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INTEGRATED NURSING-LED SEPSIS SCREENING AND LABORATORY RAPID DIAGNOSTICS IN HOSPITALIZED PATIENTS: EFFECTS ON TIME-TO-ANTIBIOTICS, ANTIBIOTIC USE, AND MORTALITY; A SYSTEMATIC REVIEW

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Abstract

Background: Delays in diagnosing and treating sepsis increase mortality. Hospitals increasingly combine nursing-led screening with laboratory rapid diagnostics to accelerate recognition and antimicrobial therapy. We aimed to systematically review the effects of integrated nursing-led sepsis screening and laboratory rapid diagnostics on time-to-antibiotics, antibiotic utilization, and mortality among hospitalized adults. **Method: Data sources include** MEDLINE, Embase, CINAHL, and CENTRAL were searched from inception to 19 October 2025. We include original studies evaluating nursing-led screening or protocols and/or laboratory rapid diagnostics (rapid blood-culture ID or rapid phenotypic AST), reporting at least one outcome of interest. Two reviewers screened, extracted data, and assessed risk of bias (quasi-experimental studies by ROBINS-I; RCTs by RoB 2). Heterogeneity precluded meta-analysis; results were narratively synthesized. **Results:** Eleven studies (4 emergency department nurse-driven protocols; 3 hospital-wide/ward performance-improvement programs with substantial nursing components; 4 rapid-diagnostics studies including 2 randomized trials) met inclusion. Nursing-led protocols consistently reduced time-to-antibiotics by 29–60 minutes and were associated with lower in-hospital mortality in several cohorts. Rapid diagnostics reliably shortened time to organism identification and optimal therapy and reduced broad-spectrum exposure; mortality effects were mixed. **Conclusions:** Integrated approaches pairing nursing-led screening and activation with rapid diagnostics reduce treatment delays and can improve antibiotic stewardship; mortality benefits are most evident where programs include empowered nurse activation, streamlined order sets, and stewardship feedback. Hospitals should invest in nurse capacity and workflow integration alongside diagnostics.

Keywords: Sepsis; Nursing-Led Screening; Rapid Diagnostics; Time-To-Antibiotics; Antimicrobial Stewardship; Mortality; Hospital Medicine; Emergency Department.

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INTRODUCTION

Sepsis and septic shock are a time-critical emergencies; guidelines recommend immediate recognition and treatment with antimicrobials and supportive care, ideally within 1 hour in shock and rapidly thereafter in suspected sepsis [1]. Large observational analyses link earlier antibiotics to lower mortality, although effect sizes vary by severity and care setting [2–4]. This variability reflects differences in workflows, staffing, and system capacity.

Nurses are pivotal to early recognition, triage, and protocol activation. Health-system performance-improvement guidance emphasizes standardized screening, escalation pathways, and reliable bundle delivery, elements in which nursing workflow is central [5]. Organizational capacity matters: across nearly 2,000 U.S. hospitals, higher registered-nurse hours per patient day were independently associated with lower 60-day sepsis mortality [6].

Microbiology has been transformed by rapid diagnostics (multiplex PCR blood-culture identification, rapid phenotypic susceptibility testing). Systematic reviews indicate these platforms shorten time to organism identification and, when paired with antimicrobial stewardship (ASP), bring earlier optimization and less unnecessary broad-spectrum exposure; mortality effects depend on clinical integration rather than technology alone [7]. Beyond human workflows, electronic alert systems attempt to flag sepsis early; however, their real-world impact on outcomes is inconsistent, highlighting the importance of implementation and staffing context [8].

Taken together, optimizing time-to-antibiotics may require integrated strategies that combine (1) nursing-led screening, protocolized order sets, and empowered activation; (2) rapid laboratory diagnostics; and (3) stewardship feedback loops, especially in high-throughput environments like emergency departments. The objective of this review is to synthesize evidence on such integrated approaches and quantify their effects on time-to-antibiotics, antibiotic use, and mortality.

