviation	IQR	Min-Max	Readiness Assessment
Resource	106	3.24	3.57	3.85	0.89	1.49	1.25 – 5	Less good

Gap Analysis: Resources at the Puskesmas are in the less ready category with an average score of 3.24 out of a maximum average score of 5. There are still quite a lot of gaps that exist.



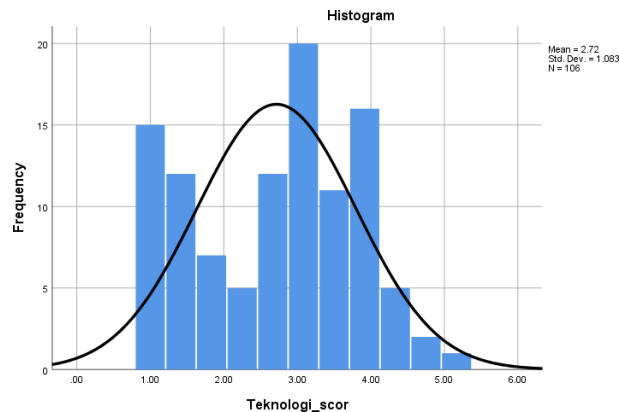
4.3.3 TECHNOLOGICAL DIMENSIONS

The following is an overall readiness assessment for the technology dimension which is built from the sum of the variable scores for each respondent and then the value obtained is divided by 12. The value obtained is the readiness of the resource dimension of a respondent. The results of the technology assessment are divided into three categories, namely:

1. A score of <1.58 is in the not ready category
2. A score of $1.58 - 3.52$ is in the less ready category
3. A score of >3.52 is in the very ready category

Variable	n	Mean	Median	Mode	Std. deviation	IQR	Min-Max	Readiness Assessment
Technology	106	2.7	2.96	3.83	1.08	1.94	1 – 5	Less good

Gap Analysis: Technology at the Puskesmas is in the less good category with an average score of 2.7 out of a maximum average score of 5. There are still quite a lot of gaps that exist.



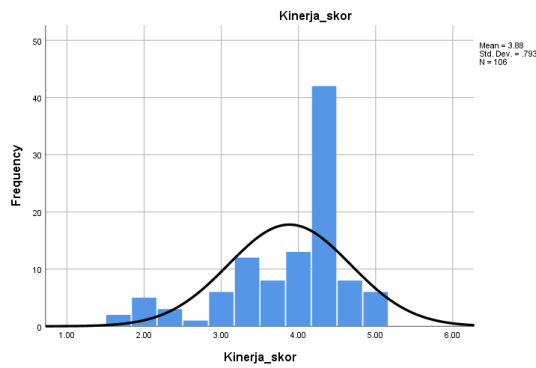
4.3.4 PERFORMANCE DIMENSIONS

The following is an overall readiness assessment for the technology dimension which is built from the sum of the variable scores for each respondent and then the value obtained is divided by 3. The value obtained is the readiness of the resource dimension of a respondent. The results of the performance assessment are divided into three categories, namely:

1. A score of <3.33 is in the not ready category
2. A score of 3.33 – 4.33 is in the less ready category
3. A score of >4.33 is in the very ready category

Variable	n	Mean	Median	Mode	Std. deviation	IQR	Min-Max	Readiness Assessment
Performance	106	3.88	4.3	4.3	0.79	1.00	1.67 - 5	Less good

Gap Analysis: Performance at the Puskesmas is in the less ready category with an average score of 3.88 out of a maximum average score of 5. There are still quite a lot of gaps that exist.



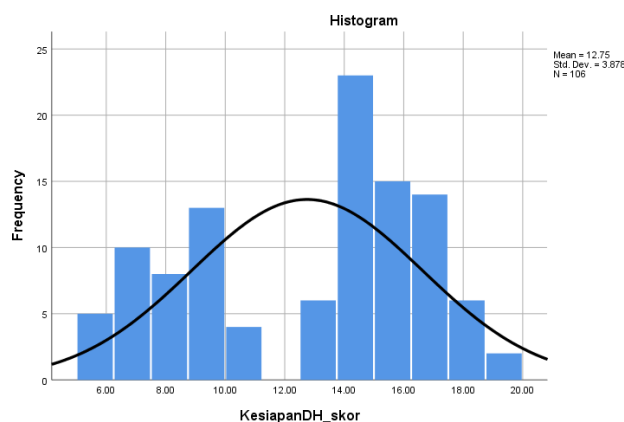
4.3.5 DIGITAL HEALTH READINESS

In this section an attempt is made to summarise to obtain a digital readiness value resulting from the sum of the scores from each dimension. Digital health readiness is built from the sum of organisational values, resources, technology and performance. The results of the digital health readiness assessment are divided into three categories, namely:

1. A score of <8.92 falls into the not ready category
2. Scores 8.92 – 16.17 are in the less ready category
3. A score of >16.17 is in the very ready category

Variable	n	Mean	Median	Mode	Std. deviation	IQR	Min-Max	Readiness Assessment
Digital Health Readiness	106	12.75	14,15	16.35	3.88	7.25	5.58 –19.56	Less Ready

Gap Analysis: Digital Health Readiness at Puskesmas is in the less ready category with an average score of 12.75 out of a maximum average score of 20. There are still quite a lot of gaps that exist.



4.4 GENERAL DESCRIPTION OF HEALTH CENTRE READINESS FOR DIGITAL HEALTH TRANSFORMATION

This research provides a general overview of digital health readiness of Puskesmas based on the collected samples, which were obtained through purposive sampling.

The results of this research are also in line with research data conducted by other organisations, such as APKESMI and Pusdatin.

Since the samples were not randomly selected, the conclusions drawn from this study cannot be generalised to the broader population in Indonesia. While the conclusions are specific to the sampled Puskesmas, the results of this research can be used to inform advocacy to the Indonesian government in implementing digital health transformation. The results of this research can be used by the government, especially in the provinces of Lampung, Central Java, and South Sulawesi.

The table below outlines digital health readiness in Puskesmas according to readiness categories:

Table Frequency Distribution of Each Dimension and Digital Health Readiness among Respondents

Dimensions	Category			n	Category
	Not ready at all	Not ready yet	Ready		
Organisation	26 (24.5%)	55 (51.9%)	25 (23.6%)	106 (100%)	
Resources	26 (24.5%)	59 (55.7%)	21 (19.8%)	106 (100%)	

Dimensions	Category			n	Category
	Not ready at all	Not ready yet	Ready		
Technology	24 (22.6%)	56 (52.8%)	26 (24.5%)	106 (100%)	<p>Tekno_Kat</p> <p>Mean = 2.02 Std. Dev. = .69 N = 106</p>
Performance	17 (16.0%)	75 (70.8%)	14 (13.2%)	106 (100%)	<p>Kin_Kat</p> <p>Mean = 1.97 Std. Dev. = .543 N = 106</p>
Digital Health Readiness	26 (24.5%)	56 (52.8%)	24 (22.6%)	106 (100%)	<p>DH_Kat</p> <p>Mean = 1.98 Std. Dev. = .69 N = 106</p>

We can see that eight (29.6%) Puskesmas are not ready at all in relation to their readiness for digital health.

The four dimensions show that, on average, roughly 50-60% of Puksemas sampled scored as “not ready yet” on the organisation, resources, technology and performance dimensions, and half scored as “not ready yet” overall (48%). Roughly one-quarter (22%) of facilities sampled scored as ready overall. Overall, while there are substantial improvements to be made, the majority of facilities sampled are on track for digital health transformation to be implemented.

Overall, there is still substantial room for improvement, over the majority of facilities sampled (> 50%) are on the right track.

Table Frequency Distribution Table of Each Dimension and Digital Health Readiness at Puskesmas

Dimensions	Category			n
	Not Good	Fairly Good	Very Good	
Organisational	7 (25.9%)	13 (48.2%)	7 (25.9%)	27 (100%)
Resources	8 (29.6%)	15 (55.6%)	4 (14.8%)	27 (100%)
Technology	8 (29.6%)	13 (48.2%)	6 (22.2%)	27 (100%)
Performance	7 (25.9%)	16 (59.3%)	4 (14.8%)	27 (100%)
Digital health readiness	8 (29.6%)	13 (48.2%)	6 (22.2%)	27 (100%)

It can be concluded that there are 13 health centres whose organisational dimensions are not ready yet, 15 health centres whose resources dimensions are not ready yet, 13 health centres whose technology is not ready yet, and 16 health centres whose performance are not ready yet.

In conclusion, 13 health centres are not ready yet in terms of organisational dimensions, 15 health centres are not ready yet in terms of resources, 13 health centres are not ready yet in terms of technology, and 16 health centres are not ready yet in terms of performance.

This shows that digital health readiness is quite ready to be implemented.

