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Development of an evaluation programme for the intelligent management of mobile infectious disease hospitals in response to public health emergencies: a Delphi study

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ABSTRACT

Objectives To construct a scientific and practical intelligent management assessment programme for mobile infectious disease hospitals and explore pathways to enhance their management effectiveness.

Design A preliminary pool of indicators was developed based on policy documents issued by the Chinese government. Two rounds of Delphi expert consultations were conducted via email between February and August 2024. These indicators were then refined using the margin method. Finally, a hierarchical analysis was employed to assign weights to each indicator.

Setting and participants In line with the policy guidance of the Chinese government, an initial set of assessment indicators for smart management of mobile infectious disease hospitals was established. 32 experts with extensive knowledge in the construction of smart management systems for such hospitals were chosen to participate in the Delphi study, offering a comprehensive professional perspective.

Results The Cr values were 0.860 (Round 1) and 0.894 (Round 2), demonstrating the accuracy and reliability of the expert consultations. The coordination coefficient among the experts was statistically significant at the $p<0.01$ level, reflecting a high degree of consensus. In total, 29 assessment items for the smart management of mobile infectious disease hospitals were finalised.

Conclusions A comprehensive set of indicators for assessing smart management in mobile infectious disease hospitals has been developed. This system is scientific, logical and dependable, providing effective guidance for the smart development of such hospitals. It not only improves the quality and efficiency of medical services but also safeguards patients' health rights.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ In the preliminary development phase of the metrics repository, this policy-informed study used the Delphi method to construct an evaluation system for the smartisation of mobile infectious disease hospitals, aiming to enhance the system's relevance and authority within the Chinese context.
- ⇒ Experts with experience in mobile infectious disease hospitals, along with those with relevant expertise, were recruited for the study. Their in-depth knowledge of the intelligent management of these hospitals provided valuable insights.
- ⇒ The indicator values derived from the Delphi method and the Analytic Hierarchy Process were calculated to ensure the scientific rigour and reliability of the evaluation system.
- ⇒ The current evaluation framework is primarily based on the perspectives from Chinese professionals engaged in mobile infectious disease hospitals, which may reduce its crosscultural applicability.
- ⇒ Since the framework lacks real-world validation in clinical settings, the practical validity and applicability of the proposed indicators remain theoretical, potentially limiting their operational effectiveness.

INTRODUCTION

In recent years, the global health landscape has evolved continuously, with the persistent threat of infectious diseases remaining a significant concern. As noted by WHO Director, General Tedros Adhanom Ghebreyesus, at the 76th World Health Assembly, new variants may emerge, triggering further outbreaks, or more lethal pathogens may appear. These crises challenge not only the emergency response capabilities of public health systems but also expose the limitations of traditional medical facilities in managing large-scale infectious disease outbreaks. Preparing for the next pandemic requires ensuring a rapid, coordinated and equitable response.[1]

Mobile infectious disease hospitals, designed based on the 'three-prevention' medical rescue concept and the 'three zones and two passages' principle for infectious diseases, are temporary facilities established to address major outbreaks in complex environments. Equipped with essential medical resources, such as isolation areas, diagnostic devices, treatment zones and pharmaceutical reserves, these hospitals provide immediate care and isolation for patients. Various forms of mobile infectious disease hospitals, including cabin hospitals, field tent hospitals and vehicle-based hospitals, can be rapidly deployed and adapted to diverse conditions.[2 3] As such, they are a critical component in enhancing public health emergency response capacity.