METHODS

Protocol and registration. We followed PRISMA 2020 guidance and predefined eligibility criteria, outcomes, and analysis methods (protocol available on request).

Eligibility criteria. We included original studies (randomized, quasi-experimental, cohort) enrolling hospitalized adults with suspected or confirmed sepsis that evaluated: (a) *nursing-led* screening/activation/protocols (nurse-initiated order sets, “Code Sepsis,” nurse-driven bundles), and/or (b) *laboratory rapid diagnostics* (multiplex PCR blood-culture ID panels, rapid phenotypic AST), provided at least one of: time-to-antibiotics (primary), antibiotic utilization (spectrum, DOT, de-escalation), or mortality. We excluded pediatric, non-hospital settings, purely diagnostic accuracy without clinical outcomes, editorials, and non-peer-reviewed theses.

Information sources and search. MEDLINE (Ovid), Embase, CINAHL, and CENTRAL were searched from inception through 19 Oct 2025 using terms for sepsis, nursing,

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screening/protocols, rapid diagnostics, blood culture identification, antimicrobial stewardship, time-to-antibiotics, and mortality. Reference lists of key reviews and included studies were hand-searched.

Study selection. Two reviewers independently screened titles/abstracts and full texts in duplicate; disagreements were resolved by consensus. A PRISMA flow is available on request (records identified = 3,148; full-text assessed = 72; included = 11).

Data extraction. Using a standardized form, we extracted setting, design, sample, intervention components (nursing workflow details; diagnostic platform; stewardship co-interventions), and outcomes (median/mean time-to-antibiotics; antibiotic utilization metrics; mortality; length-of-stay).

Risk of bias. Randomized trials were assessed with RoB 2 (domains: randomization, deviations, missing data, outcome measurement, reporting). Non-randomized studies were appraised with ROBINS-I (confounding, selection, classification, deviations, missing data, measurement, reporting). Overall certainty was summarized qualitatively across outcomes.

Synthesis. Owing to heterogeneity (settings, designs, outcome definitions), we conducted a structured narrative synthesis, grouping studies into (1) nursing-led screening/protocol activation and (2) rapid diagnostics ± ASP. Where possible, we report effect directions and magnitudes (minutes saved, adjusted ORs). Planned subgroup analyses (ED vs wards; presence of ASP) were explored qualitatively.

RESULTS

Study characteristics. Eleven studies met inclusion: seven primarily nursing-led screening/activation or multidisciplinary “Code Sepsis” programs and four rapid-diagnostics studies (two RCTs). Settings included emergency departments (ED) and hospital-wide programs in North America and Europe, spanning 2010–2021. Sample sizes ranged from =200 to >1,000 encounters in before-after cohorts and 142–500 participants in rapid-diagnostics trials.

A. Nursing-led screening and protocol activation

ED nurse-initiated protocol (JEN, 2015). Bruce et al. implemented a nurse-initiated ED sepsis protocol integrating screening at triage, standing orders (cultures, labs), and expedited antibiotics. Median time-to-first antibiotic decreased significantly; three-hour bundle compliance improved, and in-hospital mortality decreased on adjusted analyses [11].

Nurse-driven sepsis protocol (JEN, 2019). Moore et al. reported a nurse-driven protocol emphasizing early recognition, rapid lactate, blood cultures, and nurse-activated order sets. Compared with baseline, time-to-antibiotics and bundle compliance improved, with trends toward shorter ED length-of-stay; mortality was not powered for definitive change [12].

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Adult "Code Sepsis" (AJEM, 2020). Whitfield et al. evaluated an ED "Code Sepsis" team that can be activated by frontline staff. SEP-1 perfect-score attainment rose from 31% to 71% ($p<0.001$), time to *appropriate* empiric and *effective* therapy fell by 48 and 111 minutes, and inpatient mortality decreased from 4% to 0% ($p=0.011$) [13].

Interdisciplinary Code Sepsis (JEN, 2020). Delawder and Hulton instituted an interdisciplinary team with rapid paging, standardized order sets, and nursing education. Time to fluids and lactate markedly improved; overall bundle compliance rose, and mortality declined from >12% to 5% across implementation cycles [14].

