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Effectiveness of Screening for Sepsis among Hospitalized General Patients

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Abstract

Introduction: Sepsis remains a significant global health challenge, contributing to substantial morbidity, mortality, and healthcare costs. Early detection and treatment are crucial for improving patient outcomes, yet the effectiveness of various sepsis screening interventions in hospitalized general patients has been inconsistently reported. This systematic review aimed to evaluate the effectiveness of sepsis screening interventions among hospitalized general patients, focusing on outcomes such as early detection rates, time to treatment, and mortality.

Methods: A comprehensive search was conducted in databases including PubMed, MEDLINE, EMBASE, and the Cochrane Library, focusing on interventional studies and clinical trials from the last five years up to 2022. Inclusion criteria were interventional studies assessing the effectiveness of sepsis screening in adult hospitalized patients, with outcomes related to sepsis identification, treatment initiation, and patient outcomes. Studies were screened and assessed for quality, with data extracted on study characteristics, interventions, and key findings.

Results: Nine studies met the inclusion criteria, encompassing a range of interventions such as electronic alerts, standardized protocols, and educational programs. The studies demonstrated improvements in early sepsis detection (from 45% to 78%), reductions in time to antibiotic administration (median decrease of 2.5 hours), and decreases in mortality rates (20% reduction in some studies). Notably, integrated approaches combining technology and multidisciplinary teamwork showed promising results, with risk ratios for improved detection and treatment outcomes ranging significantly across studies.

Conclusions: The review highlights the potential of systematic sepsis screening interventions to significantly enhance patient outcomes in hospital settings. Despite challenges in comparing across diverse study designs and settings, the evidence supports the implementation of multifaceted sepsis screening protocols to improve early detection, timely treatment, and ultimately, patient survival rates. Future research should focus on optimizing these interventions for broader applicability and assessing their long-term impacts on healthcare systems.

***Keywords: Sepsis, Screening, Interventions, Hospitalized Patients, Mortality*.**

Introduction

Sepsis, a life-threatening response to infection leading to organ dysfunction, represents a significant challenge within healthcare settings worldwide. Recent data indicate that sepsis affects millions of people globally each year, contributing to an estimated 20% of all deaths [1]. Among hospitalized patients, the prevalence of sepsis has been reported to be as high as 6%, with higher rates observed in intensive care units [2]. Early detection and treatment of sepsis are crucial, as they significantly improve patient outcomes. Studies have shown that each hour delay in administering appropriate antibiotics increases mortality by 7.6% [3]. Furthermore, the economic burden of sepsis is substantial, with hospital costs for septic patients being approximately twice as high as for non-septic patients, amounting to billions of dollars annually [4].

The heterogeneity of sepsis symptoms, ranging from fever and increased heart rate to more severe signs such as decreased urine output and sudden confusion, complicates its early detection [5]. This variability underscores the importance of efficient screening tools and protocols in the early identification of sepsis among hospitalized patients. Despite advancements in medical technology and protocols, the sensitivity and specificity of current sepsis screening tools vary, with some studies reporting a sensitivity of 70% and specificity of 85% [6]. Moreover, the implementation of these tools is inconsistent across healthcare settings, affecting their overall effectiveness in reducing sepsis-related mortality [7].

Screening for sepsis in general hospitalized patients is further challenged by the diverse patient population and the wide range of conditions that mimic sepsis symptoms. For instance, conditions such as systemic inflammatory response syndrome (SIRS) can present with similar clinical signs, leading to potential misdiagnosis in up to 30% of cases [8]. This highlights the need for screening tools that can accurately differentiate sepsis from other inflammatory conditions. Additionally, the role of comorbidities in complicating sepsis diagnosis cannot be understated as patients with pre-existing health conditions are at a higher risk of developing sepsis. Research indicates that patients with chronic diseases, such as diabetes or kidney disease, have a two to three times higher risk of sepsis than the general population [9]. The importance of interdisciplinary approaches in sepsis screening has been increasingly recognized. Collaboration among healthcare professionals, including nurses, physicians, and laboratory technicians, is essential for the timely recognition and treatment of sepsis. Integrated screening protocols that utilize both clinical judgment and automated alert systems have shown promise in improving sepsis detection rates. A meta-analysis revealed that such integrated approaches could reduce sepsis-related mortality by up to 15% [10]. Despite these advancements, there remains a gap in the literature regarding the effectiveness of sepsis screening across the entirety of hospitalized general patient populations, indicating a critical area for research and development. The aim of this systematic review was to evaluate the effectiveness of screening for sepsis among hospitalized general patients. By synthesizing data from a wide range of studies, this review sought to identify the most effective screening tools and protocols, assess their impact on patient outcomes, and highlight areas requiring further investigation.

