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Clinical Pharmacist Interventions in Adults With Sepsis and Septic Shock: A Scoping Review

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Abstract

Clinical pharmacists may contribute to several stages of sepsis management, although interventions and reported outcomes vary across clinical settings. This scoping review aimed to map clinical pharmacist interventions among adults with suspected or confirmed sepsis or septic shock receiving hospital-based acute care and to characterize associated process, stewardship, medication-safety, and clinical outcomes. Guided by Joanna Briggs Institute methodology and the PRISMA extension for scoping reviews, we searched PubMed/MEDLINE, ScienceDirect, and Google Scholar in March 2026 for English- or Spanish-language publications from 2016 through 2025. The search identified 1,482 records; 1,306 were screened, and 235 reports underwent full-text assessment. The final synthesis included eight primary studies and one systematic review, interpreted separately because of overlapping primary evidence. Interventions encompassed early antimicrobial review, participation in sepsis response teams, protocol-guided treatment decisions, antimicrobial optimization, and structured medication review. Across the primary studies, favorable findings were reported for antimicrobial appropriateness and selected measures of treatment timeliness. Some studies also reported favorable antimicrobial stewardship and medication-safety outcomes, although adverse drug reactions and drug-related problems represented distinct measures. No statistically significant improvement in mortality or length of stay was demonstrated in the comparative studies assessing these outcomes. The findings suggest that clinical pharmacist involvement may improve selected aspects of pharmacotherapeutic care in sepsis, but differences in intervention models, study designs, and outcome definitions limit causal interpretation and generalizability. Future multicenter studies should evaluate clearly defined pharmacist roles, appropriate comparators, and patient-centered outcomes.

Categories: Pharmacology, Emergency Medicine, Infectious Disease
Keywords: antimicrobial stewardship, clinical pharmacist, critical care, emergency department, medication safety, scoping review, sepsis, septic shock

Introduction And Background

Sepsis is defined as life-threatening organ dysfunction resulting from a dysregulated host response to infection, while septic shock represents a subset characterized by profound circulatory and cellular-metabolic abnormalities associated with increased mortality [1]. The global burden remains substantial, with an estimated 48.9 million cases and 11 million sepsis-related deaths in 2017 [2]. Mortality also remains considerable among patients requiring hospital or intensive care unit (ICU) treatment [3].

Effective antimicrobial management in sepsis requires timely treatment initiation alongside appropriate drug selection, individualized dosing, and ongoing therapeutic reassessment. Empirical regimens must provide adequate coverage for likely pathogens while minimizing unnecessary broad-spectrum exposure, with subsequent adjustments informed by clinical progression, organ function, and microbiological findings. The 2026 Surviving Sepsis Campaign guidelines emphasize these principles through recommendations addressing antimicrobial timing, beta-lactam administration, therapeutic drug monitoring, and de-escalation [4]. Observational evidence has associated delayed antibiotic administration with increased mortality [5], although a recent meta-analysis suggested that the relationship between treatment timing and outcomes may be more nuanced than a uniform one-hour threshold [6]. Pharmacokinetic and pharmacodynamic variability in critically ill patients further supports individualized antimicrobial dosing [7,8], while systematic reassessment and de-escalation remain central to antimicrobial stewardship [9].

Clinical pharmacists are positioned to contribute to these therapeutic decisions through antimicrobial selection, dose optimization, medication monitoring, and participation in multidisciplinary care [10,11]. The scope of these responsibilities may vary according to postgraduate training, institutional credentialing, prescribing authority, and the organization of clinical pharmacy services. Previous evidence suggests potential benefits of pharmacist involvement, although the findings depend on the population and intervention evaluated. A systematic review and meta-analysis involving multidisciplinary ICU teams

reported associations with reduced mortality and adverse drug events [12], whereas a sepsis-focused systematic review identified improvements in antibiotic administration time without consistent reductions in mortality or length of stay [13]. Narrative literature has further described the potential contribution of clinical pharmacy services across the sepsis care pathway [14].

Nevertheless, clinical pharmacist interventions in sepsis encompass distinct activities, ranging from early antimicrobial review and prescribing support to protocol-guided treatment decisions, antimicrobial stewardship, and structured medication review. Differences in intervention design, timing, professional responsibilities, and clinical setting complicate comparisons across studies and limit the interpretation of pharmacist involvement as a single intervention. Accordingly, this scoping review aimed to map clinical pharmacist interventions reported in adults with suspected or confirmed sepsis or septic shock in hospital acute-care settings and to characterize the associated process, stewardship, medication-safety, and patient-centered clinical outcomes.