4.5 OVERVIEW OF EACH DIMENSION

The general description of Puskesmas' digital health readiness can be further detailed based on dimensions, namely, organisation, resources, technology and performance. Then these dimensions are further detailed based on the factors and variables of each factor. The readiness value of each variable ranges from a score of 1 to 5, where a score of 1 is not good and a score of 5 is very good. The value of readiness for each variable can be shown and displayed by blue blocks. The gaps can immediately be displayed with red blocks for each variable. The following is a table of Puskesmas' digital health readiness based on dimensions, factors and variables.

Figure 4.2 Puskesmas Digital Health Readiness based on Dimensions, Factors and Variables

No	Variable	Category		
		Not Good	Fairly Good	Very Good
ORGANISATION DIMENSION				
AVAILABILITY FACTOR				
1	Policy on the implementation of Digital Health from the Health Office for PKM		V	
2	Technical Guidelines and Implementation Guidelines		V	
3	SOPs for Digital health unit operations		V	
4	SOPs that have been made have been tested		V	
5	Guidelines or references in making SOPs		V	
SUPPORT FACTOR				
1	Socialization from the health office regarding the implementation of Digital Health in PKM		V	
2	Digital health unit/team/section structure at each level		V	
3	Decree for digital health unit		V	
4	Training to prepare for Digital Health implementation in PKM		V	
RESOURCES DIMENSION				
HUMAN RESOURCES DIMENSION				
1	Human Resource in Digital Health unit		V	
2	The Digital Health Unit has a person in charge		V	
3	Digital Health unit staff workload distribution		V	
4	Digital Health unit performance		V	
5	Officer culture		V	
	Officer culture at the health center		V	
	Work ethic of officers at the health center		V	
	Habits of health center staff		V	
	Openness of health center staff towards digital implementation at the health center			V
INFRASTRUCTURE FACTOR				
1	Rooms that meet the needs of digital health units		V	
2	The electricity needs used are appropriate			V
3	Computer network			V
4	Internet network			V
5	Maintenance on computers and Bandwidth	V		

Advanced Community Health Center Digital Health Readiness based on Dimensions, Factors and Variables

FACILITY FACTOR				
1	Condition of equipment and work support			V
2	Updating the software on the computer		V	
3	Software and hardware maintenance		V	
FINANCIAL FACTOR				
1	Operational funds for digital health units	V		
2	Funding source		V	
TECHNOLOGY DIMENSION				
AVAILABILITY FACTOR				
1	Local Area Network (LAN) computer network		V	
2	Wide Area Network (WAN) computer network		V	
3	The health center has a server		V	
METHOD FACTOR				
1	Work structure in the digital health unit		V	
2	Work guidelines in the digital health unit		V	
UPDATE FACTOR				
1	Information technology update			V
SKILL FACTOR				
1	Human resources with technology, hardware and software skills in the field of digital health IT		V	
2	Routine and non-routine training		V	
3	Puskesmas representatives who participated in routine and non-routine training		V	
4	Sources of funding for routine and non-routine training		V	
IMPLEMENTATION FACTOR				
1	Outputs and/or products produced by the digital health unit		V	
2	Appropriateness of HR functions and responsibilities in digital health units		V	
PERFORMANCE DIMENSION				
COVERAGE FACTOR				
1	Coverage of recording and reporting		V	
2	Monitoring and evaluation level		V	
LOAD FACTOR				
1	Overall unit workload		V	
INFORMATION				
	READINESS			
	GAP			

From the table above, the level of gap that can be seen per dimension is visualised, where financial factors and expertise have pretty significant gaps compared to infrastructure factors.

CONCLUSION

Overall, Puskesmas appears to be reasonably prepared for the implementation of digital health, although this conclusion may not represent the entire condition in Indonesia since the research sample is not yet representative. Despite being prepared enough, there are still many gaps that need to be addressed to meet the standard for digital health in Puskesmas.

Digital Health Standards for Puskesmas

Gaps are identified based on assessment results that fall below the standards. It is considered to meet the Puskesmas digital health standard of "very good"⁴ if the assessment results are within the following "standard scores" range. "Fairly good" falls below this range

Very Good: This category is achieved when the assessment results fall within the "standard scores" range for a particular dimension. For example, if the standard score range is 4.2 to 5, an average score within this range would be considered "very good."

Fairly Good: This category applies to scores that fall below the "standard scores" range but are still relatively close to it. For instance, if the standard score range is 4.2 to 5, any score below 4.2, but still reasonably close, would be considered "fairly good."

Average: This category applies to scores that fall below 3.5 to 5. For instance, if the standard score range is 3.5 to 5, any score below 5, but within the range 3.5 to 5 would be considered "average."

Poor: This category applies to scores that fall below 0 to 3.5. For instance, if the standard score range is 0 to 3.5, any score below 3.5, but within the range 0 to 3.5 would be considered "poor."

⁴ The standards are primarily based on WHO guidelines and Michael Gregg's Que-CISA in 2007, providing detailed variables and scores to measure readiness and digital transformation gaps in Puskesmas. The criteria for assessing the readiness for digital health implementation include the following dimensions: Organisation, Resources, Technology, and Performance.

The assessment results for the readiness factors for the implementation of digital health in Puskesmas are as follows:

Dimensions	Average score	Standard scores	Category
Organisation	2.9	4.2 - 5	Poor
Resources	3.24	3.8 - 5	Average
Technology	2.7	3.5 - 5	Poor
Performance	3.88	4.4 - 5	Average

This is explained in detail below.

Organisational Factors in Puskesmas Service Digital Transformation

The organisational dimension has a very strong and positive relationship with digital health readiness, representing 92% of the factors influencing digital health readiness in Puskesmas. In the organisational dimension, organisational factors still have some gaps and have not fully met the standards recommended. However, based on the current assessment, it has been found that on average, Puskesmas already has a strong organisational foundation for digital transformation implementation. The current conditions of organisational factors are as follows:

A. Policies and guidelines are available

- a. Policies on the implementation of digital health by the Health Office for Puskesmas are rated as fairly good.
- b. Technical Instructions and Implementation Guidelines are rated as quite good.
- c. Standard Operating Procedures (SOP) for the operation of the Digital Health unit are rated as fairly good.
- d. SOPs that have been created have been tested, and they are rated as fairly good.
- e. There are guidelines or references for creating SOPs, which are rated as fairly good.

B. Support for the implementation of digital health

- a. Socialisation related to the implementation of Digital Health in Puskesmas by the Health Office is rated as fairly good.
- b. The structure of the digital health unit/team/section at each level is rated as fairly good.
- c. There is a decree (SK) for the digital health unit, rated as fairly good.

- d. Training for preparing the implementation of Digital Health in Puskesmas is rated as fairly good.

Resource Factors in Puskesmas Service Digital Transformation

Resources have a very strong and positive relationship with digital health readiness, representing 90.9% of the factors influencing digital health readiness in Puskesmas. In the resource dimension, resource factors still have some gaps and have not fully met the standards.

However, based on the current assessment, it has been found that on average, Puskesmas already has a strong resource foundation for digital transformation implementation. The current conditions of resource factors are as follows:

A. Human Resources

- a. Human resources in the Digital Health unit are rated as fairly good.
- b. The person in charge is rated as fairly good.
- c. Workload distribution is rated as fairly good.
- d. The performance of the Digital Health unit is rated as quite good.
- e. Staff Culture:
 - a) The staff culture at Puskesmas falls under the category of fairly good.
 - b) The work ethic of the staff at Puskesmas is categorised as fairly good.
 - c) The habits of the staff fall under the category of fairly good.
 - d) The reception of the staff is categorised as very good.

B. Infrastructure and Facilities

- a. Rooms suitable for the needs of the Digital Health unit are rated as fairly good.
- b. Adequate electricity supply is rated as very good.
- c. Adequate computer networks are rated as very good.
- d. Adequate internet networks are rated as very good.
- e. The maintenance of computers and bandwidth is rated as not good.

C. Facilities

- a. The condition of equipment and supporting work tools is rated as very good.
- b. Software updates are rated as fairly good.

- c. Software and hardware maintenance is rated as fairly good.

D. Funding

- a. Operational funds for the Digital Health unit are rated as not good.
- b. Sources of funding are rated as fairly good.

Factors of Technology in the Digital Transformation of Puskesmas Services

Technology has a very strong and positive relationship with digital health readiness, representing 90.3% of the factors influencing digital health readiness in Puskesmas. In the technology dimension, technological factors still have some gaps and have not fully met the standards. However, based on the current assessment, it has been found that on average, Puskesmas already has a strong technological foundation for digital transformation implementation. The current conditions of technology factors are as follows:

A. Availability

- a. The availability of Local Area Network (LAN) computer networks is rated as fairly good.
- b. The availability of Wide Area Network (WAN) computer networks is rated as fairly good.
- c. Puskesmas servers are rated as fairly good.

B. Method

- a. Work structure is rated as fairly good.
- b. Work guidelines are rated as fairly good.

C. Update

- a. Information technology updates are rated as very good.