Currently, there is no unified index system for the intelligent evaluation of mobile infectious disease hospitals. Existing studies typically adopt case analyses, such as single negative pressure ward module evaluations, but lack quantitative standards covering infection control efficiency, medical process response speed, equipment stability and other dimensions.[2] Additionally, most evaluation tools follow a fixed framework, which makes them difficult to adapt to the various forms of mobile hospitals (eg, tent hospitals, vehicle-based hospitals, shelter hospitals) and operating models (temporary isolation vs long-term infectious disease treatment). The literature also points out that tent hospitals have limited effectiveness in extreme weather conditions, while vehicle-based hospitals depend on road conditions. However, existing tools do not offer the flexibility to dynamically adjust indicators.[4]

A systematic review of the existing literature highlights a significant research gap. There is a clear lack of a targeted and adaptable smart management evaluation tool for mobile infectious disease hospitals. Developing such a tool is crucial. For instance, during the COVID-19 pandemic, mobile infectious disease hospitals, such as cabin hospitals in China, played a pivotal role. However, management efficiency varied significantly among different facilities. Industry data indicate that approximately 30% of mobile infectious disease hospitals encountered challenges in resource allocation and patient flow management.[5 6] A well-designed smart management evaluation tool could have facilitated the timely identification of issues and improved management efficiency.

The Grading and Evaluation Standard System for Smart Hospital Services (Trial), issued by China's National Health Commission, advocates the transformation of medical institutions toward intelligence and digitalisation, providing a policy foundation for the smart management of mobile infectious disease hospitals.[7] In this context, the current study explores methods to enhance management efficiency based on the unique features and operational challenges of mobile infectious disease hospitals, ultimately developing a smart management evaluation framework. This framework aims to serve as an effective tool for improving the intelligent management of these hospitals.

METHODS

Study design

For the research development, a Delphi survey was conducted to gather expert insights on the development of mobile infectious disease hospitals. The initial set of questions was sourced from semistructured interviews. In February 2024, a panel of 16 scholars and practitioners from six institutions was formed. Before inviting experts to participate, an informed consent form was sent to them via email. The email outlined the study's purpose, process, potential risks and benefits, ensuring that experts could make an informed decision regarding their participation.

The panel identified nine key roles essential to the operation of mobile infectious disease hospitals: (1) office administration, (2) financial and asset management, (3) infrastructure and safety management, (4) human resources management, (5) equipment and facilities management, (6) pharmaceuticals and consumables management, (7) clinical care management, (8) operational support management and (9) hospital operations management.

Two rounds of surveys were conducted by distributing questionnaires via email. After the first round, the results were analysed and combined with expert feedback to revise the research indicators. A second round of expert consultation was then conducted to further refine the indicators. On completing the second round, the final assessment system was established.

Delphi correlation index

To ensure the scientific rigour and validity of the Delphi method, several key coefficients related to experts were calculated, namely the participation coefficient, authority coefficient and Kendall's coefficient of concordance.

Participation coefficient

In the application of the Delphi method, the participation coefficient of experts serves as an indicator of their active engagement. It is equivalent to the effective response rate to the expert consultation questionnaire. This coefficient plays a crucial role in determining the credibility and scientific basis of the results. Effective response rates above 55% are generally considered acceptable, while rates exceeding 70% are regarded as excellent for Delphi methods.[8]

Authority coefficient

The authority coefficient (Cr) is determined by two factors: the expert's familiarity with the index (Cs) and the basis for their judgement of the index (Ca). The authority coefficient is calculated as the arithmetic average of the judgement coefficient and the familiarity coefficient, that is, Cr=(Cs+Ca)/2. A higher Cr value indicates greater expert authority and enhanced prediction accuracy.[9–11]

The judgement basis (Ca) reflects the evidence that experts draw on when making assessments, which may include practical experience, theoretical analysis, domestic and international peer knowledge and intuition. The value of Ca typically ranges from 0 to 1, with higher values indicating more scientifically reliable expert judgements. The judgement coefficient and the average judgement coefficient are calculated based on the evaluation criteria presented in table 1.[9–11]

Table 1 Judgement basis and the degree of influence

Judgement basis	Degree of influence High	Medium	Low
Practical experience	0.5	0.4	0.3
Theoretical analysis	0.3	0.2	0.1
Knowledge from domestic and foreign counterparts	0.1	0.1	0.1
Intuition	0.1	0.1	0.1
Total	1	0.8	0.6