Review

Methods

Design and Reporting

This scoping review was guided by the Joanna Briggs Institute (JBI) methodology for scoping reviews [15], with reporting informed by the PRISMA extension for scoping reviews (PRISMA-ScR) [16]. A scoping approach was selected to characterize the range of clinical pharmacist interventions, care settings, and reported outcomes, rather than to estimate a pooled intervention effect [17]. The review question was developed using the population-concept-context (PCC) framework. No review protocol was registered.

Eligibility Criteria

Eligible sources addressed adults aged 18 years or older with suspected or confirmed sepsis or septic shock receiving hospital-based acute care. The concept of interest was an identifiable clinical pharmacist intervention in pharmacotherapeutic management, including antimicrobial selection, dose optimization, therapeutic monitoring, treatment adjustment, or participation in multidisciplinary sepsis response and antimicrobial stewardship activities. Eligible settings included emergency departments, intensive care units, and general hospital wards, without geographical restrictions.

The review considered peer-reviewed observational, quasi-experimental, and experimental studies, as well as systematic reviews and meta-analyses, published between 2016 and 2025 in English or Spanish and available in full text. Publications were excluded if they focused exclusively on pediatric or neonatal populations, did not describe an identifiable clinical pharmacist intervention, or addressed microbiological or pharmacological aspects without a direct connection to clinical pharmacy practice. Conference abstracts, editorials, letters without original data, individual case reports, and narrative reviews were also excluded.

Information Sources and Search

Literature searches were conducted between March 2 and March 11, 2026, using PubMed/MEDLINE, ScienceDirect, and Google Scholar. The search covered three sources with complementary scopes: PubMed/MEDLINE for biomedical literature, ScienceDirect for publisher-hosted scientific publications, and Google Scholar for broader multidisciplinary coverage. Embase, CINAHL, and Cochrane CENTRAL were not searched; consequently, the search should not be considered exhaustive. The restrictions to English- and Spanish-language publications and accessible full texts may also have limited the identification of relevant evidence. Search terms combined concepts related to sepsis or septic shock, clinical pharmacy or pharmaceutical care, and antimicrobial therapy or stewardship. The search terms and publication limits documented for each source are presented in the Appendices. Gray literature was not searched. The 2026 Surviving Sepsis Campaign guidelines, published on March 23, 2026, and the consensus guidance on beta-lactam dose individualization, published on July 22, 2026, were cited solely to provide contemporary clinical context. Neither publication was considered part of the eligible evidence corpus.

Selection of Sources of Evidence

Search records were managed and deduplicated using Zotero. Titles and abstracts were screened by a single reviewer, followed by full-text assessment of potentially eligible reports. Academic supervisors contributed to source identification and were consulted when eligibility decisions required clarification. Independent duplicate screening was not performed.

During manuscript preparation, a second reviewer independently reassessed the eligibility of the 12 sources originally retained and one additional report identified through citation checking, applying the final eligibility criteria. The resulting assessments were compared, and any discrepancies were resolved through discussion. This reassessment did not constitute independent duplicate screening of the original search

records.

Data Charting and Synthesis

Study characteristics were charted using a structured extraction table covering publication year, study design, population, clinical setting, sample size, country, pharmacist intervention, comparator when applicable, and reported outcomes. Findings were organized into four domains: processes of care, antimicrobial stewardship, medication safety, and clinical outcomes. Process measures included antimicrobial appropriateness, treatment timeliness, and protocol adherence; stewardship measures included antibiotic duration, antimicrobial spectrum, and de-escalation. Medication-safety outcomes comprised adverse drug reactions and drug-related problems, which were treated as distinct measures. Clinical outcomes included mortality and length of stay.

Results were summarized narratively, with comparative findings distinguished from descriptive observations in studies without a control group. Reported statistical significance was considered when characterizing differences between groups, but no quantitative pooling was undertaken because of heterogeneity in interventions, study designs, and outcome definitions. The included systematic review was used as secondary evidence to contextualize findings on antimicrobial timeliness and clinical outcomes. Two of its constituent studies were also included among the primary sources; therefore, its findings were considered separately to avoid double counting.