D. Skills

- a. Human resources with technology skills, both hardware and software in the field of digital health IT, are rated as fairly good.
- b. Regular and non-regular training is rated as fairly good.
- c. Representatives from Puskesmas attending regular and non-regular training are rated as fairly good.
- d. Funding sources for regular and non-regular training are rated as fairly

good.

E. Implementation

- a. Outputs or products produced by the Digital Health unit are rated as fairly good.
- b. The suitability of the functions and responsibilities of human resources is rated as fairly good.

Factors of Performance in the Digital Transformation of Puskesmas Services

Performance has a very strong and positive relationship with digital health readiness, representing 64.1% of the factors influencing digital health readiness in Puskesmas. In the performance dimension, performance factors still have some gaps and have not fully met the standards. However, based on the current assessment, it has been found that on average, Puskesmas already has a strong performance foundation for digital transformation implementation. The current conditions of performance factors are as follows:

F. Coverage

- a. Recording and reporting coverage is rated as fairly good.
- b. Monitoring and evaluation levels are rated as fairly good.

G. Workload

- a. The workload of the unit as a whole is rated as fairly good.

RECOMMENDATIONS

Observing the research results, there are several findings in community health centres; it is necessary to implement digital health transformation in community health centres according to the field conditions found.

Ensuring that Puskesmas is fully prepared for the implementation of digital health transformation, the following detailed recommendations are provided based on the gaps identified in the factors according to the dimensions of Digital Health readiness:

Organisation Dimension

While SOPs and policies for digital health are in place, they may not have been fully socialised with the Puskesmas and teams at health facilities may not be aware of digital health guidelines and SOPs as such the coalition should look into.

- a. Conduct at least 3 or more SOP trials and evaluations to ensure that the SOPs are sufficient and complete in their content.
- b. Conduct awareness and socialisation campaigns by the health department regarding the implementation of Digital Health in Puskesmas to ensure optimal implementation.
- c. Optimise the establishment of Digital Health unit/team/section structures at each level.
- d. Issue written decrees or decisions (SK) for the Digital Health unit for optimal implementation.
- e. Provide training for the preparation of Digital Health implementation in Puskesmas, attended by all staff.

Resource Dimension

Only 22.6% of CHCs assessed were ready to implement digital health--with a further 56% as nearly ready and with 30% of facilities not ready at all. The Government can leverage the strong National Digital Health Strategy already in place to allocate dedicated budget lines to the digital infrastructure upgrades, maintenance, hardware, software, connectivity, and workforce needed to make use of digital tools. The national strategy should also form the basis of donor support--holding donors accountable to align their funding to the resource gaps identified.

The assessment found that PHC facilities often lacked human and financial resources, and infrastructure (including maintenance), and a dedicated space for the workflow needed to support digital health implementation. Ensure adequate resources, personnel, funding, and infrastructure maintenance are in place before rolling out additional digital health pilots or novel technologies.

- a. Ensure that there are at least 2 or more qualified staff members in the Digital Health unit.
- b. Appoint a written responsible person for the Digital Health unit who can work effectively.
- c. Ensure that all staff members have a culture that aligns with digital transformation, including discipline, openness, dedication, willingness to learn continuously, and a strong work ethic.
- d. Ensure that all staff members are open to technological changes and are ready to support and learn with the introduction of digitalization/new methods.
- e. Provide a dedicated room for the Digital Health unit with adequate electrical supply.
- f. Conduct regular maintenance for hardware and bandwidth, at least once every 1 or 2 weeks.
- g. Update software at least every 6 months.
- h. Allocate operational funds according to the needs of the Digital Health unit.
- i. Ensure that there are at least 2 or more definite sources of funding.

Technology Dimension

Our research finds that, on average, Puskesmas already has a strong technological foundation for digital transformation implementation. In order to improve upon this strong foundation, Puksemas should be supported to:

- a. Ensure that LAN, WAN, and server networks are functional, utilised, and operating optimally.
- b. Develop and maintain written work structure and guidelines for digital health implementation.
- c. Invest in digital health personnel with relevant IT backgrounds and certifications.
- d. Implement regular training programs, both routine and ad-hoc, that all digital health staff members can attend.
- e. Allocate funds for training as a source of financial support.
- f. Establish regular and structured outputs or products that are produced

annually, monthly, and weekly.

Performance Dimension

- a. Implement digital record-keeping and reporting that meets the Puskesmas SPM target.

5.1 ORGANISATIONAL READINESS AND GAPS IN DIGITAL TRANSFORMATION

The structure of Community Health Centers has evolved, and practitioners are more often involved in collaborative partnerships (Baird et al., 2018). This primarily occurs in developed areas, such as the island of Java. In this research, the existing Community Health Center organisations generally do not contain work units that specifically handle digital health, including those related to human resources, policies (SOPs) and infrastructure, especially community health centres located outside Java. The data shows that the number of health centres that are very prepared and very unprepared is the same, namely 25.9%. The prepared health centres are those in Semarang, while those that still need to be prepared are in Barru district. Meanwhile, the others, namely 48.2%, were not ready yet.

Organisational transformation at Community Health Centers is needed to implement digital health. This organisational restructuring is essential in budget preparation and placement of human resources, especially those with digital competence.

We recommend the development of an internal management system aims to consolidate all existing applications into one efficient and effective unit and make data entry easier to avoid data redundancy (Ministry of Health of the Republic of Indonesia, 2021). The Directorate of Public Health Governance, which oversees the Community Health Center, needs to work together with the DTO and BPJS to improve the organisational structure at the Community Health Center so that it is ready to implement digital health.

5.2 READINESS AND GAPS BETWEEN RESOURCES AND DIGITAL TRANSFORMATION

A. Human resources

Human resource readiness is critical in facing changes and challenges in applying information and communication technology (ICT) in health services at community health centres. HR is not just a number; what is more important is that their knowledge and skills are adequate. HR must also be mentally and

emotionally ready to face changes and new ways of working with technology. They must be open to change and be willing to learn new things. Improving human resources involves both quantity (number and distribution) and quality (level of education and quality (level of education and competency enhancement through training)).

The research results show that more Community Health Centers are not ready (29.6%) compared to those prepared for digital health (14.8%). There are geographic differences in the condition of health centre resource readiness; on Java Island, it is better compared to Lampung and Sulawesi. This illustrates the uneven distribution of health and IT workers in Indonesia, concentrated on the island of Java. We also see better dissemination of information, knowledge, training opportunities, and more opportunities for service providers on the island of Java.

The lack of Community Health Center resources is a crucial issue that requires intensive attention because the primary operational support for digital health necessitates quality, sustainable and competent resources. Based on the results of this research, the provision of resources, including competent human resources, funding and technical coordination, is needed to ensure the widespread implementation of primary health services on a widespread basis.

B. Infrastructure

The implementation of digital health needs to be supported by adequate infrastructure, including a reliable computer network, fast and stable internet access, and hardware and software that support digital health implementation. The space and the electrical requirements must be appropriate.

This research found that the readiness of facilities and infrastructure was still lacking. The least ready aspect was space; only 16% were ready. Similarly, the readiness of electricity, computer networks and internet access was also inadequate. This shows that the majority of community health centres still need to be equipped with adequate facilities and infrastructure to support digital transformation.

C. Facilities

Based on facilities, this research found that the most improvements were updating equipment and maintaining facilities. Equipment at the health centre is available, but it needs to be updated. Additionally, the lack of proper maintenance means this equipment often breaks down and cannot be used.

D. Funds

Significant funds are needed to invest in the initial stages of digital health

implementation. The absence of technical guidance in implementing digital health means that the budget for digital health needs to be better prepared. Moreover, with a regional autonomy system, the regional government needs to pay more attention to preparing the budget for implementing digital health.

According to Law Number 39 of 2009 on Health, health financing aims to achieve sufficient, sustainable, just, effective, efficient, and comprehensive funding while ensuring equal distribution, transparency, and accountability with the primary function of mobilising financing sources, allocating national health budgets, and utilising health budgets (Law of the Republic of Indonesia No. 36 of 2009).

5.3 READINESS AND GAPS BETWEEN TECHNOLOGY AND DIGITAL TRANSFORMATION

This research found that community health centres need adequate ICT infrastructure, human resources that are adequately trained in the use of digital technology, and policies that support digital transformation in health services. So far, only 22.2% of community health centres are fully ready. Therefore, efforts need to be made to increase the readiness of community health centres to adopt digital technology to narrow the gap between technology and digital transformation in health services in Indonesia, especially community health centres.

Community health centres must integrate health information systems to support digital transformation in data and patient management. Health system integration will make things easier for staff and patients, expanding the reach of health services. Community health centres must also have digital medical equipment to diagnose or monitor patients.

