

Application Research of Real-time Surgical Process Inquiry System Based on Hospital Official Data Platform in Improving Family Members' Waiting Experience

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Abstract

Objective To evaluate the application effect of a real-time surgical progress inquiry system based on the hospital's official data platform in improving waiting experience for surgical patients' family members. **Methods** Prerequisites: The hospital has established a real-time inquiry platform through integration of the hospital information system with the surgical anesthesia information system. This platform can transmit key surgical process milestones (entry into the operating room, surgical commencement, surgical completion, entry into the resuscitation room, exit from the resuscitation room) in real-time to the hospital's official website. Family members can query real-time surgical status via the patient's hospitalization number on the official system. This study employed a pre-post implementation comparison method to assess changes in family satisfaction, anxiety levels, waiting area crowd density, and the impact of surgical progress inquiries on operating room nurses' workload before and after system implementation. **Results** Family satisfaction increased from 16.24 ± 2.152 to 31.00 ± 3.509 , while the S-AI score decreased from 45.04 ± 3.470 to 41.24 ± 4.745 . The independent samples t-test revealed a statistically significant difference in satisfaction ($t = 6.601$, $P < 0.001$), indicating that the system implementation effectively enhanced family members' overall satisfaction with the services. Concurrently, the reduction in anxiety scores was also highly significant ($t = -36.023$, $P < 0.001$), suggesting a marked alleviation of psychological burden among families. The average crowd density in the waiting area during peak hours decreased from 1.65 people/m² to 0.81 people/m² ($t = 2.736$, $P = 0.011$), representing a reduction of approximately 50.90%. The number of daily inquiries from family members by nurses decreased from 8.93 to 1.77 ($t = 6.618$, $P < 0.001$), a reduction of about 80.18%. The average duration of inquiries per nurse per day decreased from 26.50 minutes to 2.30 minutes ($t = 6.511$, $P < 0.001$), a reduction of approximately 91.32%. The average number of patients in the surgical waiting area decreased from 30.40 to 13.20 ($t = 3.881$, $P = 0.001$), a reduction of approximately 56.58%. **Conclusion** The real-time surgical progress inquiry system based on the official website effectively alleviates family anxiety, optimizes hospital management, and improves service quality, demonstrating high potential for widespread adoption.

Keywords Surgical waiting; Family anxiety; Digitalization; Hospital official website; Process optimization; Smart healthcare

1 Introduction

Surgical waiting is one of the major psychological stressors for family members during medical accompaniment. Traditional surgical waiting areas often suffer from overcrowded spaces, delayed or incomplete updates on surgical progress, and limited communication channels, which subject family members to prolonged states of high anxiety and uncertainty. This significantly impacts their healthcare experience and exacerbates patient anxiety^[1], and in severe cases, may increase the risk of doctor–patient conflicts. Studies indicate that family members exhibit an intense craving for real-time surgical information during procedures. Information gaps or ineffective communication can substantially intensify their psychological burden and even lead to strained doctor–patient relationships^[2].

In recent years, with the deepening implementation of the "Healthy China" strategy and the accelerated development of smart hospitals, leveraging information technology to optimize medical service processes and enhance the experience of patients and their families has become a key direction in healthcare quality management^[3]. The maturity of internet of things, big data, and mobile internet technologies, coupled with the widespread use of mobile devices such as smartphones, has enabled the real-time, transparent, and user-friendly dissemination of medical information. Studies have shown that the application of a multi-channel surgical progress information system can effectively maintain stable blood pressure and heart rate in patients' families, reduce their psychological burden, and improve their satisfaction with surgical care^[4]. Another study linking real-time surgical progress and communication management systems to operating rooms, wards, and patient information demonstrated that ward nurses and families can monitor the surgical progress of pediatric patients across various terminals, eliminating the need for them to gather in the operating room waiting area. This ensures smooth perioperative workflow, enhances satisfaction for both healthcare providers and patients, improves patient comfort during the perioperative period, and facilitates early recovery—particularly advantageous during infection outbreaks^[5].