Critical Appraisal

Formal critical appraisal was not used to determine source eligibility [15]. Because the purpose of this scoping review was to map the available evidence rather than estimate comparative intervention effectiveness, formal study-level risk-of-bias assessments were not undertaken. Methodological characteristics relevant to interpretation, including study design, sample size, comparator availability, and potential confounding, were instead examined descriptively. Accordingly, no numerical methodological-quality scores were calculated or used to rank the included sources.

Results

Selection of Sources

The searches identified 1,482 records through PubMed/MEDLINE (n = 847), ScienceDirect (n = 154), and Google Scholar (n = 481). Following the removal of 176 duplicates, 1,306 records were screened, of which 1,031 were excluded. Of the 275 reports sought for retrieval, 40 could not be retrieved, leaving 235 reports assessed for eligibility. The initial selection excluded 223 reports and retained 12 sources. During the final eligibility review, four additional sources were excluded: three narrative reviews [14,18,19] and one observational study without a clearly described pharmacist-delivered intervention [20]. One additional eligible report was retained following citation checking [21]. The final synthesis comprised nine sources: eight primary studies and one systematic review (Figure *1*).

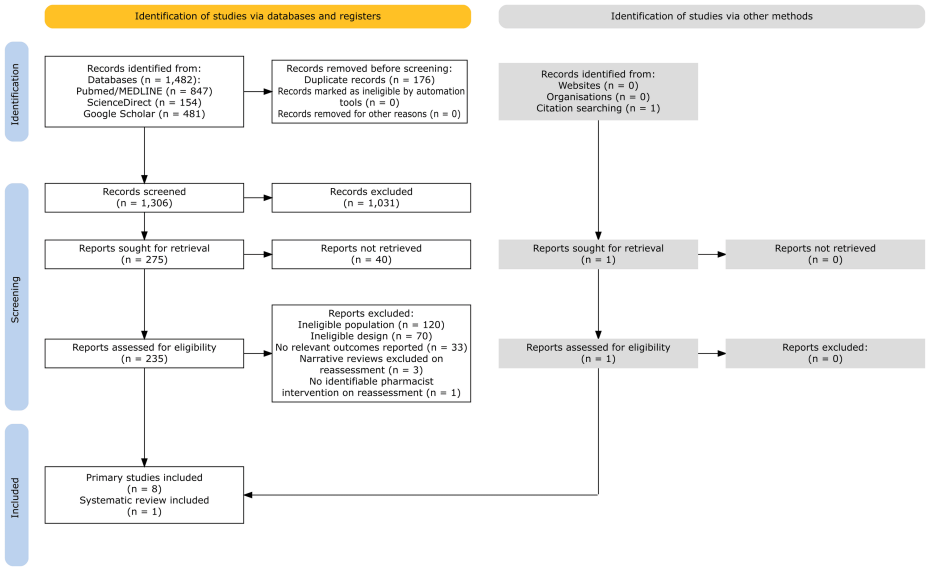


FIGURE 1: PRISMA flow diagram of source selection

The diagram summarizes database screening, eligibility reassessment, and the evaluation of an additional source through citation checking.

Characteristics of Included Sources

The eight primary studies were published between 2016 and 2025, with sample sizes ranging from 52 to 186 patients or sepsis alerts. The reported sample counts totaled 859, although this figure includes 157 sepsis alerts that may represent repeated episodes rather than unique patients. Five studies were conducted in the United States [22-26], one in Australia [27], one in China [28], and one in Türkiye [21]. Clinical settings included emergency departments (n = 3) [22,24,25], intensive care units (n = 3) [21,26,28], a hospital-wide sepsis response team [23], and general wards following rapid-response activation for suspected sepsis [27].

