MEDIA PENELITIAN DAN
PENGEMBANGAN KESEHATAN
Vol 35 No 4, Desember 2025

e-ISSN: 2338-3445
p-ISSN: 0853-9987

PATIENT DATA-DRIVEN DIGITAL HEALTH PROMOTION IN HOSPITALS: A TECHNOLOGICAL AND ETHICAL PERSPECTIVE

Strategi Promosi Kesehatan Digital Berbasis Data Pasien Di Rumah Sakit: Pendekatan Etis dan Berbasis Teknologi

Herni Johan[1*], M. Ardan[1], Haeruddin Haeruddin[2], Besse Lidia[3], Siti Saidah[3], Ramlah Ramlah[3]

[1]Program Studi Administrasi Rumah Sakit, Sekolah Tinggi Ilmu Kesehatan Mutiara Mahakam Samarinda, Samarinda, Indonesia

[2]Program Studi Pendidikan Matematika, Universitas Mulawarman, Samarinda, Indonesia

[3]Program Studi Kebidanan, Sekolah Tinggi Ilmu Kesehatan Mutiara Mahakam Samarinda, Samarinda, Indonesia

*Email: hernijohan@stikesmm.ac.id

ABSTRAK

Perubahan pola konsumsi informasi kesehatan di era digital mendorong rumah sakit berinovasi dalam strategi komunikasi. Pesan generik yang kurang efektif, rendahnya kepercayaan pasien, dan tantangan etika data menjadikan promosi kesehatan digital berbasis personalisasi serta data sebagai kebutuhan mendesak untuk meningkatkan keterlibatan dan kepatuhan pasien. Penelitian ini mengevaluasi efektivitas promosi kesehatan digital dengan menitikberatkan pada personalisasi pesan, penguatan kepercayaan, dan pemanfaatan data pasien sebagai dasar keputusan strategis. Menggunakan metode campuran dengan desain eksploratori sekuensial, penelitian dilaksanakan di RS Siaga Al Munawwarah Samarinda (September 2024–Februari 2025). Tahap kualitatif melibatkan wawancara mendalam dengan informan kunci bidang teknologi informasi dan layanan medis, menunjukkan bahwa personalisasi pesan berdasarkan usia, jenis layanan, dan riwayat medis meningkatkan keterlibatan serta kepatuhan pasien. Pengiriman pesan otomatis dan tepat waktu melalui sistem informasi rumah sakit dinilai efektif, sedangkan kolaborasi lintas unit penting untuk integrasi konten dan sistem. Etika seperti informed consent, enkripsi data, dan kontrol akses berbasis peran membangun kepercayaan pasien. Tahap kuantitatif melibatkan 232 pasien rawat jalan dan inap dengan kuesioner Likert, dianalisis menggunakan Structural Equation Modeling (SEM). Hasil menunjukkan personalisasi pesan ($\beta = 0{,}318$; $p < 0{,}001$), kepercayaan terhadap rumah sakit ($\beta = 0{,}277$; $p = 0{,}003$), kepatuhan pasien ($\beta = 0{,}342$; $p = 0{,}000$), dan perilaku digital ($\beta = 0{,}364$; $p = 0{,}035$) berpengaruh signifikan terhadap manajemen strategis promosi kesehatan ($R^2 = 0{,}587$), sementara manajemen berbasis data mendukung promosi etis berbasis teknologi ($R^2 = 0{,}506$). Temuan ini menegaskan pentingnya komunikasi adaptif, tata kelola data etis, dan kolaborasi antarunit.

Kata kunci: *data kesehatan digital, etika informasi, manajemen rumah sakit, promosi kesehatan*

ABSTRACT

The shift in health information consumption in the digital era compels hospitals to innovate communication strategies. The limited impact of generic messages, low patient trust, and ethical challenges in data use highlight the urgent need for personalized, data-driven digital health promotion to enhance engagement and compliance. This study evaluates its effectiveness by focusing on message personalization, trust-building, and the strategic use of patient data. Using a mixed-methods exploratory sequential design, the research was conducted at Siaga Al Munawwarah Hospital, Samarinda (September 2024–February 2025). The qualitative phase involved in-depth interviews with key informants from information technology and medical services. Findings indicate that

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

personalizing messages by age, service type, and medical history increases patient engagement and compliance. Automated, timely delivery through the hospital information system proved effective, while cross-unit collaboration was essential for integrating content and systems. Ethical practices—such as informed consent, data encryption, and role-based access control—strengthened trust in digital services. The quantitative phase surveyed 232 inpatients and outpatients using a Likert-scale questionnaire derived from qualitative results and literature. Structural Equation Modeling (SEM) showed significant effects of message personalization (β=0.318; p<0.001), trust in the hospital (β=0.277; p=0.003), patient compliance (β=0.342; p=0.000), and digital behavior (β=0.364; p=0.035) on strategic health promotion management (R^2=0.587). Data-driven management also supported ethical, technology-based promotion practices (R^2=0.506). These findings highlight the importance of adaptive communication, ethical data governance, and cross-unit collaboration in strengthening hospital-based digital health promotion.