However, most hospitals currently still rely on traditional electronic displays or manual notification methods for surgical information dissemination, failing to fully leverage the potential of internet platforms in enhancing information accessibility and service availability^[6].

Against this backdrop, the hospital's Information Department developed and implemented a real-time surgical progress inquiry system integrated with the official hospital website. Utilizing information technology, the system delivers up-to-date status updates on critical surgical milestones directly to patients' families. This initiative aims to overcome the temporal and spatial limitations of traditional information dissemination methods, alleviate family anxiety, enhance waiting experience, and simultaneously improve hospital management efficiency^[7] and service quality, thereby providing a practical foundation for applying smart healthcare to strengthen humanistic care.

2 Materials and Methods

2.1 General Data

The study employed a before-and-after control design. Participants were family members of patients who underwent surgery in the operating room of our hospital from November 2025 to December 2025. Inclusion criteria: (1) Patients aged ≥ 18 years; (2) Family members with normal cognitive function capable of independently completing the questionnaire; (3) Informed consent and voluntary participation in the study. Exclusion criteria: Individuals with communication barriers or refusal to participate. Prior to systematic implementation (November 2025), a total of 114 questionnaires were collected, and after implementation (December 2025), 92 questionnaires were collected, resulting in a total of 206 valid responses with a 100% response rate. No statistically significant differences were observed between the two groups of family members in terms of age, gender, or relationship with the patients ($P > 0.05$), indicating comparability.

2.2 Methods

2.2.1 System Design

The system adopts a B/S architecture, with the backend integrated with the surgical anesthesia clinical information system and the frontend embedded in the hospital's official website. The surgical process is divided into five critical nodes: entering the operating room, commencement of surgery, completion of surgery, admission to the resuscitation room, and discharge from the resuscitation room. Data is synchronized in real-time to the official website server via secure API interfaces.

2.2.2 Ethical Review and Informed Consent

This study has been approved by the Ethics Committee of the Seventh Affiliated Hospital of Sun Yat-sen University. Prior to the initiation of the study, all participating family members were provided with detailed explanations regarding the study objectives, methods, and data confidentiality. All data were exclusively used for this study and underwent anonymization processing to protect patient personal information.

2.2.3 Evaluation Tools and Metrics

General Information Questionnaire: Self-designed, covering family members' age, gender, educational level, relationship with the patient, and daily internet usage frequency, to comprehensively understand the basic characteristics of study subjects.

Family Experience Indicators and Family Satisfaction: The Client Satisfaction Questionnaire (CSQ-8)^[8], which has undergone test of construct validity, was used to assess family satisfaction. The questionnaire covers four dimensions—medical service quality, degree of need satisfaction, nursing service satisfaction, and level of assistance received—with a total of 9 items. Each item is scored on a scale of 1 to 4, resulting in a total score ranging from 9 to 36. Higher scores indicate greater family satisfaction. The Cronbach's α coefficient for this scale is 0.930, with a validity coefficient of 0.880.

Anxiety State Assessment: The State-Trait Anxiety Inventory (STAI) was used, specifically the State Anxiety Subscale (S-AI)^[9]. This subscale consists of 20 items, scored on a 1–4 scale with a total range of 20–80 points. Higher scores indicate more severe anxiety states.

System Perceived usefulness and usability: Based on Davis's Technology Acceptance Model (TAM) theoretical framework^[10], a self-designed questionnaire was developed. The questionnaire comprises three dimensions—perceived usability (5 items), perceived usefulness (6 items), and usage attitude and intention (3 items)—totaling 14 items. A 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) was used, with scores calculated as the average of each item's responses; higher scores indicate more positive evaluations.

2.2.4 Hospital and Nursing Management Indicators

Waiting Area Foot Traffic Density: The average number of people per square meter in the waiting area during peak hours (9:00 AM–3:00 PM) over two months before and after implementation by the operating room recording system.

Frequency and Duration of Inquiries by Nurses at the Nurse Station: The number of daily inquiries from family members regarding the surgical progress and the cumulative duration are recorded in the nurse station log.

