Journal of Advanced Health Informatics Research (JAHIR)
Vol. 4, No. 2, August 2026, pp. 76-82
ISSN: 2985-6124, DOI: 10.59247/jahir.v4i2.427

Implementation description of a SIMRS-Based Warning System and Automatic Stop Order for Antibiotic Therapy in a Teaching Hospital

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ARTICLE INFO

Article history:

Received June 20, 2026
Revised September 22, 2026
Published November 12, 2026

Keywords:

Antibiotic stewardship;
Automatic stop order;
Clinical decision support;
SIMRS;
Teaching hospital;

ABSTRACT

Prolonged antibiotic therapy without timely reassessment remains an important challenge in hospital antimicrobial stewardship. A teaching hospital implemented a Hospital Management Information System (SIMRS)-based warning system and automatic stop order to support prospective review of inpatient antibiotic prescriptions. The system generated electronic warnings on days 3, 4, and 5 of therapy, and on day 5 required the doctor in charge of the patient (DPJP) to document the clinical reason for continuing antibiotics beyond five days. If the justification was not completed, the antibiotic order was automatically stopped and could not be processed by the pharmacy service. This study describes the implementation of a warning system and automatic stop order for antibiotics from October 2025 to May 2026. Descriptive analysis was performed using prescription counts, patient-days, antibiotic-days, days of therapy (DOT) per 100 patient-days, and distribution of prescriptions by therapy-day category. During the observation period, 1,761 antibiotic prescriptions were followed through SIMRS, with 11,677 patient-days and 6,233 antibiotic-days. Antibiotic exposure was 53.38 DOT per 100 patient-days, prescription density was 15.08 prescriptions per 100 patient-days, and the mean exposure was 3.54 antibiotic-days per prescription. Most prescriptions were recorded during days 1-3 (1,033; 58.66%), followed by day 4 (248; 14.08%), day 5 (174; 9.88%), and more than five days (306; 17.38%). 3161 total antibiotic confirmations, 2871(90,83%) continued antibiotics and 290 (9,17%) did not continue antibiotics. The system created a structured digital pathway for reassessment and identified extended prescriptions that could be prioritised for stewardship audit. This early implementation evaluation suggests that integrating alerts, mandatory justification, and pharmacy workflow may strengthen antibiotic governance in teaching hospitals.

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1. INTRODUCTION

Antimicrobial resistance is a persistent threat to patient safety and the quality of hospital care. In daily practice, antibiotics are frequently initiated empirically before complete microbiological and clinical information is available. Without a structured reassessment process, empirical therapy may continue longer than necessary, increasing the risk of adverse drug events, selection of resistant organisms, Clostridioides difficile infection, and avoidable treatment cost [1],[2],[3],[4].

A critical stewardship opportunity arises after the first 48 to 72 hours of therapy, when the patient's clinical response, diagnostic results, and microbiological data are usually more informative [1],[2],[3]. At this point, clinicians are expected to review the indication, spectrum, route, dose, and planned duration of therapy. This review, commonly referred to as an antibiotic time-out, is particularly important in teaching hospitals where prescribing decisions involve multidisciplinary teams and learners across levels of training [1],[4],[5].

Current antibiotic prescribing methods do not always provide a structured mechanism for documenting and reassessing antibiotic duration. Warning systems and automatic stop orders can translate antimicrobial stewardship principles into routine prescribing workflows by prompting reassessment at predetermined treatment durations [6],[7],[8]. Rather than relying solely on retrospective audits or manual reminders, automatic stop orders require a defined action when therapy reaches a predetermined duration [6],[7]. When integrated into an electronic prescribing system, this approach can make antibiotic duration visible, encourage clinical justification, and prevent inadvertent continuation of therapy without reassessment [8],[4],[9]. The teaching hospital in this study implemented an automatic warning system and stop orders within the Hospital Management Information System (SIMRS). The system generated alerts on days three, four, and five of antibiotic therapy. On day five, the patient's attending physician (DPJP) was required to document the clinical rationale for continuing antibiotics beyond five days. If the justification was not completed, the pharmacy service could not process the antibiotic order, creating a direct link between clinical reassessment and dispensing authorization.

This study aims to evaluate the initial implementation of a SIMRS-based warning system and automatic stop orders by prospectively following antibiotic prescriptions from October 2025 to May 2026. The contribution of this study lies in the clinical justification from doctors on the 5th day which must be adhered to if they want to prescribe more than 5 days so that it can describe antibiotic prescriptions from doctors. In addition, with the integration of SIMRS, it will facilitate monitoring of antibiotic prescriptions and antibiotic stop order actions.

