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Development and evaluation of an antimicrobial stewardship–guided nursing care model for severe pneumonia: A retrospective cohort study

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Abstract: **Background**: Severe pneumonia is associated with high mortality and substantial antimicrobial exposure. Inappropriate antimicrobial use contributes to antimicrobial resistance and adverse drug reactions, potentially worsening outcomes. **Objectives**: To develop and evaluate an antimicrobial stewardship–guided nursing care model for patients with severe pneumonia. **Methods**: A single-center retrospective cohort study was conducted at the Second Medical Center of Chinese People's Liberation Army General Hospital (Beijing, China). Medical records of patients with severe pneumonia admitted between June 2024 and June 2025 were reviewed. Patients admitted in June–December 2024 received routine nursing care, whereas those admitted in January–June 2025 received a stewardship-guided nursing model. Outcomes were assessed until discharge or day 28, whichever occurred first. **Results**: Compared with routine care, the stewardship-guided cohort showed higher specimen collection compliance and antimicrobial selection rationality scores and lower drug utilization index (DUI), defined daily doses (DDDs) and inappropriate use of core antimicrobials (all $p<0.05$). Clinical cure rate was higher, length of stay and inflammatory-marker recovery time were shorter and complication rates were lower (all $p<0.05$). Nursing quality and patient satisfaction scores also improved ($p<0.001$). **Conclusion**: An antimicrobial stewardship–guided nursing care model was associated with improved antimicrobial-use quality, reduced antimicrobial-related complications and better clinical and nursing outcomes in patients with severe pneumonia; however, causal inference is limited by the non-concurrent retrospective design.

Keywords: Antibacterial drugs; Effect; ICU; Severe pneumonia; Value

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INTRODUCTION

Severe pneumonia is a rapidly progressive and life-threatening condition that disproportionately affects older adults and children and is associated with substantial mortality (Alcock *et al*., 2023). Globally, its prevalence has been reported as 7.13 per 1,000 persons per year, with incidence rates of 7.32 per 1,000 in men and 6.93 per 1,000 in women, showing marked geographic variation (Alhomoud *et al*., 2017). Approximately 10–20% of adults hospitalized with community-acquired pneumonia require admission to an intensive care unit (ICU) (Niederman *et al*., 2022). A broad range of pathogens may precipitate severe pneumonia, including *Legionella* spp., avian influenza virus and *Mycoplasma pneumoniae* (Allaw *et al*., 2025; Aslam *et al*., 2020). Clinically, patients often present with respiratory rales, poor peripheral perfusion (e.g., pallor and delayed capillary refill), altered mental status and shock, indicating critical illness that requires urgent intervention (Aslam *et al*., 2018).

Antimicrobial therapy remains a cornerstone of management, with quinolones, penicillins and cephalosporins commonly used in clinical practice (Attiq, 2025). However, the widespread use of broad-spectrum antimicrobials has also increased the burden of adverse drug reactions (ADRs), which can compromise safety and therapeutic effectiveness (Bianco *et al*., 2020). Rational antimicrobial use—such as pathogen-guided selection, stepwise prescribing, individualized dosing, prudent combination therapy and optimization of the administration route—is therefore essential (Dadgostar, 2019). Nevertheless, inappropriate selection, non-standardized dosing and duration and indiscriminate combination therapy remain prevalent, contributing to suboptimal outcomes, prolonged illness, secondary infections, antimicrobial resistance and higher risks of ADRs (Davey & Aveyard, 2022; Gross *et al*., 2025).

Antimicrobial resistance driven by misuse of antimicrobials has become a major public health threat (Hoffmann *et al*., 2014; Jangra *et al*., 2025). To strengthen antimicrobial stewardship, healthcare systems have implemented institutional measures and quality-improvement strategies, yet effective bedside implementation depends heavily on multidisciplinary collaboration. Nursing plays a pivotal role throughout the medication-use process—particularly in timely administration, continuous patient monitoring, patient education and early identification and reporting of ADRs (Jose *et al*., 2013). In routine practice, however, conventional nursing models often emphasize task-based care and medication delivery, with limited structured

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integration of stewardship principles (e.g., regimen assessment, risk recognition and standardized ADRs. This gap highlights the need for a nursing care approach that explicitly aligns day-to-day nursing actions with rational antimicrobial use to support safer, more precise therapy in severe pneumonia. Accordingly, we developed a rational antimicrobial use–guided nursing care model and assessed its impact on clinical outcomes and antimicrobial-related safety in patients with severe pneumonia.

