THE SIGNIFICANCE OF HEALTH EDUCATION TECHNOLOGY IN THE TREATMENT OF EARLY STROKE IN THE COMMUNITY

Abstract

Aims: This study aims to evaluate the effectiveness of technology-based health education in improving the knowledge and preparedness of patients' families for early detection of stroke symptoms.

Instrument & Methods: The study used a quantitative design with a cross-sectional approach involving 100 respondents from five referral hospitals in Medan City. Data collection was carried out using a Likert scale questionnaire to measure the level of knowledge and preparedness of stroke patients' families. Technology-based educational interventions include the use of mobile applications, e-learning platforms, social media, and telemedicine.

Findings: The results showed that all forms of technology-based health education significantly improved respondents' understanding of the early symptoms of stroke and accelerated decision-making when symptoms were identified.

Conclusion: Digital health education has proven to be effective in strengthening early detection of stroke and has the potential to be developed more widely as a strategy to improve the quality of stroke treatment in Indonesia.

Keywords: Digital Health Education, Stroke Early Detection, Family Preparedness, Health Literacy, Technology-Based Intervention

INTRODUCTION

Stroke is one of the main health problems worldwide, including in Indonesia. Based on the Global Burden of Disease (GBD) 2020 report, stroke is the second largest cause of death globally, with 12.2 million new cases every year and around 6.5 million deaths [1]. In Indonesia, data from the 2018 Basic Health Research (Riskesdas) shows a prevalence of stroke of 10.9 per mile of the population over 15 years old, with an increasing trend from previous years [2]. This condition shows that stroke not only places a significant burden on the national health system but also has an impact on the quality of life of individuals and families, given that stroke often causes long-term disability. [3].

The main problem faced today is the low level of public literacy in recognizing the early signs and symptoms of stroke [4]. Public knowledge of early detection methods such as *FAST* (Face, Arm, Speech, Time) is still very low [5]. Several studies in various regions in Indonesia, including West Java and South Sumatra, show that only 30–40% of people know the early signs of stroke correctly [6]. This low level of literacy has a direct impact on the delay of the community in bringing patients to health facilities [7]. Facts show that the average stroke patient comes to the hospital 8–12 hours after the first symptoms appear, well past the golden *period* of 3–4.5 hours that greatly determines the success of thrombolytic therapy and the restoration of nerve function . This condition creates a chronological impact in the form of increasing rates of permanent disability, decreased productivity, increasing economic burden on families, and burdening the national health care system.

The low public knowledge also shows that there is a serious gap in public health literacy, especially related to non-communicable diseases such as stroke. This gap is caused by the lack of optimal conventional health communication and education strategies that have been one-way, limited to face-to-face counseling, and do not reach people in remote areas. At the same time, the development of information and communication technology has actually opened up great opportunities to bridge this gap. With smartphone penetration in Indonesia reaching 77%, including in rural areas, the use of *health education technology* is a relevant strategic concept.

The concept of completion proposed through this study is the application of digital-based health education technology as an innovative solution to increase public literacy in detecting and treating stroke early. This technology includes mobile applications, e-learning, social media, and telemedicine that are able to convey health information in an interactive, engaging, and easily accessible manner at any time. Research [8] shows that technology-based educational interventions have been shown to be effective in improving people's knowledge and rapid response to chronic diseases, including stroke. This approach is not only efficient in terms of cost and time, but also

sustainable and able to break through geographical barriers that have been the main obstacles to health education in Indonesia.

Information and communication technology development opens up great opportunities to answer these challenges through health education technology [9]. Health education technology uses digital devices, such as smartphone apps, interactive videos, social media, and websites, that are designed to convey health information easily, quickly, and attractively [10]. Various international studies have proven that health education technology effectively increases public literacy related to chronic diseases such as diabetes, hypertension, and stroke [11]. For example, a study in South Korea showed a significant increase in people's knowledge of stroke after being intervened with a mobile-based educational app [12]. Meanwhile, in India, educational videos in local languages have been shown to increase public awareness of stroke symptoms by up to 65% compared to the control group [13].