2. METHODS

2.1. Study Design and Setting

This study used a prospective, descriptive, observational design to evaluate an antimicrobial stewardship technology implemented at a teaching hospital. The observation period was October 2025 to May 2026. The intervention was integrated into the hospital SIMRS and connected to the inpatient pharmacy dispensing workflow, allowing antibiotic prescriptions to be followed as they moved through the electronic prescribing process.

The unit of analysis was the antibiotic prescription record. Each inpatient antibiotic prescription entered into SIMRS during the study period was followed prospectively from the initial order until discontinuation, day-5 reassessment, or continuation beyond five days. The evaluation used routinely generated system data, including total prescription records, patient-days, antibiotic-days, and the distribution of prescriptions according to therapy-day category.

2.2. Prospective Prescription Follow-Up Procedure

Prospective follow-up was conducted by observing each antibiotic order recorded in SIMRS. Once an antibiotic was prescribed, the system assigned the order to therapy day 1 and updated the therapy duration according to subsequent prescribing activity. The system then generated electronic warnings on days 3, 4, and 5 to remind prescribers that antibiotic therapy should be reviewed in light of the patient's indication, clinical response, laboratory findings, and available microbiological information.

On day 5, the DPJP was required to provide a clinical justification when antibiotic therapy was intended to continue for more than five days. The justification field functioned as a mandatory reassessment point. If the DPJP did not complete the field, the prescription was automatically stopped in the SIMRS workflow, and the pharmacy could not dispense the antibiotic. This mechanism was designed to prevent unintended

continuation while still allowing clinically appropriate extended therapy when a documented rationale was provided.

2.3. Description of The Innovation

The system logic is presented in Fig. 1. After an antibiotic order was entered in SIMRS, the system calculated the therapy day based on the prescription timeline. Alerts were displayed on days 3, 4, and 5. On day 5, any request to continue therapy beyond five days required a documented clinical reason from the DPJP. The pharmacy service used this documentation as part of the dispensing decision, making the system both a reminder tool and a control point within the medication-use process.

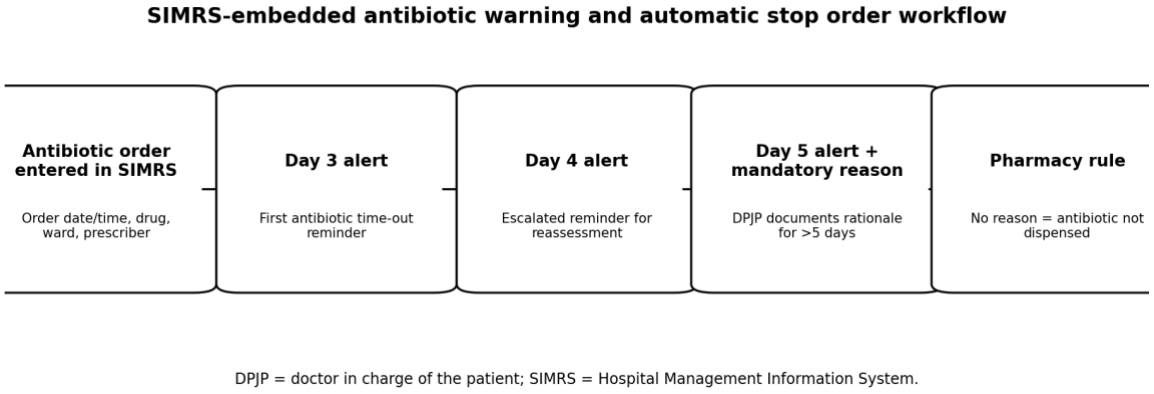


Fig. 1. Workflow of the SIMRS-based warning system and automatic stop order for antibiotic reassessment.

2.4. Variables and Outcome Measures

The main utilisation variables were the number of antibiotic prescriptions, patient-days, antibiotic-days, and prescription distribution by duration category: days 1-3, day 4, day 5, and more than five days. Because the source data grouped days 1-3 into a single category, the exact number of prescriptions that specifically reached day 3 could not be separated. The key stewardship indicators were days of therapy (DOT) per 100 patient-days, prescription density per 100 patient-days, mean antibiotic-days per prescription, the proportion of prescriptions entering the reassessment window, and the proportion of prescriptions continuing beyond five days. The definitions and calculation methods for these antibiotic utilisation and stewardship indicators are presented in Table 1.