MATERIALS AND METHODS

Study design, duration and place

A single-center retrospective cohort study was conducted at the Second Medical Center of Chinese People's Liberation Army General Hospital (Beijing, China). Medical records of patients with severe pneumonia admitted between June 2024 and June 2025 were reviewed. According to the nursing care pathway implemented during different admission periods, patients were categorized into two cohorts: a routine-care cohort (June 2024–December 2024) and a stewardship-guided nursing cohort (January 2025–June 2025). Outcomes were assessed until discharge or completion of a 28-day hospitalization, whichever occurred first.

Study population

A total of 140 patients with severe pneumonia were included (70 in each cohort) based on eligibility criteria.

Inclusion criteria:

Patients were included if they: (1) met the diagnostic criteria for severe pneumonia defined in the Chinese Emergency Expert Consensus on Clinical Practice for Severe Pneumonia (major criteria: invasive mechanical ventilation and/or septic shock requiring vasopressors; or ≥3 minor criteria; (2) were aged ≥18 years; (3) had no end-stage organ failure at baseline, except hepatic or renal impairment documented in the medical record; (4) had normal cognitive status documented in the medical record; (5) received systemic antibacterial therapy during hospitalization; and (6) had complete clinical records required for outcome assessment.

Exclusion criteria:

1. Concomitant wound infections; 2. End-stage hepatic or renal failure or immunodeficiency; 3. Exposure to one or more systemic antimicrobial agents within 72 hours before admission; 4. Severe psychiatric disorders; 5. Inflammatory/infectious conditions at other sites; 6. Extrapulmonary infections.

Exposure definition: A new nursing models

The exposure in this retrospective cohort study was the nursing care model used during hospitalization. Routine-care cohort (June–December 2024): standard nursing care for severe pneumonia based on routine ward protocols, including vital-sign surveillance, oxygen therapy and airway clearance, routine specimen collection as ordered by physicians, medication administration per orders and routine monitoring for suspected adverse drug reactions. Stewardship-guided cohort (January–June 2025): an antimicrobial stewardship–guided nursing model (described below) implemented institution-wide to standardize antimicrobial-related nursing assessment, administration, monitoring, documentation and feedback, in alignment with national/international pneumonia and stewardship guidance.

Development framework of a stewardship-guided nursing model

The stewardship-guided nursing model was developed to align nursing practice with rational antimicrobial use and was constructed by integrating four core inputs: (1) institutional antimicrobial stewardship policies, (2) national guidance for antimicrobial clinical application, (3) hospital-specific antimicrobial resistance surveillance reports and (4) multidisciplinary stewardship collaboration mechanisms. On this basis, the study team translated antimicrobial stewardship principles into standardized nursing workflows spanning surveillance, assessment, administration, monitoring, documentation and feedback and established audit-ready quality indicators for continuous evaluation and improvement.

Stewardship-guided nursing model: Implementation, evaluation parameters and criteria

During January–June 2025, the stewardship-guided nursing model was implemented at the ward level as a standardized nursing pathway. Implementation consisted of the following components:

Training and competency verification

All participating nurses completed structured training covering antimicrobial spectrum, dosing and infusion standards, contraindications, key monitoring parameters and ADR reporting. Competency was verified by (i) a post-training written assessment (pass mark ≥80%) and (ii) completion of a skills checklist (100% completion required) before independent practice. Weekly feedback sessions were conducted to address deviations identified during audits.

Standardized workflow and documentation

A stewardship checklist was embedded into nursing documentation and completed for each antimicrobial administration episode, including: pre-administration verification, administration monitoring, post-administration education and ADR screening/reporting.

Fidelity and quantitative evaluation criteria

Implementation fidelity was quantified using the Adherence to standardized administration protocols (%). A monthly fidelity rate ≥85% was predefined as acceptable implementation.

Specific content of the stewardship-guided nursing model

Monitoring of antimicrobial-resistant bacteria and medication properties

Antimicrobial resistance surveillance: The microbiology laboratory generated a weekly ward-level antibiogram (pathogen distribution, susceptibility profiles and resistance rates by organism–drug pair). A clinical pharmacist summarized key changes (e.g., rising resistance to specific agents) and disseminated the report through the nursing work platform and weekly multidisciplinary huddles. At the bedside, nurses used the report to: (i) prioritize timely collection of etiological specimens before first-dose antibiotics when indicated, (ii) strengthen monitoring for expected drug-class toxicities when high-risk agents were prescribed and (iii) flag potential mismatch between empiric therapy and local susceptibility patterns for real-time review by physicians/pharmacists.

