Appendix

STROBE Statement—checklist of items

Section	Item No.	STROBE Recommendation	Completed Content
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract(b) Provide an informative and balanced summary of what was done and what was found	(a) Title: Impact of integrating objectives and key results into an antimicrobial stewardship program: A retrospective analysis (clearly states retrospective before-and-after observational study design).(b) Abstract summary: This study retrospectively evaluated the effect of integrating OKR management into an Antimicrobial Stewardship Program (ASP) in a large tertiary hospital. A total of 259,143 hospitalized patients were divided into pre-intervention (Mar–Dec 2018, n=130,956) and post-intervention (Mar–Dec 2019, n=128,187). After OKR implementation, antimicrobial use density (AUD) decreased significantly ($p<0.017$); hospitalization rate of antibiotics, average hospital stay and per capita antimicrobial cost also declined significantly ($p<0.01$). No statistically significant differences were observed in infection-related mortality and multidrug-resistant organism incidence. The study concludes that OKR is an effective and practical management tool for ASP and worthy of widespread promotion in healthcare settings.
Introduction: Background/rationale	2	Explain the scientific background and rationale for the investigation	Antimicrobial overuse and misuse have caused a global surge in bacterial resistance, imposing severe public health threats and huge economic burdens worldwide. Approximately 10–20% of antibiotic prescriptions are inappropriate. Antimicrobial Stewardship Programs (ASP) are proven effective to standardize antibiotic use, reduce resistance, cut costs and improve patient outcomes. Objectives and Key Results (OKR) is a mature goal management tool widely adopted in various industries to align teams and boost performance; however, its application in hospital ASP has not been reported. Against the background of China's national requirements for strengthening clinical antimicrobial management, this study explored the application effect of combining OKR with ASP to fill the research gap.
Introduction: Objectives	3	State specific objectives, including any prespecified hypotheses	Primary objective: To assess the comprehensive impact of integrating the OKR management system into a hospital ASP.Prespecified key outcome indicators: Infection-related mortality rate, antimicrobial use density (AUD), incidence of multidrug-resistant organisms.Prespecified secondary indicators: Inpatient antimicrobial use rate, surgical antimicrobial prophylaxis rate, surgical site infection rate, average length of hospital stay, per capita antimicrobial cost.Hypothesis: Implementing OKR in ASP can optimize antimicrobial use, reduce AUD, lower medical costs and shorten hospital stays, without increasing infection-related mortality and drug-resistant bacteria incidence.
Methods: Study design	4	Present key elements of study design early in the paper	This is a retrospective before-and-after observational study, conducted following the STROBE statement. The study set two observation phases: pre-OKR implementation (baseline period) and post-OKR implementation (intervention period), comparing multiple clinical and managerial indicators between the two phases.

Section	Item No.	STROBE Recommendation	Completed Content
Methods: Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up and	Setting & Location: The Second Xiangya Hospital, Central South University, a 3,500-bed tertiary teaching hospital in Changsha, China.Timeline:• Pre-intervention period (baseline): March 2018 – December 2018• Post-intervention period (after OKR + ASP implementation): March 2019 – December 2019Data collection was conducted simultaneously with the two observation periods; no additional long-term follow-up was set.
Methods: Participants	6	(a) Eligibility criteria, sources and methods of participant selection(b) Details for matched study (if applicable)	(a) Inclusion criteria: All inpatients admitted to the hospital during the pre-intervention and post-intervention periods; no restrictions on age, gender or disease types.Exclusion criteria: All outpatient and emergency department patients were excluded.Recruitment method: All eligible inpatients were consecutively included via the hospital information system (HIS); no artificial screening or sampling.(b) No matching design was adopted in this study.
Methods: Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and diagnostic criteria	1. Exposure: Implementation of the OKR-managed Antimicrobial Stewardship Program (intervention measure).2. Primary outcome variables (Key Results of OKR):• Infection-related mortality rate: Deaths directly caused by infections / total inpatients• Antimicrobial Use Density (AUD): Calculated as DDDs per 100 person-days (standard DDD definition adopted)• Incidence of multidrug-resistant organisms: Cases of multidrug-resistant bacteria / relevant tested patients3. Secondary outcome variables:• Inpatient antimicrobial use rate: Inpatients using antibiotics / total inpatients• Surgical antimicrobial prophylaxis rate: Cases receiving surgical prophylactic antibiotics / total surgical patients• Surgical site infection rate: Surgical site infection cases / total surgical patients• Average length of hospital stay: Average inpatient days of all hospitalized patients• Per capita antimicrobial cost: Average expense of antibiotics per inpatient4. Potential confounders: Patient composition, admission volume, disease spectrum (affected by COVID-19 in the later stage).
Methods: Data sources/ measurement	8	For each variable, state data sources and assessment methods; describe cross-group comparability	All data were automatically extracted from the hospital information system (HIS). All indicators were measured using unified hospital statistical standards in both phases, ensuring consistent assessment methods and good comparability between the pre- and post-intervention groups. All patient data were anonymized to protect privacy.
Methods: Bias	9	Describe any efforts to address potential sources	1. Unified data extraction standard via HIS to reduce manual recording bias.2. Adopted Bonferroni correction to control Type I error caused by multiple statistical comparisons.3. The ASP team adopted standardized work specifications referring to Guiding Principles for Clinical Antibiotic Use (2015) and national antibiotic guidelines to ensure consistent intervention standards.4. Pharmacists' prescription suggestions were evidence-based and non-mandatory to avoid subjective intervention bias.
Methods: Study size	10	Explain how the study size was arrived at	The sample size was determined by all consecutive inpatients during the two designated observation periods. Pre-intervention: 130,956 inpatients; Post-intervention: 128,187 inpatients. The large sample size ensured sufficient statistical power for indicator comparison.
Methods:	11	Explain how quantitative	Continuous variables (AUD, length of hospital stay, per capita antimicrobial cost) were presented as