The evidence comprised two randomized controlled trials [27,28], two retrospective cohort studies [22,23], two pre-post studies [25,26], one single-arm implementation cohort [24], and one prospective non-randomized controlled study [21]. All primary studies were conducted at single centers. The included systematic review synthesized 10 studies involving 1,772 patients [13] and was considered separately from the primary evidence. Descriptions of pharmacist qualifications, training, and practice authority varied across the included studies. Hammond et al. [25] described emergency medicine pharmacists with Clinical Pharmacist Practitioner credentials, allowing protocol-based prescribing under physician supervision. Hixson et al. [24] reported that many participating clinical staff pharmacists were board-certified and/or residency-trained, while Laine et al. [23] described structured sepsis-response training for pharmacy residents. These differences in training and professional authority may influence intervention implementation and transferability. In Aksoy et al. [21], the clinical pharmacist was enrolled in a three-year postgraduate clinical pharmacy specialization program in Türkiye, with previous clinical rotations in internal medicine, infectious diseases, and intensive care. However, pharmacist qualifications were not reported using standardized measures that would support comparisons across studies. Study characteristics and principal findings are summarized in Table *1*.

Study (country)	Setting	Design; sample	Pharmacist intervention	Main findings	Outcome domains
Moussavi and Nikitenko, 2016 [22] (USA)	ED, academic medical center	Retrospective cohort; n = 186 (92 pharmacist present vs. 94 absent)	Physical presence of an ED clinical pharmacist (order review, dosing, preparation and delivery of antibiotics)	Median order-to-administration time 0.61 vs. 0.88 h (p = 0.001); SSC timing goal met 88% vs. 72%; appropriate initial antibiotics 97% vs. 81%; no difference in ICU or hospital LOS, ventilator days, or in-hospital mortality	Process; clinical (NS)
Laine et al., 2018 [23] (USA)	Sepsis response team, academic	Retrospective cohort; n = 76 with septic shock	Pharmacist notified by sepsis bundle order to assess and modify	Successful selection of initial therapy 66% before vs. 80% after pharmacist intervention (p = 0.04); shorter time to appropriate therapy in patients with inadequate initial	Process; clinical outcomes

	medical center		empiric therapy	regimens (p < 0.001)	(descriptive)
Hixson et al., 2022 [24] (USA)	ED, Veterans Affairs hospital	Retrospective implementation cohort, no comparator; 157 sepsis alerts	Clinical staff pharmacists applying a sepsis antibiotic algorithm and vancomycin nomogram	Correct algorithm use 98% (154/157); correct vancomycin dosing 94% (147/157)	Process (protocol fidelity and descriptive timing)
Hammond et al., 2024 [25] (USA)	ED, community hospital	Retrospective pre-post; n = 144 (80 vs. 64)	Emergency medicine clinical pharmacist practitioner selected and ordered empiric antibiotics within scope of practice	Appropriate empiric selection 57.5% vs. 86% (p < 0.01); time to first antibiotic 64 min shorter (p < 0.01); no difference in in-hospital mortality or hospital LOS	Process; clinical (NS)
Willmon et al., 2021 [26] (USA)	ICU, community teaching hospital	Pre-post (prospective vs. historical cohort); n = 52 (26 vs. 26)	Pharmacist-directed simplified procalcitonin algorithm for continuing or stopping antibiotics	Median antibiotic duration 9 vs. 12 days (p = 0.02); no difference in ICU or hospital LOS, reinitiation within 72 h, or 28-day mortality	Stewardship; clinical (NS)
Rashidzada et al., 2021 [27] (Australia)	General wards after rapid-response call for suspected sepsis	RCT; n = 90 (45 vs. 45)	Multidisciplinary antimicrobial stewardship team review, including pharmacists, 48 h after the call	Appropriate therapy at 72 h 67% vs. 44% (p = 0.03); 74% of recommendations accepted; no significant difference in antibiotic duration, sepsis-related ICU admission, or in-hospital mortality	Process; stewardship; clinical (NS)
Mai et al., 2025 [28] (China)	ICU	RCT; n = 94 with septic shock (47 vs. 47)	Pharmacist-guided anti-infective therapy for 2 weeks (selection, adjustment, ADR monitoring)	Lower carbapenem and quinolone use; higher ScvO2 and lower lactate, IL-1β, and PCT; ADRs 4.26% vs. 19.15% (p < 0.05)	Stewardship; safety; physiological surrogates
Aksoy et al., 2025 [21] (Türkiye)	Medical ICU, tertiary teaching and research hospital	Prospective non-randomized controlled study; n = 60 (30 observation vs. 30 intervention)	Daily medication review, recommendations during ICU rounds, educational sessions, and informational materials	DRPs decreased from 259 to 95 (63.3%; p < 0.001); major DRPs from 33 to 5 (p = 0.008); 70/72 recommendations accepted (97.2%)	Medication safety (DRPs); exploratory clinical outcomes (NS)
Secondary evidence — systematic review					
Atkins et al., 2023 [13] (systematic review)	ED, ICU, and wards	Systematic review; 10 studies, 1,772 participants; includes two primary studies also mapped in this review	Designated pharmacist role in sepsis response	Shorter time to antibiotics in 7 of 10 studies; no consistent reduction in ICU or hospital LOS or in-hospital mortality	Process; clinical (inconsistent)