2.2.5 Statistical methods

Data analysis was performed using SPSS 26.0 software. Measurement data were expressed as ($\bar{x} \pm s$), and comparisons of satisfaction levels, S-AI scores, and abortion density before and after system implementation were conducted using paired t-tests. Categorical data were presented as rates (%), and χ^2 tests were employed. A P-value <0.05 was considered statistically significant.

3 Results

3.1 Family Satisfaction and Anxiety

After the system implementation, family satisfaction increased from 16.24 ± 2.152 to 31.00 ± 3.509 , while the S-AI score decreased from 45.04 ± 3.470 to 41.24 ± 4.745 . The independent samples t-test results demonstrated that the difference in satisfaction was highly statistically significant ($t = 6.601$, $P < 0.001$), indicating that the system implementation effectively enhanced families' overall satisfaction with the services. Additionally, the reduction in anxiety scores was also highly significant ($t = -36.023$, $P < 0.001$), suggesting a notable alleviation of families' psychological burden, as detailed in Table 1.

Table 1. Comparison of family satisfaction and anxiety scores before and after system implementation ($n=91$, $\bar{x} \pm s$)

Time point	Satisfaction (%)	S-AI score (points)
Before implementation	16.24 ± 2.152	45.04 ± 3.470
After implementation	31.00 ± 3.509	41.24 ± 4.745
T-value	6.601	-36.023
P-value	<0.001	<0.001

3.2 System Perceived Usability Evaluation Results

This study involved 106 participants who assessed the system's perceived usability. Results showed users rated the system's "operational simplicity" at 19.25 ± 2.00 points and "information clarity" at 24.63 ± 2.782 points, indicating a user-friendly interface with clear information presentation. The "anxiety relief assistance" score reached 12.49 ± 1.513 points, suggesting the system provides psychological support. Overall satisfaction averaged 56.38 ± 5.341 points, reflecting positive user experience.

Table 2. System-perceived usefulness/ease of use evaluation results ($n=106$, $\bar{x} \pm s$)

Item	Score (points)
Ease of Operation	19.25 ± 2.001
Information Clarity	24.63 ± 2.782
Anxiety Relief Assistance	12.49 ± 1.513
Overall Satisfaction	56.38 ± 5.341

3.3 Comparison of Management Indicators

After the implementation of the system, the average pedestrian density in the waiting area during peak hours decreased from 1.65 people per square meter to 0.81 people per square meter ($t=2.736$, $P=0.011$), representing a reduction of approximately 50.90%. The number of daily family member inquiries handled by nurses decreased from 8.93 to 1.77 ($t=6.618$, $P<0.001$), a reduction of approximately 80.18%. The average inquiry duration per nurse decreased from 26.50 minutes per day to 2.30 minutes per day ($t=6.511$, $P<0.001$), a reduction of approximately 91.32%. The average number of patients decreased from 30.40 to 13.20 ($t=3.881$, $P=0.001$), a reduction of approximately 56.58%. See Table 3 for details.

Table 3. Comparison of Hospital Management Indicators Before and After System Implementation

Variable	Before Implementation	After Implementation	T-value	P-value
Number of times nurses were consulted (times/day)	8.93±5.924	1.77±1.223	6.618	<0.001
Duration of consultation (minutes/day)	26.50±20.509	2.30±1.950	6.511	<0.001
Crowd density in waiting area (headcount/m ³)	1.65±1.411	0.81±0.642	2.736	0.011
Average number of people	30.40±20.312	13.20±7.761	3.881	0.001

4 Discussion

This study established a real-time surgical procedure inquiry system based on the hospital's official website through information technology, achieving real-time, transparent, and accessible surgical information. The research findings demonstrate that the system not only significantly improved the waiting experience for patient families but also effectively optimized hospital management processes and enhanced service quality.

