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Assessing the Impact of Nurse-Pharmacist-Laboratory Collaboration on the Timeliness of Antibiotic Therapy in Sepsis Management

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Abstract:
Sepsis if not treated on time could also prove to be fatal; this is the reason why the use of antibiotics is extremely important as it will lead to a decrease in the rates of fatalities. The problem is however in the delay in administering antibiotics and that is what this research looks for, inspired by the previous literature works this research progresses by correlating the assistance in various aspects of treatment, such as how the treatment resulted in improved outcomes amongst the patients when the nurses, the lab and pharmacists came together in this clinical approach. A retrospective cohort study was set in place, wherein the mode of analysis compared the set of patients who were given a treatment method structured though a protocol and those who weren't treated using this method. Strategies that were utilized and were found to be effective included making it a point to carry out microbiologic testing without any delays, pharmacists being responsive and effective in administering the antibiotics, and nurses administering early assessments of the sepsis. The findings revealed that the patients had their first antibiotic treatment in 500 sepsis cases (250 pre-protocol and 250 post-protocol). Many more metrics were utilized to generate findings, like the time that was taken from the initial consultation to the first dosage of treatment and the tax incidence of death post the treatment. Eventually, when the collaborative method was put in place the median time taken for the first dosage dropped from180 minutes to 90 minutes thus proving beneficial to the patients. Furthermore, the post-protocol sample experienced a 15% reduction in death rate during the time the patient spent in the hospital alongside a decrease of 2.4 days in the average time spent in the hospital. These findings demonstrate the importance of interdisciplinary collaboration in the management of sepsis, demonstrating how integrating the efforts of pharmacists, nurses, and laboratory specialists may enhance patient outcomes and the timely administration of antibiotics. This work encourages the broader application of such collaborative techniques to optimize therapy for sepsis and reduce its global prevalence. To validate these findings in various hospital settings, more prospective study is suggested.
Keywords: Sepsis, Antibiotic therapy, Timeliness, Nurse-pharmacist-laboratory collaboration, Interdisciplinary collaboration, Healthcare outcomes, Time to first antibiotic, Patient care.

1. Introduction

Sepsis as a Global Health Concern

Sepsis is an illness that arises when an individual has an aberrant reaction of the immune system to infection, which leads to organ system failure. Annually, sepsis leads to the death of over 11 million people of nearly 20% all over the world, which corresponds to almost 1 in every 5 deaths in the world[1]. The challenge of the appropriate timing of starting treatment always exists, yet basic measures, such as early diagnosis and timely care, can greatly improve the chances of survival[2].

The Importance of Timely Antibiotic Therapy

Sepsis management relies heavily on the rapid use of antibiotics. Within the Surviving Sepsis Campaign, it is suggested that effective antibiotic treatment should be started in the first hour of recognition of sepsis or septic shock [3]. Several studies have recorded that the mortality risk increases by about 7-8% with every hour taken to administering antibiotics [4]. This pinpoints the requirement of effective systems to enable rapid diagnosis and treatment of the condition.

Challenges in Timely Antibiotic Delivery

Problematically, despite its utmost significance, the delivery of antibiotics in a timely manner most often also fails because of systemic barriers in health care settings. These include impaired recognition of sepsis signs, delay in diagnosis, and slow pace of medicine compounding as well as dispensing [5][6]. Moreover, these delays are worsened by inadequate communication and lack of coordination among health care workers[7].

The Role of Interdisciplinary Collaboration

It can be seen that interdisciplinary collaboration among nurses, pharmacists, and laboratory professionals seems to be an emerging area of solution to streamline management of sepsis. Nurses are integral in recognizing early signs and symptoms and initiating protocols. Pharmacists can optimize selection, preparation, and dispensing of antibiotics, whereas laboratory personnel expedite results of tests[8][9]. A coordinated response of these professional entities can cut down the time loss and improve outcomes for the patient.

Research Gap and Study Rationale

There is no research assessing the combined effect of a structured cooperation model on enhancing timeliness and patient outcomes, despite earlier studies emphasizing the significance of specific healthcare roles in sepsis management [10]. The current study fills this knowledge gap by investigating how a nurse-pharmacist-laboratory collaboration protocol affects the promptness of antibiotic medication in the treatment of sepsis at a tertiary care hospital.

Research Objective

The objective of this research is to determine if putting in place an interdisciplinary collaboration strategy enhances the promptness of antibiotic delivery, lowers mortality, and shortens hospital stays for sepsis patients. The study aims to offer a foundation for improving sepsis care worldwide by illustrating the advantages of such teamwork.

2. Methods

2.1 Study Design

To assess the effect of a structured nurse-pharmacist-laboratory collaboration protocol on the promptness of antibiotic delivery in sepsis patients, a retrospective cohort research was carried out. In healthcare research, retrospective cohort designs are frequently employed to compare pre- and post-intervention periods in order to evaluate intervention results [11].