Keywords: digital health data, information ethics, hospital management, health promotion

INTRODUCTION

The development of digital technology has triggered significant transformations in various sectors, including healthcare[1]. Hospitals, as key institutions in the national health system, are not only responsible for curative and rehabilitative services, but also play a strategic role in promotive and preventive activities[2]. Within this framework, health promotion is a key strategy that needs to be implemented adaptively to technological advances[3]. The use of digital patient data has now emerged as a strategic opportunity as well as an ethical challenge that requires proper management by hospital management[4],[5]. The implementation of Electronic Medical Records (EMR) has become a global standard[6], where in developed countries, this system plays a vital role in strategic decision-making, including health communication[7]. In Indonesia, a 2023 report from the Ministry of Health showed that almost half of hospitals had implemented EMR[8], but the use of patient data is generally still limited to administration and medical services, not optimal for personalized, data-driven, and communicative health promotion[9],[10].

In the context of social marketing, hospitals can utilize digital data to deliver health messages tailored to individual characteristics[11],[12]. Social marketing is the application of marketing principles to encourage changes in public behavior towards a healthier lifestyle for the common good[13]. Through analysis of medical history, visit patterns, and examination results, hospitals can build relevant and responsive communications[14]. For example, hypertension patients can receive regular digital reminders regarding diet, exercise recommendations, and routine check-up schedules. This approach is expected to increase patient engagement in managing their health.

Despite its potential, integrating patient data for health promotion still faces challenges in developing countries like Indonesia[15]. Common barriers include limited health data analysis expertise, the absence of internal policies regarding the use of non-clinical data, and a lack of understanding of personal data protection.[16] A 2022 national survey showed that most private hospitals do not yet have standard regulations for the use of digital data in health promotion, despite the growing need for a personalized, technology-based approach.

Ethical aspects are a crucial component in designing data-driven social marketing strategies[17]. Principles such as informed consent, data privacy, accountability for information use, and transparency in communication must be upheld[18]. Without strict ethical implementation, the risk of data misuse and a decline in public trust in hospitals

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

will increase[19]. Therefore, technology-based health promotion strategies must be built on a foundation of ethical integrity[20].

In response to these opportunities and challenges, this study designs a strategic management model for hospital social marketing based on digital patient data, which can be adapted to various types of hospitals, both urban and rural, taking into account technological capacity and organizational culture. This model includes a data collection and integration system, audience segmentation based on clinical and socio-demographic information, adaptive and personalized promotional message design, and ethical data governance policies. By combining strategic management perspectives, health information technology, and social marketing principles, this model is expected to strengthen the role of hospitals as agents of change in public health behavior through data-driven, ethical, and humanitarian-oriented communication strategies.

METHODS

This study employed a mixed-methods approach with a sequential exploratory design. A qualitative case study and a quantitative survey were used to develop and validate a strategic management model for hospital social marketing based on digital patient data. The research was conducted at Siaga Al Munawwarah Hospital, a private hospital in Samarinda that has implemented an EMR system, over six months (September 2024–February 2025).

Qualitative data were obtained through in-depth interviews with 7 purposively selected informants: one health promotion manager, two IT staff, and four medical personnel involved in health promotion. The interview guide, developed by the researcher, was based on three theoretical variable groups: (1) personalization of health messages (patient segmentation, content customization, message effectiveness); (2) inter-unit collaboration and technical challenges (system integration, coordination, technical barriers); and (3) data protection and digital communication ethics (informed consent, access control, information security, ethical perceptions). The guide consisted of flexible open-ended questions designed to explore informants' experiences and practices in digital health promotion. It was contextually developed for the qualitative phase to build foundational insights for constructing the quantitative instrument.

Quantitative data were obtained from a survey of 232 patients (margin of error 5%). Respondents were selected using stratified random sampling based on age (young adults 18-39 years, middle adults 40-59 years, elderly >60 years) and type of service (outpatient and inpatient). The survey instrument was a closed-ended questionnaire originally constructed by the researcher based on the findings of the qualitative phase and related theoretical review. The variables measured included perceptions of message personalization (sub-variables: content relevance, suitability to patient condition), trust in the hospital (sub-variables: data security, transparency, professionalism), adherence to health messages (sub-variables: following digital recommendations, behavioral change), and digital behavior (sub-variables: frequency of reading messages, response to digital reminders). This instrument was developed based on a synthesis of qualitative findings and further developed from concepts in the Technology Acceptance Model and Health Belief Model theories. The validity and reliability of the questionnaire were tested in the initial phase. The link to the qualitative phase lies in confirming the main themes that emerged from the in-depth interviews, which were then translated into measurable indicators in the quantitative instrument. In addition, digital behavioral data is also strengthened by analysis of patient interaction logs on hospital communication systems, which are accessed legally with permission and data security.

