

Documentation completeness in electronic medical records regarding infectious diseases: a retrospective cross-sectional analysis in a Kenyan rural referral hospital

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Abstract

Background:

Clinical documentation is a cornerstone of high-quality care and a foundation for antimicrobial stewardship and health system strengthening. Electronic medical records (EMRs) have the potential to improve documentation completeness and quality, but implementation in resource-limited settings is sparsely described. In sub-Saharan Africa, where antimicrobial resistance is sharply rising, incomplete clinical documentation limits antimicrobial stewardship programs. This study evaluated the completeness of infectious disease documentation in EMRs at a rural referral hospital in Kenya to establish a baseline before anticipated interventions.

Methods:

We conducted a retrospective, cross-sectional review at AIC Kijabe Hospital, a 363-bed regional referral and teaching hospital that uses a free-text EMR. Using SQL automated database queries, we had identified hospitalizations between January 2023 and September 2024 during which a new antimicrobial was initiated at least two days after admission. Hospitalizations were then randomly selected with quotas for representation of internal medicine, pediatrics, surgery, and obstetrics and gynecology. After excluding prophylactic antimicrobial use, 140 hospitalizations were reviewed by a trained clinician for the presence of predefined “critical information”, including the suspected source of infection, relevant clinical findings, microbiology testing, antimicrobial choice and dosing, treatment rationale, planned duration, and de-escalation plans. Descriptive statistics were used to summarize completeness.

Results:

Documentation completeness varied widely across domains. Antimicrobial names (83% of new concerns, 86% of existing concerns) and doses (67%, 73%) were recorded more consistently, though not universally. The suspected source of infection was documented in 86% of new diagnoses, and supporting findings in 77%. Microbiology testing was mentioned in 62%, but timing relative to antimicrobial initiation was mentioned in only 27%. Stewardship-related elements were frequently missing: documentation of treatment rationale (20%, 30%), planned duration (36%, 42%), and de-escalation strategy (9%, 20%) were uncommon. Documentation of individual comorbidities and infection risk factors ranged from 3% to 77%.

Conclusions:

This analysis demonstrated substantial gaps in documentation of infectious disease management in a rural Kenyan referral hospital. While basic prescribing details were relatively complete, critical information for stewardship and clinical decision-making was often absent. Improving documentation through structured note templates may strengthen antimicrobial stewardship, enhance clinical care, and serve as a model for similar hospitals in resource-limited settings.

Background

Clinical documentation is a critical element of high-quality patient care. Accurate documentation improves decision-making and continuity of care (1, 2). Clinical documentation also plays broader roles in health systems planning, resource allocation and reimbursement, quality improvement, and research (1). Despite its importance, the quality of providers' documentation varies considerably, with harmful effects on patient care and the healthcare system (1, 3). Structured and standardized documentation, often with templates, can improve completeness and accuracy while also improving providers' efficiency (3).

Electronic medical records (EMRs; also electronic health records, EHRs), are now widely used in high-income countries (HICs) (2, 4–6), and low- and middle-income countries (LMICs) are increasingly adopting them. Implementation of EMRs in resource-limited settings is particularly challenging due to high costs of implementation and maintenance, limited technical infrastructure (internet, electricity) and computer experience, and lack of incentives (4, 7). In Kenya, the Ministries of Health launched EMR guidelines in 2009, and KenyaEMR has been implemented in public facilities for HIV/AIDS, but comprehensive national EMR uptake has been uneven, limited mostly to larger Level 4 and Level 5 facilities (4, 7).

EMRs' anticipated benefits mostly rely on structured documentation – these benefits include data exchange between facilities, integrated decision support tools and guidelines, quality improvement initiatives, order validation and medication safety, and research (3, 6). However, EMRs alone may not improve clinical documentation; the quality of information is “necessarily documentation dependent” (1), with common pitfalls including copy-paste errors and “note bloat” (3, 5). “Quality” is most commonly assessed via documentation's “completeness” and “correctness” (8). While structure and flexibility of documentation exist in tension, structure is preferred when reusing data (9).

Infectious diseases are thus particularly well-suited to structured clinical documentation. Management of infectious diseases often requires empiric antimicrobial initiation based on limited data, followed by reassessment of clinical response and microbiology data over multi-day treatment courses, then retaining that data as a reference for future infections (10–12). Poor documentation can hinder decision-making, leading to inappropriate continuation of antimicrobials initiated by another provider (11). At the system level, documentation of infections and antimicrobial resistance trends informs prevention of healthcare-acquired infections (HAIs), promotes antimicrobial stewardship (AMS), and enables local guidelines.

