

Research on Optimizing Pre-Hospital Response Time and Resource Allocation for an Internet-Plus-Based Emergency Medical Platform

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Abstract

To investigate the role of an Internet-Plus-Based smart emergency platform in reducing pre-hospital Medical Priority Dispatch System (MPDS) response time and optimizing dynamic allocation of emergency resources, providing evidence-based support for enhancing emergency care efficiency, a mixed approach was employed including: (1) Quantitative analysis: Comparing response time and dispatch efficiency data ($n=12,358$ cases) from six months before and after the launch of an Internet-based emergency platform in a city (July 2024–June 2025); (2) Qualitative research: Conducting semi-structured in-depth interviews with 30 pre-hospital emergency nurses and 10 dispatchers, using Colaizzi's phenomenological analysis method to extract themes and analyze platform application pain points and improvement directions. The study showed that following platform implementation: Average dispatch response time (from call receipt to vehicle dispatch) decreased from (92.5 ± 15.8) seconds to (38.2 ± 9.4) seconds ($t=15.324$, $P<0.001$); and average dispatch response time (from assignment to departure) decreased from (135.6 ± 20.1) seconds to (98.7 ± 14.5) seconds ($t=8.912$, $P<0.001$) dramatically in respective. Meanwhile, resource allocation: The proportion of cross-regional collaborative ambulance assignments increased from 15.7% to 28.9% ($\chi^2=210.5$, $P<0.001$). The “resource misallocation rate” (e.g., dispatching non-critical cases to critical care units) based on platform AI triage decreased from 12.5% to 5.8% ($\chi^2=95.7$, $P<0.001$). Besides, nurse satisfaction with “intelligent triage guidance” and “dynamic route planning” functions reached 92%. In conclusion, in the era of Internet Plus and AI, the smart emergency platform integrates data and enables intelligent decision-making, significantly optimizing pre-hospital response workflows and resource allocation efficiency. This represents a core implementation pathway for “Internet Plus Emergency Nursing” and holds significant implications for improving pre-hospital

emergency response time. Therefore, future efforts should be focused on balancing technological empowerment with humanistic care while strengthening nurses' information literacy training.

Keywords: internet plus, smart emergency platform, emergency nursing, pre-hospital emergency response time, resource allocation

1. Introduction

Pre-hospital emergency care represents a critical window for survival in patients with life-threatening conditions. Response time directly impacts patient outcomes, making enhanced emergency management a vital component of pre-hospital care (Romanchuk, 2025). The World Health Organization (WHO) notes that for every minute of delay in treating cardiac arrest patients, survival rates decrease by 7%-10% (Perkins *et al.*, 2021). However, traditional emergency models suffer from limitations such as single-source information, distorted dispatch data, traffic congestion, insufficient coverage of emergency stations, non-critical patients occupying critical care resources, dispatch reliance on manual experience, and information gaps between ambulances and hospitals (Huang *et al.*, 2020). These issues lead to response delays and resource misallocation (Andersson *et al.*, 2006). International studies indicate that unpredictable emergency scenarios present increasing clinical decision-making challenges. Constrained by cultural contexts, these studies reveal the complexity of pre-hospital emergency decision-making from diverse perspectives (Bijani *et al.*, 2021). Additionally, densely populated areas, traffic congestion, and inadequate infrastructure contribute to delayed emergency responses, underscoring the urgent need to optimize pre-hospital emergency services (Nasr Isfahani *et al.*, 2024). Recommendations include increasing the number of emergency bases and ambulances, optimizing resource allocation, and enhancing personnel training to reduce response time. Emphasis is also placed on establishing more precise time-based standards to improve rescue response time (Chegini *et al.*, n.d.). This aligns with international theories and practices on “shortening response time through optimized pathways.” The related studies indicate that implementing new centralized emergency models reduces patient mortality while shortening hospital stays, thereby lowering treatment costs (Hunter *et al.*, 2013).