Medication properties database

A structured database was compiled for commonly used antimicrobials, including antimicrobial spectrum, usual dose ranges, renal/hepatic adjustment, common ADRs, contraindications and required monitoring. This database was used as a standardized reference during medication verification and patient education.

Medication intervention protocol

The medication intervention protocol was developed based on antimicrobial stewardship principles and evidence-based guidance for pneumonia management and safe antimicrobial administration, including the ATS/IDSA guideline for adult community-acquired pneumonia and the WHO ATC/DDD methodology for antimicrobial-use measurement, together with institutional infusion/compatibility standards. It was operationalized into three stages with explicit verification and escalation rules:

Pre-administration verification

Nurses verified and documented the following before each administration: indication and alignment with institutional/national guidance; allergy history; microbiological specimen collection status (when indicated); renal/hepatic function (SCr/eGFR; ALT/AST), age, weight; ④baseline ECG/QT assessment when QT-prolonging agents were used; appropriateness of dose/interval (including renal/hepatic adjustment), route, dilution, compatibility and stability.

During administration: Class-specific standardization and monitoring

Carbapenems: infusion duration was standardized; for example, imipenem/cilastatin 500 mg was infused over ≥60 min. Concurrent nephrotoxins were flagged and renal function monitoring was reinforced.

Cephalosporins: infusion reactions were monitored and documented; compatibility checks were performed and coagulation monitoring was performed when clinically indicated.

Fluoroquinolones: avoided in patients <18 years; QT interval and interacting drugs were reviewed; CNS/tendon adverse effects were actively monitored.

Aminoglycosides: dose verification based on weight and renal function; nephrotoxicity/ototoxicity surveillance; therapeutic drug monitoring (TDM) was applied when available.

Post-administration: Education and ADR surveillance

Standardized medication counseling was delivered by drug class (key ADRs, warning symptoms, adherence). ADRs were actively screened each shift. Suspected ADRs were assessed using the Naranjo algorithm and/or the WHO-UMC causality assessment system and reported within 24 hours.

Quality control

Quality control: Process and outcome indicators were predefined before data extraction and were retrospectively audited from electronic medical records and nursing documentation. Primary process indicators included (i) etiological specimen submission compliance (numerator: patients with eligible cultures collected within 24 h of admission/before first-dose antibiotics when feasible; denominator: all eligible patients), (ii) adherence to standardized administration protocols (numerator: administrations with complete checklist items; denominator: all administrations), (iii) dose-accuracy rate (numerator: administrations consistent with guideline- and renal/hepatic function–adjusted dosing; denominator: all administrations) and (iv) adverse drug reaction (ADR) reporting timeliness (numerator: suspected ADRs documented and reported within 24 h; denominator: all suspected ADRs). Safety indicators included multidrug-resistant organism (MDRO) infection control compliance (isolation and contact precautions documented within 2 h of MDRO flag) and incidence of antimicrobial-associated ADRs.

Observation indicators

Observation indicators: Outcomes were grouped into antimicrobial-use quality, clinical efficacy, complications/safety and nursing-related outcomes. Definitions and measurement methods are detailed below.

Antimicrobial selection rationality score (0–100): The score was developed a priori based on national antimicrobial clinical application guidance and pneumonia treatment guidelines. It comprised five domains: indication appropriateness (0–25), agent choice (spectrum/likely pathogens and local susceptibility) (0–25), dose and interval appropriateness including renal/hepatic

adjustment (0–20), route/infusion and compatibility compliance (0–15) and timely de-escalation/stop according to culture results and clinical response (0–15). Higher scores indicate more rational use.

Two independent reviewers (a senior clinical pharmacist and a pulmonary/critical care physician), who were not involved in bedside care, scored each case using de-identified records with admission dates removed to blind them to cohort assignment. Discrepancies >5 points were adjudicated by a third reviewer. Inter-rater reliability was assessed in a 20-case pilot sample using an intraclass correlation coefficient (ICC).

Drug utilisation index (DUI) and defined daily doses (DDDs): DDDs were calculated using the WHO ATC/DDD methodology (total dose consumed/WHO DDD for each agent). DUI was defined as the ratio of prescribed daily dose (PDD) to DDD (PDD/DDD), with values >1 suggesting potential overuse.