Antimicrobial resistance (AMR) is a growing global threat (12, 13), with the greatest burden in sub-Saharan Africa (SSA) (12). Drivers of SSA's burden include high rates of infectious diseases (12), comorbidities (including HIV/AIDS, tuberculosis, malaria, and malnutrition) (12), overuse of antimicrobials in hospitals and communities (including over-the-counter availability, which varies by region) (12–16), very limited microbiologic testing (12, 14, 15, 17), and lack of local antimicrobial guidelines (12, 14, 16, 17). Hospital usage of antimicrobials in SSA is particularly high (52–88% of inpatients) (12, 13), though lower in South Africa (with stricter regulations) (12–14) and in hospitals with

stewardship programs (12, 14, 16). Antimicrobial courses are largely broad-spectrum, empiric, multi-drug, parenteral, and for long durations (13–17). Microbiologic specimens are rarely obtained (4–16%) (14, 15). These regional patterns are also found in Kenya, with expected variability among institutions (12, 17)).

Antimicrobial stewardship (AMS) programs aim to curb AMR globally and are expanding across SSA, but face resource-related challenges – such as staffing, funding, leadership support, laboratory and information technology capabilities, and prescriber awareness – and thus have had variable success (12–14). Nonetheless, successful AMS initiatives have demonstrated measurable improvements, including reduced antimicrobial use, better documentation of treatment plans, targeted treatment based on microbiologic testing, and increased guideline adherence (when available) (12, 16).

Documentation quality – including of indications for treatment, factors affecting antimicrobial selection, and plans for de-escalation – is a cornerstone of AMS globally, but quality varies widely between institutions. Documentation of antimicrobial indications ranges from 4% to 100%; indication accuracy ranges from 25% to 100%; and use of structured documentation (versus free-text documentation) ranges from 4.6% to 70% (10). Barriers to documentation include time, logistical challenges, diagnostic uncertainty, and alert fatigue; facilitators include awareness of stewardship, use of EMRs, and use of reminders and prompts (10). Interventions can dramatically increase documentation quality (1–3, 5, 10, 14, 16), but research regarding infectious disease documentation in SSA is sorely needed. In a review of documentation of antimicrobial indications, only 5 of 123 studies were from Africa (10).

In this manuscript, we outline and perform a quantitative baseline assessment of infectious disease documentation at a rural referral hospital in Kenya. We assess clinical providers' notes for completeness of critical information regarding suspected infections and plans for antimicrobial treatment. We hope that this will serve as a regional example for assessing a critical cornerstone of AMS initiatives.

Methods

Study aim, design, and setting

This retrospective study was conducted to quantitatively evaluate the completeness of clinicians' documentation of inpatient antimicrobial treatment for suspected infectious diseases at AIC Kijabe Hospital (AICKH). AICKH is a 363-bed, non-profit regional referral and teaching hospital in Kenya (Level 5) that offers a growing range of clinical services to a diverse population. Its AMS program began in 2018 with passive surveillance for hospital-acquired infections (HAIs) and has progressed to active surveillance. AICKH fully adopted a web browser-based EMR in 2019, and clinical documentation is natively free-text. A successful pilot of structured note templates, in outpatient obstetrics, used TextBlaze, a browser-based “text expansion application” that allows insertion of dynamic text snippets with advanced logic capabilities. AICKH has planned an iterative roll-out of structured note templates,

beginning with infectious diseases, but must first assess baseline documentation practices. This study was approved by AICKH's Institutional Scientific Ethics Review Committee (ISERC).

Sampling technique

Extraction of patient data from AICKH's EMR was automated by a two-phase approach. First, as part of AICKH's hospital-acquired infections (HAI) initiative, we designed a Structured Query Language (SQL) query using Microsoft SQL Server to identify patients with a new antimicrobial ordered at least two days post-admission. Secondly, we automated this query using n8n, a workflow automation platform that reduced extraction time to seconds while eliminating manual errors. Data extracted included demographic information, admission and discharge dates, antimicrobial details (type, dosage, initiation date), ICD-10 diagnoses, and other hospitalization information. This data was securely imported into Coda, which provides end-to-end encryption and automated workflow routing. Patients were automatically excluded if this new order was a re-ordering of an ongoing antimicrobial medication. Patient hospitalizations between January 2023 and September 2024 were randomly selected, with quotas for patients under the services of Internal Medicine, Pediatrics, Surgery, and Obstetrics and Gynecology (OB/GYN) – approximately 50 hospitalizations under each service, for a total of 200 hospitalizations, as shown in Fig. 1, Study design for data collection, below. Each hospitalization was a unique patient. These 200 hospitalizations' records in AICKH's EMR were then manually reviewed by a research assistant with a background in clinical medicine. Patients who received antimicrobials without suspicion of clinical infection (i.e., as prophylaxis) were excluded from further analysis. This resulted in 140 remaining patients, including 51 patients in Internal Medicine, 51 patients in Pediatrics, 34 patients in Surgery, and 4 patients in OB/GYN (Fig. 1).

