

Digital Divide and Use of Digital Public Health Service

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ABSTRACT

This research examines the digital divide in accessing digital public health services through a survey of 400 adults from Mae Hong Son, Nong Khai, Loei, and Yala provinces in Thailand. Statistical analysis was conducted using SEM. The study reveals a significant gap in accessing digital public health services, despite the widespread use of the internet. The proposed model fits the data well (GFI = 0.902, CFI = 0.943), underscoring the relevance of the issue. Path analysis indicates that usage motivation significantly impacts both the overall digital divide and the health-related digital divide (0.788 and 0.615, $p < .01$), while social motivation also plays a critical role (0.333, $p < .05$). The digital divide itself is a key causal factor for health disparities (0.780, $p < .05$), challenging the notion that internet access alone can ensure equity. Bridging this gap requires ensuring affordable internet access and adapting digital public health services for marginalized groups. Addressing these factors is a key to preventing the digital divide from exacerbating health inequities.

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Background and Significance of the Problem

The Institute of Economics, Rangsit University in Thailand, surveyed the digital life inequality index of Thai people and found continuous improvement from 2013 to 2017, with the score rising from 23.39 to 32.9, due to advancements in computer technology. However, the average digital life inequality score for Thai people remained below half of the maximum score of 100. The report also indicated that two population groups--the elderly and the rural poor--

experienced significant digital life inequalities. Despite having knowledge, both groups lacked the financial means to access or use the internet (Pansri & Chomtohsuwan, 2019). Additionally, primary service units like schools and hospitals have installed internet for organizational use, communication, and online services, reaching 95.17% coverage (Open the 'Digital Index, 2022). While Thai people have gained more access to technology, internet access is just the first step in the digital divide. The next steps involve advanced usage skills that can impact other areas, such as improved health. (Siengcharoen, 2022).

Thailand has used technology to enhance its public health system under the eHealth Strategy,

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aiming to achieve the country's health reform goals: All population sectors are health literate, participate in system planning, have equal access to essential public health services, and live in environments conducive to wellness under a unified health system (Department of Medical Services, 2019). However, implementing this strategy amid Thailand's digital divide may create a 'digital divide in health,' linking digital inequality to access to information and health services in a digital society. Bodie and Dutta (2008) suggested that as public health practitioners use the internet to disseminate health information, disparities in knowledge, understanding, and behavior become more evident. These differences stem from health and internet literacy, affecting access, orientation, and self-efficacy in understanding health information, which influences health behaviors. Health disparity involves inequalities among different groups and areas, such as between urban and rural populations in accessing quality public services and specific population rights, reflecting problematic disparities (Laiprakobsup, 2015; Pinprathee, 2019). It also includes disparities among individuals or groups based on social class, race, status, or residence, impacting access to health care (Wattanapha, n.d.). Therefore, implementing health information and services through digital technology must consider the digital divide, ensuring understanding and application of digital health information for public health benefits, as Nilsen et al. (2020) emphasized the readiness of agencies to use eHealth. Providing services should consider stakeholders at each stage of the implementation process to ensure benefits for municipal health care and end-users.

The digital divide in health is a critical issue that must be studied to address disparities in public health services, ensuring citizens can access state resources. This research aims to explain the digital divide in using digital public health services, focusing on accessing basic health information and services under the health insurance scheme. This knowledge supports the implementation of Thailand's eHealth Strategy.

Research Objectives

This study's aims are twofold:

1. To explore the digital divide in access to information, knowledge, and basic health information under the health insurance scheme, as well as the use of digital public health services among people in areas with digital inequality.
2. To develop a model addressing the digital divide in the use of digital public health services among the population.

Literature Review

This research reviews the literature to develop the conceptual framework as follows:

Concept of Digital Divide

As society transitions into the digital age driven by the development of information and communication technology, the concept of inequality has expanded into a new social context. This context focuses on disparities resulting from differences in access to and knowledge of technology, leading to the concept of the "digital divide." The digital divide aims to explain the information gap, the disparity between information-rich and information-poor, the divide between those who have access to information and those who do not (Information Haves and Information Have-Nots), the digital gap, digital opportunities, and bridging the digital divide.