Qualitative data were analyzed using thematic analysis using an inductive approach to identify narrative patterns relevant to data-driven health promotion practices. Meanwhile, quantitative data were analyzed using Structural Equation Modeling (SEM) with the aid of SmartPLS 4 software to test the validity of the structural model and the

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

relationships between variables in the digital data-driven health promotion model developed from the results of this study. The model in question is not a standard model or national standard, but rather a conceptual model originally constructed by the researcher based on a synthesis of qualitative and quantitative findings. This model integrates four main variables: message personalization, trust in hospitals, patient compliance, and digital behavior, which collectively influence the effectiveness of strategic management of digital health promotion in hospitals. Therefore, the term "digital data-driven health promotion model" in this article refers to the empirical model resulting from the research, not merely a normative phrase[21]. This research has received ethical approval from the Health Research Ethics Committee with decision letter number: 037/KEPK/STIKES-MM/VII/2024. All informants and respondents provided informed consent before data collection, and data confidentiality was strictly maintained in accordance with the principles of personal data protection and the research code of ethics.

RESULTS

Qualitative Analysis

Table 1. Informant Characteristics (n = 7)

Informant*	Amount	Gender	Age Range (years)	Length of Service (years)	Information
Health Promotion Manager (MPK)	1	1L	45	15	Responsible for the health communication strategy
Information Technology (IT) Staff	2	2L	30-37	5-10	Managing Hospital digital communication and data systems
Doctor (D)	2	1L/1P	33-50	7-20	Involved in patient promotion and education
Nurse (P)	2	1L/1P	28-42	6-12	Providing digital education and reminders

**Interviews were conducted in separate locations*

Based on Table 1, this study involved seven informants: one health promotion manager, two information technology staff, and four medical personnel (two doctors and two nurses) who were selected purposively. The informants' ages ranged from 28 to 50 years, with 5 to 20 years of service. The informants were directly responsible for digital health promotion, including planning communication strategies, managing data systems, and educating patients.

Health Message Personalization Strategy

Personalized messaging is viewed as an effective strategy to increase patient engagement with digital health content. Health promotion managers explained that messages are tailored based on patient segmentation—such as age, service type, and visit history. Medical personnel also confirmed that patients respond better to relevant reminders delivered regularly through the hospital's communication system.

The theme of message personalization emerged from inductive thematic analysis of in-depth interviews. Coding revealed consistent patterns showing that digital health promotion becomes more effective when content is aligned with patient profiles. Segmentation based on age, service type, and visit history was identified as a key basis for personalizing digital messages.Health promotion managers noted the importance of delivering messages that are relevant to the patient's condition:

"We tailor message content based on the patient's age and the services they receive. So, not all messages are sent uniformly."(MPK)

Doctors also acknowledge the effectiveness of messages sent through digital reminder systems:

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

"Patients are more interested if the information provided is relevant to the disease or service they are undergoing."(D1)

The IT team staff stated that the hospital's digital systems have been designed to allow for automated messaging tailored to patients' demographic data and medical history:

"We've set up the system to send automated messages tailored to each patient's profile and needs." (IT1)

These findings formed the key theme of "personalized patient data-driven messaging," which emerged from the informants' lived experiences and not simply from theory testing. This theme served as the basis for developing indicators in the quantitative phase.

Inter-unit Collaboration and Technical Challenges

Cross-unit collaboration is increasingly recognized as essential for enhancing the effectiveness of health promotion campaigns. Information technology staff highlighted the need for seamless integration between the electronic medical record system and the hospital's internal digital communication platform, noting that the main obstacles involve limited system interoperability and inadequate human resource capacity in data management. Despite these challenges, collaboration between IT units and medical services is viewed as critical to ensuring successful educational communication. From the analysis, recurring patterns were grouped into categories such as technical coordination, information system support, and digital human resource capacity, which collectively formed the theme of "cross-unit collaboration." This theme emerged inductively from informants' experiences and narratives, not from predefined sub-variables. IT staff conveyed the challenges of system integration and the importance of cross-unit coordination:

"Our systems aren't fully integrated yet. Sometimes patient data doesn't automatically enter the communication platform."(TI2)

However, cross-unit collaboration is considered to be improving:

"We now routinely coordinate with the medical department so that the data can be more targeted."(TI1)

One nurse stated that coordination with the IT team was helpful in ensuring patients received messages relevant to their medical condition:

"We often discuss with the IT team so that information from medical records can be used as reminders for patient check-up schedules." (P1)

Another nurse added that internal training on the use of digital communication systems was very helpful for medical staff in conveying health information:

"*We are trained to use digital platforms, so now it is easier to send education to patients through the system." (P2)*

A doctor also underscored the importance of technical collaboration in supporting digital patient education:

"If the data is synchronized, we can provide the right education to patients more quickly, directly from the system." (D2)

Thus, this theme is formed through a thematic process based on empirical data and becomes the foundation for formulating indicators in the quantitative stage.

