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Optimisation of aetiological examination processes for enhanced quality and efficiency in hospitalised patients prior to antimicrobial therapy: a multicentre quasi-experimental study

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ABSTRACT

Objectives This study aimed to optimise the aetiological examination process in hospitalised patients to enhance pathogen detection quality and efficiency. The hypothesis was that process management strategies would improve specimen submission rates, quality, timeliness and antimicrobial use adjustment.

Design A multicentre quasi-experimental pre–post comparison design was used, with baseline and postoptimisation phases.

Setting Two hospitals in Guangming District, Shenzhen, China.

Participants 34 790 inpatients in the baseline and 34 361 in the postoptimisation phase, across all departments.

Interventions Implemented process clarification, standardisation of specimen collection/submission and multidisciplinary collaboration, with comprehensive staff training.

Primary and secondary outcome measures The primary outcome measures were the pathogen submission rate before antimicrobial therapy. The secondary outcome measure was the adjustment rate of antimicrobial use based on test results, specimen qualification rate and specimen submission time. These measures were evaluated before and after process optimisation.

Results Postoptimisation, key metrics improved significantly: pathogen submission rate (50.82%–71.77%), specimen qualification rate (90.20%–98.71%), submission time (192–104 min) and antimicrobial adjustment rate (74.11%–93.24%; all p<0.001).

Conclusions Process management effectively enhanced aetiological examination quality and efficiency, with potential for widespread adoption.

Trial registration number Not applicable as this was a quasi-experimental study.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Existing evidence highlights the critical role of timely aetiological examinations in guiding appropriate antimicrobial therapy and reducing nosocomial infections. However, hospitals often face inefficiencies due to fragmented workflows, interdepartmental coordination gaps and inconsistent adherence to standardised protocols. Prior studies on process management in healthcare have focused broadly on clinical workflows, but limited research specifically addresses optimising preantimicrobial testing processes or evaluates multidisciplinary interventions using robust statistical methods.

WHAT THIS STUDY ADDS

⇒ This multicentre quasi-experimental study demonstrates that comprehensive process management—including standardised specimen collection protocols, real-time data integration via hospital information systems and multidisciplinary collaboration—significantly improves preantimicrobial pathogen submission rates (50.82% to 71.77%), specimen qualification rates (90.20% to 98.71%), turnaround time (192 min to 104 min) and antimicrobial adjustment rates (74.11% to 93.24%). Rigorous validation using generalised estimating equations confirms the effectiveness of these strategies, providing a replicable framework for enhancing diagnostic quality and efficiency.

INTRODUCTION

Nosocomial infections,[1] a critical concern in the medical arena, have attracted substantial attention owing to their high global incidence rates[2 3] and the resultant threats to public health security.[4] Accurate and timely aetiological testing improves treatment efficacy and patient outcomes. Nevertheless, hospitals are confronted with myriad challenges in conducting these examinations promptly and accurately, with interdepartmental collaboration deficiencies and non-optimised processes being the principal factors contributing to inefficient and inconsistent submission qualities.[5 6]

In recent years, the relentless progression in management science, particularly the evolution of process management theory,[7–11] has presented novel perspectives and instruments to tackle these challenges. Process management theory advocates for a shift from the conventional

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The findings advocate for integrating process management into hospital infection control protocols, emphasising cross-departmental collaboration and technology-driven standardisation. Policymakers could adopt these strategies to refine antimicrobial stewardship programmes, while healthcare institutions may use the model to reduce diagnostic delays and improve patient outcomes. Future research should explore long-term sustainability and scalability across diverse healthcare settings.

'function-oriented' paradigm to a 'process-oriented' one.[12] It systematically improves management efficiency and service quality through process planning and optimisation. This theory has demonstrated remarkable success in the business sector and is increasingly being recognised for its potential in elevating the quality and efficiency of medical services within hospital management.[13–15]

Previous studies[16 17] have delved into the application of process management in hospital settings, research focusing on the optimisation of pathogen testing processes prior to antimicrobial therapy remains sparse, especially concerning multidisciplinary collaboration, standardised operating procedures (SOPs) and the rigorous evaluation of effectiveness using statistical methodologies. This multicentre study specifically addresses the optimisation of pathogen testing processes before antimicrobial therapy, with the overarching goal of enhancing testing quality and efficiency by integrating process management principles and techniques. We aim to transcend the traditional 'departmental silos'[18 19] prevalent in medical institutions, fostering a collaborative work environment through measures, including process clarification, strengthening multidisciplinary cooperation and refining personnel training.