Entering the 21st century, this concept extends beyond mere access and connectivity. It includes other resources that enable individuals to use technology effectively, such as content, language, literacy and education, community and institutional structures. It proposes shifting the assessment of the digital gap towards the dimension of digital inequality, which is complex and multi-layered, encompassing physical, digital, human, and social resources and relationships (Sangsuriyong, 2018).

The Ministry of Digital Economy and Society (2019) defines the policy addressing the "digital divide" as tackling social inequality with multiple dimensions, including the quality of people, education, social opportunities, and the benefits received from the state. It also includes digital inequality or the differences and gaps between those who can benefit from digital technology and those who lack access, understanding, and the ability to utilize IT. Information and communication technology can be a contributing factor that expands the economic and social gap between high-income and low-income individuals.

Factors Contributing to the Digital Divide

The review of various research papers and articles has identified the following factors contributing to the digital divide:

1. Demographic Characteristics: Personal demographics are a primary factor in the digital divide. This directly affects different groups using digital or technological resources, such as the elderly and the rural poor. Despite having knowledge, these groups may lack the financial means to access or use the internet (Pansri & Chomtohsawun, 2019). Additionally, there is a gap

between the rich and the poor, and between marginalized individuals and the urban middle class (Digital Citizens, n.d.). Educational attainment, social and economic status, and differences in learning also play a role (Office of The National Broadcasting and Telecommunications Commission [NTTC], 2019). The quality and efficiency of technology, often related to price, also matter. Wealthier individuals are more likely to own high-performance technology than those with lower income (Sukkong et al., 2020).

2. Geographical Area, Community Readiness, and Climate: Geographic and community readiness, along with climate, can hinder digital access. For instance, rugged mountainous areas may impede the widespread distribution of digital technology, leading to concentrated availability in major provinces and adjacent areas (Pansri & Chomtohsawun, 2019).

3. Motivation to Use Technology: The digital divide is also related to motivation and skills for using digital technology (Min, 2010). Motivation can be divided into:

Technology Usage Motivation: Onitsuka et al. (2018) stated that once there is a motivation to use technology, the next step is to have the necessary equipment, skills, and suitable usage characteristics. There are additional variables that support appropriate usage.

Social Motivation for Technology Use: This refers to the attachment to oneself or the community. A sense of belonging to the community and participation in it can help users engage with content that is appropriate and beneficial. This highlights the connection between online and interpersonal communication. Internet use can help reduce traditional social inequalities, as internet users have fewer social disparities. It has been concluded that internet connectivity can help reduce social inequalities (Rains & Tsetsi, 2017).

Digital Divide in Health

Data from the National Economic and Social Development Board (2018) indicates that although the poor have high access rates to universal health insurance policies, they also bear the highest financial burdens. Additionally, there is a significant concentration of doctors in major provinces. The digital divide in health refers to disparities in public health within the digital society context. It also includes significant differences in utilizing health information sources between internet users and non-users, perceptions of information search processes, access channels, efforts in searching, and understanding and confidence in selected information (Geana & Greiner, 2011; Malone et al., 2014). Government policies need to address this disparity. Kittikun (2016) explained that government services

transformed by digital technology aim to serve the public efficiently, securely, with good governance, and to create equal social opportunities through digital media to improve the quality of life for all citizens, especially the socially disadvantaged. This allows equal access to digital technology and media. Quality of life will improve through access to information resources and public services, particularly essential public services for living, via digital technology. The Ministry of Public Health's eHealth Strategy for the years 2017-2026 aims to link digital technology and information and communication services between health service providers and the public to ensure efficient, fair, and safe access to health services, making it more convenient and quicker for patients to access health systems (Information Technology and Communication Center, 2017).