Driven by the rapid advancement of mobile Internet, big data, artificial intelligence, and other technologies, alongside the policy initiatives of “Healthy China 2030” and “Internet Plus Healthcare,” the deep integration of “Internet Plus” with healthcare offers new approaches to addressing these challenges. In particular, smart emergency platforms have emerged as a key breakthrough. Existing research indicates that 5G-enabled smart emergency platforms can significantly enhance pre-hospital emergency care efficiency and quality through real-time information interconnection and remote collaboration (Xiang *et al.*, 2023). Technological support such as 5G, the Internet of Things (IoT), and AI algorithms enabling patient location tracking, intelligent triage, and dynamic route planning all represent emerging trends. Leveraging smart phone GPS positioning, crowd sourced volunteer networks, and advanced algorithms can establish a more intelligent, efficient, and transparent emergency response ecosystem (DeVito *et al.*, 2018). From a nursing perspective, this platform significantly

advances the starting point of emergency care interventions from “arrival at the scene” to “the moment the emergency call is answered.” It enables nurses to gain valuable preparation time through predictive information and empowers them to make more precise clinical decisions (Cone & Murray, 2002).

2. Research Methodology

2.1 Research Design

A mixed approach combining retrospective cohort research with descriptive phenomenological analysis (Qualitative) was employed to compare response time and dispatch efficiency metrics between the Internet-based smart emergency platform (January 2025–June 2025) and traditional models (July 2024–December 2024). Purposeful sampling was used to select emergency nurses and dispatchers for semi-structured in-depth interviews.

2.2 Study Population

Quantitative Component: All emergency call event data ($n=12,358$ events) from a municipal emergency center database between July 1, 2024, and June 30, 2025, were selected. Using the January 1, 2025, launch of the Internet-based emergency platform as the cutoff point, the first six months constituted the pre-intervention group ($n=6,102$ emergency calls), and the subsequent six months formed the post-intervention group ($n=6,256$ emergency calls).

Qualitative Component: Purposeful sampling was employed to select 40 staff members for in-depth interviews, including 30 pre-hospital emergency nurses (12 male, 18 female); mean tenure (8.4 ± 3.2) years and 10 dispatchers. All interviewees had fully participated in platform application training, passed assessments, and demonstrated proficiency in relevant operations.

2.3 Research Tools

The core architecture of the Internet-based smart emergency platform used in this study is illustrated below:

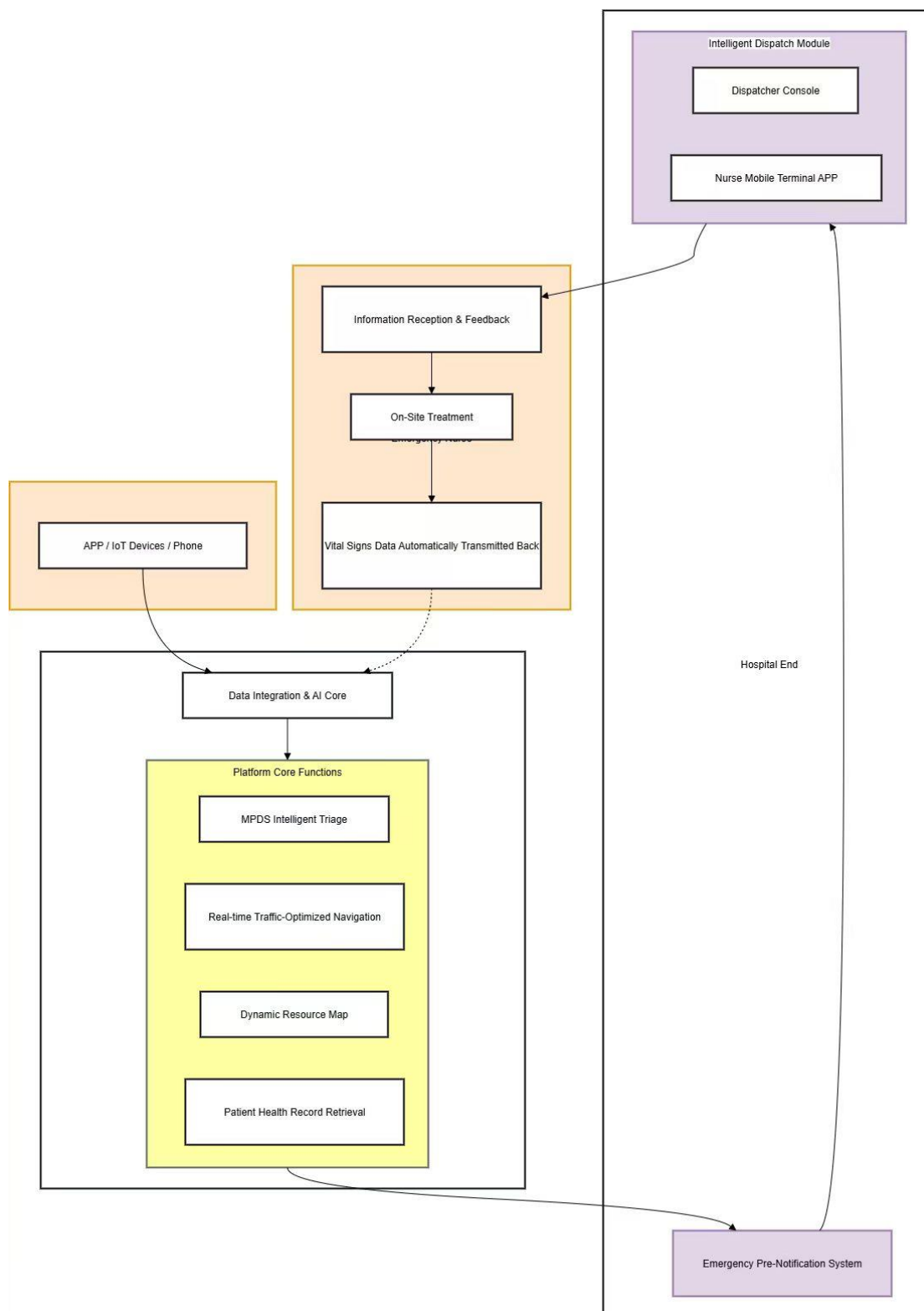


Figure 1. Title

2.4 Evaluation metrics

2.4.1 Dispatch response time (seconds): Time from emergency call reception to dispatcher issuing dispatch order for nearest ambulance.

2.4.2 Vehicle response time (seconds): Time from dispatch order issuance to ambulance departure from emergency department.

2.4.3 Resource mismatch rate (%): Proportion of cases where AI triage recommendations did not align with the emergency resource level required for the patient's final diagnosed condition.

2.4.4 Cross-region collaboration rate (%): Proportion of non-local ambulances assigned to cross-region tasks due to dynamic dispatch strategies.

2.4.5 Nurse satisfaction evaluation of the “Intelligent Triage Guidance” and “Dynamic Route Planning” functions.

2.5 Data Collection and Analysis Methods

2.5.1 Quantitative Data

Directly extracted from the emergency platform database. Statistical analysis performed using SPSS 26.0 and quantitative data expressed as ($\bar{x} \pm s$), with Independent samples t-tests for intergroup comparisons, categorical data expressed as %, with χ^2 tests for intergroup comparisons. $P < 0.05$ indicates statistically significant differences.

2.5.2 Qualitative Data

Semi-structured interviews lasting 30–45 minutes per session were conducted. Interview prompts included: “How has your work experience changed before and after platform implementation?”, “What conveniences and challenges have the platform introduced?”, and “How has it impacted your professional role?”. After transcribing recorded interviews into text, the Colaizzi 7-step analysis method was applied to code, categorize, analyze the content, and extract themes.

3. Research Findings

3.1 Quantitative Results

Comparing dispatch response time and dispatch-to-arrival time between the two emergency dispatch models, both metrics were significantly longer for the Internet-based emergency platform compared to the traditional model ($P < 0.05$).