The familiarity coefficient (Cs) reflects the expert's familiarity with the issue at hand. It is usually categorised into five levels: very unfamiliar (0), somewhat unfamiliar (0.3), generally familiar (0.5), quite familiar (0.7) and very familiar (1). The familiarity coefficient also ranges from 0 to 1, with higher values indicating greater expert familiarity with the issue.[9–11]

Kendall's coefficient of concordance

This coefficient evaluates the consistency and credibility of expert opinions.[12] Kendall's W consistency coefficient test is used to assess the alignment of expert evaluations regarding the importance, feasibility and sensitivity of each indicator.[13]

Inclusion and exclusion criteria for indicators

Delphi studies often use per cent agreement as the standard for evaluating consistency.[14 15] In one study on the overall framework for building construction quality assessment, researchers suggested an acceptable range of 60%–70%, with 70% being the threshold between 'good' and 'acceptable' agreement.[16] In a physical therapy skill assessment, 142 interventions were reduced to 29 after three rounds of Delphi, using expert consensus (with an agreement rate of over 70%) as the screening criterion.[17] Additionally, in a Delphi study for developing reporting guidelines for innovative surgical procedures and devices, items deemed very important by patients or professionals (or both) were retained for further investigation if they achieved ≥70% agreement.[18] Evidently, setting 70% as a cut-off value for consistency meets the practical requirements in most decision-making scenarios. Therefore, in this study, the consensus criteria are as follows: if more than 70% of experts assign a consensus score of 7 or higher, the indicator is included; if more than 70% assign a score of 5 or lower, the indicator is excluded.

Setting and participants

Based on the 'Grading and Evaluation Standard System for Smart Hospital Management (Trial)',[7] the 'Notice on Further Improving the Appointment-Based Medical Treatment System and Strengthening the Construction of Smart Hospitals',[19] the 'Guidelines for the Informationalisation of Public Hospital Operation and Management'[20] and the 'Chongqing Smart Hospital Demonstration Construction Evaluation Indicators (2021 Edition)',[21] a comprehensive review of the diagnosis, treatment and management services in mobile infectious disease hospitals was conducted. This review led to the development of a preliminary draft of evaluation items for the smart management of mobile infectious disease hospitals.

An expert consultation form was developed, covering smart diagnosis and treatment service projects for emergency mobile infectious disease hospitals. This form included a letter to experts, instructions for completion, a survey on expert background information and a table of evaluation items for the smart management of these hospitals. The consultation form was distributed to experts, and two rounds of expert consultations were conducted.

According to the literature, the ideal number of experts for a Delphi consultation ranges from 15 to 30.[22] Due to the specialised nature of this topic, it was essential to consider not only the professional titles of the experts but also their current professional backgrounds. The smart management evaluation system developed in this research aligns with both the characteristics of infectious disease disciplines and the principles of scientific management standards.

The selection of Delphi experts was based on their extensive knowledge, experience and relevant expertise to ensure a comprehensive understanding of the research question.[23] Furthermore, the literature emphasises that experts must possess advanced knowledge and specialised skills pertinent to the research context.[24] Given the specificity of the subject, the research team selected experts not only for their professional titles but also for their relevant professional experience. Several experts with mid-level titles, who had actively contributed to the construction of similar mobile infectious disease hospitals, were selected due to their demonstrated practical experience. The smart management evaluation system developed in this study aligns with both the disciplinary-specific characteristics of infectious diseases and the rigorous standards of scientific management. Therefore, the experts selected for this study should have professional backgrounds in emergency management, infectious disease management and hospital informatisation. Additionally, they should possess extensive practical experience in infectious disease prevention and control.

Questionnaires were sent to participants via email. Each round of the survey was designed to be completed within approximately 1 month. In cases where no response was received within 2 weeks, a reminder email was promptly sent. Non-respondents were contacted by phone 1 week after the second reminder. Participants who failed to respond after this follow-up were excluded from the study and no longer considered as potential data sources. Following the first round, statistical analysis was conducted, and the research indicators were adjusted based on the expert feedback. Subsequently, a second round of expert consultation was carried out. On completion of the second round, the final evaluation system was determined through statistical analysis and formally confirmed.[25 26] The names and institutions of the participants were anonymised and coded to ensure confidentiality.[27] The data collection process spanned from February 2024 to August 2024.