Moreover, this study will employ statistical methods like generalised estimating equations (GEE) to scientifically evaluate the impact of process optimisation, thereby providing a robust, replicable and scalable quality improvement model for other medical institutions. Our findings are anticipated to contribute significantly to the advancement of nosocomial infection management theory and offer pragmatic guidance for the management of nosocomial infections in clinical practice.

MATERIALS AND METHODS

Research institution and study subjects

This metropolitan-centred investigation was conducted within a medical group encompassing two tertiary hospitals in Shenzhen, China: the East Campus (550 open beds) and West Campus (800 open beds) in Guangming District. Annually serving over 70 000 inpatients, the study included all departments across both campuses to evaluate changes in preantimicrobial specimen submission practices before and after workflow optimisation. Eligible subjects comprised inpatients receiving systemic antimicrobial therapy, with exclusion criteria applied to: (1) cases managed solely with topical antimicrobials, (2) patients transferred out within 24 hours of admission and (3) palliative care patients lacking diagnostic testing. Comparative analysis of specimen submission indicators was performed between baseline (preoptimisation) and intervention (postoptimisation) periods, ensuring temporal consistency across all study units.

Study design

This study employed a quasi-experimental pre–post comparison design, consisting of two distinct phases. The quasi-experimental approach was selected to accommodate the need for synchronised, large-scale implementation across both hospitals, ensuring uniform protocol adoption while balancing operational feasibility. The first phase, serving as the baseline investigation (July–December 2023) involved the establishment of a professional team dedicated to process optimisation. This team conducted a thorough analysis of the existing specimen submission process prior to antimicrobial therapy, subsequently formulating an improved process scheme along with detailed SOPs. The second phase, encompassing implementation and evaluation (January–June 2024), centred on the deployment and monitoring of the newly optimised process. During this phase, comprehensive training was organised for all relevant staff, and the effects of the optimisation were rigorously evaluated. The GEE statistical method was used to compare key indicators, such as the pathogen submission rate and specimen qualification rate, across departments between the two phases. We collected preintervention and postintervention data system-wide but omitted monthly tracking due to resource limitations.

This study adhered to ethical regulations, obtained formal approval from the hospital's ethics committee and ensured patient privacy by anonymising all sensitive data. A detailed flowchart is provided in figure 1.

Microbiological detection method

The VITEK2 bacterial identification and antimicrobial susceptibility analyser (Biomerieux, Merieux Alliance, France) was employed for the identification of bacterial microorganisms. The identification method for microorganisms followed the recommendations of the Clinical and Laboratory Standards Institute.

Methodology for process management

Establishment of a process management project team

A process management project team, comprising dedicated and part-time infection control personnel, representatives from clinical departments, medical affairs, nursing, pharmacy, information technology (IT) and the testing centre, was established. This team is responsible for project planning, implementation, monitoring and evaluation.[18 20–22]