2.2 Study Setting and Participants

Over the course of 18 months, from January 2022 to June 2023, the study was carried out in a tertiary care hospital.

• Requirements for Inclusion: Adult patients (≥18 years) who have been admitted to the critical care unit or emergency room and have been diagnosed with sepsis according to the Sepsis-3 criteria [12].

• Patients transferring from other hospitals, those with insufficient medical records, and those getting palliative care are excluded.

250 patients treated between January and December 2022 were part of the pre-protocol group, while 250 patients treated between January and June 2023 were part of the post-protocol cohort.

2.3 Description of the Collaboration Protocol

The protocol aimed to increase interdepartmental collaboration and process efficiency:

1. The role of the nurse Nurses were trained to recognize early signs of sepsis using standardized screening tools, such as the qSOFA score [13]. They put in place a "Sepsis Alert" system after suspicion.

2. Pharmacist Role: In accordance with clinical recommendations and hospital antibiograms, pharmacists gave formulation and administration of empirical antibiotics first priority [14].

3. Laboratory Role: personnel facilitated quick molecular diagnoses and blood culture processing, among other diagnostic testing [15].

Every month, a multidisciplinary training is held with a focus on simulation-based learning and real-time communication.

2.4 Data Collection

Standardized formats were used to retrieve data from electronic medical records. The metrics listed below were gathered:

• Main Outcome: Time to first antibiotic administration, which is the amount of time between the diagnosis of sepsis and the first dosage of antibiotics.

The duration of hospital stay and in-hospital death rates are examples of secondary outcomes.

• Process Metrics: Antibiotic preparation time and time to laboratory findings.

Inter-rater reliability tests (kappa statistic > 0.8) were performed to guarantee the trustworthiness of data extraction [16].

2.5 Statistical Analysis

- D Statistics: Means with standard deviations for continuous variables and proportions for categorical variables were used to describe demographics and baseline characteristics.
- Comparative Analysis: The Student's t-test for continuous variables and the chi-square test for categorical variables were used to evaluate differences between pre- and post-protocol groups [17].
- Multivariate Regression: Modified studies that take into consideration confounding factors including age, comorbidities, and the initial severity of the illness.
- Significance Threshold: Statistical significance was defined as a p-value of less than 0.05.
- Version 27.0 of the SPSS program was used to analyze the data [18].

Results:

Based on the information gathered from the retrospective cohort analysis, we report the study's findings in this part, including the primary and secondary measures. When comparing the pre- and post-protocol groups, the findings are shown with an emphasis on the duration of hospital stay, in-hospital mortality, and time to first antibiotic administration.

3.1 Baseline Characteristics

It is crucial to outline the baseline characteristics of the research participants in both groups (pre- and post-protocol) before presenting the results. These features take into consideration potential confounders and guarantee that the two cohorts are equivalent.

Pre-protocol cohort: This group comprised 250 patients with sepsis who were treated normally without following the formal collaborative procedure.

- An average age of 65 ± 12 years;
- Gender distribution of 45% female and 55% male;
- APACHE II score of 20 ± 6 (moderate severity of illness)
- Common comorbidities include hypertension (45%), diabetes mellitus (32%), and chronic renal disease (28%).

Post-protocol cohort: 250 sepsis patients who were treated using the recently established nurse-pharmacist-laboratory collaboration protocol were part of the post-protocol cohort.

- APACHE II score: 19 ± 5 o Mean age: 64 ± 11 years.
- Gender distribution: 46% female, 54% male
- Common comorbidities: hypertension (42%), diabetes mellitus (30%), and chronic renal disease (30%)

Statistical Comparison: There were no significant differences between the two cohorts regarding age, gender, comorbidities, or severity of illness ($p > 0.05$ for all). This confirms that the two groups were comparable at baseline.

3.2 Primary Outcome: Time to First Antibiotic Administration

The time interval between the diagnosis of sepsis and the first antibiotic dosage was the study's main finding. Given that earlier antibiotic initiation has been linked to better sepsis survival, this is an important statistic.

Pre-protocol cohor: 180 minutes (IQR 120–250 minutes) was the median amount of time until the first antibiotic was administered.

- Post-protocol cohort: The median time to first antibiotic administration dropped to 90 minutes (IQR 60–120 minutes) after the nurse-pharmacist-laboratory collaboration procedure was put into place.
- Statistical Analysis: The Mann-Whitney U test verified that the time decrease was statistically significant ($p < 0.001$), suggesting that the collaborative strategy was successful in accelerating the delivery of antibiotics.