This research protocol received approval from the Ethics Committee of the 958th Hospital of Army Medical University (protocol number: IRB20241k-10).

Procedure

Round 1

Guided by relevant policy documents, we initially formulated evaluation indicators for the intelligent management of mobile infectious disease hospitals. These indicators covered nine key areas: medical and nursing management, human resource management, financial management, asset management, equipment and facilities management, pharmaceuticals and consumables management, operational management, operational support management and basic and safety management. A total of 39 assessment items were included, each with clearly defined criteria. A five-point scale was used for scoring: very important (5 points), important (4 points), moderate (3 points), less important (2 points) and very unimportant (1 point). A comment section was also provided to gather suggestions for modification.

Round 2

Subsequent to the first round of expert consultation, a preliminary data analysis was conducted. In light of the inclusion and exclusion criteria, as well as through discussions and expert feedback, the indicators from the first round were either deleted or merged. Compared with the first round, some operational items were removed, and the structure was adjusted accordingly. The second round of consultations followed the same process as the first round. Participants were asked to review the results of the first round and the modifications made to the assessment items. Following the second round, statistical analysis was performed to finalise the evaluation system.

Using the Analytic Hierarchy Process to assign weights

The Analytic Hierarchy Process (AHP) is a decision analysis method that combines qualitative and quantitative analyses. It decomposes indicators, establishes a hierarchical structure and conducts pairwise comparison-based quantitative analysis.[28 29] In this study, we developed a hierarchical structure model, constructed a judgement matrix and tested the consistency of the matrix to determine the weight of each indicator.

To determine the relative proportion of each indicator at a given level compared with the upper-level indicator (target or first-level indicator), the importance level was assigned using the Satty scale, based on the average importance scores provided by experts during the second round of inquiry. Pairwise comparisons were made between indicators at the same level, and a judgement matrix was constructed.[30] The Satty scale values are shown in table 2.

The consistency index (CI) is typically used to check for logical inconsistencies in the relative priority order of items, calculated as: CI=$(\lambda\text{max}-n)/(n-1)$.[31] The average random index (RI) is used to assess the consistency of judgement matrices of different orders.[32] The RI values differ depending on the matrix order. When the matrix order is less than 2, CI is used to test the logical consistency of the relative order of indices within this hierarchy. For matrices of order >2, RI is applied to correct CI, with the result reflected by the random consistency ratio (CR). The CR is calculated as: CR=confidence interval/RI. A CR value <0.10 indicates satisfactory consistency in the judgement matrix.[32]

Patient and public involvement

This study did not include patients as participants. To ensure confidentiality, the findings are presented anonymously.

Table 2 Satty scale of relative importance

Satty scale value	Mean difference in importance scores	Satty scale value	Mean difference in importance scores	Implication
1	X–Y=0.0	1		Equally important
2	0.00<X–Y≦0.25	1/2	–0.25<X–Y≦0.00	
3	0.25<X–Y≦0.50	1/3	–0.50<X–Y≦–0.25	Slightly more important
4	0.50<X–Y≦0.75	1/4	–0.75<X–Y≦–0.50	
5	0.75<X–Y≦1.00	1/5	–1.00<X–Y≦–0.75	Obviously important
6	1.00<X–Y≦1.25	1/6	–1.25<X–Y≦–1.00	
7	1.25<X–Y≦1.50	1/7	–1.50<X–Y≦–1.25	Strongly important
8	1.50<X–Y≦1.75	1/8	–1.75<X–Y≦–1.50	
9	X–Y>1.75	1/9	X–Y<11.75	Extremely important

X and Y represent the mean importance scores of two different indicators at the same level.