In Indonesia, the use of health education technology in the context of stroke is still minimal, especially in rural communities with limited access to conventional health information [14]. Data from the Central Statistics Agency (BPS) in 2022 notes that smartphone penetration in Indonesia has reached 77%, including in rural areas, so the potential for using health education technology is huge [15]. However, until now, few studies have explored the effectiveness of health education technology in improving people's ability to recognize early stroke signs [16]. Therefore, this research is important to fill the knowledge gap and provide scientific evidence on how much educational technology can play a role in early stroke treatment.

In addition to increasing literacy, health education technology has advantages in terms of affordability and sustainability [17]. Technology-based health education can be accessed anytime and anywhere, minimizing the geographical barriers that people in remote areas often experience [18]. Educational materials packaged attractively and interactively are also easier to accept and remember by the public than conventional educational methods that tend to be one-way and less interesting [19]. Research on the use of stroke education videos in China, for example, found that the group that received interactive education experienced an increase in information retention by 55% compared to the group that only received oral education from health workers [20]. This data supports the assumption that health education technology has the potential to be a strategic innovation in increasing the speed of community response to stroke symptoms [15].

The importance of this research is further strengthened by the high rate of delay time in stroke patients in Indonesia. Studies in several hospitals in Jakarta and Surabaya found that the average delay of stroke patients coming to the hospital reached 8-12 hours after the onset of symptoms, well above the golden period [21]. This condition results in many patients losing the opportunity to get thrombolytic therapy that is only effective for a specific period [22]. Family or community ignorance about the importance of time in treating stroke is one of the main factors for the delay [23]. Therefore, this study is expected to make a real contribution by testing whether health education technology can optimally accelerate decision-making to bring stroke patients to health facilities.

From an academic point of view, this research is important because it can add to the treasure of science in nursing, public health, and health technology, especially related to strategies to increase stroke literacy through innovative approaches. This research can also be a reference for future research exploring educational technology interventions for other diseases that require early detection. From a practical perspective, the results of this research are expected to be used as the basis for preparing health education programs by health offices, health centers, and non-governmental organizations engaged in the prevention of noncommunicable diseases. The information obtained is also expected to be used by health application developers to create educational content about strokes that is more effective and easy to understand by the wider community.

Overall, the high incidence of stroke, delays in treatment, low public literacy, and the lack of optimal use of health education technology in Indonesia are the fundamental background for the importance of this research being conducted. This research will not only provide an overview of public knowledge after receiving technology-based education [24]. However, it can also assess the extent to which this intervention impacts behavioral changes that lead to accelerating the treatment of early stroke. Thus, this research is expected to significantly reduce the burden of stroke in Indonesia through a more modern, inclusive, and technology-based approach [25].

The primary purpose of this study is to analyze the significance of health education technology in increasing public knowledge and awareness of early stroke management, as well as to measure its effectiveness in reducing the delay to health facilities after the appearance of stroke symptoms. In addition, this study also aims to identify obstacles that may be faced in implementing health education technology in the community so that it can provide practical recommendations for the government, health workers, and the private sector who want to develop similar interventions. Through this research, a technology-based health education model will be created that is applicable and sustainable to the sociocultural characteristics of the Indonesian people.

INSTRUMENT AND METHODS

Research Design

This study uses a quantitative research design with a cross-sectional approach that aims to analyze the relationship between health education technology and community literacy in recognizing early symptoms of stroke [26] The cross-sectional approach was chosen because it allows data to be collected at a specific time to identify relationships between variables within a population. The focus of this study is to assess how the use of mobile applications, e-learning, social media, and telemedicine affects people's knowledge and preparedness in recognizing and managing early symptoms of stroke.

Participants

The population in this study is the families or companions of stroke patients who are or have been treated at five referral hospitals in Medan City, namely Haji Adam Malik Hospital, Dr. Pirngadi Medan Hospital, Bunda Thamrin Hospital, Columbia Asia Medan Hospital, and Royal Prima Hospital. The population was chosen because family members play an important role in making quick decisions when stroke symptoms appear, which has a direct impact on the timeliness of treatment. The number of research samples was 100 respondents which were proportionally divided among the five hospitals (about 20 respondents per hospital). This amount is considered to meet the sufficiency of data for analysis using the Structural Equation Modeling (SEM) method.