Data collection and analysis

A research assistant with a background in clinical medicine then manually reviewed AICKH's EMR records of these 140 selected hospitalizations for the presence or absence of "critical information" in clinicians' documentation. Our list of "critical information" was derived from Center for Disease Control and Prevention (CDC) and National Healthcare Safety Network (NHSN) surveillance definitions for infections (18, 19), as well as from AMS literature on quality indicators in documentation (10–16). Categories of critical information included patient demographics, admission date and indication, findings that prompted concern for infection (e.g., signs, symptoms, laboratory results), risk factors for healthcare-acquired infections (HAI), risk factors for immunocompromise, any specific infections suspected, microbiology orders and results, choice of antimicrobials, rationale for antimicrobial choice, and plan for antimicrobial de-escalation. See Appendix for a full list of critical information extracted from patient charts. Each piece of critical information (or its absence) was manually entered into REDCap, a secure web application for managing online databases. Data analysis was performed using Stata 18. Descriptive statistics were used to characterize the data and identify gaps in documentation of critical information.

Results

Study Population Characteristics

A total of 140 hospitalizations to AICKH between January 2023 and September 2024 (of 140 unique patients) were analyzed in this study. Each patient had a new antimicrobial ordered after at least 2 days of hospitalization due to concern for an active infectious disease. Table 1 presents patients' demographic data, which demonstrates similar proportions of females (n = 76, 54%) and males (n = 64, 46%), and a broad range of ages: 44 (31%) aged younger than 1 year, 8 (6%) aged 1–5 years, 12 (9%) aged 6–18 years, 25 (18%) aged 19–40 years, 27 (19%) aged 41–65 years, and 24 (17%) aged older than 65 years. Equivalent proportions were being treated for new diagnoses (n = 71, 51%) and for existing diagnoses (n = 64, 46%); five cases (4%) had unclear diagnostic status. Equivalent proportions were managed primarily by Internal Medicine (n = 51, 36%) and Pediatrics (n = 51, 36%) due to sampling design; however, far fewer of the analyzed patients were managed primarily by Surgery (n = 34, 24%) or OB/GYN (n = 4, 3%), as many of the screened patients were on prophylactic antimicrobials without suspicion for active infection. Ward distribution included 84 patients (61%) in the standard-acuity wards; 45 patients (32%) in high-dependency units (“step-down”) and critical care units; and the remaining 11 (8%) in private, maternity, and newborn units.

Table 1
Patient demographics and clinical characteristics (n = 140)

Characteristic	Category	n (%)
Sex	Female	76 (54%)
	Male	64 (46%)
Age group (years)	< 1	44 (31%)
	1–5	8 (6%)
	6–18	12 (9%)
	19–40	25 (18%)
	41–65	27 (19%)
	> 65	24 (17%)
Diagnostic status	New diagnosis	71 (51%)
	Existing diagnosis	64 (46%)
	Unclear	5 (4%)
Primary managing service	Internal Medicine	51 (36%)
	Pediatrics	51 (36%)
	Surgery	34 (24%)
	Obstetrics/Gynecology	4 (3%)
Ward type	Standard-acuity wards	84 (61%)
	High-dependency or critical care units	45 (32%)
	Private, maternity, and newborn units	11 (8%)
Note: Percentages may not total 100% due to rounding.		

Documentation of Infection, Microbiology, and Hospital-Acquired Infection Risks

New diagnoses (n = 71) were analyzed for documentation of the specific causes of concern for infection and the workup for infection, as shown in Fig. 2, *Completeness of documentation by topic*, below.

Documentation of suspicion for specific infections, or specific body systems as infectious sources, was found for 86% (n = 61) of new-start antimicrobials. Findings specifically causing this concern were documented in 77% (n = 55) of new-start antimicrobials – these included vitals in 35% (n = 22), symptoms in 31% (n = 22), labs in 30% (n = 21), exam in 11% (n = 8), and imaging in 8% (n = 6).