TABLE 1: Characteristics and main findings of the included sources

ADR: adverse drug reaction; ED: emergency department; ICU: intensive care unit; IL-1β: interleukin-1 beta; LOS: length of stay; NS: no statistically significant difference; PCT: procalcitonin; RCT: randomized controlled trial; ScvO2: central venous oxygen saturation; SSC: Surviving Sepsis Campaign; DRP: drug-related problem

Overview of Reported Outcomes

The eight primary studies assessed heterogeneous outcomes across the four predefined domains. Selected quantitative findings are summarized in Table *2*. Five primary studies reported antimicrobial appropriateness or protocol adherence, and five reported measures of treatment timeliness. Among the latter, two comparative studies favored pharmacist involvement, one identified a significant difference within a selected subgroup, one reported descriptive administration times without a comparator, and one found no statistically significant between-group difference. Three studies examined antimicrobial stewardship outcomes.

Study	Selected quantitative findings	Interpretation
Moussavi [22]	Antibiotic administration: 0.61 vs. 0.88 h (p = 0.001); appropriate initial therapy: 97% vs. 81% (p = 0.0008)	Pharmacist present vs. absent; retrospective comparison
Laine [23]	Appropriate antimicrobial coverage: 66% before vs. 80% after pharmacist reassessment (p = 0.04); time to appropriate therapy: 2 h 22 min vs. 49 h 10 min (p < 0.001)	Timing comparison restricted to patients with initially inadequate coverage
Hixson [24]	Algorithm adherence: 154/157 (98%); vancomycin dosing adherence: 147/157 (94%); median administration times: 39 min after alert and 96 min after ED presentation	Descriptive findings; no comparator
Hammond [25]	Appropriate antibiotics: 86% vs. 57.5% (p < 0.01); time to first antibiotic approximately 64 min shorter (p < 0.01)	Pharmacist practitioner vs. historical controls
Willmon [26]	Median antibiotic duration: 9 vs. 12 days (p = 0.02)	Pharmacist-directed algorithm vs. standard care
Rashidzada [27]	Appropriate therapy at 72 h: 67% vs. 44% (p = 0.03); time to appropriate therapy: 43 vs. 74 h (p = 0.19)	Multidisciplinary intervention; timing difference not statistically significant
Mai [28]	ADRs: 2/47 (4.26%) vs. 9/47 (19.15%) (p = 0.025); carbapenem use: 23.40% vs. 40.43% (p = 0.021)	Pharmacist-guided treatment vs. control; utilization difference does not establish prescribing superiority
Aksoy [21]	DRPs: 259 vs. 95 (p < 0.001); major DRPs: 33 vs. 5 (p = 0.008)	Observation vs. intervention periods; non-randomized comparison

TABLE 2: Selected quantitative findings from the eight primary studies

ADR, adverse drug reaction; DRP, drug-related problem; ED, emergency department

Values are presented as reported in the original studies. Comparisons differ in design, measurement, and outcome definition; the findings should not be interpreted as pooled estimates. Only selected outcomes are displayed.

Medication safety was evaluated in two studies using distinct measures: adverse drug reactions [28] and drug-related problems [21]. Four primary studies compared mortality or length of stay between groups [22,25-27]; these outcomes were also reported descriptively by Laine et al. and explored across consecutive study periods by Aksoy et al. No statistically significant improvement in mortality or length of stay was demonstrated. Because the included systematic review overlapped with the primary evidence, its findings were considered separately and are not represented in Table *2* [13].