Methods

To conduct this systematic review, we initiated our research by defining a comprehensive search strategy aimed at identifying studies that investigated the effectiveness of sepsis screening among hospitalized general patients. The search terms were carefully selected to encompass a wide range of relevant concepts, including "sepsis," "screening," "detection," "hospitalized patients," and "effectiveness." These terms were used in various combinations with Boolean operators to maximize the search scope. The primary databases queried included PubMed, MEDLINE, EMBASE, and the Cochrane Library, recognized for their extensive collections of healthcare-related research articles. The search was limited to articles are

published in the English language, considering studies conducted in the last five years up to the year 2022, to ensure that the review reflected the most current evidence regarding sepsis screening practices and their outcomes. The inclusion criteria were meticulously defined to ensure the systematic review focused on high-quality, relevant studies. Only interventional studies that evaluated the effectiveness of sepsis screening tools or protocols among adult hospitalized general patients were considered. These studies needed to report on outcomes such as the accuracy of sepsis identification, time to diagnosis, time to treatment initiation, patient outcomes (including mortality, length of hospital stay, and intensive care unit admission rates), and any reported improvements in clinical practice or policy.

Exclusion criteria were set to omit studies that focused exclusively on pediatric populations, those conducted in settings outside of general hospital environments (such as specialized intensive care units), case reports, reviews, and studies that did not provide specific outcomes related to the effectiveness of sepsis screening. The initial search yielded a substantial number of records. Each title and abstract were screened independently by two reviewers to assess their relevance based on the predefined inclusion and exclusion criteria. This preliminary screening phase aimed to eliminate any studies that clearly did not meet the criteria, such as those not focusing on sepsis screening or not involving hospitalized general patients. Disagreements between reviewers at this stage were resolved through discussion or, if necessary, consultation with a third reviewer.

Following the title and abstract screening, full texts of the potentially eligible studies were obtained and evaluated in detail. This phase involved a more rigorous assessment to ensure that studies met all inclusion criteria, particularly emphasizing the intervention's nature and the reported outcomes. Studies that did not provide clear data on the effectiveness of sepsis screening or that were not interventional in nature were excluded. The process was thorough to ensure that only studies contributing valuable insights into the effectiveness of sepsis screening practices were included in the final review.

Data extraction was conducted systematically for each of the included studies. Extracted data included study characteristics (such as design, setting, and sample size), details of the sepsis screening interventions (including the tools or protocols used), and key findings related to the effectiveness of these interventions. This process was essential for synthesizing the evidence in a manner that would allow for clear comparisons and conclusions to be drawn regarding the most effective sepsis screening practices in hospital settings.

The final step involved assessing the quality of the included studies. This assessment was critical for ensuring the reliability and validity of the review's findings. Quality appraisal focused on the study design, risk of bias, precision of outcomes, and the relevance of the studies to the review's aim. Only studies deemed to have a low to moderate risk of bias and that provided high-quality evidence on the effectiveness of sepsis screening were included in the synthesis. This methodological rigor ensured that the conclusions drawn from the review were based on robust evidence, thereby providing valuable insights into the effectiveness of sepsis screening among hospitalized general patients.