Microbiology testing was documented in 62% (n = 44) of new diagnoses, but only 27% (n = 19) documented whether microbiology specimens were obtained before or after antimicrobial administration. Risk factors for hospital-acquired infection were documented in 77% (n = 55) of new diagnoses; most frequent risks among new diagnoses were hospitalization within 30 days (59%, n = 42) and antimicrobial use within 90 days (45%, n = 32), followed by urinary ("Foley") catheter (25%, n = 18), surgery within 90 days (18%, n = 13), mechanical ventilation (13%, n = 9), central venous catheter (11%, n = 8), and dialysis catheter (3%, n = 2) as shown in Fig. 3, *Prevalence of documented risks for hospital-acquired infections among new diagnoses of infectious diseases*. No patients were documented to have resided in a long-term care facility. Comorbidities (HIV, tuberculosis, diabetes, malnutrition, immunocompromise) were documented in 32% of new diagnoses (n = 23), Fig. 3.

Documentation of Antimicrobial Treatment

All cases (n = 140) were analyzed for documentation of antimicrobial prescription, rationale, and treatment plan. Names of antimicrobials were documented very often in new diagnoses (83%, n = 59) and existing diagnoses (86%, n = 55). Dosing was documented less consistently in both new diagnoses (67%, n = 48) and existing diagnoses (73%, n = 47). Rationale for the choice of antimicrobial treatment was infrequently documented, in only 30% of new diagnoses (n = 21) and 20% of existing diagnoses (n = 13). Rationales for choice of antimicrobial treatment included type of pathogen in 9% (n = 12), source coverage in 6% (n = 9), risk of multi-drug resistance in 5% (n = 7), prior infections in 4% (n = 5), spectrum of activity in 2% (n = 3), HIV diagnosis and TB risk in 1% (n = 2), and immunocompromised state in 1% (n = 1). Plans for treatment duration were documented somewhat more often, in 42% of new diagnoses (n = 30) and 36% of existing diagnoses (n = 23). Plans for de-escalating antimicrobials were documented very infrequently, in only 20% of new diagnoses (n = 14) and 9% of existing diagnoses (n = 6).

Discussion

Summary of Key Findings

This study represents one of the first assessments of infectious diseases documentation completeness in an East African healthcare setting with an electronic medical record (EMR). Our quantitative, retrospective analysis, performed in a regional referral hospital, reveals a concerning pattern of severe gaps in the documentation of information that is critical for managing infectious diseases. Even the most basic information was documented in fewer than 90% of cases: names of antimicrobials in 83–86% (of new and existing diagnoses, respectively) and dosing of antimicrobials in 67–73%. Suspected source of infection was documented in 86% of new diagnoses, with supporting specific signs or symptoms documented in only 77% of new diagnoses. All other critical information was found to have even larger deficits. There was moderate adherence to documentation of microbiology testing in new diagnoses (62%), but very poor documentation of whether the testing was pre- or post-antimicrobials (27%). There was also especially poor documentation of relatively complex but critically important

information that guides clinical decision-making and antimicrobial stewardship: rationale for choice of antimicrobial (30% of new diagnoses, 20% of existing diagnoses), plan for treatment duration (42% of new diagnoses, 36% of existing diagnoses), and plan for de-escalation (20% of new diagnoses, 9% of existing diagnoses).

Implications for Antimicrobial Stewardship

Our study's selection of "critical information" was developed from evidence-based guidelines from the NHSN (19). The CDC's Core Elements of Hospital Antimicrobial Stewardship Programs (18) further supports such documentation for antimicrobial stewardship (AMS). While antimicrobial names, antimicrobial dosages, and suspected sources of infection had acceptable documentation rates in our study, information was severely lacking in domains with direct implications for AMS program effectiveness and patient care (1, 3, 20, 21). Poor documentation of treatment rationale (indication) and planned duration limits stewardship teams' ability to assess antimicrobial appropriateness and implement targeted interventions. Our documentation rate of rationale for choice of antimicrobial (20–30%) is particularly alarming, given its fundamental role in AMS programs – this rate is well below the median global rate of 75%, though the global range is incredibly broad (4-100%) (10). The extremely poor documentation of plans for de-escalation (9–20%) is particularly concerning, as de-escalation strategies are crucial for reducing selective pressure for antimicrobial resistance, as well as for minimizing adverse effects of antimicrobials (20, 22). This is especially relevant amid sub-Saharan Africa's documented challenges in de-escalation from empiric treatments that are prolonged, broad-spectrum, and multi-agent. These discrepancies, between basic prescription information and AMS elements, suggest that current documentation practices prioritize immediate clinical needs over stewardship considerations (1, 8).