Initial Antimicrobial Selection and Timeliness

Studies examining early antimicrobial management generally reported favorable process outcomes, although the interventions and timing definitions differed. In a retrospective emergency department cohort, pharmacist presence was associated with a shorter median interval from antibiotic ordering to administration (0.61 vs. 0.88 hours; p = 0.001), greater achievement of Surviving Sepsis Campaign timing targets (88% vs. 72%), and more frequent appropriate initial antimicrobial selection (97% vs. 81%) [22]. In a hospital-based sepsis response team, pharmacist reassessment increased the proportion of regimens providing adequate coverage against subsequently identified pathogens from 66% to 80% (p = 0.04). Among patients with initially inadequate antimicrobial coverage, median time to appropriate therapy was 2 hours and 22 minutes in those whose regimen was successfully corrected through pharmacist intervention, compared with 49 hours and 10 minutes among those without successful correction of the initial antimicrobial regimen (p < 0.001). This selected subgroup comparison should not be interpreted as an intervention effect across the entire cohort. Furthermore, 20 of 35 patients (57%) with documented pharmacist interventions received antimicrobial coverage broader than subsequently considered necessary based on culture findings [23].

In a community hospital emergency department, pharmacist-led selection and prescribing of empirical antibiotics were associated with greater antimicrobial appropriateness (86% vs. 57.5%; p < 0.01) and a 64-minute shorter time to first antibiotic administration [25]. In contrast, a single-arm implementation study involving 157 sepsis alerts documented 98% adherence to an antimicrobial selection algorithm and 94% adherence to a vancomycin dosing nomogram. Median antibiotic administration times were 39 minutes from sepsis alert activation and 96 minutes from emergency department presentation. Without a comparator,

these findings establish protocol implementation performance but do not demonstrate a reduction in treatment time attributable to the intervention [24].

The reported timing measures were not directly interchangeable, as studies assessed different intervals between recognition, prescribing, and administration of appropriate antimicrobial therapy. Consistent with the broader evidence, the included systematic review reported shorter time to antibiotic administration in seven of its 10 constituent studies [13].

Treatment Optimization and Stewardship After Initiation

Three studies examined antimicrobial optimization after treatment initiation, addressing treatment duration, appropriateness, and antimicrobial utilization. In a pre-post ICU study, implementation of a pharmacist-directed procalcitonin algorithm was associated with a reduction in median antibiotic duration from 12 to nine days ($p = 0.02$), without significant differences in length of stay, antibiotic reinitiation within 72 hours, or 28-day mortality [26].

In a randomized trial involving non-ICU patients with suspected sepsis, multidisciplinary antimicrobial stewardship review 48 hours after rapid-response activation improved treatment appropriateness at 72 hours (67% vs. 44%; $p = 0.03$). Of the recommendations issued, 74% were accepted, and 30% involved antimicrobial discontinuation or de-escalation. Because the intervention was delivered jointly by infectious diseases physicians and pharmacists, its effects cannot be attributed independently to the pharmacist component [27]. A separate randomized trial involving 94 ICU patients with septic shock reported lower carbapenem and quinolone utilization and greater third-generation cephalosporin use with pharmacist-guided anti-infective management [28]. These changes in antimicrobial utilization did not, by themselves, establish superior prescribing appropriateness.

Medication Safety

Medication-safety outcomes were examined in two primary studies using distinct measures [21,28]. In a randomized ICU trial, Mai et al. reported fewer adverse drug reactions among patients receiving pharmacist-guided anti-infective therapy than among controls (4.26% vs. 19.15%; $p < 0.05$). The intervention group also showed favorable differences in physiological and inflammatory markers, including central venous oxygen saturation, lactate, interleukin-1 beta, and procalcitonin [28]. These surrogate findings do not establish corresponding improvements in patient-centered clinical outcomes.

Aksoy et al. evaluated structured pharmacist-led medication review in 60 ICU patients with sepsis or septic shock using consecutive observation and intervention periods. The number of identified drug-related problems decreased from 259 to 95 (63.3%; $p < 0.001$), while problems classified as major decreased from 33 to five (84.8%; $p = 0.008$). Of 72 pharmacist recommendations, 70 were accepted by physicians (97.2%) [21]. Unlike confirmed adverse drug reactions, drug-related problems also encompass prescribing and treatment-related issues that may not have resulted in clinical harm. Interpretation of these findings is limited by the non-randomized design and differences in baseline medication exposure, with a median of 13.5 medications at ICU admission during the observation period compared with 10 during the intervention period ($p < 0.001$).