Factors Related to the Digital Divide in Health

When considering population characteristics such as gender, age, education, status, occupation, and income, they are related to health disparities. Wang et al. (2022) surveyed China, India, Indonesia, Thailand, the Philippines, Malaysia, South Korea, Japan, Vietnam, and Singapore on national-level health information disparity. The survey found that individuals, particularly married women, families, employed individuals, those with high household income, and higher education levels, use mobile phones to seek health information more frequently and significantly. Kontos et al. (2014) found significant differences in race, socioeconomic status (SES), age, and gender in using websites to manage diet, weight, physical activity, or download health information to mobile phones. Lower SES groups, older adults, and men are less likely to engage in health information technology activities than other groups. Women tend to use and share health information more, while age influences information searching. Additionally, the Health Systems Research Institute (HSRI) (2021) highlighted that vulnerable groups, such as migrant children, urban poor, and marginalized people, face limitations in using online technology.

Hage et al. (2013) pointed to structural factors, community participation in health information technology adaptation, and Morey (2007) noted cultural factors linked to rural areas and local information. The complexity of technology also plays a role. McInnes and Haglund (2011) identified that people avoid digital health information services due to website design and coding systems that need improvement for ease of use. Other crucial factors include website attributes that build trust, such as ease of use and simple search terms. The digital divide in health is also connected to non-internet users (Naszay et al., 2018). This

divide can lead to different health behaviors (Geana & Greiner, 2011).

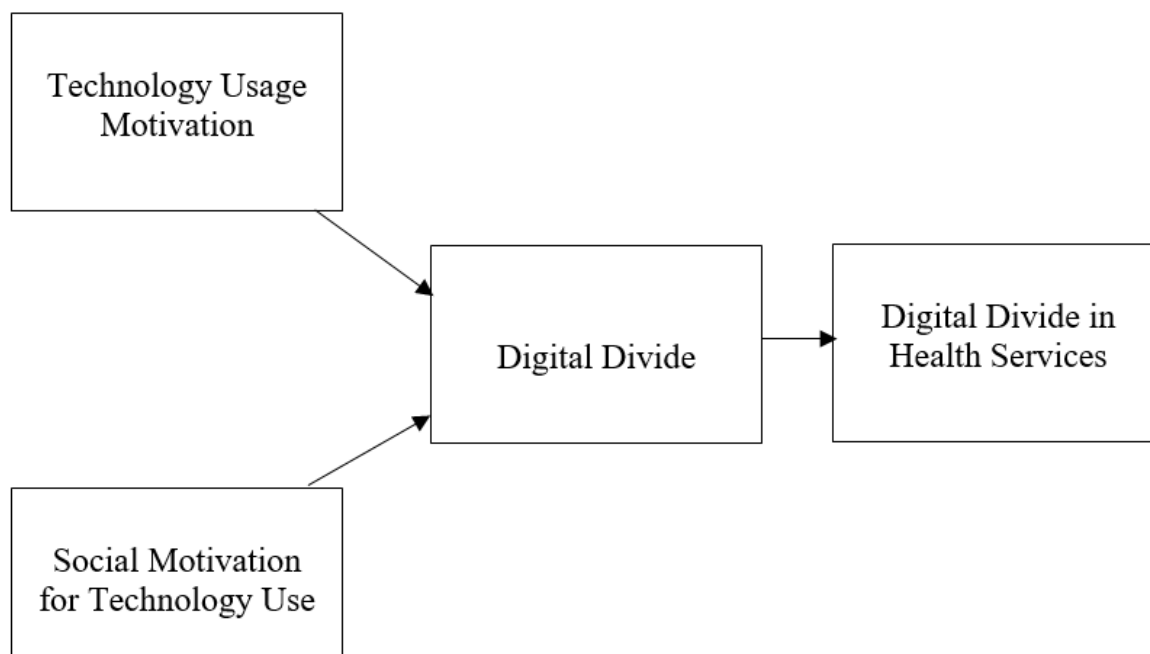
Additionally, factors such as equipment, internet signal stability, and platform trust are obstacles. Gonzales (2016) identified barriers such as access, inability to pay for services, device malfunction, and unstable connections from both equipment and signals. Kaihlanen et al. (2022) noted that fear and distrust in digital platforms, security concerns, and reduced perceived privacy

in interacting with health service providers contribute to potential misunderstandings in digital environments compared to in-person services.

Research Framework

This research employs a conceptual framework for developing a model of the digital divide in the use of digital public health services, as illustrated in Figure 1.