Clinical efficacy: Clinical cure was defined as resolution or substantial improvement of pneumonia-related signs and symptoms, stabilization of vital signs without escalation of respiratory support and improvement in inflammatory biomarkers, assessed at discharge or day 28, whichever occurred first. Length of stay and time to normalization of C-reactive protein and procalcitonin were extracted from records.

Complications and safety: Multidrug-resistant organism (MDRO) infections and superinfections were defined according to the Chinese expert consensus on prevention and control of hospital infections caused by MDROs. Antimicrobial-related adverse drug reactions were identified from chart documentation and adjudicated using the Naranjo algorithm and the WHO–UMC causality assessment system.

Nursing quality and patient satisfaction: Nursing quality (0–100) and patient satisfaction (0–100) were assessed using structured instruments (Tables 1 and 2). Both tools were developed by adapting nurse-sensitive quality domains and patient satisfaction frameworks and were reviewed by an expert panel for content validity. To reduce assessment bias, scoring was performed by trained assessors not involved in the patient's direct care and inter-rater reliability/internal consistency were evaluated in a pilot subset.

Statistical analysis

Data were analysed using SPSS 20.0 software. Categorical variables are presented as n (%) and compared using the χ^2 test; Fisher's exact test was used when expected cell counts were <5. Continuous variables are presented as mean ± SD and compared using the independent-samples t-test after checking normality; non-normally distributed variables were analysed using the Mann–Whitney U test. To mitigate confounding inherent to the non-concurrent retrospective design, baseline covariates available in the medical record (age group, sex, comorbidities, ICU admission, baseline inflammatory markers and key severity indicators) were examined between cohorts and were additionally adjusted for in multivariable regression models as sensitivity analyses. Given multiple secondary outcomes, we prespecified antimicrobial-use indicators as primary endpoints and interpreted p-values for secondary endpoints as exploratory; no formal multiplicity adjustment was applied. A two-sided $p < 0.05$ was considered statistically significant.

RESULTS

Comparison of antimicrobial stewardship indicators

Results indicated that the test group demonstrated significantly higher rates of pathogen specimen submission compliance and antimicrobial selection rationality scores compared to the control group. Furthermore, the test group exhibited significantly lower rates of DUI, DDDs and inappropriate use of core antimicrobials than the control group, with statistically significant differences ($p < 0.05$) (Table 3).

Comparison of clinical efficacy

Statistical results indicate that the clinical cure rate in the experimental group was higher than that in the control group. The duration of hospitalisation and the time required for inflammatory markers to return to normal were significantly shorter in the experimental group compared to the control group, with statistically significant differences ($p<0.05$) (Table 4).

Comparison of complication incidence rates

The incidence of multidrug-resistant bacterial infections, secondary infections and adverse drug reactions was significantly lower in the experimental group than in the control group ($p<0.05$). The distribution of adverse reaction types indicated higher rates of gastrointestinal reactions and hepatic/renal impairment in the control group, while the experimental group exhibited a marked reduction in all types of adverse reactions (Table 5).

Comparison of nursing quality and satisfaction

The nursing quality scores and patient satisfaction scores in the experimental group were significantly higher than those in the control group ($p < 0.05$) (Table 6).

DISCUSSION

Antimicrobial agents are commonly employed in modern medical treatment, holding significant therapeutic value across numerous fields, including infection control (Kosiyaporn *et al*., 2020).

Table 1: Nursing quality score criteria

Assessment domain	Scoring criteria	Max score
Nursing practice compliance	Fully compliant with standards (24-25); minor deviations (15-23); major non-compliance (0-14)	25
Patient communication & support	Effective communication and comprehensive support (23-25); needs improvement (15-22); inadequate (0-14)	25
Patient safety management	Fully ensured patient safety (18-20); some risks (10-17); inadequate safety (0-9)	20
Nursing documentation completeness	Complete, timely, and accurate (14-15); some omissions (8-13); significant incompleteness (0-7)	15
Nursing service quality	High quality (13-15); good (8-12); average or poor (0-7)	15
Total score	Sum of all domains	100

Table 2: Patient satisfaction score criteria

Assessment domain	Scoring criteria	Max score
Nursing attitude	Excellent attitude (26-30); good (16-25); average or poor (0-15)	30
Communication effectiveness	Clear and effective communication (21-25); acceptable (11-20); inadequate (0-10)	25
Response speed	Timely response (16-20); slow (8-15); delayed (0-7)	20
Nursing quality	High quality (21-25); good (11-20); average or poor (0-10)	25
Environment & facilities	Excellent environment (9-10); good (5-8); poor (0-4)	10
Total score	Sum of all domains	100

Table 3: Comparison of rationality indicators for antibacterial drug use between the two groups.