Table 1. Operational Definitions and Formulas Used in The Evaluation

Indicator	Formula/definition	Interpretation
Prescription density	Total antibiotic prescriptions / patient-days x 100	Frequency of antibiotic prescribing standardised to hospital activity.
Days of therapy (DOT) per 100 patient-days	Antibiotic-days / patient-days x 100	Antibiotic exposure standardised to hospital activity.
Average antibiotic-days per prescription	Antibiotic-days / total antibiotic prescriptions	Average antibiotic exposure per prescription record.
Reassessment window	Day-4 + day-5 + >5-day prescriptions	Prescriptions reaching the later alert-and-reassessment phase.
Continuation beyond five days	>5-day prescriptions / total prescriptions x 100	Prescriptions requiring documented clinical justification for continuation.

2.5. Data Analysis

Data from prospectively followed prescription records were analysed descriptively. Categorical data were summarised as frequencies and percentages. Antibiotic exposure was calculated as DOT per 100 patient-days by dividing total antibiotic-days by total patient-days, then multiplying by 100. Prescription density was calculated as the number of antibiotic prescriptions per 100 patient-days. The proportion of prescriptions in each therapy-day category was calculated using the total number of antibiotic prescriptions as the denominator.

The unit of analysis was the antibiotic prescription record. Individual patients could contribute more than one antibiotic prescription record during a single admission if they received combination therapy, antibiotic switching, or repeated orders. Each inpatient antibiotic prescription entered into SIMRS during the study period was followed prospectively.

2.6. Ethical considerations

This study was conducted as a prospective quality-improvement and health-informatics evaluation using prescription data captured through SIMRS. The analysis was performed on aggregate utilisation indicators and did not include identifiable patient information in the reporting dataset. The final manuscript should include the relevant institutional approval or ethics committee statement, in accordance with local policy, particularly if patient-level clinical variables are included in subsequent analyses.

3. RESULTS AND DISCUSSION

3.1. Overall Prescribing Volume and Antibiotic Exposure

Between October 2025 and May 2026, the SIMRS-based warning system prospectively captured 1,761 antibiotic prescription records. The total length of stay was 11,677 patient-days, and total antibiotic exposure reached 6,233 antibiotic-days. These figures corresponded to 53.38 DOT per 100 patient-days and 15.08 antibiotic prescriptions per 100 patient-days. The mean antibiotic exposure was 3.54 antibiotic-days per prescription, suggesting that most prescriptions were discontinued or reassessed before entering prolonged treatment. Antibiotic-use metrics such as antibiotic-days and DOT per 100 patient-days are commonly used to quantify hospital antibiotic consumption [10],[11]. The key antibiotic utilisation indicators for the study period are summarised in Table 2 and illustrated in Fig. 2.

Table 2. Main Utilisation Indicators Captured by The SIMRS-Based Warning System

Indicator	Value	Notes
Observation period	October 2025-May 2026	Prospective implementation evaluation period.
Total antibiotic prescriptions	1,761	Prescription records followed through SIMRS.
Total patient-days	11,677	Aggregated patient-days during the observation period.
Total antibiotic-days	6,233	Total days of antibiotic therapy recorded by the system.
DOT per 100 patient-days	53.38	Antibiotic-days / patient-days x 100.
Prescriptions per 100 patient-days	15.08	Antibiotic prescriptions / patient-days x 100.
Average antibiotic-days per prescription	3.54	Antibiotic-days / antibiotic prescriptions.

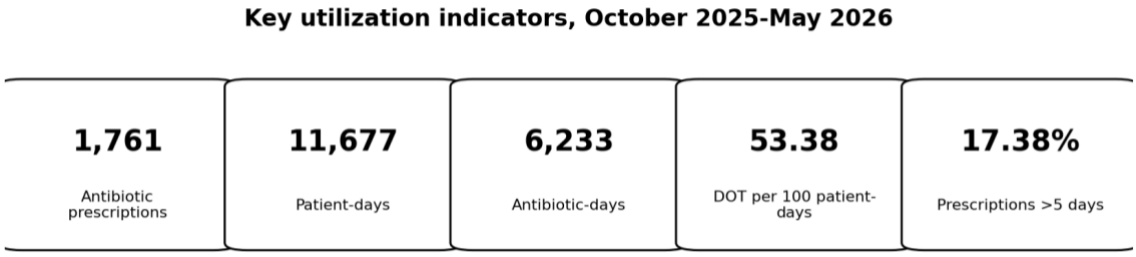


Fig. 2. Summary Dashboard of Antibiotic Utilisation Indicators During The Prospective Evaluation Period.