The adoption of telemedicine technology can also support community health centres in Indonesia to expand their reach, particularly given Indonesia's diverse geography and inadequate officer-to-community ratio. Information technology-based remote health centres have higher accessibility in areas with limited resources, such as using smartphones to improve the skills of health workers so they can provide 'virtual' nurses or doctors in the form of chatbots or question-and-answer services. Telemedicine has been found to significantly improve prevention and self-care, and mobile telehealth services can connect people with primary care physicians located elsewhere (Anstey Watkins et al., 2018; Jack, 2021).

Implementation can be carried out in stages by involving Community Health Centers according to their readiness, so that they are aware of any significant gaps that could hinder effectiveness and efficiency.

5.4 READINESS AND GAPS BETWEEN PERFORMANCE AND DIGITAL TRANSFORMATION

Performance in this research includes output, the workload for each unit, the scope of monitoring and evaluation, including observation and follow-up. The result obtained was a score of 3.88 (on a scale of 1-5), which means it is quite good, but there are still gaps, and there is considerable variation between health centres. The most significant gap is in workload.

In our research, performance varied according to digital health readiness in community health centres. Community health centres that already have a sound health information system tend to perform better in recording and reporting health data.

One opportunity to reduce the workload is integrating machine learning and Artificial Intelligence into clinical software, decision support tools, and primary care applications to optimise care (Lin, Mahoney, and Sinsky, 2019). Digital health can create opportunities for patients in these conditions to manage their health more affordably by encouraging preventive lifestyle changes, facilitating disease self-management, and reducing direct and indirect costs for clinic visits, travel, or unpaid leave. The integration of recording and reporting will provide quality data and evidence-based information while reducing direct and indirect costs due to a paperless and real-time approach. (Snoswell et al., 2020).

NEXT STEP

To support the government establish national standards for digital health at the primary healthcare level, the coalition analysed the digital health readiness of 27 Primary HealthCare Centres (Puskesmas) across selected states to assess their current levels of preparedness against a set benchmark. The study produced tools to complement the readiness assessment of primary health facilities, including a digital maturity Index. The findings from this study are being used to advocate with the Ministry of Health and guide policy development and standard setting on the digitisation of primary health care units, to ensure gaps are addressed and additional resources are allocated effectively. These findings will be used to support the development of a digitally ready Puskesmas as a means of further testing and improving the standards.

These research findings on readiness and gaps in Puskesmas can aid in the development and tailoring of these guidelines. This research will be translated into implementation in the following ways.

Package and Present the Readiness Assessment:

- **Advocacy for key persons in the Ministry of Health:** Creating a number of advocacy materials including policy briefs based on research findings. These materials will be used to support intensive advocacy from the THI coalition to policy makers and stakeholders through a number of advocacy meetings. Advocacy activities are expected to produce a number of policy recommendations to become material in policy development for policy makers at the Ministry of Health.
- **Leverage existing meetings and forums:** Present the results of the readiness assessment at key MOH meetings, including the Technical Working Group for health and digital transformation.
- **High-level briefings:** Organise formal presentations for high-level officials in the MOH and DTO, highlighting the key findings and recommendations.

Propose Integration into the Blueprint 2025-2029:

- **Align with the Blueprint:** Emphasise how the readiness assessment tool directly supports the goals of the upcoming 2025-2029 MOH "Blueprint for Digital Health Transformation Strategy". Advocate for the formal integration of the tool into national operational guidelines and standards as a mechanism for evaluating and prioritising digital health resource allocation.

Recommend tailored operational guidelines and standards for digital

- **Health at Puskesmas:** Suggest the tool be used to develop targeted guidelines for Puskesmas digital health implementation, focusing on filling the identified gaps in infrastructure, workforce, and operational readiness. Currently, Puskesmas serves as the first level of health care facility for the community with digital health being implemented only in hospitals. The Government of Indonesia is preparing a policy on digital health for Puskesmas, which will be operationalized into guidelines to enable Puskesmas to implement digital health in their services. These guidelines are necessary for the implementation of digital healthcare transformation tailored to the conditions of Puskesmas.
- **Support the Ministry of Health to disseminate the final version of operational guidelines** for implementing standards of digital health at Puskesmas (PHC) completed by May 2026.

Develop a Costed Implementation Roadmap:

- **Secure adequate funding for digital health initiatives (Digital Health Strategy and Investment Plan):** These gaps can help to inform a costed roadmap for digital health investment that supports the Ministry of Health Blueprint 2025-2029 currently under development. There is a need to have a costed roadmap for digital health investment and to be accompanied by a prioritised and sequenced investment roadmap that lays out the different sources of funding, as well as the gaps.
- **Costed roadmap:** Once tested and validated, Transform Health Indonesia and partners, including the Department of Digital Transformation in the Ministry of Health, will calculate the set up and running costs of SMART Puskesmas and work with the government to integrate this into the national and then District budgets for deployment.
- **Budget advocacy:** Present a clear case for the required financial investments to close the gaps identified (e.g., infrastructure, human resources, internet connectivity) and ensure these are reflected in the national and district health budgets.

Pilot and Scale the SMART Puskesmas Model:

- **Test and validate the SMART Puskesmas:** Share preliminary findings from the SMART Puskesmas model with MOH, and recommend scaling up successful elements based on evidence from pilot testing.
- **Integrate into MOH digital transformation agenda:** Advocate for the model's inclusion in future government health strategies and budgets, demonstrating its scalability and potential impact.

Secure MOH Support for Capacity Building and Digital Workforce:

- **Training and development:** Advocate for MOH to initiate national digital health training programs for Puskesmas staff, based on the identified skill gaps, using findings from the readiness assessment to support budget allocation for human resource development. This will complement the work of the Transform Health Coalition to develop a digital health literacy assessment.
- **Create digital health units at Puskesmas:** Urge MOH to formalise the establishment of digital health units at Puskesmas with clear Standard Operating Procedures (SOPs), providing the necessary funding and capacity building.

Adjust Assessment Tool:

- **Continuous operational research:** Recommend conducting periodic reviews and assessments to monitor the implementation of digital health at Puskesmas. Use these insights to refine the national digital health strategy and make ongoing adjustments to the guidelines, policies, and investment plans.

Detailed recommendations identified in the research are included in the **Annex**.

Annex: Key Recommendations for Policy & Advocacy Identified in the Research

Area identified in recommendations section of research report	Specific policy/ legislation do you intend to change or advocate for to support the recommendation	Key Stakeholders	Outcome you hope to achieve
Advocacy for key persons at the Ministry of Health	MOH representatives under the human resource capacity to influence digital health policies	<p>KTKI (Indonesia Health Workforce Council. Whose role is to provide capacity building for the health workforce Approach Parliament to encourage the Ministry of Health to adopt the operational regulation for health law no 17 2023 and PDP (personal data protection) law this translates to the digital health law, Government regulation no 28 of 2024.</p> <p>Leveraging on multiple events on how we can advocate to ensure that the research we have done can be added to the new blue print. This is disseminated through the (DG circulation letter) at the health facility. For Ministry of Home Affairs there is a decentralisation system where resources are under Ministry of</p>	Advocacy for key persons at the Ministry of Health

Area identified in recommendations section of research report	Specific policy/ legislation do you intend to change or advocate for to support the recommendation	Key Stakeholders	Outcome you hope to achieve
		Home Affairs, MOH convenes meetings where multiple ministries are hosted	
Policy Development	Operational regulation by the Minister, there will be a discussion to discuss the draft of the MOH regulation and digital transformation is under health information system and health technology.		Support MOH to develop operational guidelines of the MOH regulations such as Health Information systems and health technology to implement the new blueprint
Further Policy Research	Supporting MOH in further adoption of the laws	Involve Civil society to provide input and feedback for adopting the model Ia and HDG principles	Health data Governance framework adopted at national level. Once adopted at the National level the sub national level will follow.
Linkage to SMART PHC is missing guidance from the MOH is that SMART PHC's is no longer used as a term but instead Integrated Primary Health Services. This is one of the health transformation programs at the primary health services level It is called ILP	Integrated digital health into ILP	DG of Public health this is the leading unit at MOH, DG Health Workforce, DG Health Services, DTO, PUSTADIN, BKPK and Bureau of Planning	Provide recommendations for strengthening the health workforce to support ILP and these recommendations include health worker competency standards for primary health care workers to deliver primary health services supported by digital systems.