Data Protection and Digital Communication Ethics

Ethical awareness is a key concern when using patient interaction data for evaluation and communication strategy development. Informants emphasized the importance of maintaining data confidentiality and security in all digital health promotion activities by implementing data protection protocols and the principle of informed consent in every interaction.

The theme "patient data protection and digital communication ethics" emerged from inductive thematic analysis, which revealed consistent patterns related to commitment

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

to confidentiality, the use of respectful communication language, and informed consent mechanisms. The coding process yielded categories such as "respectful and educational communication," "restricting data access," "informed consent," and "protecting medical privacy."The health promotion manager said that the digital communication approach always takes into account the values of politeness and confidentiality:

"We always ensure that no patient data is misused. All messages are delivered in polite and educational language." (MPK)

A doctor said that the precautionary principle is always applied when digital information to patients:

"We ensure that the message content does not explicitly mention details of the disease, in order to maintain medical confidentiality." (D1)

The nurse also added:

"We first explain to patients that they will receive health messages, and they can choose whether or not they agree."(P2)

Meanwhile, IT staff explained that the hospital's digital systems had been equipped with multi-layered security:

"We use encryption and restricted access, so only authorized personnel can see and manage patient data." (TI3)

Thus, this theme is not a concept that was determined from the start, but rather was built from the results of narrative exploration of informants and became the basis.compilation indicators at the quantitative stage.

Quantitative Analysis

Table 2. Respondent Characteristics (n = 232)

Variables	Category	Frequency (n)	Percentage (%)
Gender	Man	106	45.7
	Woman	126	54.3
Age	Young Adults < 30 Years	64	27.6
	Middle Adults 30 – 49 Years	97	41.8
	Elderly >50 Years	71	30.6
Type of Service	Outpatient	168	72.4
	Inpatient	64	27.6

Based on Table 2 regarding the characteristics of respondents, 54.3% are women.And45.7% were male. Based on age, respondents were divided into young adults (<30 years) at 27.6%, middle adults (30–49 years) at 41.8%, and elderly (>50 years) at 30.6%. The majority of respondents came from outpatient services (72.4%), while the remainder were inpatients (27.6%).

Evaluation of the Reflective Measurement Model

The results of the reflective measurement model evaluation analysis which describes the results of Outer Loading (λ), Composite Reliability (CR), Croncbah's Alpha (α) and Average Variance Extranced (AVE). Based on Table 3, the results of the measurement model evaluation show that all constructs demonstrate adequate validity and reliability. The outer loading values for all indicators range from 0.72 to 0.91, indicating a strong contribution of each indicator to its construct. Composite Reliability (CR) ranges from 0.88 to 0.92, while Cronbach's Alpha (α) ranges from 0.81 to 0.87, indicating excellent internal consistency. All Average Variance Extracted (AVE) values also meet the criteria, being above 0.50, with a range of 0.69 to 0.76, indicating convergent validity. Thus, all constructs in the model—message personalization, trust in hospitals, adherence to health messages, patient digital behavior, data-driven strategic management, and ethical and technology-based health promotion practices—have proven worthy of further analysis at the structural model evaluation stage.

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Table 3. Results of the Reflective Measurement Model Evaluation Based on Outer Loading, Composite Reliability, Crohn's Alpha, and Average Variance Extranced Values

Variables	Code	Indicator	*Outer Loading (λ)**	*Composite Reliability (CR)* **	*Croncbah's Alpha (α)* ***	*AVE* ****
Personalize Messages (PP)	PP1	Relevance of personal information	0.74 - 089	0.88	0.82	0.70
	PP2	Uniqueness/personal touch				
	PP3	The appeal of private messages				
Trust in Hospitals (KRS)	KRS1	Credibility of information	0.78 – 0.90	0.91	0.85	0.74
	KRS2	Personal data security				
	KRS3	Institutional integrity				
Compliance with Health Messages (KPS)	KPS1	Behavioral compliance	0.72 – 0.87	0.88	0.81	0.69
	KPS2	Lifestyle changes				
	KPS3	Motivational push				
Patient Digital Behavior (PDP)	PDP1	Frequency of engagement	0.76 – 0.88	0.89	0.83	0.71
	PDP2	Digital interaction				
	PDP3	Participation in digital systems				
Data-Driven Strategic Management (MSD - Mediator)	MSD1	Data-Driven Personalization	0.75 – 0.89	0.90	0.84	0.73
	MSD2	Data-Driven Effectiveness				
	MSD3	Precision of Service				
Ethical Health Promotion Practices & Technology (PPK - Output)	PPK1	Communication Ethics	0.79 – 0.91	0.92	0.87	0.76
	PPK2	Technology Accessibility				
	PPK3	Promotional Media Innovation				

* Outer Loading (λ) >0.70;
** Composite Reliability (CR) >0.70;
*** Croncbah's Alpha (α) >0.60;
****Average Variance Extraordinary (AVE) >0.50

Structural Model Evaluation

Structural model evaluation is related to hypothesis testing regarding the influence between research variables. Structural model evaluation is carried out by examining the Inner Variance Inflated Factor (VIF), Path Analysis (β), standard deviation (STDEV), p-value (p), Path coefficient confidence interval (CI 95%), and f-square (f2).