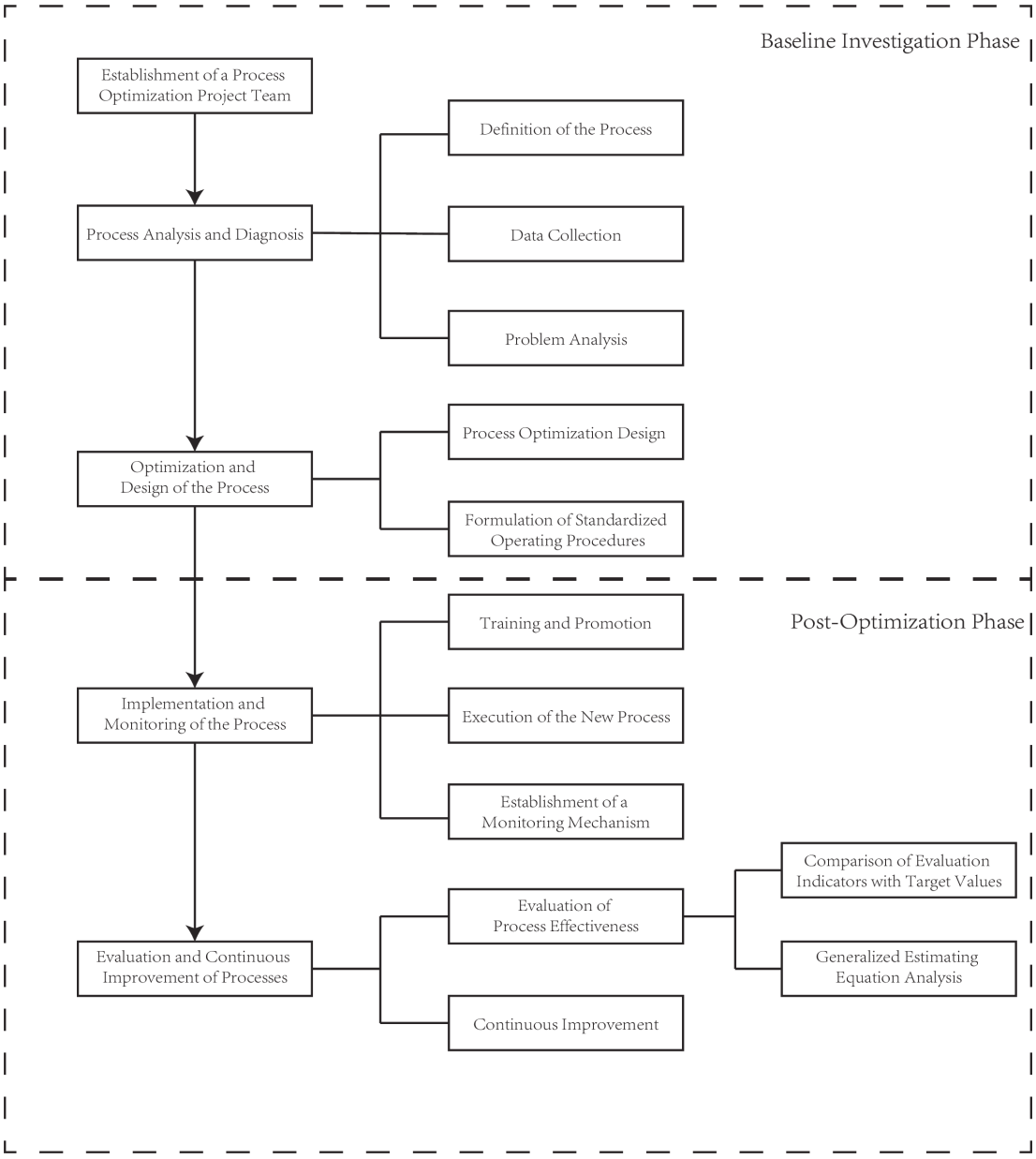

Figure 1 The flowchart of the study. It depicts the flowchart of the process optimisation project, covering establishment, analysis, design, implementation, evaluation and continuous improvement. Key stages include process definition, data collection, problem analysis, optimisation design, standardised operating procedures, monitoring mechanism establishment and effectiveness evaluation, with a focus on comparing evaluation indicators to target values using generalised estimating equation analysis, distinguishing baseline and post-optimisation phases.

Process analysis and diagnosis

Process definition

The complete process for specimen submission prior to antimicrobial therapy was clearly defined, encompassing stages such as prescription issuance, sample collection, sample submission, laboratory testing and result feedback. Ensuring that the process definition is clear and accurate, covering all critical steps. See figure 2 for details.

Data collection

Collect relevant data on the current specimen submission process, including aetiological test submission rates, specimen qualification rates, submission timelines and adjustment rates of antimicrobial usage. Ensure that data sources were reliable and that data collection was comprehensive to accurately analyse the current status of the process.

Problem analysis

Use process analysis tools (such as fishbone diagrams, flowcharts, etc) to identify specific reasons for low submission rates. Conduct an in-depth analysis of the root causes of the problems, distinguishing whether they stem from issues in process design, execution or management. See table 1 for details.