Section	Item No.	STROBE Recommendation	Completed Content
Quantitative variables		variables were handled; describe grouping rules (if applicable)	mean ± standard deviation. Categorical variables (all rate indicators: mortality, drug resistance, antibiotic use rate etc.) were presented as frequency and percentage. No additional grouping or stratification was performed for quantitative variables.
Methods: Statistical methods	12	(a) All statistical methods for analysis & confounding control(b) Subgroup/interaction analysis (if applicable)(c) Handling of missing data(d) Follow-up/loss to follow-up handling (if applicable)(e) Sensitivity analyses (if applicable)	(a) Software: SPSS 26.0. Chi-square test for categorical rate indicators; independent t-test for continuous indicators (AUD, cost, hospital stay). Bonferroni correction was used to adjust multiple comparisons: Primary indicators α=0.017, secondary indicators α=0.01.(b) No subgroup or interaction analysis was conducted.(c) No missing data in the extracted HIS datasets.(d) No long-term follow-up was set, so loss to follow-up did not occur.(e) No sensitivity analysis was performed.
Results: Participants	13	(a) Number of participants at each research stage(b) Reasons for non-participation(c) Flow diagram (if applicable)	(a) Total enrolled patients: 259,143. Pre-intervention: 130,956 inpatients; Post-intervention: 128,187 inpatients. All eligible inpatients were included, no exclusion after enrollment.(b) Outpatients and emergency patients were excluded per preset criteria; no other non-participation cases.(c) A flow chart of OKR integrated ASP and research procedure was attached in the original paper.
Results: Descriptive data	14	(a) Baseline characteristics of participants(b) Number of cases with missing data(c) Summary of follow-up time (for cohort study)	(a) Basic patient characteristics (age, gender, disease) were not stratified and compared; overall inpatient volume was slightly lower in the post-intervention period.(b) No missing data in all research variables.(c) This is a before-and-after study without long-term follow-up; no follow-up time statistics.
Results: Outcome data	15	Report outcome events or summary measures	Primary outcomes:1. Infection-related mortality: 0.01% (pre) vs 0.01% (p=0.450)2. AUD: 43.31 DDDs/100 person-days (pre) vs 39.07 DDDs/100 person-days (p=0.0013)3. Multidrug-resistant organism rate:13.72% (pre) vs 14.07% (p=0.260)Secondary outcomes:1. Inpatient antibiotic use rate: 39.96% → 38.09% (p<0.01)2. Surgical prophylaxis rate: 34.18% → 33.21% (p=0.0120)3. Surgical site infection rate: 0.08% → 0.06% (p=0.080)4. Average hospital stay: 9.18 days → 8.57 days (p<0.01)5. Per capita antimicrobial cost: 1109.70 Yuan → 1061.70 Yuan (p<0.01)
Results: Main results	16	(a) Unadjusted/adjusted estimates & confidence intervals(b) Grouping boundary for categorical variables(c) Convert relative	(a) All results are unadjusted estimates; no additional confounding factor adjustment was performed. P-values were reported to indicate statistical significance.(b) All categorical indicators were presented as rates, no artificial categorization of continuous variables.(c) Not applicable for this study.

Section	Item No.	STROBE Recommendation	Completed Content
		risk to absolute risk (if applicable)	
Results: Other analyses	17	Report subgroup, interaction or sensitivity analyses	No subgroup analysis, interaction analysis or sensitivity analysis was conducted in this study.
Discussion: Key results	18	Summarise key results against study objectives	The integration of OKR into ASP successfully reduced antimicrobial use density, inpatient antibiotic use rate, average hospital stay and per capita antimicrobial cost, fully achieving the expected optimization goals for antimicrobial management. Infection-related mortality and multidrug-resistant organism incidence showed no significant changes, which is consistent with the actual clinical situation. Overall, the OKR + ASP model delivered positive practical effects.
Discussion: Limitations	19	Discuss potential bias, inaccuracies and limitations	1. Limited observation period: The pre- and post-intervention phases were both less than one year; the short observation window cannot reflect the long-term change of bacterial resistance (a slow-evolving indicator).2. External interference: The COVID-19 pandemic caused changes in inpatient volume and disease spectrum, affecting the long-term comparability of historical data.3. Manpower shortage: The ASP clinical pharmacist team was understaffed, restricting daily audit and intervention efficiency.4. No long-term follow-up for long-term clinical outcomes.
Discussion: Interpretation	20	Cautious interpretation combining objectives, limitations and existing evidence	OKR clarified team goals and unified work direction, enabling the multidisciplinary ASP team to perform targeted interventions on antibiotic prescriptions, infection prevention and respiratory care. The non-mandatory pharmacist suggestions were well accepted by clinicians, which guaranteed the rational use of antibiotics. The non-significant changes in mortality and drug resistance are mainly because the hospital's initial antibiotic use was relatively standardized, and drug resistance changes require a longer cycle to observe. The study results confirm that OKR is a simple and effective management tool for hospital antimicrobial management.
Discussion: Generalisability	21	Discuss the external validity/generalisability of results	This study was conducted in a large tertiary teaching hospital with a complete multidisciplinary ASP team and mature HIS system. The OKR + ASP model and related experience are highly referable for domestic tertiary hospitals. For primary and secondary hospitals with different patient composition, staffing and management foundation, the model needs to be adjusted appropriately according to local conditions.
Other information: Funding	22	State funding source and funder's role	This study received no external funding. The funder had no participation in study design, data collection, analysis, paper writing or publication.