Group	Case number	Qualified rate of etiological specimen submission (%)	Rationality score of antibacterial drug selection (Score)	DUI	DDDs	Irrational use rate of core antibacterial drugs (%)
Routine-care group	70	82.9 (58/70)	76.3±6.5	0.95±0.14	61.38±6.94	18.57 (13/70)
Stewardship-guided group	70	97.1 (68/70)	91.5±4.2	0.61±0.11	43.26±5.18	2.86 (2/70)
χ^2 Value	-	8.964	9.231	-	-	-
p Value	-	0.003	0.002	-	-	-
t Value	-	-	-	16.247	15.362	16.893
p Value	-	-	-	<0.001	<0.001	<0.001

Abbreviation: Abbreviations: DUI, drug utilization index (PDD/DDD, ratio); DDD, defined daily dose; DDDs, defined daily doses (DDD equivalents); PDD, prescribed daily dose.

Table 4: Comparison of clinical efficacy indicators between the two groups.

Group	Case number	Clinical cure rate (%)	Length of hospital stay (d)	Recovery time of inflammatory indicators (d)
Routine-care group	70	71.4 (50/70)	19.5±4.6	9.3±2.5
Stewardship-guided group	70	91.4 (64/70)	14.2±3.1	6.1±1.6
χ^2 Value	-	10.245	-	-
p Value	-	0.001	-	-
t Value	-	-	8.263	8.547
p Value	-	-	<0.001	<0.001

However, as the variety and applications of these agents continue to expand, issues surrounding their inappropriate use have become increasingly apparent. Antimicrobial resistance has emerged as one of the primary threats to public health (Nurmeksela *et al*., 2022). Presently, pharmaceutical interventions within the framework of novel nursing models are playing a positive role in the management of antimicrobial usage.

Table 5: Comparison of complication rates between the two groups.

Group	Case number	Incidence of multidrug-resistant bacteria infection (%)	Incidence of superinfection (%)	Incidence of adverse reactions to antibacterial drugs (%)	Incidence of gastrointestinal reactions (%)	Incidence of hepatorenal function impairment (%)	Incidence of allergic reactions (%)
Routine-care group	70	18.6 (13/70)	15.7 (11/70)	17.1 (12/70)	7.14 (5/70)	5.71 (4/70)	4.29 (3/70)
Stewardship-guided group	70	2.9 (2/70)	1.4 (1/70)	2.9 (2/70)	1.43 (1/70)	1.43 (1/70)	0 (0/70)
χ^2 Value	-	9.258	9.434	8.457	-	-	-
p Value	-	0.002	0.002	0.004	-	-	-
Fisher's exact test	-	-	-	-	-	0.0001	0.004

Table 6: Comparison of nursing quality and patient satisfaction between the two groups

Group	Case number	Nursing quality score (Score)	Patient satisfaction score (Score)
Routine-care group	70	81.2±5.6	81.8±5.9
Stewardship-guided group	70	94.3±3.8	93.7±4.2
t Value	-	15.632	13.258
p Value	-	<0.001	<0.001

This study integrates core antimicrobial stewardship elements into routine nursing workflows for severe pneumonia, moving beyond task-based medication administration toward a structured, audit-ready pathway. The model is innovative in three practical aspects: (i) it operationalizes local antimicrobial resistance surveillance (weekly antibiograms) into bedside nursing actions and escalation triggers; (ii) it standardizes antimicrobial administration and monitoring using checklists and competency verification; and (iii) it links these processes to quantitative indicators (e.g., specimen collection compliance, dose accuracy, ADR reporting timeliness) for continuous quality improvement. These features aim to improve the appropriateness and safety of antimicrobial use while supporting multidisciplinary decision-making.