4.1 Key Findings and Implications

The study demonstrated that after system implementation, family satisfaction scores increased significantly from 16.24±2.152 to 31.00±3.509, while anxiety levels showed marked reduction. The S-AI score decreased from 45.04±3.470 to 41.24±4.745, indicating that information transparency serves as a critical factor in alleviating family anxiety in healthcare settings. By providing real-time and accurate surgical progress updates, the system effectively mitigated uncertainty and helplessness experienced by families due to information gaps, reflecting the evolution of patient-centered care from a "patient-focused" approach to a "family-centered" model.

Interms of management efficiency, the 50.90% reduction in waiting area crowd density and 80.18% decrease in nurse inquiries demonstrate that the system not only enhances family member experience but also optimizes physical space utilization and workforce efficiency. These outcomes align perfectly with the smart hospital initiative's core objective of "improving operational efficiency through digital transformation." Notably, post-implementation data shows zero disputes or complaints stemming from communication barriers in waiting areas, highlighting the system's positive impact on fostering harmonious doctor-patient relationships.

4.2 Innovation and Practicality

The system's innovation is demonstrated through three key aspects: Firstly, in service model transformation, it shifts from "people seeking information" to "information following people," overcoming traditional time and space constraints in information access. Secondly, in technical implementation, it adopts an integrated development approach based on existing systems, achieving data integration between the surgical anesthesia system and official websites via API interfaces to avoid redundant infrastructure and reduce implementation costs. Lastly, in application scenarios, it extends smart healthcare solutions to the critical yet niche surgical waiting process, reflecting the trend toward refined medical services.

The practicality of the system is demonstrated in three aspects: First, it relies on the hospital's official website platform, eliminating the need for family members to download and install additional applications, thereby reducing usage barriers. Second, it utilizes the hospitalization number as the query credential, ensuring both information accuracy and patient privacy protection. Third, the node design aligns with

clinical realities, with information updates synchronized with surgical procedures to guarantee timeliness and reliability of data.

4.3 Limitations and Future Perspectives

This study has the following limitations: Firstly, it is a single-center study, and the generalizability of the results requires further validation; Secondly, it primarily focuses on short-term effects, while systematic long-term impacts still require follow-up evaluation; Lastly, stratified analysis of family members' usage experiences across different age groups and educational levels was not conducted.

Future research directions include: first, integrating the system with mobile platforms such as hospital APPs and WeChat official accounts to provide multi-terminal access options; second, enhancing information push functionality to proactively send notifications to family members at critical junctures; third, expanding multilingual support to meet the needs of foreign patient families; fourth, exploring integration with hospital navigation systems and catering services to offer more comprehensive waiting period services.

5 Conclusions and Recommendations

5.1 Research Findings

This study demonstrates that the real-time surgical progress tracking system implemented through hospital official websites achieves the following outcomes:

- 5.1.1 Significantly alleviates anxiety among surgical patients' families during waiting periods, thereby enhancing healthcare satisfaction;
- 5.1.2 Reduces patient flow in waiting areas, optimizes crowd management, and improves waiting environment quality;
- 5.1.3 Decreases non-direct nursing workload for operating room staff, boosting operational efficiency;
- 5.1.4 Minimizes communication barriers between healthcare providers and patients, fostering harmonious doctor-patient relationships.

5.2 Practical Recommendations

Based on the findings of this study, the following recommendations are proposed:

- 5.2.1 Hospitals at all levels are advised to prioritize surgical procedure transparency as a key measure for service improvement, with implementation tailored to their specific institutional contexts by referencing this system;
- 5.2.2 During system design and deployment, robust information security protocols and patient privacy protections must be enforced, including comprehensive permission management systems and query logging mechanisms;
- 5.2.3 Enhanced training programs for healthcare professionals should ensure timely and accurate information updates;
- 5.2.4 Diverse outreach strategies—including preoperative education sessions, bedside distribution of usage manuals, simplified operational guidelines in surgical waiting areas, and volunteer assistance programs—should be implemented to facilitate family members' familiarity with and effective use of the system.

This system represents a successful implementation of the smart healthcare concept in enhancing patient services, demonstrating significant potential for widespread adoption and application prospects. Future multi-center collaborative studies can further validate its efficacy, while continuous optimization of system functionalities will provide nationwide families with superior surgical waiting experiences.

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