Table 3 Basic information on the two rounds of consultants

Basic information	Round 1 (n=16)		Round 2 (n=16)	
	Number	Composition ratio (%)	Number	Composition ratio (%)
Gender				
Male	14	87.50	14	87.50
Female	2	12.50	2	12.50
Age				
30–40 years old	6	37.50	4	25.00
41–50 years old	8	50.00	10	62.50
51–60 years old	2	12.50	2	12.50
Above 60 years old	0	0.00	0	0.00
Professional title				
Full senior title	7	43.75	6	37.50
Deputy senior title	8	50.00	8	50.00
Intermediate title	1	6.25	2	12.50
Junior title	0	0.00	0	0.00
Fields of work				
Health emergency	3	18.80	2	12.50
Hospital infection	1	6.30	2	12.50
Hospital management	1	6.30	2	12.50
Hospital information	5	31.30	4	25.00
Health research	4	25.00	3	18.80
Nursing management	1	6.30	1	6.30
Infectious disease	1	6.30	1	6.30
Disease prevention and control	0	0.00	1	6.30
Number of years in the specialty				
<10 years	4	25.0	2	12.50
10–20 years	5	31.30	5	31.30
20–30 years	5	31.30	6	37.50
>30 years	2	12.50	3	18.80
Experience in infectious disease prevention and control				
Yes	16	100.00	16	100.00
No	0	0.00	0	0.00

RESULTS

Baseline characteristics of participants

A total of nine experts from four cities in China—Beijing, Chongqing, Chengdu and Guangzhou—participated in the questionnaire consultation. In total, 32 experts were involved across both rounds of consultation, with 16 experts participating in each round, resulting in a 100% response rate. All 32 experts have extensive experience in infectious disease prevention and control. The basic information of the experts from both rounds is presented in table 3. All experts remained engaged throughout the entire consultation process.

Key coefficients of the Delphi method

It is widely accepted that an expert authority coefficient (Cr) ≥0.7 indicates high reliability.[10] The Cr values from the two rounds of expert consultation were 0.860 and 0.894, respectively, suggesting a high level of expert authority and confirming the accuracy and reliability of the questionnaire results. The specific results are presented in table 4.

Consistency of expert evaluation

The consistency of expert evaluations further validates the scientific rigour of the index system. The results indicate that for the two rounds of expert opinions, the Kendall's coefficient of concordance was 0.209 in the first round and 0.445 in the second round. These values were statistically significant ($p<0.01$) based on the χ^2 test, suggesting a high degree of consistency among the expert scores. The detailed results are presented in table 5.

Table 4 Expert authority coefficients

	Ca=∑MjWj/M	Cs=∑MjWj/M	Cr=(Ca+Cs)/2
Round 1	0.944	0.775	0.860
Round 2	0.963	0.825	0.894

Ca represents the judgement coefficient, Cs represents the degree of familiarity and Cr represents the degree of authority.

Round 1：Ca=∑MjWj/M=（16*0.5+7*0.3+9*0.2+3*0.1+11*0.1+2*0.1++2*0.1+8*0.1+6*0.1）/16=0.944；Cs=∑MjWj/M=（1*1+12*0.8+3*0.6）/16=0.775；

Round 2：Ca=∑MjWj/M=（16*0.5+9*0.3+7*0.2+5*0.1+10*0.1+1*0.1+5*0.1+8*0.1+3*0.1）/16=0.963；Cs=∑MjWj/M=（3*1+12*0.8+1*0.6）/16=0.825.

Indicator screening

In this study, the median and mode were used to characterise the central tendency of experts' ratings for each strategy, while the SD was employed to assess the variability in the ratings. The coefficient of variation was calculated to evaluate the degree of consensus among experts. Moreover, for each indicator, the percentages of ratings ≥7 and ≤5 were determined. The deletion of indicators was based on the preoutlined deletion criteria, expert feedback and practical relevance. After deliberations within the research team, requisite adjustments were made.

In the first round, four items were deleted, six items were merged and the definitions of 17 items were revised.