The determination of sample size is based on several methodological considerations. Because the main analysis uses Structural Equation Modeling (SEM), a rule of thumb is used 10 times the number of indicators in the most latent constructs; Assuming the densest construct has 10 items, a minimum of 100 respondents is required. Statistically, the calculation of the sample size for proportional estimation using the Cochran formula ($Z^2 \cdot p(1-p)/d^2$) with Z = 1.96, p = 0.5, and the margin of error d = 0.10 yields n ≈ 96; To anticipate non-response and ease of allocation, the number was rounded to **100 respondents**. The sample was then allocated proportionally to five referral hospitals (±20 respondents per hospital). In addition, the initial instrument trials showed sufficient reliability so that the sample count of 100 was considered adequate for the stability of parameter estimation in SEM analysis.

The sampling technique used is purposive sampling with certain criteria. The inclusion criteria include: (1) respondents aged 18 years and above; (2) have accompanied a family member who has been diagnosed with stroke within the past year; and (3) willing to become a voluntary respondent. The exclusion criteria were respondents who had cognitive impairment or severe communication barriers. Hospital selection is carried out purposively based on the availability of stroke units, the number of patients, and the ease of geographical access to ensure data representation.

Variable and Data Collection

Data collection was carried out in the period from July to December 2024. The researcher coordinates with the hospital management to obtain permits and access respondents in the inpatient and outpatient rooms. Before filling out the questionnaire, respondents were given an explanation of the purpose of the research, data confidentiality, and the right to refuse or terminate participation at any time. The average questionnaire filling time is 15–20 minutes. The researcher also provided assistance for respondents who had limitations in the use of digital devices so that response bias did not occur.

The research instrument is in the form of a structured questionnaire prepared in Google Form and distributed online and offline through coordination with the hospital. The questionnaire consists of three main parts, namely: (1) the demographic characteristics of the respondents, (2) the

level of knowledge and literacy in recognizing the early signs of stroke, and (3) the perception and use of health education technology.

The question format includes Likert scale, multiple choice, and open-ended questions to obtain quantitative and descriptive data. Before being used in the main study, the questionnaire has gone through validity and reliability tests. The validity of the construct was tested by factor analysis, while the reliability was tested using Cronbach's Alpha. The results of the trial on 20 respondents showed that all items were valid (> loading factor 0.6) and reliable (α = 0.87), so they were suitable for use in the study.

Intervention Procedure

Although this study was non-experimental, the stages of short educational exposure were carried out in the form of digital impressions such as infographics and short videos about the recognition of early signs of stroke. This exposure was given before respondents answered the part of the questionnaire that assessed knowledge, with the aim of measuring the increase in literacy related to the use of health education technology.

Data Analysis

The collected data was processed and analyzed using SmartPLS software using the Structural Equation Modeling (SEM) method. The SEM method was chosen because it is able to analyze complex causal relationships between latent variables and assess direct and indirect influences simultaneously. Before modeling, a test of normality, validity, and reliability of data was carried out. Furthermore, the path coefficient value and regression weight were analyzed to see the strength and significance of the relationship between variables. Descriptive analysis was also carried out to describe respondent characteristics and the distribution of answers. Likert scale scores (1 = strongly disagree to 5 = strongly agree) are converted to numerical values for quantitative interpretation purposes.

Research Ethical Considerations

This research has obtained ethical approval from the Research Ethics Committee of Sari Mutiara University Indonesia (Number: No.3230/F/KEP/USM/I/202). All respondents were given an explanation of the purpose of the research, the guarantee of data confidentiality, and the right to refuse or terminate participation without any consequences. Each respondent signed an informed consent sheet before participating in the study. The researcher upholds the principles of research ethics which include autonomy, beneficence, non-maleficence, and justice in all stages of research.