Results and discussion

In the systematic review, we identified and included nine interventional studies and clinical trials that evaluated the effectiveness of various sepsis screening interventions among hospitalized general patients. The sample sizes across these studies ranged notably, from as small as 100 participants to over 1,000, reflecting a broad spectrum of hospital settings and patient demographics. The interventions implemented across these studies varied significantly, encompassing electronic sepsis alert systems, standardized screening protocols, and educational interventions for healthcare staff. For instance, one study employed an electronic alert system designed to identify sepsis symptoms early, resulting in a significant reduction in time to antibiotic administration, with a median decrease of 2.5 hours compared to standard care [11]. Another study focused on a multidisciplinary approach, incorporating nurse-led screenings coupled with immediate physician review, which demonstrated a

30% improvement in early sepsis detection and a corresponding reduction in sepsis-related mortality [12]. Comparatively, educational interventions aimed at improving the knowledge and responsiveness of healthcare providers to sepsis symptoms showed varying degrees of success. One study reported a significant increase in early detection rates, from 45% to 78%, post-intervention, with a risk ratio (RR) of 1.73 (95% CI, 1.22 to 2.44) [13]. However, another study found a more modest improvement in detection rates, with a reported risk ratio of 1.25 (95% CI, 0.99 to 1.58), suggesting that the effectiveness of educational interventions may depend heavily on the existing protocols and the specific hospital environment [14].

Among the clinical trials included, one notable study evaluated the impact of a comprehensive sepsis protocol, which included standardized assessment tools, biomarker testing, and automated alerts. This study found a 20% reduction in mortality rates among sepsis patients, with an adjusted risk ratio of 0.80 (95% CI, 0.68 to 0.95) [15]. Another trial focused on the use of point-of-care lactate testing combined with a sepsis response team, which reported a reduction in ICU admission rates from 35% to 25%, showcasing the potential benefits of rapid testing and team-based approaches to sepsis care [16].

The effectiveness of the interventions varied across the studies, but a common theme was the improvement in patient outcomes, including reduced time to treatment and lower mortality rates, when systematic screening protocols or technological aids were utilized. The range of risk ratios and percentages, along with their confidence intervals, highlights the potential impact of tailored interventions on sepsis outcomes in hospital settings. However, the studies also underscore the need for further research to optimize sepsis screening protocols and interventions for diverse hospital environments and patient populations.

The systematic review's results, highlighting the effectiveness of various sepsis screening interventions in hospitalized general patients, reveal significant insights into the potential for improving patient outcomes through early detection and management of sepsis. The included studies demonstrated a range of risk differences attributable to the interventions, from enhanced early detection rates to reduced mortality and shorter times to antibiotic administration. These findings align with and contribute to the broader body of medical literature on sepsis management, offering a comparative perspective on the efficacy of different screening and treatment approaches. In the medical literature, numerous studies have evaluated the impact of sepsis interventions, including rapid testing protocols, automated alert systems, and multidisciplinary care teams. For example, studies have shown that rapid testing protocols can significantly reduce the time to diagnosis and treatment initiation, with some reporting a reduction in mortality rates among severe sepsis patients by as much as 15% [19]. These findings are consistent with those from our review, where interventions such as point-of-care lactate testing combined with a sepsis response team demonstrated a notable decrease in ICU admission rates [16].

Automated alert systems, similar to those evaluated in our included studies, have been widely studied in the literature. A study reported a 25% improvement in early sepsis detection and a corresponding 10% reduction in sepsis-related mortality following the implementation of an electronic sepsis alert system [20]. These results echo the positive outcomes observed in our review, underscoring the potential of technology-assisted interventions in enhancing sepsis care. Furthermore, the effectiveness of educational interventions for healthcare staff in improving sepsis outcomes has been a focus of several studies. A literature review highlighted a study where an educational program led to a significant increase in healthcare providers' ability to identify sepsis early, with an associated reduction in mortality from 50% to 30% [21]. While our review found varying degrees of success with educational interventions, the importance of continuous education and training in improving sepsis outcomes remains evident.

The risk differences observed in our review also align with findings from clinical trials examining the impact of standardized sepsis protocols. One such trial reported a 20% reduction in hospital mortality for sepsis patients, which is comparable to the reduction in mortality rates observed in studies within our

review that utilized comprehensive sepsis protocols [22, 23]. Comparing the numerical results of the included studies with those in the literature, it is clear that while there is variability in the effectiveness of specific interventions, the overall trend indicates that systematic approaches to sepsis screening and management can significantly improve patient outcomes. However, it is also apparent that the optimal strategy may vary depending on the hospital setting, the patient population, and the resources available.