Table 1. Comparison of Response Time Before and After Implementing the Smart Emergency Platform ($\bar{x} \pm s$)

Group	Number of Cases	Dispatch Response Time (seconds)	Vehicle Dispatch Response Time (seconds)
Traditional Model	6102	92.5 ± 15.8	135.6 ± 20.1
Internet Emergency Platform	6256	38.2 ± 9.4	98.7 ± 14.5
t		15.324	8.912
P		<0.001	<0.001

Comparing the cross-regional coordination rates and resource mis-dispatch rates between the two emergency response models, the Internet-based emergency platforms demonstrated significantly higher cross-regional coordination rates and significantly lower resource mis-dispatch rates than the traditional model ($P < 0.05$).

Table 2. Comparison of Resource Allocation Efficiency Before and After Implementing the Smart Emergency Platform (n, %)

Group	Number of Cases	Cross-Region Collaboration Rate	Resource Misallocation Rate
Traditional Model	6102	958 (15.7%)	763 (12.5%)
Internet Emergency Platform	6256	1808 (28.9%)	363 (5.8%)
χ^2		210.5	95.7
P		<0.001	<0.001

Platform Satisfaction: Platform satisfaction is evaluated using a custom-designed satisfaction survey questionnaire. The satisfaction score is out of 100 points, with higher scores indicating greater satisfaction among nurses and dispatchers. This primarily reflects evaluations of satisfaction with the “Intelligent Triage Guidance” and “Dynamic Route Planning” features.

Table 3. Comparison of Platform Satisfaction Scores (Points)

Group	Number of Cases	The Satisfaction Scores
Smart Triage Guidance	40	94.34 ± 2.17
Dynamic Path Planning	40	92.26 ± 3.38
t		14.081
P		0.000

3.2 Qualitative Interview Findings

Analysis of 40 interview transcripts yielded three core thematic clusters and seven themes:

Thematic Cluster I: Empowering Decision-Making and Efficiency Enhancement.

Theme 1: Information Forecasting Reshapes Preparation Processes.

Most nurses (n=26) mentioned that they could view patients' basic information, suspected diagnoses, and medical histories *via* mobile terminals en route to the scene, enabling them to “prepare mentally before arriving.” N12 (9 years of experience): “Before, we were ‘blindly responding’; now it's like ‘gaining divine insight.’ If the platform alerts us to a high-risk chest pain patient, we prepare the defibrillator and ECG machine in advance during transport—even pre-packing the oral ‘one-dose chest pain medication’ (anti-platelet drugs)—saving significant time searching for supplies on-site.”

Theme 2: Optimizing Collaboration through Smart Navigation and Information Synchronization.

Dispatchers (n=8) and nurses (n=19) both agree that real-time traffic navigation and automatically pushed Estimated Time of Arrival (ETA) have exponentially boosted coordination efficiency. D05 (Dispatcher): “The system automatically selects optimal routes in real-time and avoids congestion. We no longer need to consult maps while answering calls. ETAs are automatically pushed to families and receiving hospitals, eliminating redundant communication.”

Theme Cluster II: Challenges in Process Optimization.

Theme 3: Technology Dependency and System Vulnerability.

Some senior staff (n=7) expressed concerns about overreliance on technology. N25 (15 years of service): “What if network outages or system crashes occur? Could we lose our traditional judgment and navigation skills? It's a double-edged sword.”

Theme 4: Data Privacy and Ethical Security.

A minority of nurses (n=5) questioned permissions for accessing patient health records and privacy boundaries.

Theme Cluster III: Expanded Nursing Roles and Shifting Competency Requirements.

Theme 5: Transitioning from Task Executors to Information Integrators and Decision-Makers.

Nurses (n=22) widely acknowledged shifting from passive order execution to actively interpreting, validating platform information, and making final clinical decisions. N03 (6 years' experience): “AI triage provides recommendations, but the final decision rests with us. This demands not only emergency expertise but also the ability to interpret data—like why the system flags someone as high-risk.”