In the second round, all evaluation items achieved a score of ≥7 from over 70% of experts. Additionally, no further modifications were suggested, resulting in no eliminations or new indicators. In total, 29 intelligent evaluation items for mobile infectious disease hospitals were finalised, as detailed in table 6.

Final index system and indicator weights

The judgement matrix construction method (referring to table 2, Satty relative importance ranking table) was applied to calculate the weights of the indices in this study. The differences in the mean scores assigned to each first-level index were used to evaluate the judgement matrix and determine the weight calculation results. Among the primary assessment items, smart operational management and record management were assigned the highest weight (0.8333), followed by server room management (0.75) and intelligent diagnostic equipment auxiliary management (0.5531). The lowest weight was assigned to examination auxiliary management (0.0267). According to the consistency judgement criteria, the CR values of all 29 assessment items were below 0.10, indicating a high degree of consistency. The detailed results are presented in table 7.

Table 5 Test results: Kendall's coefficient of concordance

	Round 1	Round 2
Kw	0.209	0.445
χ^2	127.354	199.349
P value	0.000	0.000

DISCUSSION

The intelligent assessment requirements pool for mobile infectious disease hospitals is grounded in scientific principles

The development of the evaluation item pool is based on the principles of tri-defence medical rescue and the 'three zones and two passages' design for infectious disease control, incorporating advanced technologies such as the Internet of Things (IoT), big data and artificial intelligence (AI). This approach rigorously follows relevant policy guidelines, ensuring a strong integration of theory and practice. The '*Opinions of the General Office of the State Council on Promoting the Development of 'Internet+Medical Health*'[33] advocates for the integration of the internet with healthcare services, leveraging emerging technologies to improve the quality and efficiency of medical services. This provides essential policy guidance for the application of IoT, big data and AI in the project. Additionally, the '*Grading Evaluation Standard System for Smart Healthcare Services in Hospitals (Trial)*'[34] sets clear evaluation criteria for healthcare services at various stages, including prediagnosis, diagnosis and postdiagnosis. This project adheres strictly to these standards, ensuring the standardisation and scientific integrity of the evaluation process. Furthermore, the '*Technical Guidelines for Hospital Informatization Construction and Application (2017 Edition)*'[35] offers comprehensive technical guidance on infrastructure, information systems and data governance, providing essential operational norms for the smart management evaluation of mobile infectious disease hospitals. This ensures the scientifically sound application of advanced technologies. The research team conducted two rounds of expert consultations, incorporating multiple revisions to develop a comprehensive evaluation framework comprising 29 indicators for the smart management of mobile infectious disease hospitals. This framework not only addresses the operational requirements for non-contact services during sudden outbreaks of infectious diseases but also takes into account the essential features of smart development and construction. It serves as a tool for assessing the level of smart construction in these hospitals, ensuring a solid scientific foundation for indicator setting.

Reliability of the intelligent assessment requirement pool for mobile infectious disease hospitals

This study, referencing the '*Grading Evaluation Standard System for Hospital Smart Management (Trial)*',[34] systematically evaluates the likelihood, severity and characteristics of sudden infectious disease outbreaks, as well as

Table 6 Evaluation indicators for mobile infectious disease hospitals

Job role	Indicator code	Evaluation indicators
Clinical care management	1.1	Auxiliary management for medical treatment
	1.2	Auxiliary management for medical examinations
	1.3	Intelligent care management
	1.4	Health record management
	1.5	Quality control management for medical and nursing services
	1.6	Electronic signature management
	1.7	Infection control management
	1.8	Adverse event management
Equipment and facilities management	2.1	IoT sensing management
	2.2	Intelligent device management
	2.3	Auxiliary management for intelligent diagnostic equipment
	2.4	Management of medication reminder devices for examinations
Pharmaceuticals and consumables management	3.1	Drugs and consumables purchase management
	3.2	Inventory management
	3.3	Management of disinfection and recyclable items
	3.4	Monitoring and utilisation management
Hospital operations management	4.1	Intelligent operation management
	4.2	Medical services analysis management
Operational support management	5.1	Logistics support management
	5.2	Medical waste management
	5.3	Automated process management
	5.4	Information system management
	5.5	Data security management
	5.6	Video surveillance management
	5.7	Centralised control management
Office administration	6.1	Collaborative office management
	6.2	File management
Infrastructure and safety management	7.1	Network security management
	7.2	Server room management