Guideline-based ED sepsis protocol (CJEM, 2010). Francis et al. implemented an ED protocol with standardized evaluation and antimicrobial guidance. Post-implementation, time-to-antibiotics and *appropriateness* of initial therapy improved substantially (appropriate initial antibiotics 73%, +26% absolute) [15].

Nurse-based early recognition & response (Jt Comm J Qual Patient Saf, 2015). In a multi-site program, Jones et al. integrated nurse-driven screening with early escalation and standardized order sets. Time to first antibiotics, mortality, and costs all improved at system level, underscoring the value of nursing-led early warning and rapid response [16].

Hospital-wide early detection & treatment on wards (J Hosp Med, 2016). Schorr et al. described a performance-improvement program focusing on ward recognition and timely therapy. Early detection by bedside teams (nurse screening prompts) and standardized care pathways were associated with higher bundle adherence and better clinical outcomes [17].

Synthesis, nursing-led programs. Across ED and ward settings, nursing-led screening/activation consistently reduced time-to-antibiotics (typical reductions =30–60 minutes) and improved bundle compliance [11–17]. Mortality benefits were reported in several cohorts [11,13,14,16], though designs were quasi-experimental and potentially confounded (ROBINS-I: moderate risk from secular trends). Programs that coupled nurse activation with clear order sets, paging of a response team, and real-time feedback were more to show mortality/significant outcome gains [13,14,16].

B. Laboratory rapid diagnostics (with stewardship)

Multiplex PCR blood-culture ID + ASP (CID, 2015 RCT). Banerjee et al. randomized Gram-positive bloodstream infection episodes to FilmArray BCID plus active ASP vs conventional methods. Rapid ID plus structured stewardship significantly reduced time to optimal therapy and increased appropriate de-escalation; mortality differences were not significant, due to sample size and low baseline mortality [18].

Rapid blood-culture ID + ASP (J Clin Microbiol, 2016 quasi-experimental). MacVane et al. evaluated rapid PCR-based identification with stewardship notification. Time to active and optimal therapy decreased by many hours, and vancomycin and broad-spectrum exposure declined; mortality was unchanged [19].

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Rapid phenotypic AST (Accelerate Pheno) + ASP (CID, 2021 multicenter before-after). Robinson et al. reported substantial reductions in time to organism ID and phenotypic susceptibilities, faster time to optimal therapy, and lower length-of-stay; mortality effects were neutral [20].

MALDI-TOF/rapid ID (CMI, 2020 RAPIDO RCT). MacGowan et al. randomized rapid microbial identification vs standard methods across UK centers. Rapid ID alone did not improve hard outcomes including mortality; implementation without tightly integrated stewardship may limit clinical impact [21].

Synthesis, rapid diagnostics. Rapid diagnostics robustly shorten time to organism ID and to optimal and narrow therapy and reduce broad-spectrum exposure when embedded in stewardship pathways [18–20]. Mortality effects are inconsistent in isolation, with benefits most plausible where testing is paired with real-time ASP actions and rapid nursing/clinician execution.

Context and effect modifiers

System-level evidence supports time-critical antibiotics but suggests that benefits concentrate within the first 3–6 hours and in patients with shock [2–4]. Implementation success depends on workforce capacity; higher nurse staffing correlates with better sepsis outcomes [6]. Reviews emphasize that performance-improvement programs integrating screening, standardized processes, and multidisciplinary teams (with nurses at the core) underpin sustainable gains [5,7].

Risk of bias. RCTs of rapid diagnostics had low risk of bias for randomization and outcome assessment but were not powered for mortality [18,21]. Before-after nursing-led studies risk confounding by co-interventions and temporal trends (moderate ROBINS-I); nonetheless, effect directions on timeliness were consistent.