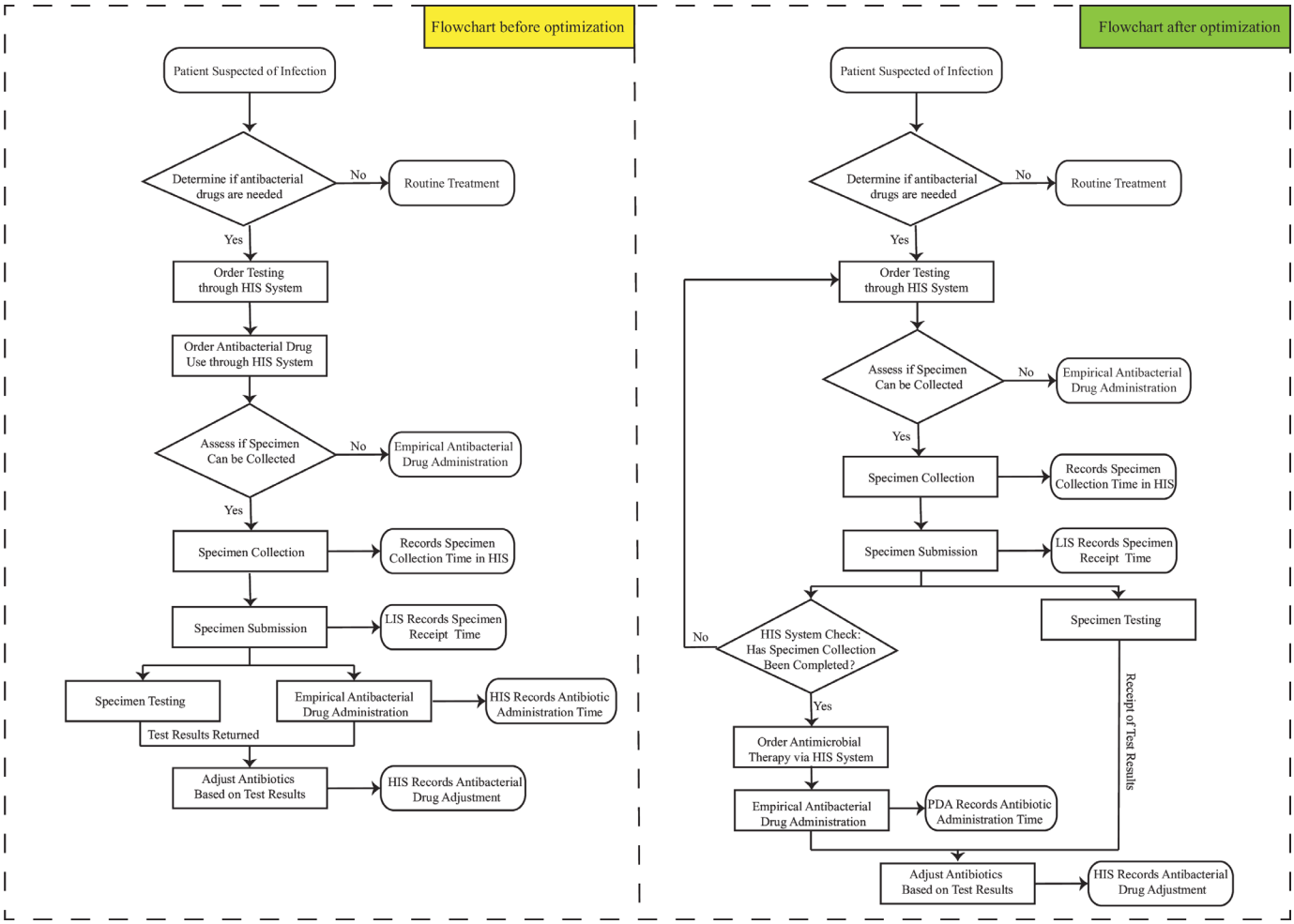

Figure 2 Flowcharts comparing processes before and after optimisation. It displays the flowcharts illustrating the processes before and after optimisation in managing antibacterial drug administration for patients suspected of infection. The pre-optimisation flowchart highlights steps such as determining the need for antibacterial drugs, ordering tests, specimen collection and empirical drug administration, followed by test result-based antibiotic adjustment. The post-optimisation flowchart introduces enhancements, including the use of information systems (HIS, LIS, PDA) for more streamlined and efficient specimen tracking, testing and drug administration. HIS, hospital information system; LIS, laboratory information system; PDA, point-of-care nursing system.