REFERENCES

- Anstey Watkins, J.O.T. et al. (2018) 'Mobile phone use among patients and health workers to enhance primary healthcare: A qualitative study in rural South Africa', *Social Science and Medicine*, 198(August 2017), pp. 139–147. Available at: <https://doi.org/10.1016/j.socscimed.2018.01.011>.
- Baird, B. et al. (2018) 'Innovative models of general practice', *The King's Fund*, (June), pp. 1–90. Available at: https://www.kingsfund.org.uk/sites/default/files/2018-06/Innovative_models_GP_summary_Kings_Fund_June_2018.pdf.
- Baum, F., Newman, L. and Biedrzycki, K. (2014) 'Vicious cycles: Digital technologies and determinants of health in Australia', *Health Promotion International*, 29(2), pp. 349–360. Available at: <https://doi.org/10.1093/heapro/das062>.
- Centres for Disease Control and Prevention. (2019). *Public health data modernization initiative: Harnessing the power of data to save lives*. <https://www.cdc.gov/surveillance/pdfs/Data-and-IT-Transformation-IB-508.pdf>
- Centres for Disease Control and Prevention. (2022). *Public health data modernization initiative*. <https://www.cdc.gov/surveillance/data-modernization/index.html>
- Chen, W. (2013) 'The Implications of Social Capital for the Digital Divides in America', *Information Society*, 29(1), pp. 13–25. Available at: <https://doi.org/10.1080/01972243.2012.739265>.
- Data Quality in Healthcare - Benefits, Challenges, and Steps for Improvement - Data Ladder. 2021. Medico Reach. <https://dataladder.com/data-quality-in-healthcare-data-systems/> (July 24, 2023).
- European Center for Disease Prevention and Control. (2021, June). *Digital technologies for key public health functions: Results of an ECDC expert consultation*. <https://www.ecdc.europa.eu/en/publications-data/digital-technologies-key-public-health-functions-results-ecdc-expert-consultation>
- Gasparyan, A. Y., Ayvazyan, L., Blackmore, H., & Kitas, G. D. (2011). Writing a narrative biomedical review: Considerations for authors, peer reviewers, and editors. *Rheumatology International*, 31(11), 1409–1417. <https://doi.org/10.1007/s00296-011-1999-3>
- Government Data Quality hub. (2021). *Hidden costs of poor data quality*.
- Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: Secrets of the trade. *Journal of Chiropractic Medicine*, 5(3), 101–117. [https://doi.org/10.1016/S0899-3467\(07\)60142-6](https://doi.org/10.1016/S0899-3467(07)60142-6)
- Gregg, M. (2007) 'CISA (Certified Information Systems Auditor)', *Professional Ethics* [Preprint]. Hargittai, E. and Hinnant, A. (2008) 'Digital inequality: Differences in young adults' use of the Internet', *Communication Research*, 35(5), pp. 602–621. Available at: <https://doi.org/10.1177/0093650208321782>.

- Ibarrera. 2022. "The Impact of Data Quality Problems in Healthcare." Dataladder. <https://intelligent-ds.com/blog/data-quality-problems-in-healthcare> (July 24, 2023).
- Jack, A. (2021) 'Rwanda venture tests digital health potential in developing world', Financial Times [Preprint]. Available at: <https://www.ft.com/content/4fe33c92-cbd5-459a-8df6-20d0d1f57ec8>.
- Lin, S.Y., Mahoney, M.R. and Sinsky, C.A. (2019) 'Ten Ways Artificial Intelligence Will Transform Primary Care', Journal of General Internal Medicine, 34(8), pp. 1626–1630. Available at: <https://doi.org/10.1007/s11606-019-05035-1>.
- Lupton, D. (2014) 'Critical perspectives on digital health technologies', Sociology Compass, 8(12), pp. 1344–1359. Available at: <https://doi.org/10.1111/soc4.12226>.
- Ministry of Health of the Republic of Indonesia (2021) 'Blueprint for Digital Health Transformation Strategy Indonesia 2024', pp. 1–68. Available at: <https://dto.kemkes.go.id/ENG-Blueprint-for-Digital-Health-Transformation-Strategy-Indonesia-2024.pdf>.
- Ministry of Health of the Republic of Indonesia. (2021a). Blueprint for health digital transformation strategy 2024. Ministry of Health of the Republic of Indonesia.
- Ministry of Health of the Republic of Indonesia. (2021b). Strategi transformasi digital kesehatan 2024 diluncurkan, fokus ke pelayanan kesehatan bukan pelaporan untuk pejabat. <https://sehatnegeriku.kemkes.go.id/baca/rilismedia/20211216/5238996/strategi-transformasi-digital-kesehatan-2024-diluncurkan-fokus-ke-pelayanan-kesehatan-bukan-pelaporan-untuk-pejabat/>
- Ministry of Health of the Republic of Indonesia. (2021c). Transformasi digital bidang kesehatan: Strategi jangka panjang atasi pandemi COVID-19. <https://sehatnegeriku.kemkes.go.id/baca/rilis-media/20211007/4038678/transformasi-digital-bidang-kesehatan-strategi-jangka-panjang-atasi-pandemi-covid-19/>
- Ministry of Communication and Information of the Republic of Indonesia. (2021). Kompetensi SDM kunci keberhasilan transformasi digital. https://www.kominfo.go.id/content/detail/34702/kompetensi-sdm-kunci-keberhasilan-transformasi-digital/0/berita_satker
- Ministry of Communication and Information of the Republic of Indonesia. (2022). Percepatan pengembangan SDM TIK milenial melalui literasi digital. <https://aptika.kominfo.go.id/2022/07/percepatan-pengembangan-sdm-tik-milenial-melalui-literasi-digital/>
- NHS Digital (2021) General Practice Data for Planning and Research (GPDPR) - NHS Digital. Available at: <https://digital.nhs.uk/data-and-information/data-collections-and-data-sets/data-collections/general-practice-data-for-planning-and-research> (Accessed: 17 July 2023).
- Nohl-Deryk P, Brinkmann JK, Gerlach FM, Schreyögg J, Achelrod D. [Barriers to Digitalisation of Healthcare in Germany: A Survey of Experts]. Gesundheitswesen (Bundesverband der Ärzte des Öffentlichen Gesundheitsdienstes (Germany)).

2018 Nov;80(11):939-945. DOI: 10.1055/s-0043-121010. PMID: 29301149.

- Onofrei, M., Vatamanu, A.-F., Vintilă, G., & Cigu, E. (2021). Government Health Expenditure and Public Health Outcomes: A Comparative Study among EU Developing Countries. *International Journal of Environmental Research and Public Health*, 18(20), 10725. <https://doi.org/10.3390/ijerph182010725>
- Snoswell, C.L. et al. (2020) 'Determining if Telehealth Can Reduce Health System Costs: Scoping Review', *Journal of Medical Internet Research*, 22(10). Available at: <https://doi.org/10.2196/17298>.
- Sudiana, S. (2022, February 2). Tantangan digitalisasi pelayanan kesehatan: Keharusan VS kesiapan (interpretasi kondisi di Dinkes Kab.Sumedang. Birokrat Menulis.
- Stoumpos, A. I., Kitsios, F., & Talias, M. A. (2023). Digital Transformation in Healthcare: Technology Acceptance and Its Applications. *International journal of environmental research and public health*, 20(4), 3407. <https://doi.org/10.3390/ijerph20043407>
- Tsabita, R., & Sugandi, M. S. (2022). Analisis Kesenjangan Kepuasan dalam Pemanfaatan Situs Layanan Kesehatan di Indonesia. *Jurnal Ilmu Komunikasi*, 19(3), 321. <https://doi.org/10.31315/jik.v19i3.4228>
- World Health Organization (2012) 'National eHealth Strategy Toolkit'.
- World Health Organization. 2021.Global strategy on digital health 2020-2025. Geneva: Licence: CC BY-NC-SA 3.0 IGO
- World Health Organization. 2016. Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment. World Health Organization. <https://apps.who.int/iris/handle/10665/252183>. License: CC BY-NC-SA 3.0 IGO
- World Health Organization. (2019). WHO guideline recommendations on digital interventions for health system strengthening. World Health Organization.
- World Health Organization. (2021). Global strategy on digital health 2020-2025. World Health Organization

APPENDIX

1. DIVISION OF RESEARCH PERSONNEL TASKS:

Activities	Principal Investigator (PI)	Vice PI	Member Research							
	Prof. Kemal	Martya	Artha	Dewi	Delma	Tuti	Bangga	Nayaka	Nurul	Wayan
Narrative review										
Determination of questions, objectives, criteria, and information sources	√	√	√	√	√	√	√	√	√	√
Literature review				√	√	√	√	√	√	√
Preparation of an inception report		√	√	√	√	√	√	√	√	√
Inception report presentation	√	√		√	√				√	√
Instrument development	√	√	√	√	√	√	√	√	√	√
Enumerator training	√			√	√				√	√
Instrument validity and reliability testing	√	√	√	√	√	√	√	√	√	√
Licensing		√		√	√	√	√	√	√	√
Data collection				√	√				√	√
Gap Analysis	√	√	√	√	√	√	√	√	√	√
Scientific publication	√	√	√	√	√	√	√	√	√	√
Preparation of the final report	√	√	√	√	√	√	√	√	√	√