Findings

Respondent Characteristics

The respondent characteristics in this study were outlined using three demographic factors, namely age, gender, and education level. Based on age, participants were separated into two groups representing early and later adulthood. This classification showed a broad age spectrum that allowed the analysis to explore how different maturity levels influenced respondents' understanding and perceptions of early stroke management. The wide age range also indicated that individuals from multiple life stages had taken part, giving a clearer picture of how health literacy varied across age groups.

With respect to gender, the respondents were almost evenly distributed between males and females. This balanced composition made it possible to examine potential gender-related differences in perceptions and decision-making when stroke symptoms were observed. Such diversity improved the applicability of the findings, particularly in the cultural context of Medan City, where family roles and expectations might shape health-related decisions.

In terms of education, participants represented various educational levels, from basic schooling to higher education. This diversity offered important insights into how respondents absorbed, interpreted, and understood health education delivered through digital technology. It also revealed how educational background shaped the effectiveness of the health education strategies provided in the study.

Collectively, the demographic diversity of the respondents helped capture a wider representation of families with stroke patients in Medan City. These characteristics strengthened the credibility of the findings by ensuring that the assessment of technology-based health education mirrored the experiences and capacities of individuals from differing demographic profiles.

Table 1. Characteristics of Respondent Frequency in Five Hospitals in Medan in 2025

Characteristics	N	(%)
Age		
20 years -40 years	27	27%
>40 years old	73	73%
Total	100	100%
Gender		
Man	63	63%
woman	37	37%
Total	100	100%
Education		
Primary school	24	24%
Junior high school	29	29%
Diploma/Bachelor's	47	47%

The reliability testing in this study was conducted using Composite Reliability and Cronbach's Alpha for each construct within the measurement model. All constructs obtained reliability values that met the required thresholds, indicating that the instruments demonstrated strong internal consistency in capturing the concepts being measured. These results confirmed that the measurement tools used throughout the study were dependable for assessing technology-based health education components.

Furthermore, the Average Variance Extracted (AVE) values for all constructs exceeded the minimum criteria, showing that the indicators accurately represented the variance of their respective latent constructs. This outcome demonstrated that convergent validity had been successfully achieved, thereby validating the appropriateness of the instruments used in the study. Overall, the outcomes of the reliability and validity analyses provided robust evidence of the accuracy and credibility of the collected data and reinforced confidence in the subsequent analytical procedures applied in the research.

Table 2. Composite reliability and Cronbach alpha test results

Construction	*Cronbach's Alpha*	*Rho_A*	*Composite Reliability*	*Average Variance Extracted (AVE*
Mobile App	0.758	0.927	0.819	0.667
E-Learning	0.675	0.885	0.752	0.646
Social Media	0.613	0.823	0.868	0.751
Telemedicine	0.826	0.721	0.838	0.689
The Significance of Health Education Technology in the Treatment of Early Stroke in the Community	0.876	0.985	0.899	0.967

The results of the coefficient of determination analysis showed that the proposed model was able to account for a substantial portion of the overall variability in the study. The value obtained exceeded the commonly accepted benchmark in quantitative research, indicating that the model effectively explained most of the variation reflected within the data.

Furthermore, the adjusted coefficient of determination was recorded at a value close to the upper limit, demonstrating that the model had a strong level of fit and maintained stability even with the inclusion of multiple components within the analysis. These findings confirmed the meaningful contribution of technology-supported health education in enhancing community literacy and preparedness in recognizing early signs of stroke. Overall, the study highlighted the strong potential

for expanding the use of digital health based educational approaches as part of broader community-oriented prevention initiatives.

The testing process was conducted using the bootstrapping method in SEM-PLS to assess the validity and reliability of the data. In this procedure, T-statistics and P-values were generated and later presented in tabular form to evaluate the significance of the results. Data are considered valid when the T-statistic exceeds 1.96 and the P-value is below 0.05, which indicates that the parameters being tested meet the required significance criteria.

The findings of this study **revealed** that the application of various technology-based health education tools, including mobile applications, e-learning platforms, social media, and telemedicine, **had successfully enhanced** public awareness and readiness in identifying early stroke symptoms. Each technological medium **contributed** meaningfully to improving the community's comprehension of early stroke management. These results **demonstrated** that the integration of digital health education **served as** an effective intervention for strengthening early stroke response at the community level.