Process optimisation and design

To address inaccuracies and delays in specimen collection and antimicrobial administration, several measures are proposed:

1. Inaccuracy and delay in recording: implement a point-of-care nursing system (PDA) with training for proficient use. Ensure real-time data synchronisation with the hospital information system (HIS) to enhance accuracy.
2. Inappropriate sequencing: re-engineer the process, embedding intelligent control logic in HIS to prevent antimicrobial administration prior to specimen collection, and strengthen communication with clinical departments.
3. Non-standardised collection: enhance standardised training on specimen collection procedures, developing detailed guidelines and ensuring proficiency through regular training and assessment.
4. Delayed submission: optimise the submission process by establishing a rapid submission mechanism with clear time nodes and an emergency channel. Provide specialised transport containers and labels to ensure safety and traceability.
5. Untimely medication adjustment: establish a cross-departmental collaboration mechanism for medication adjustment, developing guidelines and strengthening physicians' understanding through training and assessments. Implement a feedback mechanism for professional guidance.
6. Delayed reporting: collaborate with the clinical laboratory department to create a rapid reporting channel for test results. Establish a supervision and assessment mechanism to ensure timeliness and effectiveness of information.

In summary, through multidepartmental collaboration, technological innovations and process optimisations, an

Table 1 Analysis and diagnosis of aetiological examination process prior to antimicrobial therapy

Number	Process	Existing issues	Issue category	Key point
1	Patient infection → antimicrobial therapy assessment	None	None	No
2	Antimicrobial therapy assessment → routine treatment	None	None	No
3	Antimicrobial therapy assessment → order testing through HIS system	None	None	No
4	Order testing through HIS system → order antimicrobial therapy through HIS system	Although the antimicrobial therapy order follows the testing order, the execution sequence may differ	Process design issue	Yes
5	Order antimicrobial therapy through HIS system → assess specimen collection feasibility	None	None	No
6	Assess specimen collection feasibility → empirical therapy	None	None	No
7	Specimen collection feasibility → specimen collection	None	None	No
8	Specimen collection → record execution time in HIS by nurse	Nurses may fail to record the specimen collection time accurately and timely	Execution issue	Yes
9	Specimen collection → specimen submission	Specimen collection may not be standardised; specimen submission may not be timely	Execution issue	Yes
10	Specimen submission → LIS records specimen receipt time	None	None	No
11	Specimen submission → empirical antimicrobial therapy	Antimicrobial therapy may be administered before specimen submission	Process design issue	Yes
12	Specimen submission → specimen testing	None	None	No
13	Empirical antimicrobial therapy → record therapy execution time in HIS by nurse	Failure to record antimicrobial therapy time accurately and timely	Execution issue	Yes
14	Empirical antimicrobial therapy → adjust therapy based on test results	Some physicians may fail to adjust therapy promptly	Management issue	Yes
15	Specimen testing → test results return → adjust therapy	Test results may not be returned timely	Management issue	Yes
16	Adjust therapy → record therapy adjustment in HIS	None	None	No

HIS, hospital information system; LIS, laboratory information system.

efficient, collaborative and accurate specimen submission system will be constructed, improving medical service quality and promoting patient safety and satisfaction. The optimised process is illustrated in figure 2.

Development of SOPs

Detailed SOPs should be developed for the optimised process, including operational steps, time requirements and quality standards for each step. Ensure that the SOPs are practical, measurable and easy to implement and monitor.

Implementation and monitoring of processes

Training and promotion

Relevant personnel, including doctors, nurses and laboratory staff, should be trained and informed to ensure they understand and are familiar with the optimised processes and operational norms. The training should be comprehensive and in-depth, guaranteeing that the personnel can correctly implement the new processes.

Execution of new processes

For effective postrelease process execution, key measures include comprehensive training, IT system integration, policy incorporation, regular monitoring and proactive issue resolution, ensuring adherence, consistency and achievement of desired outcomes.

During the intervention phase, several challenges arose, necessitating real-time adjustments:

1. HIS integration delays: initial integration of intelligent control logic into the HIS encountered technical incompatibilities, delaying rollout by 2 weeks. This was resolved through iterative collaboration between IT and clinical teams.

2. Staff resistance to PDA adoption: nurses initially resisted using the PDA due to workflow disruptions. Additional hands-on training sessions and simplified PDA interfaces were introduced to improve compliance.
3. Specimen transport bottlenecks: despite optimised protocols, delayed submissions persisted in emergency departments during peak hours. A dedicated courier team was deployed to prioritise urgent specimens.
4. Partial non-adherence to SOPs: audits revealed inconsistent compliance with standardised collection guidelines in surgical wards. Reinforcement measures, including weekly audits and peer mentoring, were implemented to address this.

Notably, the proposed 'emergency reporting channel' for test results required simplification after physicians reported information overload. The final protocol prioritised critical results via automated alerts.