Figure 1: Research Framework



Methodology

This research employs survey research design. The target population includes individuals aged 18 and above residing in provinces identified as having digital life inequality, based on the digital life inequality report from 2013-2017 by the Institute of Economics, Rangsit University, Thailand (Pansri & Chomtohsawun, 2019). These Thai provinces are Loei, Nong Khai, Mae Hong Son, and Yala. The sample size is 400 individuals, and data collection is conducted using a questionnaire.

Variable Measurement

Variables are measured using a 5-point summated rating scale (least, less, moderate, more, most) as follows:

1. Technology usage motivation: Respondents indicate their level of motivation to use technology across five items, such as using technology for information and accessing government health services.

2. Social motivation for technology use: Respondents indicate their level of social motivation to use technology across five items, such as using technology because friends use it and find it beneficial or because it is widely used within their social group.

3. Digital divide: Respondents indicate their level of ability to access and utilize the internet across five items, such as the ability to connect, access content, and understand internet content.

4. Digital divide in health services: Respondents indicate their level of capability in using digital technology for health purposes across fifteen items, including accessing health information, understanding health knowledge, utilizing health information through digital technology, and using health services via technology.

Experts reviewed the questionnaire for content validity, and it was pretested for reliability with 30 samples. Variables were measured using the Summated Rating Scale, applying Cronbach's alpha coefficient formula. The obtained values are as follows: technology usage motivation ($\alpha = .82$), social motivation for technology use ($\alpha = .88$),

digital divide ($\alpha = .98$), and digital divide in health services ($\alpha = .94$).

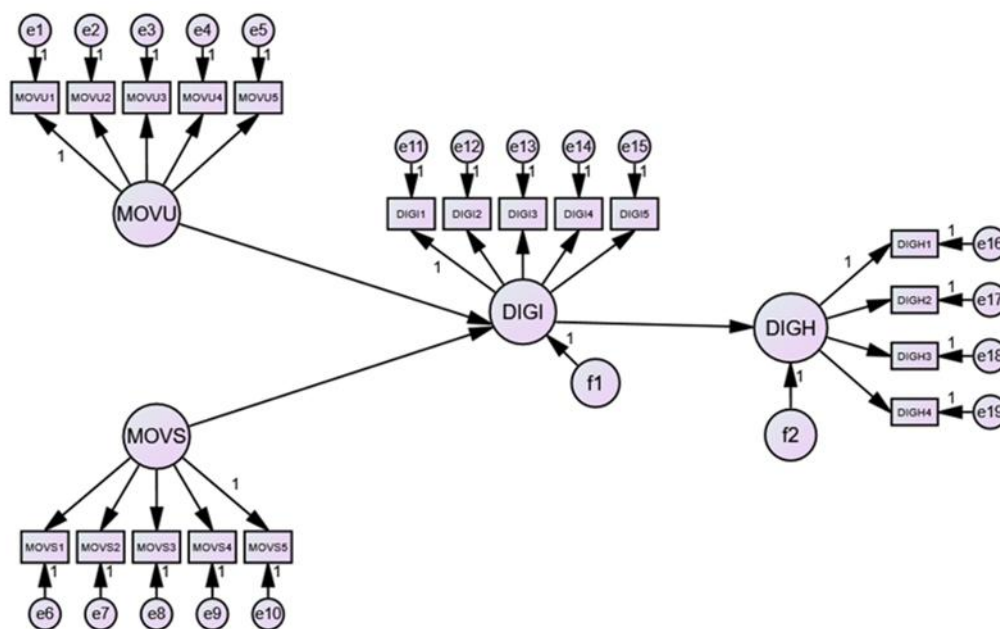
The questionnaire was also reviewed and approved by the Research Ethics Review Committee for Research Involving Human Subjects: The Second Allied Academic Group in Social Sciences, Humanities and Fine and Applied Arts at Chulalongkorn University (COA No. 153/66). To protect respondents' rights, data collectors provide a detailed explanation of the research objectives, project details, and questionnaire instructions before the survey begins. Participation is entirely voluntary.