Implications for Regional and Global Context

Our findings are especially significant within the context of sub-Saharan Africa's antimicrobial resistance crisis. The region faces the highest global burden of AMR-related mortality – contributing factors include high infectious disease burden, limited diagnostic capabilities, and suboptimal antimicrobial prescribing practices (23, 24). Documentation gaps, as identified in our study, perpetuate these challenges by hindering effective AMS interventions. Studies in similar settings report microbiology specimen collection rates of only 4–16% (25, 26). Poor documentation of microbiology specimen timing relative to antimicrobial initiation (27%) in our study suggests that even when specimens are collected, this critical piece of information is generally absent, precluding interpretation and therapy adjustments. This documentation gap is particularly problematic in settings where diagnostic capabilities are already limited and empiric therapy is often necessary (27).

Our findings also reflect common barriers in resource-limited settings, including competing clinical priorities, limited time for documentation, and insufficient training on antimicrobial stewardship principles (28, 29). Documentation of HAI risk factors in our study shows some strengths (e.g., 45% documentation of recent antimicrobial use), but gaps in comprehensive risk assessment likely impair

infection prevention and antimicrobial selection (30). Variable documentation of device-associated risks (3–25%) and the absence of documented long-term care facility residence may reflect the local epidemiological context rather than documentation failure, but we see significant opportunities for improvement in systematic HAI risk assessments (31).

This study has broader implications for healthcare systems in LMICs that seek to implement electronic medical records or antimicrobial stewardship programs. Our findings suggest that current free-text documentation practices may be insufficient to support effective AMS in this setting (3, 9). Structured note templates, having been successfully implemented in AICKH's outpatient department of Maternal and Child Health, may offer a viable solution that is feasible even in resource-constrained settings. Structured note templates have been shown to improve documentation completeness and accuracy while also reducing physician documentation time, thus addressing concerns about both quality and efficiency (3, 5). Interventions to improve AMS documentation in LMIC settings must nevertheless account for clinicians' concerns about time constraints and high patient-to-clinician ratios, as well as clinicians' varied familiarity with inputting digital information (4). We further hypothesize that poor documentation is due to several factors, including a lack of knowledge of AMS, a perception that it does not directly impact patient care, a workplace culture that does not prioritize AMS documentation, and insufficient information obtained on admission due to time and staff constraints. These hypotheses should be further explored in a qualitative assessment of documentation practices. The use of browser-based text expansion tools offers a cost-effective approach that could be scaled across departments and institutions, which is particularly relevant in institutions with financial constraints that limit the implementation of more sophisticated EMR enhancements (4, 7) Fig. 4.

Limitations and Future Directions

Our study was conducted at a single institution – specifically, a regional referral hospital with resources exceeding those of many facilities in LMICs, and with a fully integrated EMR, which limits generalizability to other settings. While our findings are likely representative of similar regional referral hospitals in East Africa, future studies are needed to confirm this. Our study focused on documentation presence and did not attempt to assess the accuracy of documentation, which would be significantly more difficult to assess in a retrospective study, but is of critical importance. Prospective studies, while more resource-intensive, would be better able to assess accuracy. Our methodology for patient selection led to the inclusion of relatively few admissions to Surgery and OB/GYN services, due to the higher prevalence of prophylactic antimicrobials in these services. Future studies' methodologies should anticipate this difference in clinical practice to ensure broad sample sizes across disciplines. Future studies should also explore the relationship between documentation quality and clinical outcomes, including rates of antimicrobial resistance, length of hospitalization, and rates of treatment failure. Qualitative studies examining healthcare providers' perspectives on documentation barriers and facilitators would complement these baseline quantitative findings and inform intervention design.

Conclusions

This study reveals significant gaps in the documentation of infectious disease management at a regional referral hospital in Kenya, with especially severe deficiencies in antimicrobial stewardship-related documentation. While basic prescribing information was more adequately documented, though with room for improvement, there was only infrequent documentation of rationales for antimicrobial treatment, plans for duration of treatment, and plans for de-escalation. These findings highlight the urgent need for interventions to enhance documentation quality, as a foundation for effective antimicrobial stewardship programs, especially with the rising threat of antimicrobial resistance, particularly in sub-Saharan Africa. This baseline analysis provides a foundation for measuring the impact of future interventions such as structured documentation templates. This study also contributes to the limited literature on infectious disease documentation quality in sub-Saharan African settings, as healthcare systems across the region seek to implement EMRs and develop AMS capabilities on a foundation of optimized documentation practices.