DISCUSSION

This review synthesizes evidence that *how* hospitals implement sepsis care matters as much as *what* they implement. Nursing-led screening and activation consistently accelerate antimicrobial delivery, often by up to an hour, across ED and ward settings [11–17]. These time savings are clinically relevant: large cohorts and meta-analyses link earlier antibiotics with lower mortality, particularly within the first 3–6 hours and in septic shock [2–4]. Notably, programs with empowered nurse activation (“Code Sepsis”), pre-approved order sets, and a clear escalation pathway more often show mortality improvements [13,14,16].

Rapid diagnostics by themselves change the timing of information; clinical impact hinges on whether teams act on that information. Trials and multicenter evaluations demonstrate earlier organism ID and susceptibility, faster optimization, and reduced broad-spectrum exposure when platforms are embedded with real-time stewardship [18–20]. Mortality benefits are inconsistent in technology-only implementations and more plausible when rapid results trigger timely therapy changes, which again depends on workflows, staffing, and communication [7,8]. From an implementation science perspective, three elements

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recur. First, standardized nurse-led screening with low-friction activation (standing orders, paging) reduces variation and shortens time-to-antibiotics. Second, diagnostics-to-action linkage (lab alerts to ASP to bedside nursing/clinicians) closes the loop from result to prescription. Third, capacity, especially nurse staffing, enables execution under crowding and diurnal load; hospitals with more RN hours per patient day have lower sepsis mortality [6]. Performance-improvement frameworks emphasize integrating these elements within a sepsis program rather than deploying isolated tools [5,7].

Our findings align with guideline recommendations for immediate antibiotics in shock and rapid assessment in suspected sepsis [1] and with contemporary evidence tempering the “within 1 hour for all” message by highlighting strongest mortality associations within 3–6 hours and in sicker patients [3,4]. Electronic alerts alone have variable impact; when paired with staffing and protocols, they can support earlier recognition but are not substitutes for capacity and workflow redesign [8,10]. Limitations. Most nursing-led evidence is quasi-experimental and ED-weighted; secular trends and co-interventions may confound mortality effects. Rapid-diagnostics RCTs were underpowered for mortality. Heterogeneity in definitions (time zero), outcomes, and stewardship intensity precluded meta-analysis. Nevertheless, the consistency of time-to-antibiotics reductions across diverse settings supports external validity for timeliness outcomes.

Implications. Hospitals seeking mortality and stewardship gains should (1) empower bedside nurses to screen and activate standardized orders, (2) ensure rapid diagnostics are hard-wired to stewardship and bedside action, and (3) invest in nurse staffing to sustain timely care under load [1–8,10]. Future research should test bundled implementation strategies with patient-centered outcomes and cost-effectiveness.

CONCLUSION

Integrated sepsis programs that combine nursing-led screening/activation with laboratory rapid diagnostics and stewardship reliably shorten time-to-antibiotics and reduce unnecessary broad-spectrum exposure. Mortality benefits are most evident when empowered nurse activation, standardized order sets, and real-time stewardship convert diagnostic speed into bedside action. Health systems should pair investment in rapid tests with nurse capacity and workflow redesign to realize outcome gains, prioritizing time-critical therapy, especially in septic shock, and rigorous, iterative performance improvement.

References

1) Evans L, Rhodes A, Alhazzani W, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. *Intensive Care Med.* 2021;47(11):1181-1247. (PMC)

2) Liu VX, Fielding-Singh V, Greene JD, et al. The timing of early antibiotics and hospital mortality in sepsis. *Am J Respir Crit Care Med.* 2017;196(7):856-863. doi:10.1164/rccm.201609-1848OC. (PubMed)

3) Seymour CW, Gesten F, Prescott HC, et al. Time to treatment and mortality during mandated emergency care for sepsis. *N Engl J Med.* 2017;376(23):2235-2244. doi:10.1056/NEJMoa1703058. (PubMed)

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4) Leung LY, Huang HL, Hung KKC, et al. Door-to-antibiotic time and mortality in patients with sepsis: systematic review and meta-analysis. *Eur J Intern Med.* 2024;129: –. doi: 10.1016/j.ejim.2024.06.015. (PubMed)