Establishment of a monitoring mechanism

A monitoring mechanism for the aetiological examination process should be established to regularly inspect process execution and promptly rectify any identified issues. The monitoring mechanism should be real time, accurate and capable of identifying and addressing problems in the process promptly.

Process evaluation and continuous improvement

Evaluation of process effectiveness

The effectiveness of the optimised process is evaluated through data collection and comparative analysis:

1. Performance evaluation of the process is conducted based on the quantifiable target values set for the process.
2. Longitudinal comparative analysis of the indicators is performed using GEE. The evaluation should be objective and impartial to ensure the accuracy and reliability of the results.

Continuous improvement

Based on the evaluation results, the aetiological examination process is continuously adjusted and optimised to improve the quality of the examination work. Simultaneously, a mechanism for continuous improvement is established to ensure the sustainability and effectiveness of process management. Continuous improvement is a cyclical process that requires ongoing attention to the process's operation, with timely identification and resolution of issues.

Process evaluation indicators and definitions

In the process of optimisation, to facilitate the assessment and evaluation of the implementation effectiveness of the process, we have established process evaluation indicators. The calculation formulas for each indicator are presented in table 2.

Collection of indicator data

Patient demographic data, clinical details, submission records, microbiological test results and antimicrobial utilisation information are all derived from the nosocomial infection information system. This system is seamlessly integrated with the HIS, laboratory information system, radiology information system, PDA and anaesthesia information system, facilitating the comprehensive aggregation of patient-related data.

Table 2 Evaluation indicators and achievement after process optimisation

Indicator	Formula	Before optimisation	After optimisation	Statistic	P value	Target	Achievement
Pathogen testing rate prior to antimicrobial therapy (%)	Number of cases with pathogen testing prior to antimicrobial therapy ÷ total number of antimicrobial therapy cases during the same period×100%	50.82%	71.77%	300.56	< 0.001	≥50%	Yes
Specimen qualification rate (%)	Number of qualified specimens ÷ total number of specimens tested during the same period×100%	90.20%	98.71%	30.236	< 0.001	≥95%	Yes
Specimen turnaround time (min)	Time from specimen collection to actual arrival at the laboratory	192±23.07	104±9.57	7.879	< 0.001	≤120	Yes
Antimicrobial therapy adjustment rate (%)	Number of cases with antimicrobial therapy adjusted based on pathogen test results ÷ total number of antimicrobial therapy cases with pathogen testing during the same period×100%	74.11%	93.24%	94.481	< 0.001	≥80%	Yes

GEE analysis

The GEE,[23] first proposed by Liang and Zeger in 1986, is a regression model used to analyse correlated data by employing quasi-likelihood estimation methods within the framework of generalised linear models and repeated measurement data. GEE is an advanced statistical model developed from generalised linear models, specifically designed to handle longitudinal data and other repeated measurement data. It effectively addresses the issue of correlation in longitudinal data and uses the results of each measurement, significantly reducing information loss.

In this study, the implementation phase of process optimisation (before and after) is considered as the independent variable. The process evaluation indicators, including the aetiological examination rate before antimicrobial treatment, specimen qualification rate, examination time and antimicrobial adjustment rate, are taken as dependent variables. Using the identity link function and Gaussian distribution function, with an exchangeable working correlation matrix, regression models are established to analyse the impact of the process optimisation implementation phase on the values of the process evaluation indicators.

Statistical analysis

The data were entered into Excel V.365 to establish a database, and R software (V.4.2.1) was used for GEE analysis. Continuous variables that followed a normal distribution were described using mean and SD, while non-normally distributed data were described using median (IQR). Paired t-tests or paired Wilcoxon rank-sum tests were employed for comparisons of differences between groups. Categorical variables were described using proportions, and comparisons between groups were conducted using x^2 tests or Fisher's exact test. A p value ≤0.05 was considered statistically significant for all comparisons.

RESULTS

Comparison of baseline characteristics before and after process optimisation

During the two phases before and after the implementation of the optimised aetiological examination process for patients before antimicrobial treatment, most baseline variables were balanced. However, the average age of patients was slightly higher in the phase after the implementation of process optimisation. See table 3 for details. To account for this imbalance, age was included as a covariate in all GEE models, ensuring adjusted effect estimates.