3.2. Distribution of Prescriptions by Antibiotic-Day Category

The largest proportion of prescriptions was in the 1-3 days category (1,033 prescriptions; 58.66%). A total of 248 prescriptions (14.08%) reached day 4, while 174 prescriptions (9.88%) reached day 5. Prescriptions continuing beyond five days accounted for 306 records (17.38%). In total, 728 prescriptions (41.34%) entered the later reassessment window, consisting of day-4, day-5, and more-than-five-day prescriptions. This distribution indicates that the system captured a substantial number of prescriptions at clinically meaningful reassessment points, consistent with the principle of periodic reassessment embedded in antimicrobial stewardship programs [1],[2],[3]. The distribution of antibiotic prescriptions by treatment duration is presented in Table 3 and illustrated in Fig. 3.

Table 3. Distribution of Antibiotic Prescriptions by Duration Category

Duration category	Prescription count	Percentage of all prescriptions	Stewardship implication
Days 1-3	1,033	58.66%	Early treatment phase; day-3 warning was included but could not be separated from the grouped source data.
Day 4	248	14.08%	Later reassessment reminder before the mandatory day-5 justification point.
Day 5	174	9.88%	Mandatory clinical reason required if therapy was intended to continue beyond five days.
More than five days	306	17.38%	Extended therapy requiring documented rationale and potential antimicrobial stewardship review.
Total	1,761	100.00%	All antibiotic prescriptions captured during the prospective observation period.

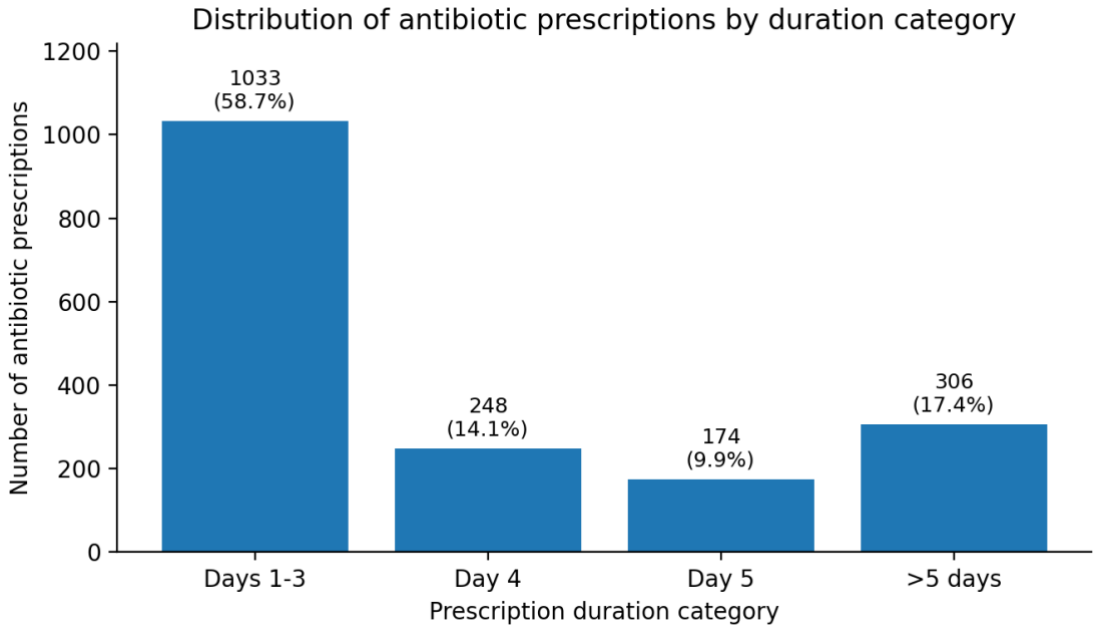


Fig. 3. Distribution of Antibiotic Prescriptions According to Therapy-Day Category.

3.3. Interpretation as An Antimicrobial Stewardship Intervention

The innovation translated the antibiotic time-out concept into a routine digital workflow. Instead of relying solely on individual memory or manual audit, the SIMRS generated reminders on predetermined therapy days and required a documented decision when treatment was intended to continue for more than 5 days. This approach is consistent with antimicrobial stewardship principles, which emphasise timely reassessment, documentation of indication and duration, and multidisciplinary accountability for antibiotic use [1],[12],[2],[3].

The five-day threshold was selected as a pragmatic point for reassessment rather than as a universal maximum duration for all infections. Many empirical regimens should be reviewed after 48 to 72 hours, while antibiotic duration should be determined according to the infection, clinical response, microbiological findings, and applicable treatment guidelines [1],[2],[3].

Nevertheless, extended therapy may remain appropriate in selected clinical conditions, and therefore the system did not prohibit continuation but required the DPJP to document the clinical rationale [2].