Data Analysis

Statistical analysis is conducted using Structural Equation Modeling (SEM), comprising three components: Measurement model analysis, first-order confirmatory factor analysis, and second-order confirmatory factor analysis.

The model analysis includes four variables: Technology usage motivation, social motivation for technology use, digital divide, and digital divide in the use of digital public health services. Figure 2 illustrates the model for the digital divide in the use of digital public health services.

Figure 2: Model of the Digital Divide in the Use of Digital Public Health Services



Note: Symbols and statistics used in the analysis of variables

MOVU - Technology Usage Motivation

- MOVU1: The internet is beneficial to you.
- MOVU2: The internet provides information, news, and knowledge when needed.
- MOVU3: Using the internet to receive government welfare services.
- MOVU4: Ability to use technology proficiently.
- MOVU5: Trust in using the internet.

MOVS - Social Motivation for Technology Use

- MOVS1: Using the internet because friends use it.
- MOVS2: Using the internet because friends benefit from it.
- MOVS3: Using the internet to communicate with children, grandchildren, and family members.
- MOVS4: Using the internet to communicate with friends.

- MOVS5: Being a member of a group of friends who use the internet.

DIGI - Digital Divide

- DIGI1: Ability to connect to and use the internet well.
- DIGI2: Access to information on the internet.
- DIGI3: Using the internet in daily life.
- DIGI4: Ability to search for information on the internet.
- DIGI5: Ability to understand news, information, content, images, and clips on the internet.

DIGH - Digital Divide in Health Services

- DIGH1: Access to health information.
- DIGH2: Health knowledge.
- DIGH3: Utilization of health information.
- DIGH4: Using health services via digital technology.

The analysis consists of three steps as follows:

(1) Step 1: Measurement Model Analysis, which examines whether observable variables can measure or explain latent variables in each model. The researcher tested 19 observable variables and 4 latent variables across four models: Technology usage motivation, social motivation, digital divide, and digital divide in health.

(2) Step 2: First-order confirmatory factor analysis, where all four measurement models were tested simultaneously to assess construct validity and confirm whether observable variables can accurately measure latent variables.

(3) Step 3: Second-order confirmatory factor analysis, which tests the fit of the developed digital divide in health model with empirical data and analyzes the causal relationships between the variables.

Findings

The survey research can summarize the characteristics of the sample as follows:

The sample consisted of more females than males. The largest age group was 40-59 years old, followed by 23-39 years old, 60 years and older, and 18-22 years old. Most of the sample had a bachelor's degree, followed by high school, associate degree, and vocational certificate. The sample had various occupations, with most being laborers and self-employed/business owners, followed by farmers, company employees, workers, and government employees/state enterprise workers. The majority had an income of THB10,001-20,000, followed by THB5,001-10,000 (THB35 is approximately USD1). Most had no social position, and the majority had used the internet for less than 1 year, followed by 1-2 years.

Most of the sample lived in urban or municipal areas with internet signals, with only a few livings in remote, rugged rural areas without internet signals. Most lived in lowland areas, with only a few in complex mountainous areas. Almost all the sample had experienced weather conditions affecting internet signals. Half of the sample stated that the coverage was partial, with some areas having weak signals and others having no signal at all.

Most of the sample used internet services provided by private companies, with only a few using government-provided internet. The most common price range for equipment was THB3,001-7,000, followed by more than THB10,000 and THB7,001-10,000. The majority used monthly subscription services, followed by prepaid services. Monthly internet expenses were

mostly between THB101-300, followed by THB301-600. The most common internet connection device was a smartphone, with fewer using laptops, portable computers, and tablets.

Motivation for Using Digital Technology

The overall motivation for using digital technology was high ($M = 3.88$). When broken down by motivation type, technology usage motivation was high ($M = 3.90$), with "the internet is beneficial to you" scoring the highest. Social motivation for technology use was also high overall.

Digital Divide

The digital divide was found to be generally low, meaning the sample could connect to the internet, access information, use the internet daily, search for information, and understand online content at a high level. Although digital divide is not yet much because the internet signal infrastructure is accessible, while data showed the sample group uses services through private providers, which remains an obstacle for low-income individuals. Therefore, there is still inequality between the poor and the rich.