Evaluation of process performance

1. This study compared antimicrobial therapy-related indicators before and after process optimisation. The aetiological examination rate before therapy increased from 50.82% to 71.77% (p<0.001), with improved specimen qualification rates (90.20% to 98.71%, p<0.001)

Table 3 Comparison of baseline conditions before and after process optimisation implementation

Variable Stage	Before process optimisation	After process optimisation	Statistic	P value
Demographic characteristics				
Number of inpatients	34 790	34 361		
Gender				
Male	17 086	16 639	χ^2= 3.2584	0.07106
Female	17 703	17 722		
Age (years)	38.00±20.30	38.73±20.84	t=−4.7289	< 0.001
Ethnicity				
Han	32 641	32 181	χ^2=0.79664	0.3721
Ethnic minorities	2149	2180		
Clinical characteristics				
RW	0.79 (0.54–1.09)	0.77 (0.54–1.09)	W=599 661 483	0.457
Charlson index	1.00 (0–3.00)	1.00 (0–3.00)	W=601 322 180	0.1445
Others				
Patient source				
Outpatient	23 747	23 223	χ^2=3.5914	0.166
Emergency	9115	9193		
Others	1928	1945		

RW, relative weight.

Table 4 Comparison of various evaluation indicators after process optimisation implementation (analysed through generalised estimating equations)

Index	Viable	Estimate	SE	Statistic	P value
The pathogen submission rate before antimicrobial therapy	Stage=after-optimisation	0.209	0.0291	51.9	<0.001
Specimen qualification rate	Stage=after-optimisation	0.085	0.0059	210	<0.001
Specimen turnaround time	Stage=after-optimisation	−88	10.2	74.5	<0.001
Antimicrobial therapy adjustment rate	Stage=after-optimisation	0.193	0.0245	62.1	<0.001

and reduced submission times (192±23.07 min to 104±9.57 min, p<0.001). The adjustment rate for antimicrobial use also rose significantly (74.11% to 93.24%, p<0.001). See table 2 for details.

2. GEE analysis revealed significant improvements: the pathogen submission rate before antimicrobial therapy increased (estimate: 0.209, p<0.001), specimen qualification rate rose (estimate: 0.085, p<0.001), specimen submission time decreased (estimate: −88 min, p<0.001) and the antimicrobial use adjustment rate improved (estimate: 0.193, p<0.001). See table 4 for further details.

DISCUSSION

In this study, optimisation strategies were implemented for the aetiological examination process prior to antimicrobial therapy across two hospitals within a medical group. These interventions yielded notable outcomes, specifically manifesting in elevated submission rates, enhanced sample quality and streamlined process efficiency. These improvements support precise antimicrobial use and personalised patient management. Most crucially, by ensuring the precision and timeliness of aetiological testing, this study not only facilitated targeted antimicrobial therapy but also markedly bolstered the efficacy of nosocomial infection control, indirectly shielding patients from unnecessary infection risks and elevating the overall standard of nosocomial infection management. The following section delves into an in-depth discussion of the study results.

First, the application of process management in nosocomial infection control has once again underscored its significance and value.[24] Consistent with numerous management theories, process management stands as a pivotal scientific management approach and theory.[13 25 26] In this study, through process clarification, step optimisation, reinforcement of multidisciplinary collaboration and personnel training, we successfully navigated numerous challenges inherent in the traditional specimen submission process. This practice not only validated the applicability of process management theory within the hospital context but also resonated with the findings of studies by Becker *et al*[16] and Mens *et al*,[17] which demonstrated enhanced clinical diagnostic efficiency and reduced workload through process management, further attesting to its effectiveness.

Second, the utilisation of GEE for data analysis in this study provided robust statistical underpinning for a scientific assessment of process optimisation effects. GEE adeptly addressed correlation issues in longitudinal data, yielding more precise and reliable statistical outcomes.[27] This aligned seamlessly with the substantial improvements observed in submission rates, specimen qualification rates, submission times and antimicrobial use adjustment rates, thereby enhancing the persuasiveness of our research conclusions. Furthermore, this method also reduced biases from traditional linear models in repeated measurements,[28] improving accuracy.

Additionally, this study unveiled the positive impact of process management on fostering organisational synergy. By dismantling departmental silos and bolstering cross-disciplinary communication and collaboration, we successfully elevated the overall efficiency and quality of specimen submission endeavours. This finding mirrored the research by Rusjan and Kiauta,[29] who analysed the application of process standardisation concepts at the hospital level and emphasised the importance of interdepartmental collaboration. This further substantiated the potential of process management in promoting tight cooperation among diverse hospital departments and enhancing the level of medical services.