Based on Table 4, all relationships between variables have a VIF value of 1.388–1.510 (below 5), so no multicollinearity problems were found. The path coefficient value of exogenous variables on Data-Based Strategic Management is in the range of 0.277–0.364, with the largest contributions from Patient Digital Behavior (β = 0.364; p = 0.035; f^2 = 0.173) and Compliance with Health Messages (β = 0.342; p = 0.000; f^2 = 0.161), which show a moderate effect and strong significance. Message Personalization (β = 0.318; p = 0.001; f^2 = 0.129) and Trust in Hospitals (β = 0.277; p = 0.003; f^2 = 0.106) also have a significant effect with a low to moderate effect.

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Data-Driven Strategic Management significantly influences Ethical & Technological Health Promotion Practices (β = 0.412; p = 0.013; f² = 0.189). All 95% confidence intervals do not cross zero, confirming the significance of each relationship. Overall, the structural model meets statistical quality criteria and supports the hypothesis that personalization, trust, adherence, and digital behavior contribute significantly to strengthening health promotion practices through data-driven strategic management.

Table 4. Results of Structural Model Evaluation based on Variance Inflated Factor, Path, Standard Deviation, p-value, 95% Path Confidence and f Square values

Hypothesis	*VIF* *	*Path (β)*	*STDEV*	*p-value (p)* **	*Path Confidence (CI95%)*		*f Square* (f2) ***
					Lower Limit	Upper Limit	
Personalize Messages→ Data-Driven Strategic Management (H1)	1,462	0.318	0.074	0.001	0.174	0.453	0.129
Trust in Hospitals→ Data-Driven Strategic Management (H2)	1,388	0.277	0.069	0.003	0.143	0.405	0.106
Compliance with Health Messages→ Data-Driven Strategic Management (H3)	1,401	0.342	0.065	0,000	0.218	0.468	0.161
Patient Digital Behavior→ Data-Driven Strategic Management (H4)	1,427	0.364	0.062	0.035	0.243	0.486	0.173
Data-Driven Strategic Management→ Ethical Health Promotion Practices & Technology (H5)	1,510	0.412	0.070	0.013	0.274	0.538	0.189

* VIF <5;
** p-value <0.05;
***f Square (0.02 low; 0.15 medium, and 0.35 high).

Evaluation of Goodness of Fit and Model Fit

ResultsThe analysis of the goodness of fit and suitability of the model is proven by the R Square value, Q Square value and Standardized Root Mean Residual (SRMR) value as well as the linearity test value, as follows:

Table 5. Results of the Evaluation of the Goodness of Fit and Fit of the Model Based on the Values of R Square, Q Square and Standardized Root Mean Residual

Indicator	*R Square (R2)**	*Q Square (Q2)***	*SRMR****
Data-Driven Strategic Management	0.587	0.421	0.061
Ethical Health Promotion Practices & Technolo	0.506	0.368	

* R Square (0.19 low, 0.33 medium and 0.66 high);
** Q Square (0 is low, 0.25 is medium and 0.50 is high);
*** SRMR < 0.08

Based on Table 5, the Data-Driven Strategic Management variable has an R^2 of 0.587 and a Q^2 of 0.421, indicating good predictive ability and approaching high. The Ethical Health Promotion Practices & Technology variable also shows an R^2 of 0.506 (medium-high category) and a Q^2 of 0.368 (medium category), indicating a strong predictive contribution from the mediating and independent variables. The SRMR value of 0.061, which is below the threshold of 0.08, confirms that the model has a good global fit and is suitable for use in structural testing.

Based on Table 6, the Quadratic effect test, most of the relationships between variables in the research model showed a linear pattern, which is indicated by a p-value > 0.05. Specifically, the relationship between Message Personalization and Data-Based

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

Strategic Management (p = 0.187), Trust in Hospitals and Data-Based Strategic Management (p = 0.320), and Patient Digital Behavior and Data-Based Strategic Management (p = 0.394) did not show a significant quadratic effect, which means the relationship between these variables is linear.

However, there are two relationships that show a significant positive quadratic effect, namely from Compliance with Health Messages to Data-Based Strategic Management (β= 0.102; p = 0.011) and from Data-Driven Strategic Management to Ethical & Technological Health Promotion Practices (β = 0.147; p = 0.002). This finding indicates that at certain variable levels, the relationship can increase non-linearly and needs to be taken into account in the development of technology-based health promotion strategies.