The drug-related problems identified by Aksoy et al. included potentially suboptimal treatment effectiveness, unnecessary pharmacotherapy, inappropriate drug selection or dosing, and medication-administration issues such as unsuitable infusion duration, final concentration, or solvent compatibility [21]. These problems were classified using the Pharmaceutical Care Network Europe system and encompassed both actual and potential medication-related concerns rather than exclusively confirmed adverse drug reactions.

Mortality and Length of Stay

Four primary studies compared mortality or length of stay between intervention and control groups, without identifying statistically significant differences [22,25-27]. Laine et al. reported an overall mortality rate of 53%, a median hospital length of stay of 18 days, and a median ICU length of stay of 11 days; however, these outcomes were not evaluated against a non-pharmacist comparison group [23].

In the non-randomized study by Aksoy et al., ICU mortality was 63.3% during the observation period and 66.7% during the intervention period ($p > 0.999$), while median ICU length of stay was seven and 9.5 days, respectively ($p = 0.213$) [21]. These comparisons were exploratory rather than primary efficacy outcomes. The included systematic review similarly reported no consistent reductions in mortality or length of stay [13]. Overall, the available studies did not demonstrate statistically significant improvements in these clinical outcomes.

Discussion

The findings of this scoping review suggest that the contribution of clinical pharmacists to sepsis

management is most consistently reflected in the quality and timeliness of pharmacotherapeutic care rather than in demonstrated improvements in patient-centered clinical outcomes. The interventions identified covered three related areas: early antimicrobial management, subsequent treatment optimization, and structured medication review. Although several studies reported favorable process outcomes, the evidence for medication safety was more limited and relied on distinct measures, including adverse drug reactions and drug-related problems. These findings highlight potentially meaningful contributions to sepsis care while underscoring the need to distinguish improvements in therapeutic processes from established clinical benefits.

The clinical relevance of these findings requires careful interpretation. Outcomes such as mortality are influenced by numerous factors, including illness severity, underlying comorbidities, infection source, adequacy of source control, and antimicrobial resistance [19]. The relatively small samples and heterogeneous designs of the included studies limit their ability to detect differences in these outcomes. Although observational evidence supports an association between earlier appropriate antimicrobial treatment and improved survival [5,6], and a meta-analysis involving multidisciplinary ICU teams reported lower mortality with pharmacist participation [12], these findings do not establish an independent survival benefit attributable to clinical pharmacist interventions in sepsis. Similarly, the absence of statistically significant differences in mortality or length of stay in the included studies should not be interpreted as evidence that such effects are absent.

An important consideration is the substantial variation in what constituted a clinical pharmacist intervention. The studies examined models ranging from pharmacist presence during emergency department care and pharmacist-led antimicrobial prescribing to protocol-based treatment decisions, multidisciplinary stewardship activities, and comprehensive medication review. These approaches differ in their clinical objectives, timing, professional autonomy, and dependence on institutional resources. Consequently, their findings cannot be interpreted as estimates of a uniform intervention effect. Greater consistency in describing the pharmacist's responsibilities, the intensity and timing of the intervention, and the characteristics of usual care would improve the comparability and applicability of future research.

Contemporary clinical guidance provides a relevant framework for interpreting these potential roles. The 2026 Surviving Sepsis Campaign guidelines address medication reconciliation and therapeutic drug monitoring as components of pharmacotherapeutic care [4], while multidisciplinary consensus guidance supports individualized beta-lactam dosing in acutely ill patients [8]. Evidence from medication-related interventions during transitions from intensive care [29] and pharmacist-led antimicrobial stewardship initiatives [30] further illustrates service models that may be relevant to sepsis management. Within the sepsis-specific evidence mapped here, structured pharmacist-led medication review was associated with fewer identified drug-related problems [21]. Nevertheless, the effectiveness of individual interventions, particularly medication reconciliation at transitions of care and therapeutic drug monitoring, remains insufficiently characterized in sepsis-specific populations.