IoT, Internet of Things.

the specific needs of mobile infectious disease hospitals. A practical smart management evaluation system for these hospitals was developed through the application of the Delphi method. The '*National Contingency Plan for Public Health Emergencies*'[36] emphasises the significance of adhering to scientific principles, promoting collaboration, leveraging expert insights and enhancing the scientific validity and effectiveness of public health emergency responses. As a structured group decision-making method, the Delphi method is characterised by anonymous communication, iterative feedback and statistical analysis. It harnesses the collective expertise of participants, combining professional knowledge, practical experience and subjective judgement. After two rounds of expert consultations, the variation coefficient for all indicators fell below 0.25, indicating a high degree of consensus among experts on each indicator. Throughout the process, experts' opinions remained independent and were scarcely swayed by authoritative figures, thereby leading to more robust and credible outcomes.[37] Additionally, the '*Opinions on Strengthening the Standardization System Construction of National Health Information*'[38] advocates for the standardisation of national health information, providing guidelines for data collection, indicator setting and related aspects within the evaluation system for mobile infectious disease hospitals. This not only reinforces the reliability of the system but also ensures data comparability and the measurability of indicators across hospitals.

Construction of an intelligent assessment requirement pool for mobile infectious disease hospitals holds significance

The primary objective of smart management evaluation is to ensure that hospitals deliver comprehensive, accurate

Table 7 Assessment of evaluation indicator weights and consistency test results

Evaluation indicators	Wi	λmax	CR
Auxiliary management for medical treatment	0.2468	8.3166	0.0321
Auxiliary management for medical examinations	0.0267		
Intelligent care management	0.1706		
Health record management	0.0395		
Quality control management for medical and nursing services	0.2468		
Electronic signature management	0.0317		
Infection control management	0.1706		
Adverse event management	0.0673		
IoT sensing management	0.0583	4.1501	0.0562
Intelligent device management	0.2685		
Intelligent diagnostic equipment management	0.5531		
Management of medication reminder devices for examinations	0.1201		
Drugs and consumables purchase management	0.4195	4.1061	0.0397
Inventory management	0.0556		
Management of disinfection and recyclable items	0.4195		
Monitoring and utilisation management	0.1055		
Intelligent operation management	0.8333	2	0
Medical service analysis management	0.1667		
Logistics support management	0.2576	7.239	0.0293
Medical waste management	0.0604		
Automated process management	0.2576		
Information system management	0.0358		
Data security management	0.045		
Video surveillance management	0.1521		
Centralised control management	0.1914		
Collaborative office management	0.1667	2	0
File management	0.8333		
Network security management	0.25	2	0
Server room management	0.75		

CR, consistency ratio; IoT, Internet of Things.

and continuous smart healthcare services throughout their entire lifecycle.[34] This is especially critical in the context of infectious disease prevention and control, as it directly impacts the safety of patients, medical personnel and the broader public health system.[39 40] The '*Law of the People's Republic of China on the Prevention and Treatment of Infectious Diseases*'[41] mandates the strengthening of efforts in monitoring, early warning, epidemic reporting and improving prevention and treatment capabilities. In the wake of the COVID-19 pandemic, the importance of intelligent medical systems has significantly increased. The adoption of paperless closed-loop management through information technology not only alleviates clinical burden but also improves operational efficiency and service quality.[42] Considering the evolving needs of hospitals, technical feasibility and patient experience, the development of a smart management evaluation framework for mobile infectious disease hospitals can identify deficiencies in areas such as the functionality of smart service systems, the scope of application, technical infrastructure and information security. This enables targeted improvements and better equips hospitals to effectively respond to future public health crises. The '*Notice on Further Promoting the Construction of Informationization in Medical Institutions with Electronic Medical Records at the Core*'[43] emphasises the crucial role of electronic medical records in the digital transformation of medical institutions. For mobile infectious disease hospitals, a robust electronic medical record system facilitates the rapid sharing of information, enhances smart management capabilities and provides essential data to respond to infectious disease outbreaks. This further highlights the critical need for a smart management evaluation framework in mobile infectious disease hospitals.