Table 6. Results of the Evaluation of the Goodness of Fit and Fit of the Model Based on the Quadratic Effect Linearity Test Values

Quadratic Effect (QE)	*Path Coefficient*	*p-value**	Information
Personalize Messages→Data-Driven Strategic Management	0.063	0.187	Not significant – The relationship remains linear
Trust in Hospitals→Data-Driven Strategic Management	-0.029	0.320	Not significant – No quadratic effect
Compliance with Health Messages→Data-Driven Strategic Management	0.102	0.011	Significant – There is a positive quadratic effect
Patient Digital Behavior→Data-Driven Strategic Management	0.022	0.394	Not significant – The relationship remains linear.
Data-Driven Strategic Management→Ethical Health Promotion Practices & Technology	0.147	0.002	Significant – There is a positive quadratic effect.

* p-value > 0.05

DISCUSSION

This study confirms that the effectiveness of digital health promotion in hospitals is greatly influenced by personalized communication strategies, where segmenting messages based on age, type of service, and medical history has been shown to increase patient engagement and compliance, especially if messages are delivered automatically and in a timely manner through the hospital information system, in line with the Elaboration Likelihood Model which emphasizes the importance of message matching with recipient characteristics to encourage in-depth processing and behavior change[22], and supported by evidence that clinical data-driven personalization strengthens the effectiveness of digital health interventions and the patient-care relationship. The success of this strategy depends strongly on cross-unit collaboration, especially between information technology and medical services. Although integrating electronic medical records with digital communication platforms poses technical challenges, regular coordination and capacity building can enhance data synchronization and the availability of patient education materials. Data protection and information ethics also form the core of patient trust. Clear consent procedures, encryption, and role-based access controls help minimize data breach risks, aligning with the Health Information Privacy Framework, which prioritizes transparency and information security[23].[24]. Statistical analysis confirmed the qualitative findings that the integration of message personalization, trust in the institution, patient compliance, and digital behavior significantly increased the effectiveness of digital health promotion, in line with the Technology Acceptance Model (TAM) and the Health Belief Model (HBM) which view perceived usefulness and institutional credibility as the main determinants of positive

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

patient responses[25], [26]Personalization serves as a key driver of communication effectiveness, while patient digital behavior drives the formation of data-driven strategic management and reflects the shift in the patient's role from passive recipients to active partners in healthcare services, as emphasized by the theory of co-production of health services[27], [28]. Every digital interaction generates strategic data that enables more targeted interventions, and patient adherence to health messages increases data validity and decision-making accuracy, in line with the Theory of Planned Behavior, which positions intention and adherence as strong predictors of actual behavior[29], [30], [31].

The results of the study indicate a non-linear dynamic between variables, where increasing factors such as patient compliance can have a multiplier effect on the effectiveness of promotional strategies. These findings reflect the nature of a complex adaptive system influenced by the interaction of technology, human resources, and patient behavior. Therefore, hospital management strategies need to be flexible, based on real-time data, and responsive to behavioral changes. The synthesis of qualitative and quantitative data also confirms that message personalization, cross-unit collaboration, trust in the system, and data protection play a role in building effective, ethical, and sustainable health promotion. This is in line with behavioral and information management theories and provides a practical basis for more humanistic, technology-based healthcare innovations.

This study contributes significantly to strengthening digital health promotion in hospitals by analyzing factors influencing patient engagement and adherence. Using a sequential, exploratory mixed methods approach, the study combines qualitative and quantitative findings and integrates the theories of TAM, HBM, TPB, and the concept of co-production. The results indicate that the effectiveness of digital communication is influenced by ease of use of the technology, risk perception, patient confidence and participation, and personalized content tailored to individual characteristics. Successful implementation also depends on organizational readiness, including digital infrastructure, cross-divisional collaboration, and data protection. Hospitals need to increase human resource capacity, form cross-sector teams, and establish information security-based operating standards to ensure a sustainable system and build patient trust. These findings underscore the shift in the role of hospitals toward providing data-driven healthcare that is adaptive, proactive, and oriented toward patient quality of life.

However, this study has limitations, such as the sequential qualitative-quantitative methods so that changes in digital behavior are not recorded in real-time, the use of perception instruments that have the potential to cause social bias, a single context that limits generalization, and the integration of EMR and digital platforms that is not yet fully automated so that evidence of long-term impacts on service efficiency and data security is still limited.

CONCLUSION

This study concludes that message personalization, trust in healthcare institutions, patient compliance, and digital behavior are key factors in strengthening the strategic management of data-driven health promotion in hospitals. These four factors work in tandem to create ethical, technologically advanced, and patient-centered health promotion. Hospitals are advised to develop digital promotion strategies that combine personalized messages with secure and responsive information systems, supported by cross-unit collaboration, particularly between IT and medical teams. Strengthening real-time data management is also necessary to monitor patient digital behavior. Furthermore, developing standard operating procedures (SOPs) that guarantee data protection and ethics, as well as ongoing training for human resources, are crucial steps to ensure the effectiveness and sustainability of digital health promotion that focuses on patient quality of life.