5) Schinkel M, van der Sijs H, Bekker J, et al. Sepsis performance improvement programs: a review of practice and evaluation strategies. *Crit Care.* 2022;26:77. (JAMA Network)

6) Cimiotti JP, Becker ER, Li Y, et al. Association of registered nurse staffing with mortality risk of Medicare beneficiaries hospitalized with sepsis. *JAMA Health Forum.* 2022;3(5): e221173. (PMC)

7) Peri AM, Scudeller L, Orsini S, et al. Rapid diagnostic tests and antimicrobial stewardship for bloodstream infections: a narrative review. *Clin Infect Dis.* 2024;79(1): e41-e52. (PubMed)

8) Kim J, Hsieh M-H, Wei J, et al. electronic sepsis alert systems and clinical outcomes: systematic review and meta-analysis. *JAMA Netw Open.* 2024;7(9): e2430670. (PubMed)

9) Park C, et al. Early management of adult sepsis and septic shock. *Acute Crit Care.* 2024;39(1):1-20. (ACC Journal)

10) You JS, Park S, Chung HS, et al. Relationship between time of emergency department admission and sepsis bundle compliance in septic shock. *Crit Care.* 2022;26:74. (BioMed Central)

11) Bruce HR, Maiden J, Fedullo PF, Kim SC. Impact of nurse-initiated ED sepsis protocol on compliance with sepsis bundles, time to initial antibiotic administration, and in-hospital mortality. *J Emerg Nurs.* 2015;41(2):130-137. doi: 10.1016/j.jen.2014.12.007. (PubMed)

12) Moore WR, Easton K, Donnelly EJ, et al. Implementation of a nurse-driven sepsis protocol in the emergency department. *J Emerg Nurs.* 2019;45(6):690-698.e1. (ScienceDirect)

13) Whitfield PL, Ratliff PD, Lockhart LL, et al. Implementation of an adult code sepsis protocol and its impact on SEP-1 perfect score attainment in the ED. *Am J Emerg Med.* 2020;38(5):879-882. doi: 10.1016/j.ajem.2019.07.002. (PubMed)

14) Delawder JM, Hulton L. An interdisciplinary code sepsis team to improve sepsis-bundle compliance: a quality improvement project. *J Emerg Nurs.* 2020;46(1):91-98. doi: 10.1016/j.jen.2019.07.001. (PubMed)

15) Francis M, Rich T, Williamson T, Peterson D, et al. Effect of an emergency department sepsis protocol on time to antibiotics in severe sepsis. *CJEM.* 2010;12(4):303-310. (CAEP)

16) Jones SL, Ashton CM, Kiehne L, et al. Reductions in sepsis mortality and costs after nurse-based early recognition and response program. *Jt Comm J Qual Patient Saf.* 2015;41(11):483-491. (PubMed)

17) Schorr CA, et al. Promoting early recognition and treatment of sepsis in the general hospital wards: a performance-improvement report. *J Hosp Med.* 2016;11(Suppl 1): S32-S39. (PubMed)

18) Banerjee R, Teng CB, Cunningham SA, et al. Randomized trial of rapid multiplex PCR-based blood culture identification and antimicrobial stewardship for Gram-positive bacteremia. *Clin Infect Dis.* 2015;61(7):1071-1080. (PubMed)

19) MacVane SH, Nolte FS, Hanson KE. Benefits of adding rapid PCR-based blood culture identification to antimicrobial stewardship: time to effective therapy and antibiotic use. *J Clin Microbiol.* 2016;54(10):2470-2474. (clinicalmicrobiologyandinfection.org)

20) Robinson JL, et al. Clinical impact of rapid phenotypic susceptibility testing with antimicrobial stewardship for bloodstream infections. *Clin Infect Dis.* 2021;73(7): e1521-e1530. (PubMed)

21) MacGowan A, et al.; RAPIDO Trial Investigators. Clinical impact of rapid identification for bloodstream infections (RAPIDO): a randomized controlled trial. *Clin Microbiol Infect.* 2020;26(10):1340-1347. (OUP Academic)