Digital Divide in Health Services

The digital divide in the use of digital public health services was found to be moderate overall. The sample had high capabilities in accessing health information, understanding health knowledge, and utilizing health information through digital technology. However, the capability to use health services via digital technology was low. The group with lower income experiences a greater digital divide in accessing health services through digital technology compared to other groups.

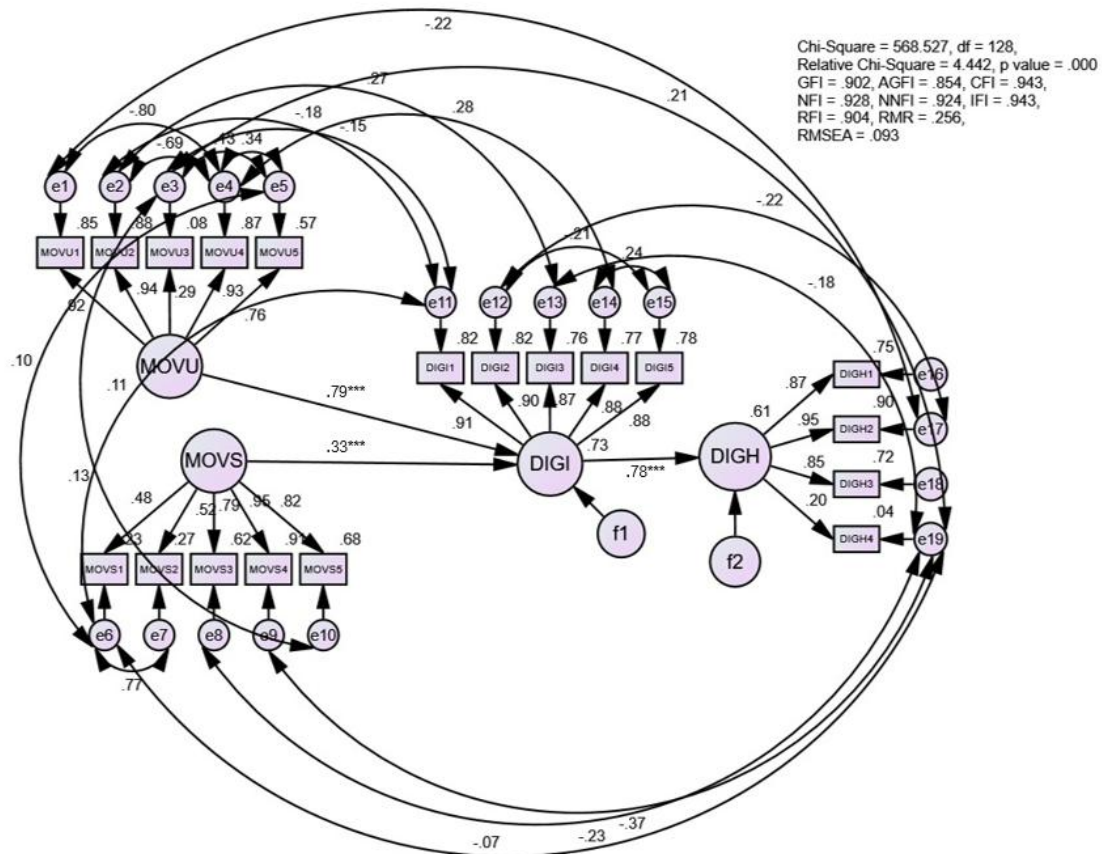
Use of Basic Health Services under the Health Insurance Scheme

The most commonly used basic health services under the health insurance scheme included medical examinations, diagnosis, and treatment of various diseases, dental services such as fillings, extractions, and scaling, health promotion and disease prevention services such as family planning, prenatal care, newborn care, immunization, risk screening, and receiving free medication and medical supplies post-treatment.

Model of the Digital Divide in the Use of Digital Public Health Services

The results of the analysis for assessing the consistency of the model are shown in Figure 3.