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

REFERENCES

[1] Y. YahiaMarzouk, "Digital transformation in the healthcare sector: a novel strategic perspective," *J Health Organ Manag*, vol. 39, no. 3, pp. 1–18, Apr. 2025, doi: 10.1108/JHOM-08-2024-0349.

[2] D. Skempes, C. Kiekens, A. Malmivaara, X. Michail, J. Bickenbach, and G. Stucki, "Supporting government policies to embed and expand rehabilitation in health systems in Europe: A framework for action," *Health Policy (New York)*, vol. 126, no. 3, pp. 158–172, Mar. 2022, doi: 10.1016/j.healthpol.2021.06.014.

[3] N. F. Alias and R. A. Razak, "Revolutionizing learning in the digital age: a systematic literature review of microlearning strategies," *Interactive Learning Environments*, vol. 33, no. 1, pp. 1–21, Jan. 2025, doi: 10.1080/10494820.2024.2331638.

[4] K. Hameed, R. Naha, and F. Hameed, "Digital transformation for sustainable health and well-being: a review and future research directions," *Discover Sustainability*, vol. 5, no. 1, p. 104, May 2024, doi: 10.1007/s43621-024-00273-8.

[5] J. Sattar, "Navigating the Grey Area: Legal Frameworks for Digital Health Monitoring & Use of AI for Elderly Patients in the Nordics," *International Journal of Technology and Emerging Sciences (*, vol. 4, no. 1, pp. 1–18, 2024.

[6] N. S. Yadav and V. K. Goar, "IoT in Healthcare and Telemedicine: Revolutionizing Patient Care and Medical Practices," in *IGI Global*, 1st ed., Bikaner: IGI Global, 2024, ch. 2, pp. 19–58. doi: 10.4018/979-8-3693-1686-3.ch002.

[7] Md. K. Hossain, J. Sutanto, P. W. Handayani, A. A. Haryanto, J. Bhowmik, and V. Frings-Hessami, "An exploratory study of electronic medical record implementation and recordkeeping culture: the case of hospitals in Indonesia," *BMC Health Serv Res*, vol. 25, no. 1, p. 249, Feb. 2025, doi: 10.1186/s12913-025-12399-0.

[8] M. M. Elsangidy, N. S. Farag, salman Rawaf, and N. F. Ibrahim, "Electronic Medical Records: Evolution, Usability, Challenges, and Trends in Health Care Settings," *Medicine Updates*, vol. 22, no. 22, pp. 45–60, Jul. 2025, doi: 10.21608/muj.2025.355128.1202.

[9] Z. Rashid, H. Ahmed, N. Nadeem, S. B. Zafar, and M. Z. Yousaf, "The paradigm of digital health: AI applications and transformative trends," *Neural Comput Appl*, vol. 37, no. 8, p. 1, Mar. 2025, doi: 10.1007/s00521-025-11081-0.

[10] M. Song, J. Elson, and D. Bastola, "Digital Age Transformation in Patient-Physician Communication: 25-Year Narrative Review (1999-2023)," *J Med Internet Res*, vol. 27, p. e60512, Jan. 2025, doi: 10.2196/60512.

[11] Onyekachukwu Victor Unanah and Olu James Mbanugo, "Integration of AI into CRM for Effective U.S. healthcare and pharmaceutical marketing," *World Journal of Advanced Research and Reviews*, vol. 25, no. 2, pp. 609–630, Feb. 2025, doi: 10.30574/wjarr.2025.25.2.0396.

[12] K. Djakeli, "Healthcare Marketing, Meaning, Historical Development, Applications, and Current Status," 2023, pp. 1–25. doi: 10.4018/979-8-3693-0679-6.ch001.

[13] A. Bastos, T. Veludo-de-Oliveira, M. Yani-de-Soriano, M. Atalla, and B. Gualano, "Leveraging macro-social marketing to achieve sustainable development goals: a city-wide intervention addressing obesity in Brazil," *J Soc Mark*, vol. 12, no. 1, pp. 29–48, Jan. 2022, doi: 10.1108/JSOCM-09-2020-0187.

[14] P. Mishra and G. Singh, "Internet of Medical Things Healthcare for Sustainable Smart Cities: Current Status and Future Prospects," *Applied Sciences*, vol. 13, no. 15, p. 8869, Aug. 2023, doi: 10.3390/app13158869.