Strengths and limitations

This study strictly adheres to relevant policy guidelines in the initial development of an evaluation system for the smart capabilities of mobile infectious disease hospitals, while innovatively applying the Delphi method to create metrics tailored to China's national context. To ensure the system is both professional and practical, experts with extensive experience in mobile infectious disease hospitals, along with those with relevant expertise, were recruited for the study. Their in-depth and practical expertise provided valuable insights. Methodologically, the study combines the Delphi method with the AHP to precisely calculate indicator values to ensure the evaluation system's scientific rigour and reliability. The current evaluation framework is specifically tailored to the unique characteristics of mobile infectious disease hospitals in China, integrating domain-specific expertise to enhance both applicability and practical value in real-world healthcare scenarios.

However, it should be noted that the framework, designed primarily based on China's healthcare ecosystem and domestic expert consensus, may lack direct applicability in international medical contexts. To enhance the global applicability of the research findings, it is essential to gather and analyse perspectives from experts across multiple countries regarding the proposed evaluation system. This approach ensures broader representativeness of the conclusions. Additionally, incorporating case studies from various countries and regions for crossnational comparative analysis can help identify commonalities and differences, contributing to the development of a more universally applicable evaluation system.

Furthermore, as it has not undergone rigorous validation in clinical practice settings, the effectiveness and applicability of the proposed indicators remain largely theoretical, thereby limiting their potential for broader application. Subsequent phases of this research will prioritise practical verification to optimise the system's crosscultural generalisability and practical value. In the subsequent validation phase, this study will select a mobile infectious disease hospital in China as the validation subject. This hospital has experience in emergency responses to public health incidents and comprises a multidisciplinary team, including clinical medical staff, operations management, information technology and logistics support personnel. This diversity ensures a comprehensive perspective on the practical needs of intelligent construction. The study will employ quantitative analysis to assess the alignment between the importance and existence of intelligent construction needs. Specifically, methods such as radar chart-based quantified scoring will be used to identify priority deviations within the 29-item evaluation system, thereby evaluating its applicability in real-world scenarios. The findings will provide empirical evidence for developing an evaluation index to assess the effectiveness of intelligent construction.

CONCLUSIONS

Smart management evaluation seeks to improve the efficiency and effectiveness of decision-making by integrating advanced information technologies, such as intelligent evaluation management systems,[44] automated evaluation systems[45] and comprehensive evaluation methods based on smart technologies.[46] These tools enable managers to collect, analyse and apply data more effectively, leading to more accurate and timely decisions. In the realm of infectious disease control, smart management systems can rapidly identify potential health threats through real-time data analysis and pattern recognition, thereby facilitating early warnings and swift responses. For example, event-based surveillance systems can detect and assess potential threats from online sources.[47] The COVID-19 pandemic has further highlighted the significance of smart healthcare systems, which, through paperless closed-loop management, not only alleviate clinical burden but also enhance work efficiency and quality.[48]

The development of evaluation criteria for the smart management of mobile infectious disease hospitals considers the hospitals' actual needs, technical feasibility and patient experience. This approach aims to identify shortcomings in areas such as the functionality of smart service information systems, the scope of application, technological infrastructure and information security.

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Contributors We declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We understand that the corresponding author is the sole contact for the editorial process. He is responsible for communicating with the other authors about progress submissions of revisions and final approval of proofs. XL is responsible for the overall content as guarantor. XL contributed to the conception and design of the study. JH and RN acquired the data. JH performed the data analysis and wrote the first draft of the manuscript. RN and SW revised the manuscript critically. All authors contributed to manuscript revision and read and approved the submitted version.

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