Figure 3: Model of the Digital Divide in the Use of Digital Public Health Services (After Model Adjustment)



Note: ***Statistically significant at the .001 level

The research findings conclude that the model of the digital divide in the use of digital public health services developed by the researchers is consistent with empirical data. This is evidenced by the model fit indices meeting more than three criteria. The model fit indices that met the criteria include six indices:

1. Goodness of Fit Index (GFI) = 0.902 (greater than 0.90)
2. Comparative Fit Index (CFI) = 0.943 (greater than 0.90)
3. Normal Fit Index (NFI) = 0.928 (greater than 0.90)
4. Non-normed Fit Index (NNFI) = 0.924 (greater than 0.90)
5. Incremental Fit Index (IFI) = 0.943 (greater than 0.90)
6. Relative Fit Index (RFI) = 0.904 (greater than 0.90)

Additionally, path analysis and the influence of each latent variable in the model reveal that technology usage motivation has a significant positive overall influence on the digital

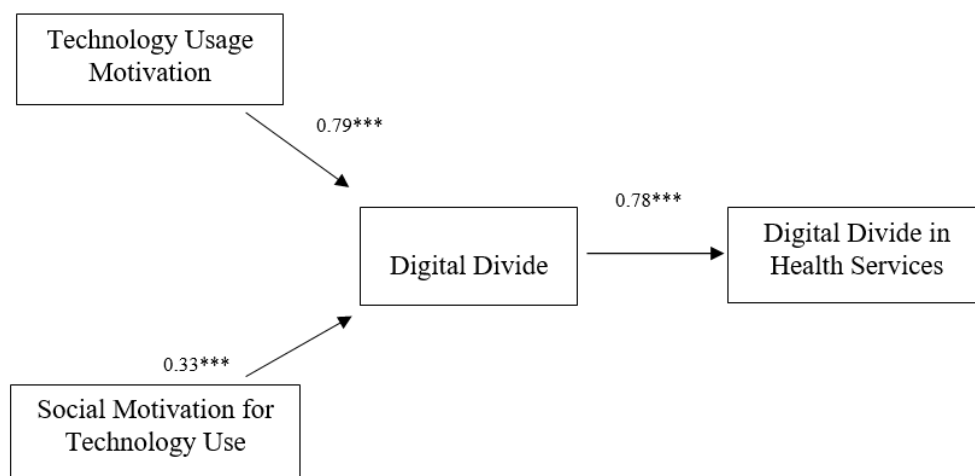
divide and the digital divide in health services, with influence values of 0.788 and 0.615, respectively, at a significance level of .01.

Social motivation for technology use has a significant positive overall influence on the digital divide, with an influence value of 0.333 at a significance level of .05, and also has a significant positive overall influence on the digital divide in health services, with an influence value of 0.260 at a significance level of .01.

The digital divide has a significant overall influence on the digital divide in health services, with an influence value of 0.780 at a significance level of .05.

Therefore, it can be concluded that the digital divide is the variable with the highest overall influence, or in other words, it is the causal variable that most significantly leads to the digital divide in health services. Additionally, the digital divide in health services is also indirectly influenced by technology usage motivation and social motivation for technology use.

The summary of the model of the digital divide in the use of digital public health services is illustrated in Figure 4.

Figure 4: Diagram of the Model of the Digital Divide in the Use of Digital Public Health Services

Note: ***Statistically significant at the .001 level

Discussion

The research findings indicate that both technology usage motivation and social motivation for technology use are related to the digital divide. This is consistent with Min (2010), who pointed out that the digital divide is linked to motivation and skills in using digital technology. Onitsuka et al. (2018) further emphasized that once there is motivation to use technology, having access to devices and skills leads to usage according to individual needs. This motivation is connected to social motivation, as individuals with community attachment are likely to use technology in meaningful ways. Internet usage helps reduce social inequalities among users, and connecting with others online can lessen traditional social disparities (Rains & Tsetsi, 2017). This is aligned with the views of Sukkong et al. (2020), who noted that individuals in highly technologically developed areas are more motivated to use digital technology to enhance their capabilities compared to those in less developed areas.