[15] L. Putri, E. Girsang, I. Lister, H. Kung, E. Kadir, and S. Rosa, "Public Health Implications for Effective Community Interventions Based on Hospital Patient Data Analysis Using Deep Learning Technology in Indonesia," *Information*, vol. 15, no. 1, p. 41, Jan. 2024, doi: 10.3390/info15010041.

https://doi.org/10.34011/jmp2k.v35i4.3159

e-ISSN: 2338-3445
p-ISSN: 0853-9987

[16] H. Zainal, X. Xiao Hui, J. Thumboo, and F. Kok Yong, "Organizational Leaders' Views on Digital Health Competencies in Medical Education: Qualitative Semistructured Interview Study," *JMIR Med Educ*, vol. 11, p. e64768, Mar. 2025, doi: 10.2196/64768.
[17] M. J. Pour and S. A. Emami, "Designing an Integrated Methodology for Data- Driven Marketing Strategic Planning," in *2023 9th International Conference on Web Research (ICWR)*, IEEE, May 2023, pp. 289–293. doi: 10.1109/ICWR57742.2023.10139064.
[18] S. Temara, "Ethics for Responsible Data Research," 2024, pp. 103–144. doi: 10.4018/979-8-3693-3848-3.ch005.
[19] P. Goktas and A. Grzybowski, "Shaping the Future of Healthcare: Ethical Clinical Challenges and Pathways to Trustworthy AI," *J Clin Med*, vol. 14, no. 5, p. 1605, Feb. 2025, doi: 10.3390/jcm14051605.
[20] D. Bevere and N. Faccilongo, "Shaping the Future of Healthcare: Integrating Ecology and Digital Innovation," *Sustainability*, vol. 16, no. 9, p. 3835, May 2024, doi: 10.3390/su16093835.
[21] J. F. Hair, J. J. Risher, M. Sarstedt, and C. M. Ringle, "When to use and how to report the results of PLS-SEM," *European Business Review*, vol. 31, no. 1, pp. 2–24, Jan. 2019, doi: 10.1108/EBR-11-2018-0203.
[22] D. H. Permata, E. M. M. Mahadi, I. Poerwaningtias, and M. A. Iswandiariwati, "Komunikasi Persuasi melalui Media Sosial Instagram," *Jurnal Communio : Jurnal Jurusan Ilmu Komunikasi*, vol. 14, no. 1, pp. 1–13, Jan. 2025, doi: 10.35508/jikom.v14i1.9631.
[23] A. Prima, D. Gayatri, Y. Afiyanti, and C. Effendy, "Remote Patient Monitoring Pada Pasien Kanker: Analisis Konsep," *Media Kesehatan Politeknik Kesehatan Makassar*, vol. 20, no. 1, pp. 192–206, Jun. 2025, doi: 10.32382/medkes.v20i1.1424.
[24] S. Sofia, E. T. Ardianto, N. Muna, and S. Sabran, "Analisis Aspek Keamanan Informasi Data Pasien Pada Penerapan RME di Fasilitas Kesehatan," *Jurnal Rekam Medik & Manajemen Informasi Kesehatan*, vol. 1, no. 2, pp. 94–103, Oct. 2022, doi: 10.47134/rmik.v1i2.29.
[25] D. Jairam, S. K S, and S. Nayak, "Embracing smart wellness: Exploring perceptions of preventive healthcare technology in the digital era," *F1000Res*, vol. 14, p. 125, Apr. 2025, doi: 10.12688/f1000research.160126.2.
[26] A. Rahman and J. Uddin, "Revealing Factors Influencing mHealth Adoption Intention Among Generation Y: An Empirical Study Using SEM-ANN-IPMA Analysis," *Digital*, vol. 5, no. 2, p. 9, Mar. 2025, doi: 10.3390/digital5020009.
[27] A. Kozak, "Macroenvironmental factors favouring the co-production of social and healthcare services for seniors in Poland," *International Journal of Public Sector Management*, vol. 38, no. 3, pp. 373–389, Mar. 2025, doi: 10.1108/IJPSM-05-2023-0154.
[28] J. Amorim and A. C. Ventura, "Co-created decision-making: From co-production to value co-creation in health care," *The Journal of Medicine Access*, vol. 7, Jan. 2023, doi: 10.1177/27550834231177503.
[29] T. A. Alameraw *et al.*, "Intention to use telemonitoring for chronic illness management and its associated factors among nurses and physicians at public hospitals in Bahir Dar, northwest Ethiopia: using a modified UTAUT2 model," *Frontiers in Health Services*, vol. 5, Mar. 2025, doi: 10.3389/frhs.2025.1460077.
[30] S. Lin *et al.*, "Development and psychometric evaluation of beliefs about the orthokeratology lens compliance scale (BOLCS): Based on the theory of planned behavior," *Contact Lens and Anterior Eye*, vol. 48, no. 1, p. 102186, Feb. 2025, doi: 10.1016/j.clae.2024.102186.
[31] R. Zhao, X. Zhang, S. Wang, N. Zhao, D. Li, and H. Fan, "Factors affecting T2DM patients' behaviors associated with integrated treatment and prevention services in China," *Int J Equity Health*, vol. 22, no. 1, p. 223, Oct. 2023, doi: 10.1186/s12939-023-02028-9.

https://doi.org/10.34011/jmp2k.v35i4.3159