Abbreviations

AICKH = AIC Kijabe Hospital

AMR = antimicrobial resistance

AMS = antimicrobial stewardship

CDC = Center for Disease Control and Prevention

EMR = electronic medical record

HAI = healthcare-acquired infection

HIC = high-income country

HIV/AIDS = human immunodeficiency virus / acquired immunodeficiency syndrome

LMICs = low- and middle-income countries

NHSN = National Healthcare Safety Network

OB/GYN = obstetrics and gynecology

SSA = sub-Saharan Africa

Declarations

Ethics approval and consent to participate:

This study was approved by Kijabe Hospital Institutional Scientific Ethics and Review Committee (KH-ISERC) (Approval number-KH/ISERC/02718/0059/2023) and conducted in accordance with the

Declaration of Helsinki. The KH-ISERC approved this study and waived the requirement for informed consent as it involved a retrospective review of de-identified medical records. Please see the approval letter here: *ISERC clearance letter*

Consent for publication:

All authors consent.

Availability of data and materials:

Deidentified data can be availed in a CSV file

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All authors report no competing interests

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Authors' contributions:

Conception of the work – PWM, AMC,

Design of the work – PWM, AMC, JAC

Acquisition of data – AMC and PWM

Analysis/Interpretation of data – JAC, AC, PWM