The applicability of these findings across healthcare systems warrants careful consideration. Five of the eight primary studies were conducted in the United States, while the remaining studies originated in Australia, China, and Türkiye. All were single-center investigations, and no included study originated in Latin America or Saudi Arabia. Differences in pharmacist staffing, prescribing authority, access to diagnostic and therapeutic monitoring resources, and antimicrobial stewardship infrastructure may influence both implementation and outcomes across healthcare systems. These considerations may be particularly relevant in low- and middle-income countries, where access to specialized clinical pharmacy training, independent prescribing authority, timely microbiological testing, therapeutic drug monitoring, and dedicated antimicrobial stewardship resources may differ substantially from the settings in which the included interventions were evaluated. The present review did not directly assess how these contextual differences influence intervention effectiveness. Consequently, the transferability of these findings to settings with different organizational and regulatory characteristics remains uncertain. Additional sepsis-specific research from Latin America, Saudi Arabia, and other underrepresented healthcare systems is needed to evaluate the feasibility and reproducibility of clinical pharmacy interventions across diverse practice models.

From a practice perspective, the available evidence supports considering clearly defined pharmacist responsibilities within multidisciplinary sepsis pathways, particularly early antimicrobial assessment, dose individualization, therapeutic reassessment, medication-safety monitoring, and antimicrobial stewardship [4,10,11]. Implementation should be informed by local resources and professional scope of practice rather than by assuming that all pharmacist involvement produces equivalent effects. Future investigations should prioritize reproducible intervention models, appropriate comparison groups, and adequately powered multicenter designs. Beyond antimicrobial process measures, studies should evaluate patient-centered outcomes, preventable medication harm, antimicrobial consumption, resistance, and resource utilization to clarify the clinical and organizational value of these services.

Limitations

Several limitations should be considered when interpreting these findings. The search was restricted to three sources and did not include major bibliographic databases such as Embase, Scopus, or Web of Science, or gray literature. Language and full-text availability restrictions may also have introduced a selection bias. Complete search histories and record-level screening documentation were unavailable, limiting independent reconciliation of the reported full-text exclusion categories and assessment of potential overlap with the report identified through citation checking. In addition, study selection was conducted by a single reviewer without independent duplicate screening, and 40 reports could not be retrieved.

The primary evidence consisted predominantly of small, single-center studies with heterogeneous interventions, comparators, and outcome definitions. Differences in concurrent pharmacy staffing [22] and baseline patient characteristics [25] may have influenced observed process outcomes. The exclusion of patients who died within the first three days in one randomized trial further limits the applicability of its findings to patients at greatest risk of early mortality [28]. Differences in baseline medication exposure in the non-randomized medication-review study also complicate causal interpretation.

Finally, the included systematic review shared primary studies with the present evidence map and included publications outside the search period of this review. Its findings were therefore considered as secondary evidence rather than independent confirmation of the primary-study results [13]. Given the diversity of study designs and outcomes and the descriptive purpose of this scoping review, findings were synthesized narratively; their generalizability across clinical settings remains limited.

Conclusions

Across the eight primary studies, clinical pharmacist involvement in sepsis care was associated most consistently with improvements in antimicrobial appropriateness and selected measures of treatment timeliness. Individual studies also reported shorter antibiotic treatment duration and favorable medication-safety findings, although adverse drug reactions and drug-related problems were assessed separately and should not be interpreted as equivalent outcomes. No statistically significant improvement in mortality or length of stay was demonstrated.

These findings support further evaluation of clearly defined clinical pharmacy services within multidisciplinary sepsis care rather than assuming a uniform benefit from pharmacist involvement. Future multicenter studies should use appropriate comparators, standardized intervention descriptions, and patient-centered outcomes, with greater representation of underrepresented healthcare systems, particularly in Latin America.

Appendices

Source	Search terms	Filters
PubMed/MEDLINE	sepsis AND pharmacist AND antimicrobial stewardship; septic shock AND clinical pharmacist AND antibiotic therapy	2016-2025; English or Spanish
ScienceDirect	sepsis AND pharmacist AND antimicrobial stewardship; septic shock AND pharmaceutical care	2016-2025; English or Spanish
Google Scholar	sepsis pharmacist antimicrobial stewardship; septic shock clinical pharmacist antibiotic therapy	2016-2025; English or Spanish

TABLE 3: Search terms used in the review

Searches were run between March 2 and March 11, 2026

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Esteban Zavaleta-Monestel, José A. Castro Gamboa, Jeaustin Mora-Jiménez, José Pablo Díaz-Madriz, Kimberly R. Torres-Mora

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Disclosures

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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