2. TABLE OF THE PLANNED AND ACTUAL DATA RELATED TO THE SAMPLE IN THE FIELD:

2.1 SEMARANG CITY, CENTRAL JAVA PROVINCE

Name of Puskesmas	Sub-district	Planned Number of Respondents	Actual Number Obtained
Urban Area:	East Semarang	4 individuals	4 individuals
Puskesmas Halmahera	East Semarang	4 individuals	4 individuals
Puskesmas Karang Doro	East Semarang	4 individuals	4 individuals
Puskesmas Bungangan			
Sub-urban Area:	West Semarang	4 individuals	4 individuals
Puskesmas Lebdosari	West Semarang	4 individuals	4 individuals
Puskesmas Manyaran	West Semarang	4 individuals	4 individuals
Puskesmas Ngemplak Simongan			
Rural Area:	Pedurungan	4 individuals	4 individuals
Puskesmas Telogosari Wetan	Genuk	4 individuals	4 individuals
Puskesmas Genuk	Genuk	4 individuals	4 individuals
Puskesmas Banget Ayu			

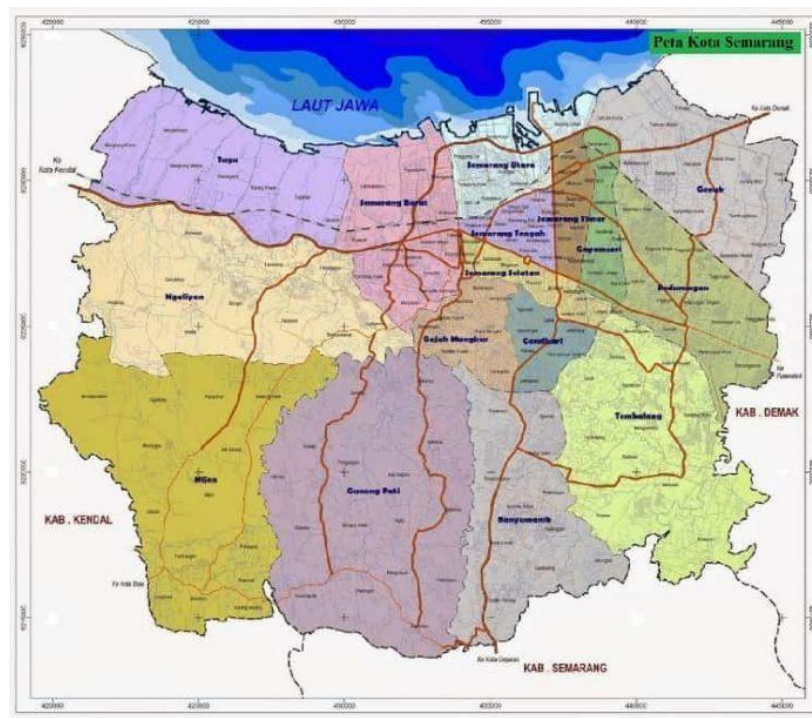


Figure SEQ Figure * ARABIC 2 Map of Semarang City

2.2 NORTH LAMPUNG REGENCY, LAMPUNG PROVINCE

Name of Puskesmas	Sub-district	Planned Number of Respondents	Actual Number Obtained
Puskesmas Kotabumi II (Urban)	South Kotabumi	4 individuals	4 individuals
Puskesmas Kotabumi I (Urban)	Kotabumi	4 individuals	4 individuals
Puskesmas Bukit Kemuning (Rural)	Bukit Kemuning	4 individuals	4 individuals
Puskesmas Ketapang (Sub Urban)	South Sungkai	4 individuals	5 individuals ^a
Puskesmas Madukoro (Sub Urban)	North Kotabumi	4 individuals	7 individuals ^b
Puskesmas Negara Ratu (Rural)	North Sungkai	4 individuals	4 individuals
Puskesmas Pekurun (Rural)	Abung Pekurun	4 individuals	4 individuals
Puskesmas Kalibalangan (Sub Urban)	South Abung	4 individuals	3 individuals ^c
Puskesmas Cempaka (Sub Urban)	Sungkai Jaya	4 individuals	4 individuals

^a Head of Health Center, Regional Coordinator, Administrative Staff, and Nurses (2)

^b Head of Health Center (2), Midwife, Administrative Staff (2), Nurses (2)

^c No IT staff



Figure SEQ Figure 1* ARABIC 2 Map of North Lampung Regency

2.3 BARRU REGENCY, SOUTH SULAWESI PROVINCE

Name of Puskesmas	Sub-district	Planned Number of Respondents	Actual Number Obtained
Puskesmas Lisu (Urban)	Tanete Riaja	4 individuals	4 individuals
Puskesmas Ralla (Urban)	Tanete Riaja	4 individuals	3 individuals ^a
Puskesmas Pujananting (Sub Urban)	Pujananting	4 individuals	3 individuals ^a
Puskesmas Doi-Doi (Sub Urban)	Pujananting	4 individuals	4 individuals
Puskesmas Pekkae (Urban)	Tanete Rilau	4 individuals	5 individuals ^b
Puskesmas Palakka (Urban)	Barru	4 individuals	3 individuals ^a
Puskesmas Mangkoso (Rural)	Soppeng Riaja	4 individuals	3 individuals ^a
Puskesmas Madello (Sub Urban)	Balusu	4 individuals	3 individuals ^a
Puskesmas Bojo Baru (Rural)	Mallusetasi	4 individuals	3 individuals ^a

^a No IT Staff

^b Head of Puskesmas, IT, Administrative Office, Midwives (2)



Figure 3 Map of Barru Regency

3. TABLE OVERVIEW OF DIGITAL HEALTH TRANSFORMATION READINESS BY DIMENSION IN EACH PROVINCE

Region	Dimension	Category			n
		Not Ready	Less Ready	Very Ready	
Semarang City, East Java	Organisation	1 (2.8%)	11 (30.6%)	24 (66.7%)	36
	Resource	3 (8.3%)	18 (50.0%)	15 (41.7%)	36
	Technology	0	12 (33.3%)	24 (66.7%)	36
	Performance	2 (5.6%)	27 (75.0%)	7 (19.4%)	36
	Digital Health Readiness	2 (5.6%)	11 (30.6%)	23 (63.9%)	36
Lampung District, North Lampung	Organisation	1 (2.6%)	37 (94.9%)	1 (2.6%)	39
	Resource	0	33 (84.6%)	6 (15.4%)	39
	Technology	0	37 (94.9%)	2 (5.1%)	39
	Performance	1 (2.6%)	31 (79.5%)	7 (17.9%)	39
	Digital Health Readiness	0	38 (97.4%)	1 (2.6%)	39
Barru District, South Sulawesi	Organisation	24 (77.4%)	7 (22.6%)	0	31
	Resource	23 (74.2%)	8 (25.8%)	0	31
	Technology	24 (77.4%)	7 (22.6%)	0	31
	Performance	14 (45.2%)	17 (54.8%)	0	31
	Digital Health Readiness	24 (77.4%)	7 (22.6%)	0	31

4. TABLE OVERVIEW OF DIGITAL HEALTH TRANSFORMATION READINESS BY DIMENSION AT EACH HEALTH CENTRE

Puskesmas	Dimension	Mean	n	Category
Kota Semarang, Jawa Tengah				
Halmahera	Organisation	4.14	4	Good Enough
	Resource	4.28	4	Good
	Technology	3.67	4	Good
	Performance	4.83	4	Good
	Digital Health Readiness	16.92	4	Good

Puskesmas	Dimension	Mean	n	Category
Karang Doro	Organisation	4.31	4	Good
	Resource	3.85	4	Good Enough
	Technology	3.81	4	Good
	Performance	4.33	4	Good Enough
	Digital Health Readiness	16.31	4	Good
Bugangan	Organisation	4.36	4	Good
	Resource	3.66	4	Good Enough
	Technology	3.39	4	Good Enough
	Performance	4.50	4	Good
	Digital Health Readiness	15.91	4	Good Enough
Lebdosari	Organisation	4.44	4	Good
	Resource	4.79	4	Good
	Technology	4.50	4	Good
	Performance	4.33	4	Good Enough
	Digital Health Readiness	18.06	4	Good
Manyaran	Organisation	4.50	4	Good
	Resource	3.75	4	Good Enough
	Technology	2.83	4	Good Enough
	Performance	4.33	4	Good Enough
	Digital Health Readiness	15.42	4	Good Enough
Ngemplak Simongan	Organisation	4.47	4	Good
	Resource	4.55	4	Good
	Technology	4.69	4	Good
	Performance	4.50	4	Good
	Digital Health Readiness	18.21	4	Good
Telogosari Wetan	Organisation	4.33	4	Good
	Resource	3.85	4	Good Enough
	Technology	3.83	4	Good
	Performance	4.33	4	Good Enough