The research also reflects the digital divide in the use of digital public health services. The group with lower income experiences a greater digital divide in accessing health services through digital technology compared to other groups. The use of health services through technology can be explained by the concept of health inequality. Laiprakobsup (2015) discussed equality and fairness in accessing health services, highlighting differences due to social class, race, status, or residence. Pinpratheep (2019) pointed out that wealth and income disparities lead to differences in public health services in different areas. Wang et al. (2022) surveyed countries including China, India, Indonesia, Thailand, the Philippines, Malaysia,

South Korea, Japan, Vietnam, and Singapore, finding that employed individuals with high household income and education levels use mobile health information more frequently. Kaihlanen et al. (2022) linked socioeconomic and cultural status to health.

Path analysis and the influence of each latent variable in the digital divide model in health services reveal that technology usage motivation (MOVU) positively influences the digital divide (DIGI) and the digital divide in health services (DIGH). This aligns with Onitsuka et al. (2018), who stated that motivation leads to the necessary skills and appropriate usage, supporting Bodie and Dutta (2008), who highlighted disparities in health knowledge, understanding, and behavior due to health and internet literacy.

Social motivation for technology use (MOVS) also positively influences the digital divide (DIGI), as Rains and Tsetsi (2017) noted that social motivation stems from community attachment, which helps users engage with relevant content, reducing traditional social inequalities.

The digital divide (DIGI) significantly influences the digital divide in health services (DIGH). This is supported by the research of Siengcharoen (2022) who developed an index to measure computer and internet skills. The findings indicate that that internet access is just the first step in the digital divide. The divide also relates to skills in using the internet for work and other continuous tasks, such as generating income and improving health. This is consistent with Gladkova et al. (2020), who noted digital inequality in Russia concerning internet use and benefits, such as online information searching and content creation, showing that digital inequality extends to health services. Morey (2007) emphasized the importance of

educating on technology access and use, providing internet access points at homes and public places, and financial support to reduce the digital divide, which enhances health literacy.

The digital divide in health services (DIGH) is indirectly influenced by technology usage motivation (MOVU) and social motivation for technology use (MOVS). Geana and Greiner (2011) and Malone et al. (2014) viewed the digital divide in health services as including differences in utilizing health information sources between internet users and non-users. Those who see the benefits of health information are motivated to use technology for health purposes. Vulnerable groups face barriers in internet access, as Saeed and Masters (2021) noted that the digital divide is narrowing with internet and technology access improvements, but issues persist among the poor, women, and Black individuals, affecting the likelihood of using telehealth. Millions of Americans still lack internet access due to disinterest or lack of motivation, as highlighted by the Health Systems Research Institute (2021). Vulnerable groups, such as minorities, the elderly, migrant children, urban poor, and marginalized people, face health technology usage barriers, especially during the COVID-19 pandemic, when vaccine registration required online access, which these groups could not use, leading to health-related digital inequality.

Recommendations for Future Research

1. Expand studies on the digital divide to include social and technological dimensions: Develop causal models of the digital divide in public health services, incorporating aspects of public health, technology, society, digital literacy, and economics.

2. Develop indicators for the digital divide in public health services in the digital age: Research the development of digital divide indicators in public health services within the Thai context, addressing aspects of public health, technology, usage, literacy, socio-cultural factors, and economic efficiency.

Policy Recommendations to Reduce the Digital Divide in Public Health Services

The findings show that the digital divide is the primary cause of disparities in health services, indirectly influenced by Technology Usage Motivation and Social Motivation for Technology Use. Therefore, policies to reduce this divide should focus on three key areas:

1. *Reducing the digital divide by addressing access barriers:* This includes ensuring internet coverage, speed, and stability in both

urban and remote areas, reducing and subsidizing service costs, promoting access to basic technology for vulnerable and general populations, enhancing digital skills, and developing user-friendly, reliable service systems.

2. *Stimulating health benefits from technology use:* This involves setting up service systems that provide concrete health benefits through technology, ensuring that these systems meet the actual health needs of users.

3. *Encouraging social change towards health-promoting technology use:* This includes fostering societal values that integrate technology into daily life to promote health, thereby enhancing social motivation for technology use.

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