Despite demonstrating significant improvements in preantimicrobial aetiological examination workflows, this study has notable limitations. First, the constrained evaluation period spanning several months limits assessment of long-term sustainability, and the lack of temporal granularity in data collection (eg, monthly metrics) precludes time-series analysis to track dynamic intervention effects. Second, the bundled implementation of optimisation measures, while pragmatic for real-world adoption, hinders causal attribution to individual components. Third, potential observer bias may influence data interpretation despite rigorous controls.

To address these limitations, a 24-month follow-up study is planned to incorporate:

1. Longitudinal tracking of key performance indicators (eg, specimen submission rates, time-to-culture positivity) with annotated run charts for temporal trend analysis.

2. Factorial designs to isolate the effects of specific intervention components (eg, HIS logic updates vs staff training).
3. Blinding procedures and automated data validation to mitigate observer bias.

Furthermore, future investigations should expand beyond the current single metropolitan medical group to validate generalisability across heterogeneous healthcare systems with varying resource allocations and patient demographics.

This study primarily focused on optimising the specimen submission process and its implications for antimicrobial use, demonstrating the potential efficacy of process management in enhancing the quality and efficiency of nosocomial infection control. However, the broader applications of process management extend beyond this narrow scope, encompassing areas such as the management of multidrug-resistant organisms and the control of surgical site infections, as evidenced by research conducted by Andellini *et al*.[30] The insights gained from this study offer valuable lessons and reference points for other medical institutions, highlighting the potential for process management to be tailored to unique contexts and reinforced through multidisciplinary collaboration to improve nosocomial infection control efforts. These findings underscore the widespread adoption and adaptation potential of process management strategies in diverse medical environments, thereby enhancing healthcare quality and patient safety.

CONCLUSION

This study has demonstrated the effectiveness of optimising the aetiological specimen submission process prior to antimicrobial therapy. The key findings reveal significant improvements in submission and qualification rates, a notable reduction in submission time and enhanced adjustment of antimicrobial use. These results underscore the profound impact of process management in elevating the quality and efficiency of nosocomial infection control measures.

We recommend other hospitals adapt this optimised process to address similar challenges. By doing so, they can potentially replicate our achievements in enhancing submission timeliness and accuracy, thereby fostering more informed clinical decisions and improving patient outcomes. Policymakers should also consider incorporating process management strategies into wider infection control frameworks to bolster patient safety and healthcare quality. This study offers robust evidence for the benefits of process optimisation in nosocomial infection control and provides a clear pathway for institutions aiming to enhance their infection prevention and control measures.

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Contributors XZ is responsible for study design, data analysis, interpretation and statistical analysis of the data, as well as drafting the article. L-HX was responsible for the supervision and guidance of the study process. YL, L-FM, Q-FW, S-WY, ML, X-FL and L-FH implemented the study, collected data, and provided final approval. L-HX and YL interpreted the data, critically revised the article for important intellectual content and gave final approval. All authors read and approved the final manuscript. XZ is the guarantor of the study, accepting full responsibility for the overall content, integrity and accuracy of the research.

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Competing interests None declared.

Patient and public involvement In this study, patients and members of the public were not directly involved in the design, conduct, reporting or dissemination plans of the research. The focus of this study was on optimising aetiological examination processes prior to antimicrobial therapy in hospitalised patients, which did not require direct patient input due to the technical and operational nature of the interventions. While the ultimate goal of the research is to improve patient outcomes by enhancing the quality and efficiency of medical services, no specific plans were made to involve patients or the public in the research process itself. Therefore, it is hereby stated that there was no patient or public involvement in this study.

Patient consent for publication Not applicable.

Ethics approval Ethics Committee of Guangming District People's Hospital approved the study. Additionally, as it did not involve individual patients, written informed consent from patients was waived by the committee. To protect patient privacy, data involving patient names and hospitalisation numbers were concealed and replaced with special numbers during data analysis. All methods were conducted in accordance with relevant guidelines and regulations.

Provenance and peer review Not commissioned; externally peer-reviewed.

Data availability statement Data are available upon reasonable request. The data utilised in the study were obtained from the infection management department of Guangming District People's Hospital.

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