Puskesmas	Dimension	Mean	n	Category
	Digital Health Readiness	16.35	4	Good
Genuk	Organisation	1.25	4	Good Enough
	Resource	2.18	4	Not Good
	Technology	1.89	4	Good Enough
	Performance	2.58	4	Not Good
	Digital Health Readiness	7.91	4	Good Enough
Banget Ayu	Organisation	4.39	4	Good
	Resource	3.88	4	Good
	Technology	3.87	4	Good
	Performance	4.33	4	Good Enough
	Digital Health Readiness	16.48	4	Good
Kabupaten Lampung, Lampung Utara				
Kotabumi I	Organisation	2.86	4	Good Enough
	Resource	3.61	4	Good Enough
	Technology	3.02	4	Good Enough
	Performance	3.83	4	Good Enough
	Digital Health Readiness	13.33	4	Good Enough
Kotabumi II	Organisation	3.39	4	Good Enough
	Resource	3.57	4	Good Enough
	Technology	2.73	4	Good Enough
	Performance	4.58	4	Good
	Digital Health Readiness	14.27	4	Good Enough
Bukit Kemuning	Organisation	3.71	4	Good Enough
	Resource	3.50	4	Good Enough
	Technology	2.81	4	Good Enough
	Performance	4.25	4	Good Enough
	Digital Health Readiness	14.29	4	Good Enough
Ketapang	Organisation	3.89	5	Good Enough
	Resource	3.64	5	Good Enough
	Technology	2.90	5	Good Enough

Puskesmas	Dimension	Mean	n	Category
	Performance	4.07	5	Good Enough
	Digital Health Readiness	14.50	5	Good Enough
Madukoro	Organisation	2.43	7	Good Enough
	Resource	3.65	7	Good Enough
	Technology	2.84	7	Good Enough
	Performance	3.71	7	Good Enough
	Digital Health Readiness	12.64	7	Good Enough
Negara Ratu	Organisation	3.64	4	Good Enough
	Resource	3.62	4	Good Enough
	Technology	3.08	4	Good Enough
	Performance	4.33	4	Good Enough
	Digital Health Readiness	14.67	4	Good Enough
Pekurun	Organisation	3.28	4	Good Enough
	Resource	3.60	4	Good Enough
	Technology	2.85	4	Good Enough
	Performance	3.91	4	Good Enough
	Digital Health Readiness	13.65	4	Good Enough
Kalibalangan	Organisation	3.63	3	Good Enough
	Resource	3.27	3	Good Enough
	Technology	3.25	3	Good Enough
	Performance	4.33	3	Good Enough
	Digital Health Readiness	14.48	3	Good Enough
Cempaka	Organisation	3.33	4	Good Enough
	Resource	3.45	4	Good Enough
	Technology	3.39	4	Good Enough
	Performance	4.17	4	Good Enough
	Digital Health Readiness	14.34	4	Good Enough
Kabupaten Barru, Sulawesi Selatan				
Lisu	Organisation	1.19	4	Good Enough
	Resource	1.87	4	Not Good

Puskesmas	Dimension	Mean	n	Category
	Technology	1.10	4	Not Good
	Performance	2.67	4	Not Good
	Digital Health Readiness	6.84	4	Not Good
Rala	Organisation	1.04	3	Not Good
	Resource	1.87	3	Not Good
	Technology	1.17	3	Not Good
	Performance	3.22	3	Not Good
	Digital Health Readiness	7.29	3	Not Good
Pujananting	Organisation	1.00	3	Not Good
	Resource	1.83	3	Not Good
	Technology	1.14	3	Not Good
	Performance	3.00	3	Not Good
	Digital Health Readiness	6.96	3	Not Good
Doi-Doi	Organisation	1.11	4	Not Good
	Resource	2.38	4	Good Enough
	Technology	1.31	4	Not Good
	Performance	3.00	4	Not Good
	Digital Health Readiness	7.80	4	Not Good
Pekkai	Organisation	1.18	5	Not Good
	Resource	2.50	5	Good Enough
	Technology	1.70	5	Good Enough
	Performance	3.73	5	Good Enough
	Digital Health Readiness	9.11	5	Good Enough
Palakka	Organisation	1.44	3	Good Enough
	Resource	2.09	3	Not Good
	Technology	1.56	3	Not Good
	Performance	2.88	3	Not Good
	Digital Health Readiness	7.99	3	Not Good
Mangkoso	Organisation	1.15	3	Not Good
	Resource	2.04	3	Not Good

Puskesmas	Dimension	Mean	n	Category
	Technology	1.50	3	Not Good
	Performance	3.89	3	Good Enough
	Digital Health Readiness	8.58	3	Not Good
Madello	Organisation	1.00	3	Not Good
	Resource	2.16	3	Not Good
	Technology	1.41	3	Not Good
	Performance	4.33	3	Good Enough
	Digital Health Readiness	8.91	3	Not Good
Bojo Baru	Organisation	1.00	3	Not Good
	Resource	2.06	3	Not Good
	Technology	1.22	3	Not Good
	Performance	2.11	3	Not Good
	Digital Health Readiness	6.39	3	Not Good

5. BIVARIATE ANALYSIS

In this bivariate analysis, we tried to use a correlation test because both variables are numerical in nature. This correlation test aims to determine the strength and direction of the relationship between variables and the relationship between two variables can have a positive or negative pattern. After carrying out the correlation, a simple linear regression analysis is then carried out to determine the form of the relationship between two or more variables. The coefficient of determination is used to find out how much variation in the dependent variable (Y) can be explained by the independent variable (X).

However, these results cannot be generalised to a wider population, because they only apply to the sample studied. Bearing in mind that this sample was selected purposively and cannot yet represent the wider population.

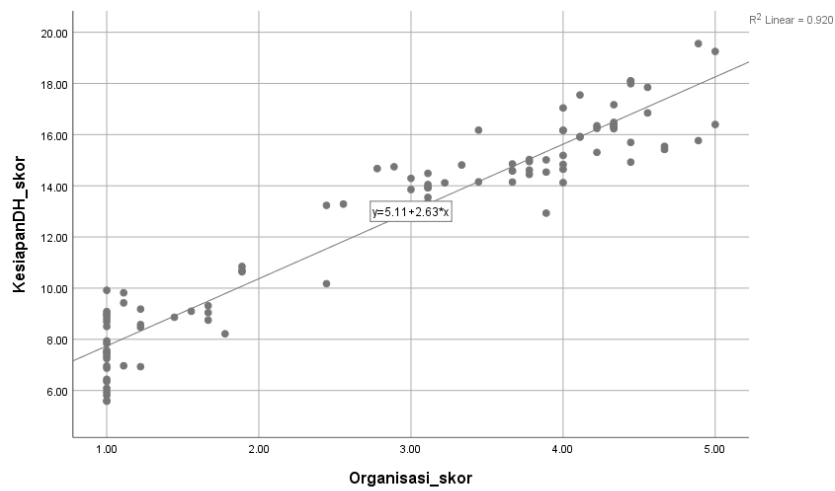
In the bivariate analysis the dependent variable is digital health readiness, and the independent variables are (a) Organisation, (b) Resources, (c) Technology, (d) Performance. Bivariate analysis was also attempted where the dependent variable was performance, and the independent variables were (a) Organisation, (b) Resources, (c) Technology.

Relationship of Independent Variables (Organisation, Resources, Technology, and Performance) with Digital Health Readiness

1. Organisational Relationships to Digital Health Readiness

Dimensions	r	R2	Line Equations	p-value
Organisation	0.938	0.920	Readiness = 5,114 + 2,628*organisation	0.0005

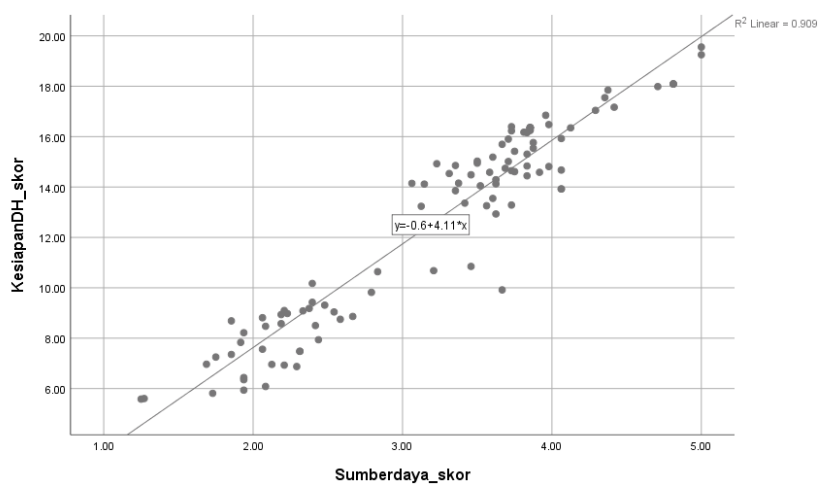
Based on the table above, it was found that the relationship between organisations and digital health readiness shows a very strong relationship ($r=0.938$) and has a positive pattern, meaning that the better the organisation at the Puskesmas, the better prepared the Puskesmas is to implement digital health. The coefficient value with a determinant of 0.920 means that the regression line equation we obtained can explain 92% of the variation in digital health readiness or the line equation obtained is good enough to explain the dimensions of digital health readiness. The statistical test results showed that there was a significant relationship between organisations and digital health readiness ($p=0.0005$).