Theme 6: The “Human Touch” Challenge in Empathy.

Over half of nurses (n=17) noted that focusing on mobile device information may reduce eye contact and physical reassurance with patients at the bedside. N19 (11 years of experience): “We can't just stare at tablet data and forget the trembling, frightened person at the bedside. Machines give us efficiency, but care must come from people.”

Theme 7: The Urgency of Continuous Learning.

All interviewees expressed the need for ongoing training and interpretation of platform alert data to keep pace with iterative updates to platform functionality.

4. Discussion

This study confirms that an Internet-based smart emergency platform can significantly reduce pre-hospital response time and optimize resource allocation, consistent with findings from international research (Ebinger *et al.*, 2014; Reddy *et al.*, 2005). U.S. emergency guidelines

emphasize comprehensive management across the entire chain from on-site emergency care to long-term rehabilitation, particularly focusing on technology-assisted interventions, early intervention, and personalized training (Highlights_2020_ecc_guidelines_English, n.d.). However, this study further reveals, from a unique nursing perspective, the practice transformations and humanistic challenges underlying technology-enabled advancements. Currently, China faces talent shortages, insufficient specialization, and fragmented dispatch systems. Telemedicine platforms present new opportunities for emergency systems (Kim *et al.*, 2020), while regional network development can significantly reduce EVT time (Lima *et al.*, 2019). The era of Internet big data provides crucial support for enhancing emergency efficiency and ultimately achieving the “Healthy China 2030” goal.

4.1 Technology-driven Efficiency Enhancement Mechanisms

Platforms drive efficiency gains through three key mechanisms: (1) Intelligent decision-making: AI-powered MPDS replaces manual inquiries and judgments, drastically reducing dispatch time; (2) Networked information transmission: Breaking down information barriers between dispatchers, ambulances, and hospitals creates closed-loop management, minimizing information loss and redundant communication; (3) Resource Visualization and Dynamic Dispatch: Electronic map-based real-time resource distribution enables cross-regional coordination, enhancing overall resource utilization efficiency.

4.2 Transformation of Emergency Nursing Practice: From “Blind Response” to “Intelligent Response”

Qualitative findings from this study profoundly reveal the evolution of pre-hospital emergency nursing roles. Nurses transition from “lone warriors” rushing to scenes with limited information to “foreseers” capable of anticipating and preparing using multidimensional data insights. Information-Driven Nursing has emerged as a hot topic across nursing disciplines (Gause *et al.*, 2022). This signifies that beyond traditional emergency skills, future emergency nurses must develop clinical data analysis capabilities and human-machine collaborative decision-making abilities.

4.3 Balancing Technological Efficiency and Humanistic Care

The coldness of technology and the warmth of nursing are not mutually exclusive. The “humanistic care challenges” identified in this study are critical. We must guard against the dehumanization risks posed by “technological supremacy.” Future development must prioritize both “technology empowerment” and “humanistic care.” By enhancing nurse training and optimizing human-machine interaction design, we can ensure that while improving technological efficiency, the indispensable professional wisdom and human warmth in emergency care are preserved. This guarantees technology truly serves humanity.

5. Summary and Limitations

Internet-based emergency response platforms can significantly reduce pre-hospital emergency response time and optimize resource allocation. Despite certain challenges, this model represents the future direction of pre-hospital emergency care systems. Through

continuous technological innovation, policy support, and cross-departmental collaboration, it is possible to build a faster, more efficient, and more equitable nationwide emergency care network. However, this study only employed a single-center design, and future research should conduct large-scale, multi-center, long-term follow-up studies to further quantify the platform's impact on patients' long-term outcomes (e.g., disability rates, survival rates). Concurrently, information literacy training programs tailored for pre-hospital emergency nurses should be developed and validated to address challenges arising from new roles and operational models.

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Data sharing statement

No additional data are available.

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