This review highlights the critical role of tailored sepsis interventions in enhancing patient care and outcomes. The comparison with existing literature not only validates the findings of our review but also suggests that there is considerable potential for further improvement in sepsis management through the adoption of evidence-based interventions. Future research should focus on identifying the most effective components of sepsis screening and management protocols, with an emphasis on scalability and adaptability to diverse healthcare settings [24, 25].

The systematic review presented herein possesses several strengths that bolster its relevance and applicability in clinical practice. Primarily, the inclusion of a wide range of interventional studies and clinical trials provides a comprehensive overview of the current evidence on the effectiveness of sepsis screening interventions among hospitalized general patients. This broad inclusion criterion ensures that the review captures a diverse array of screening protocols and technologies, offering insights into their practical implementation and outcomes. Additionally, the focus on recent studies conducted in the last five years up to 2022 allows for an up-to-date assessment of sepsis screening practices, reflecting the latest advancements and innovations in sepsis care. The methodological rigor applied in the selection and analysis of included studies further enhances the reliability of the review's findings, providing a solid foundation for evidence-based recommendations in clinical settings. However, the review is not without limitations. One notable limitation is the potential for publication bias, as studies reporting positive outcomes are more likely to be published than those with neutral or negative results. This bias could skew the review's findings toward more favorable outcomes, potentially overestimating the effectiveness of certain interventions. Additionally, the heterogeneity in study designs, interventions, and patient populations across the included studies poses a challenge for direct comparison and synthesis of results. This variability makes it difficult to derive a one-size-fits-all conclusion regarding the most effective sepsis screening intervention, limiting the ability to make generalized recommendations applicable to all hospital settings.

Conclusions

The systematic review revealed that sepsis screening interventions, including electronic alert systems, standardized screening protocols, and educational programs for healthcare staff, can significantly improve patient outcomes in hospitalized general patients. Notably, interventions were associated with improvements in early sepsis detection rates, reductions in time to antibiotic administration, and decreases in mortality rates, with risk ratios and percentages indicating substantial clinical benefits. Despite the limitations related to study heterogeneity and potential publication bias, these findings underscore the critical importance of implementing systematic sepsis screening protocols in hospitals to enhance the timely identification and treatment of sepsis, ultimately improving patient care and outcomes.

Conflict of interests

The authors declared no conflict of interests.

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Table (1): Summary of the findings of the included studies that aimed to evaluate the effectiveness of sepsis screening interventions among hospitalized general patients

Study ID	Sample Size	Population Characteristics	Type of intervention	Effectiveness of the intervention	Study conclusion
[11]	101	General hospital patients	Electronic sepsis alert	Reduced time to antibiotics by 2.5 hours	Electronic alerts significantly reduce treatment delays
[12]	253	Mixed ICU and general ward patients	Nurse-led screening protocol	30% improvement in early detection, 25% reduction in mortality	Multidisciplinary approach effectively improves detection and reduces mortality
[13]	477	Elderly patients in medical wards	Educational program for staff	Increase in detection from 45% to 78%	Educational interventions significantly enhance staff's ability to detect sepsis early
[14]	359	Adults in surgical wards	Automated screening tool	Modest improvement in detection, risk ratio 1.25 (95% CI, 0.99 to 1.58)	Automated tools show promise but require further optimization
[15]	621	General ward patients at high risk of sepsis	Comprehensive sepsis protocol	20% reduction in mortality, RR 0.80 (95% CI, 0.68 to 0.95)	Comprehensive protocols significantly lower mortality rates
[16]	503	Emergency department admissions	Point-of-care lactate testing	Reduction in ICU admissions from 35% to 25%	Rapid testing and team response improve critical care access
[17]	289	General ward patients	Multidisciplinary sepsis team	Improved teamwork and patient outcomes	Team-based interventions enhance overall patient care

Study ID	Sample Size	Population Characteristics	Type of intervention	Effectiveness of the intervention	Study conclusion
[18]	175	Adult patients in a tertiary hospital	Standardized assessment tool	Enhanced early detection and treatment initiation	Standardized tools are effective in early sepsis identification
[19]	997	Hospital-wide screening program participants	Hospital-wide sepsis alert system	10% reduction in hospital-wide sepsis mortality	System-wide alerts reduce overall sepsis-related mortality


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