This study demonstrates that introducing antimicrobial stewardship (AMS) principles into the management of critically ill pneumonia patients and reinforcing implementation through standardized processes leads to improvements in prescription-related indicators (such as specimen collection compliance and rational drug selection), alongside reductions in antimicrobial exposure metrics (e.g., DDDs, DUI). Concurrently, hospital-related outcomes show an optimizing trend. This direction of change aligns with previous high-quality evidence. It has been noted that AMS interventions in hospitalized patients can enhance antimicrobial prescription quality, often shortening hospital stays or improving resource utilization without increasing adverse outcome risks (Davey P *et al*., 2017). It has been further demonstrated that AMS programs correlate with reduced rates of resistant bacterial infections/colonization and Clostridioides difficile infections, suggesting potential safety benefits from reducing unnecessary or inappropriate antimicrobial exposure (Baur D *et al*., 2017). In the pneumonia setting, similarly, reported improved guideline adherence, reduced antimicrobial exposure, and concomitant improvements in clinical process indicators, comparable to the downward trends in DDDs and DUI observed in this study (Bos M *et al*., 2023). From a regulatory framework perspective, it has been emphasized that AMS should encompass a closed-loop management covering "drug selection—dosage—route of administration—duration of therapy—reassessment." Thus, this study's reinforcement of execution nodes ("collection—administration—monitoring—communication") at the nursing level can be viewed as a practical implementation of this closed-loop concept. Concurrently, underscored nurses' critical role in specimen collection, efficacy/adverse reaction monitoring, and therapeutic management communication (Tamar F *et al.,* 2016). This aligns logically with the observed process improvements and reduced drug exposure in this study.

Although this study emphasizes the crucial role of nurses in antimicrobial stewardship at the bedside, key prescribing decisions (initiation, escalation, de-escalation and

discontinuation of antimicrobials) remained physician- and pharmacist-led. Within this context, nurses contributed by ensuring timely specimen collection when indicated, verifying administration parameters, conducting structured toxicity monitoring and communicating risk signals and adherence data to the antimicrobial stewardship team. Pharmacists supported evidence-based agent selection, compatibility checks and dose optimization, while physicians provided diagnosis and individualized treatment planning based on clinical response. Such multidisciplinary collaboration is essential to optimize antimicrobial use, reduce resistance risks and improve patient outcomes; future implementations should further strengthen team-based decision pathways and shared accountability.

Limitations and future research directions

While this study provides valuable insights into integrating antimicrobial stewardship into nursing care for severe pneumonia, several limitations should be acknowledged. First, as a retrospective, non-concurrent cohort study, the observed associations may be influenced by secular trends and residual confounding, including unmeasured factors such as clinician prescribing preferences, staffing patterns and changes in case-mix or disease severity over time. Although we compared available baseline characteristics and performed sensitivity analyses adjusting for measured covariates, unmeasured confounding cannot be fully excluded. Future studies should employ prospective designs (ideally randomized or cluster-randomized), or advanced causal-inference approaches (e.g., propensity-score methods, interrupted time-series analyses, negative-control outcomes/exposures and quantitative bias/sensitivity analyses such as E-values) to strengthen causal interpretation. Second, this single-center study may limit generalizability; multicenter evaluations are needed. Third, outcomes were assessed only through discharge or day 28 and longer-term outcomes (e.g., post-discharge mortality, readmissions and longitudinal resistance trends) warrant investigation. Finally, subgroup analyses by age and disease phenotype were not powered; future work should examine whether effects differ across older adults and other key subgroups. In addition, the sample size was determined by the available admissions during the study period and no a priori power calculation was performed, which may limit precision for secondary outcomes.

CONCLUSION

This study pioneered an innovative nursing model integrating ‘patient antimicrobial resistance monitoring-targeted interventions-multidisciplinary collaboration-quality control’. By systematically consolidating the characteristics of commonly used antimicrobial agents in critically ill pneumonia patients alongside principles for their appropriate utilisation, it achieved standardised management and administration of these medications. Results demonstrate that this model significantly enhances the rationality of antimicrobial use, reduces the incidence of multidrug-resistant bacterial infections and adverse reactions and aims to improve patient clinical outcomes while elevating nursing quality and patient satisfaction. It provides a novel pathway for innovating critical care pneumonia nursing models and managing antimicrobial agents.

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Authors’ contributions

Dongze Peng: Designed the study, collected the data and drafted the manuscript; Jing Fu: Recruited patients, managed the clinical data and revised the manuscript; Simin Song: Supervised the study, interpreted the results and approved the final version of the manuscript. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

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Ethical approval

Ethical approval for this retrospective study was granted by the Ethics Committee of the Second Medical Center of Chinese People’s Liberation Army General Hospital. Because this was a retrospective chart review using de-identified data, the requirement for individual informed consent was waived according to the Ethics Committee requirements. (Approval No.: M2026-268-01) The ethics approval documentation has been provided to the editorial office for verification.

Conflict of interest

The authors declared no conflict of interest.

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