2. Relationship of Resources to Digital Health Readiness

Dimensions	r	R2	Line Equations	p-value
Resource	0.915	0.909	Readiness = (-0.597) + 4.113*resources	0.0005

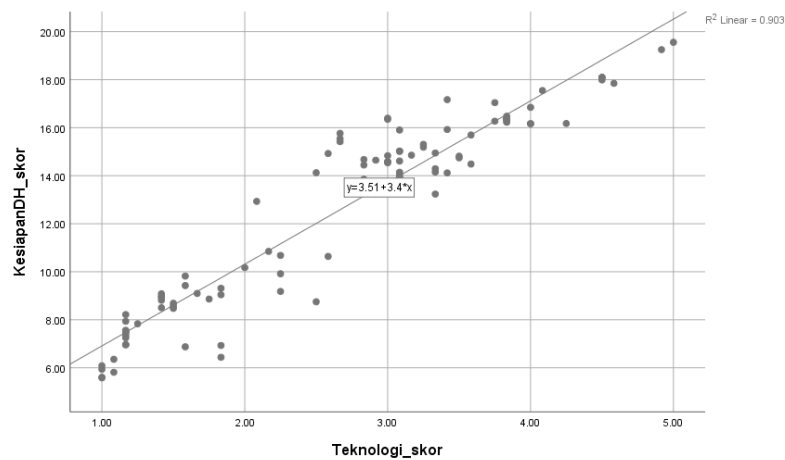
Based on the table above, it was found that the relationship between resources and digital health readiness shows a very strong relationship ($r = 0.915$) and has a positive pattern, meaning that the better the resources at the Puskesmas, the better prepared the Puskesmas is to implement digital health. The coefficient value with a determinant of 0.909 means that the regression line equation we obtained can explain 90.9% of the variation in digital health readiness or the line equation obtained is good enough to explain the dimensions of digital health readiness. The statistical test results showed that there was a significant relationship between resources and digital health readiness ($p = 0.0005$).



3. Technology's Relationship to Digital Health Readiness

Dimensions	r	R2	Line Equations	p-value
Technology	0.924	0.903	Readiness = 3.508 +3.403*technology	0.0005

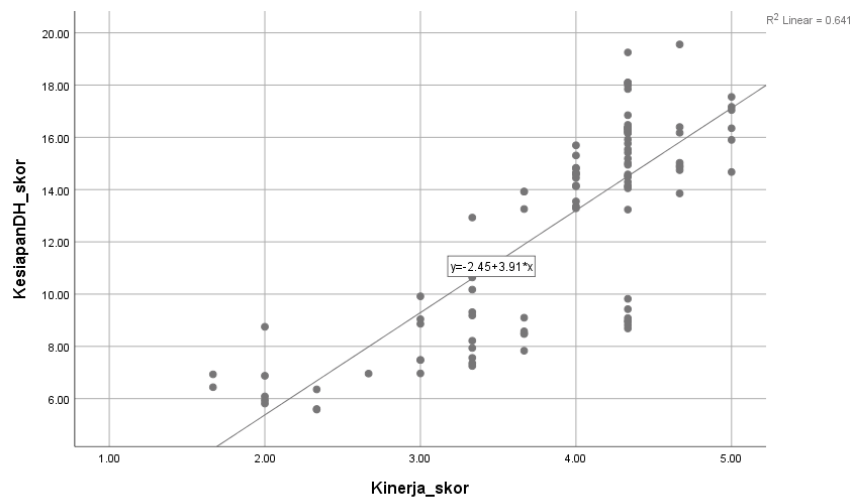
Based on the table above, it was found that the relationship between technology and digital health readiness shows a very strong relationship ($r= 0.924$) and has a positive pattern, meaning that the better the technology at the Puskesmas, the better prepared the Puskesmas is to implement digital health. The coefficient value with a determinant of 0.903 means that the regression line equation that we obtained can explain 90.3% of the variation in digital health readiness or the line equation obtained is good enough to explain the dimensions of digital health readiness. The statistical test results showed that there was a significant relationship between technology and digital health readiness ($p=0.0005$).



4. Relationship between Performance and Digital Health Readiness

Dimensions	r	R2	Line Equations	p-value
Performance	0.776	0.641	Readiness = (-2.453) + 3.915*performance	0.0005

Based on the table above, it was found that the relationship between performance and digital health readiness shows a very strong relationship ($r= 0.776$) and has a positive pattern, meaning that the better the performance at the Puskesmas, the better prepared the Puskesmas is to implement digital health. The coefficient value with a determinant of 0.641 means that the regression line equation we obtained can explain 64.1% of the variation in digital health readiness or the line equation obtained is good enough to explain the dimensions of digital health readiness. The statistical test results showed that there was a significant relationship between performance and digital health readiness ($p=0.0005$).

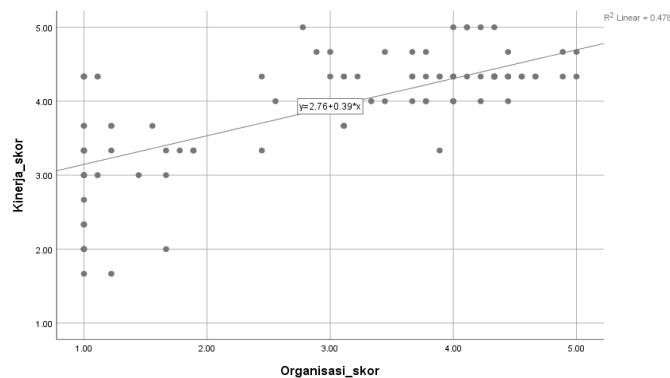


Relationship between Independent Variables (Organisation, Resources, Technology) and Performance

1. Organisational Relationship with Performance

Dimensions	r	R2	Line Equations	p-value
Organisation	0.644	0.478	Performance = 2.759 + 0.387*organisation	0.0005

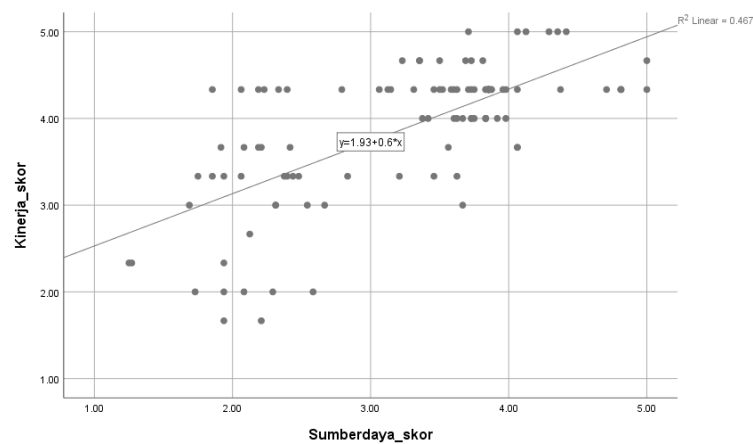
Based on the table above, it was found that the relationship between organisation and performance shows a strong relationship ($r = 0.644$) and has a positive pattern, meaning that the better the organisation at the Puskesmas, the better the performance of the Puskesmas. The coefficient value with a determinant of 0.478 means that the regression line equation that we obtained can explain 47.8% of the variation in performance or that the line equation obtained is good enough to explain the dimensions of performance. The statistical test results showed that there was a significant relationship between organisation and performance ($p = 0.0005$).



2. Relationship between Resources and Performance

Dimensions	r	R2	Line Equations	p-value
Resource	0.614	0.467	Performance = 1.927 + 0.603*resources	0.0005

Based on the table above, it was found that the relationship between resources and performance shows a strong relationship ($r = 0.614$) and has a positive pattern, meaning that the better the resources at the Puskesmas, the better the performance of the Puskesmas. The coefficient value with a determinant of 0.467 means that the regression line equation we obtained can explain 46.7% of the variation in performance or the line equation obtained is good enough to explain the performance dimensions. The statistical test results showed that there was a significant relationship between resources and performance ($p = 0.0005$).



3. The Relationship between Technology and Performance

Dimensions	r	R2	Line Equations	p-value
Technology	0.671	0.441	Performance = 2.564 + 0.486*tech	0.0005

Based on the table above, it was found that the relationship between technology and performance shows a strong relationship ($r = 0.671$) and has a positive pattern, meaning that the better the technology at the Puskesmas, the better the performance of the Puskesmas. The coefficient value with a determinant of 0.441 means that the regression line equation we obtained can explain 44.1% of the variation in performance or the line equation obtained is good enough to explain the performance dimensions. The statistical test results showed that there was a significant relationship between technology and performance ($p = 0.000$).



HEALTH INFORMATICS
RESEARCH CLUSTER
FAKULTAS KESEHATAN MASYARAKAT



**Transform
Health
INDONESIA**