Creation of new software(Algorithm) used in the work – PWM and AC

Drafted the work or substantively revised it – PWM, AMC, JAC

All authors read and approved the final manuscript – AC, JAC, PWM

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Figures

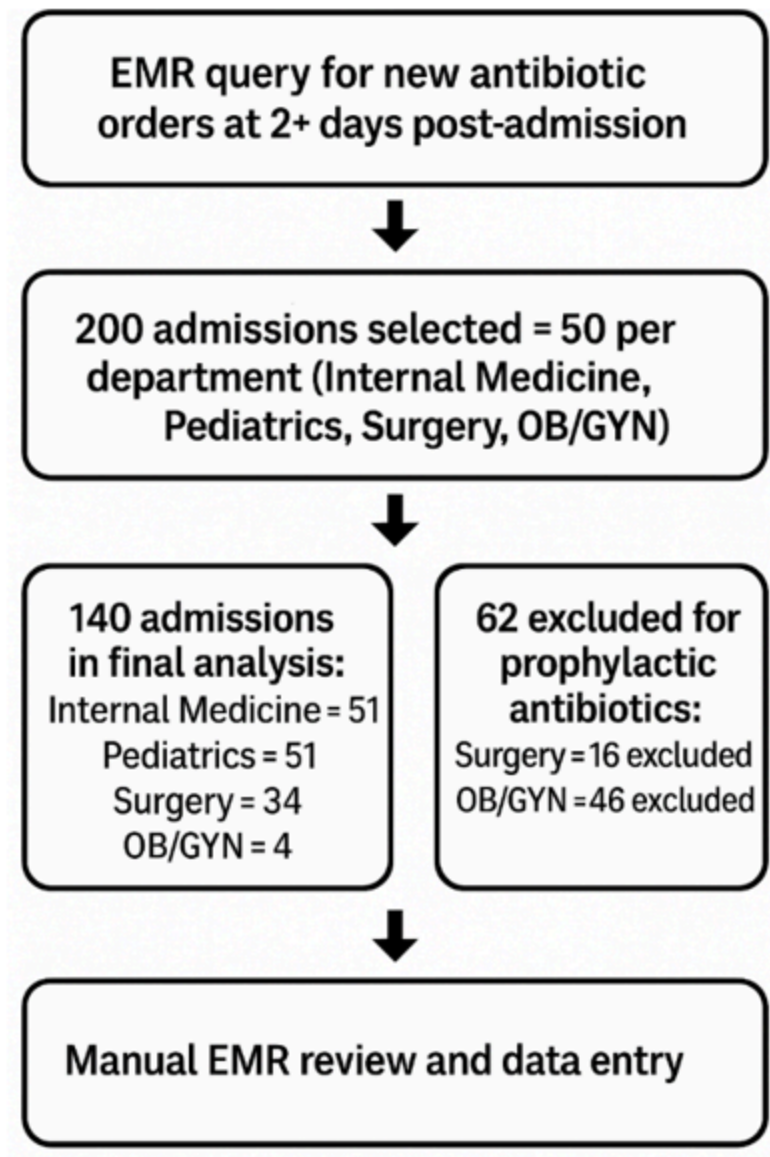


Figure 1

Study design for data collection

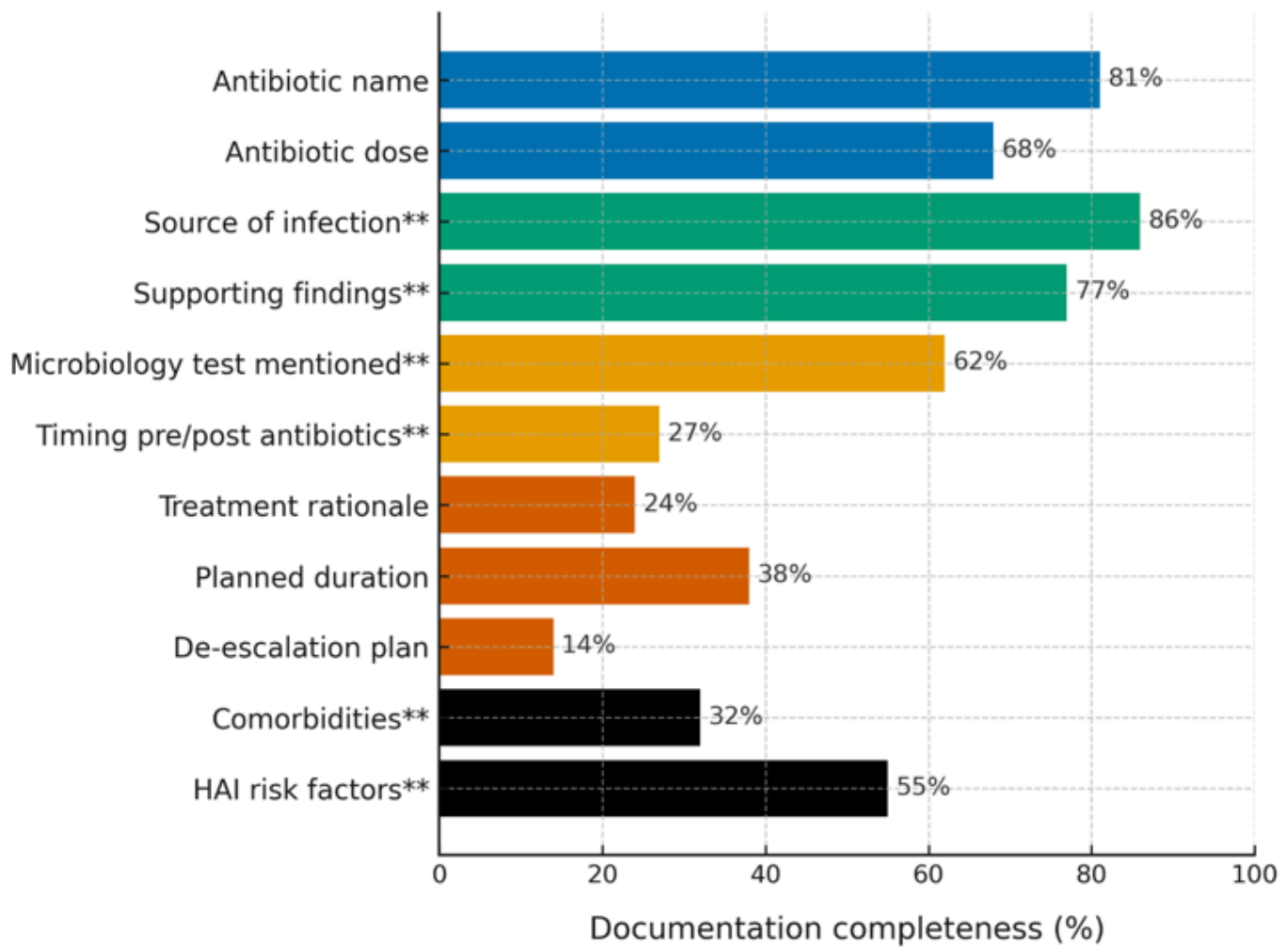


Figure 2

Completeness of documentation by topic

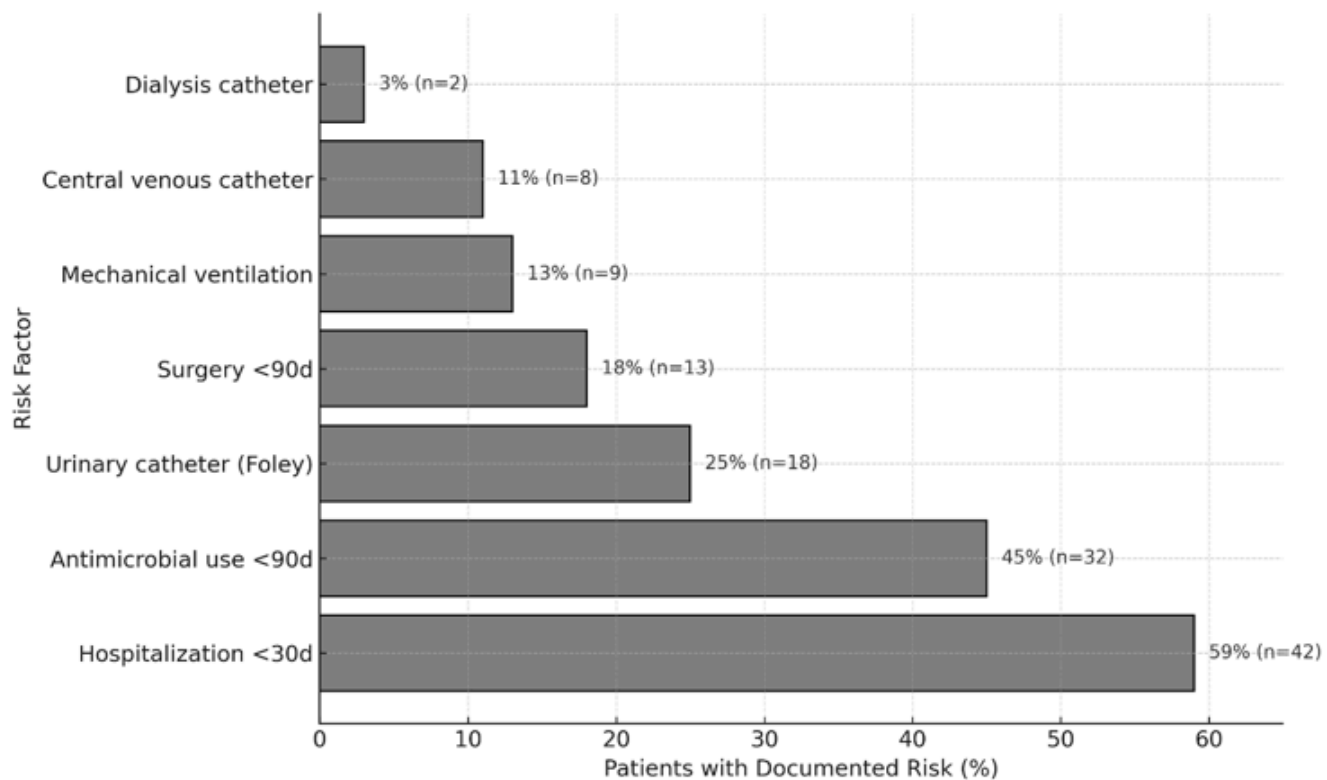


Figure 3

Prevalence of documented risks for hospital-acquired infections among new diagnoses of infectious diseases

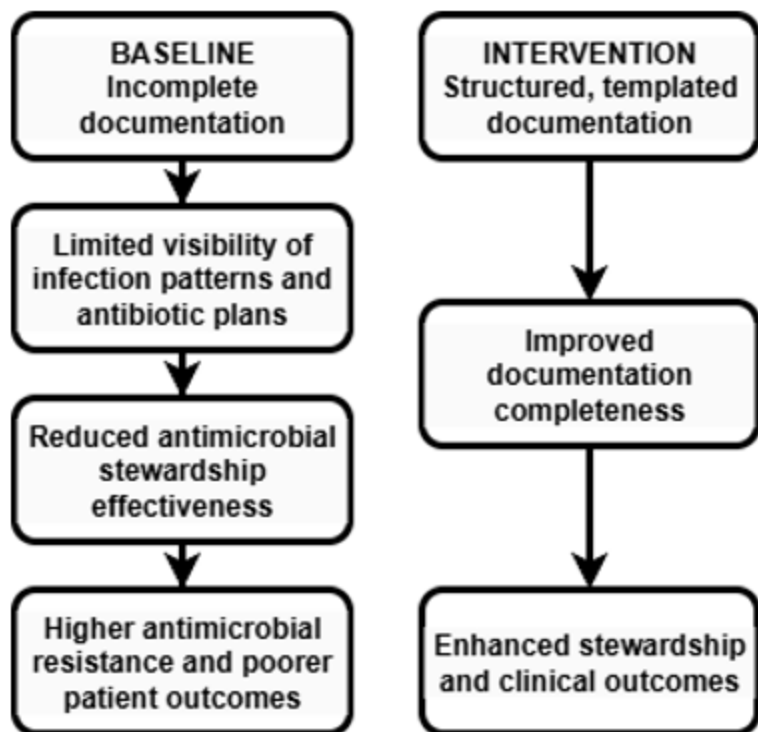


Figure 4

Conceptual framework of documentation quality affecting antimicrobial stewardship