The finding that 17.38% of prescriptions continued beyond five days provides a potentially useful denominator for targeted stewardship review. Rather than manually screening all 1,761 prescriptions, pharmacists and the antimicrobial stewardship team can focus review activities on the 306 extended prescriptions and evaluate whether the documented reasons are clinically appropriate. Targeted review and

feedback are consistent with core antimicrobial stewardship activities designed to improve antibiotic use [1][12].

3.4. Comparison with Electronic Stewardship Literature

Electronic prescribing and clinical decision support systems are more likely to be incorporated into routine practice when they are integrated with existing clinical workflows and provide actionable information [4],[13],[14],[15].

The present innovation illustrates this principle by placing the reminder and stop-order mechanism within the existing SIMRS and pharmacy dispensing pathway. This design may increase the likelihood that the intervention is noticed, acted upon, and recorded as part of routine care rather than treated as an external administrative requirement [4],[9],[16]. In a teaching hospital, the system may also provide an educational opportunity. The mandatory day-5 justification creates a structured opportunity for clinical discussion among DPJP, residents, pharmacists, nurses, and the antimicrobial stewardship team regarding antibiotic indication, response to therapy, microbiological evidence, de-escalation, intravenous-to-oral switch, and planned duration [1],[4],[5]. During ward rounds or case reviews, the recorded reason can be used to discuss antibiotic indication, response to therapy, microbiological evidence, de-escalation, intravenous-to-oral switch, and the planned duration of treatment [1],[2].

3.5. Implementation Strengths and Safety Considerations

The main strength of the intervention was its integration with both SIMRS and pharmacy workflow. This integration allowed the alert to function not only as information but also as an actionable control point, consistent with the use of electronic prescribing and decision-support interventions to support antimicrobial stewardship activities [4],[9],[16]. In addition, the system generated measurable indicators for stewardship reporting, including prescription counts, antibiotic-days, patient-days, DOT per 100 patient-days, and the proportion of prescriptions continuing beyond five days.

The principal safety concern is that necessary antibiotic therapy may be interrupted if the warning is missed or the DPJP fails to complete the justification despite a valid indication. Similar safety considerations have been raised in the implementation of automatic end dates and stop-order strategies for antimicrobial therapy [6],[7]. This risk should be mitigated through clear notification, visible therapy-day information, escalation procedures for urgent cases, and pharmacist review [1],[6],[7]. Automatic stop orders should therefore be implemented as a stewardship safeguard, not as a substitute for clinical judgment.

3.6. Recommended Improvements for The Next Development Cycle

Further development should enable the system to capture structured clinical variables, including indication, diagnosis, infection severity, microbiology results, culture date, source-control status, renal function, allergy history, AWaRe classification, route of administration, planned duration, de-escalation decision, and intravenous-to-oral switch eligibility. The day-5 justification should also be standardised using selectable categories with an optional free-text field. These enhancements would support more detailed evaluation of appropriateness, not only duration.

3.7. Limitations

This evaluation has several limitations. First, although prescriptions were prospectively captured in SIMRS, the dataset analysed in this manuscript was aggregated and did not include patient-level diagnoses, antibiotic names, doses, routes, wards, microbiology results, or clinical outcomes. Second, the grouped days 1-3 category prevented separate analysis of day-3 alerts. Third, due to the prospective descriptive observational design without a baseline comparison group (pre-implementation data), this study cannot draw causal inferences regarding changes or reductions in antibiotic use or clinical outcomes. The findings solely reflect the descriptive metrics and patterns captured by the SIMRS system during the early implementation period. Future evaluative studies should incorporate controlled before-and-after or interrupted time-series designs to establish causal relationships.

4. CONCLUSION

The SIMRS-based warning system and automatic stop order provided a structured digital mechanism for prospective reassessment of antibiotic use in a teaching hospital. During October 2025 to May 2026, the system followed 1,761 antibiotic prescriptions across 11,677 patient-days and 6,233 antibiotic-days, corresponding to 53.38 DOT per 100 patient-days. Most prescriptions were concentrated in the first three therapy days, while

17.38% continued beyond five days and therefore represented a focused target for stewardship review. The findings suggest that integrating warning alerts, mandatory clinical justification, and pharmacy dispensing controls may strengthen antibiotic governance. However, further patient-level and comparative studies are needed to evaluate their effects on appropriateness, safety, and clinical outcomes.

Acknowledgments

The authors thank the hospital leadership, SIMRS development team, pharmacy department, antimicrobial stewardship committee, infection prevention and control team, and clinical units involved in implementing the antibiotic warning system and automatic stop order. Funding information and institutional approval details should be completed before submission.

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