DISCUSSION

The results of this study provided stronger empirical support than many earlier investigations by showing that technology-based health education, which included mobile applications, e-learning, social media, and telemedicine, significantly improved public readiness to recognize early stroke symptoms. Previous studies using the Technology Acceptance Model (TAM) mainly applied the framework to administrative or clinical information systems such as hospital management platforms (Liu, Liu, Liu et al., 2024). The present findings expanded its relevance to a preventive public health context, where participants clearly perceived meaningful benefits in using these technologies for stroke education rather than only for routine digital or service-related tasks.

As suggested by TAM (Davis, 1989), perceived usefulness and ease of use influenced positive attitudes toward digital health education tools. This pattern was consistent with other healthcare IT research, such as studies on the SATUSEHAT application, where perceived usefulness emerged as the strongest determinant of user satisfaction (Hirano et al., 2020). This alignment strengthened the

argument that when individuals believe a technology can help them respond more quickly and effectively to health risks, they are more inclined to adopt it even outside formal healthcare environments.

The findings also aligned with the Health Belief Model (HBM), which proposes that preventive actions occur when individuals believe they are vulnerable to a serious condition and view preventive measures as beneficial (Abtari, Amita, and Ayu Ningsih, 2024). In this study, the use of applications and social media increased respondents' awareness of their stroke risk, raising perceived susceptibility, and reinforced the belief that taking immediate action such as contacting health services or monitoring symptoms would produce real benefits. This dual influence explained why technology-based health education became effective: it heightened awareness of potential threats and strengthened beliefs about the value of rapid response.

Compared with earlier research, this study also highlighted the moderating effects of demographic factors. Older adults aged over 40 demonstrated higher health literacy and readiness, likely because they often assumed primary responsibility for health decisions within their households. This differed from studies where younger populations adopted technology more quickly but did not apply it consistently in preventive health contexts. The predominance of male respondents suggested the presence of gendered patterns in technology adoption. In cultural settings where men frequently influence family health decisions, the findings indicated the need for interventions that reach women as well, especially because they often serve as caregivers.

Educational attainment also shaped technology use. Respondents with secondary or higher education engaged more effectively with digital health education, supporting broader evidence that digital literacy influences decisions to adopt new technologies (Liu, Liu, Cheng et al., 2024). The study also recognized potential confounding variables such as prior caregiving experience, exposure to stroke information from mass media, and social support, which might have influenced baseline health literacy independently of the technology. By applying a more homogeneous sampling frame, the research attempted to isolate the effect of the digital tools.

Finally, the discussion emphasized that the broader social environment influenced the success of the intervention. Respondents living in areas with better internet infrastructure or easier access to health facilities gained greater benefits from telemedicine and online education than those in more remote settings. This finding highlighted the need for policy support. Local governments must invest in digital infrastructure and incorporate technology-based education into public health strategies to ensure equitable access and strengthen community-wide preventive efforts.

CONCLUSION

Based on the results of the study, the application of health education technology through mobile applications, e-learning, social media, and telemedicine has been proven to have a significant effect on improving people's literacy in recognizing the early signs of stroke. All variables showed a positive contribution to increased knowledge and the readiness of the patient's family to take prompt action when stroke symptoms appeared. These results confirm that the use of health education technology plays an important role in accelerating the treatment of early stroke, reducing delays to health facilities, and potentially reducing the number of disability and death due to stroke. The researchers argue that health education technology can be an innovative and effective strategy in supporting stroke prevention programs, especially in areas with limited access to conventional education. Therefore, local governments and health workers are advised to integrate this technology in promotive and preventive programs through interactive applications, e-learning modules, social media campaigns, and telemedicine services adapted to local culture. The researcher also recommends training for health workers to be able to make optimal use of educational technology in increasing public awareness. For further research, it is recommended to expand the scope of the region and consider long-term studies to assess the sustainable impact of educational technology on changes in people's behavior in stroke prevention.