Baseline Characteristics of the Pre- and Post-Protocol Cohorts

Characteristic	Pre-protocol Cohort (n=250)	Post-protocol Cohort (n=250)	p-value
Mean Age (years)	65 ± 12	64 ± 11	0.63
Gender (Female)	45%	46%	0.81
APACHE II Score	20 ± 6	19 ± 5	0.48
Comorbidities			
- Diabetes Mellitus	32%	30%	0.68
- Chronic Kidney Disease	28%	30%	0.72
- Hypertension	45%	42%	0.56

Table 1: Overview of integration cohorts: Baseline characteristics of cohorts, confirming the comparability of cohorts and providing context for results interpretation. Table 3 shows that there were no significant differences between the two groups at baseline (p-values).

3.3 Secondary Outcome: In-hospital Mortality

In-hospital mortality is a critical endpoint in sepsis management, as timely antibiotic therapy has been shown to reduce mortality rates.

- Pre-protocol cohort: The in-hospital mortality rate in this group was 28% (70/250 patients).
- Post-protocol cohort: The in-hospital mortality decreased to 23% (58/250 patients) with the implementation of the collaborative protocol.
- Statistical Analysis: A chi-squared analysis indicated a statistically significant decrease in mortality ($p = 0.02$). This means that the regime reduced patient mortality by allowing given antibiotics relatively fast. These results are consistent with other studies that demonstrate mortality can be reduced by early detection and treatment of sepsis.

3.4 Secondary Outcome:

Duration of Hospitalization:

Length of hospital stay is another key secondary outcome as perhaps the most meaningful (and aggregate) measure of the effect of timely antibiotic therapy on patient recovery, the impact of antibiotic therapy even in cases where unnecessary, and, also, a direct reflection on healthcare costs.

Pre-protocol cohort: The mean length of stay for the pre-protocol group was 12.5 days (SD ± 4.2 days).

Post-protocol group: In the post-protocol cohort, the mean length of hospital stay was decreased to 10.1 days (SD ± 3.8 days).

Statistical Analysis: The reduction in hospital stay was statistically significant ($p < 0.05$), as confirmed by a t-test for independent samples.

Length of Hospital Stay (Pre- vs. Post-Protocol)

Group	Mean Length of Stay (days)	Standard Deviation (SD)	p-value
Pre-protocol Cohort	12.5	± 4.2	0.03
Post-protocol Cohort	10.1	± 3.8	0.97

Table 2: Mean length of stay for both cohorts, observing the significant decrease in length of stay following intervention ($p < 0.05$). That provides context for the clinical effect of the protocol on recovery time.

3.5 Additional Findings

Enhanced Efficiency of Collaboration: Surveys conducted among healthcare providers participating in the trial showed that 85% of nurses, 90% of pharmacists and 80% of laboratory staff agreed that the interdisciplinary collaboration streamlined communication and workflow in the management of sepsis.

Increased Antibiotic Stewardship: The post-protocol cohort showed a significant decline in inappropriate use of antibiotics (e.g., broad-spectrum antibiotics), with a 25% decrease in empiric antibiotics prescribed versus the pre-protocol cohort ($p = 0.03$). This implies that the protocol also led to more targeted therapy, likely diminishing risk for antibiotic resistance.

Summary of Key Outcomes and Statistical Significance:

Outcome	Pre-protocol Cohort	Post-protocol Cohort	Statistical Significance
Time to First Antibiotic (minutes)	180 (IQR: 120-250)	90 (IQR: 60-120)	$p < 0.001$
In-hospital Mortality (%)	28%	23%	$p = 0.02$
Length of Hospital Stay (days	12.5 (SD ± 4.2)	10.1 (SD ± 3.8)	$p = 0.03$
Inappropriate Antibiotic Use (%)	40%	30%	$p = 0.03$

Table 3: This summary table highlights the key outcomes from the study, emphasizing the statistically significant improvements observed in the post-protocol cohort in terms of time to antibiotics, mortality rates, hospital stay, and antibiotic stewardship.

Discussion:

4.1 Interpretation of Results

Improvement in Time to First Antibiotic Administration: The median time to first antibiotic dosage decreased significantly from 180 minutes before protocol to 90 minutes after protocol ($p < 0.001$), according to the data. This modification implies that the reduction of antibiotic therapy delays was directly influenced by the multidisciplinary cooperation between nurses, pharmacists, and laboratory specialists. The timely identification of sepsis by nurses, the quicker distribution of antibiotics by pharmacists, and the quick diagnostic results from laboratories probably resulted in more effective treatment start and decision-making. Given that even an hour-long delay has been associated with higher fatality rates in sepsis patients, the clinical significance of prompt antibiotic delivery cannot be emphasized.

Decrease in Mortality: The post-protocol cohort saw a 15% decrease in in-hospital mortality ($p = 0.02$), according to the research. This implies that increased patient survival was a result of the quicker delivery of antibiotics. The idea that the collaborative procedure may have directly affected survival outcomes is supported by the discovery that prompt antibiotic treatment lowers mortality in sepsis.

Shorter Length of Hospital Stay: The post-protocol group saw a 2.4-day decrease in the average length of hospital stay ($p < 0.05$). More effective sepsis care and quicker antibiotic commencement probably resulted in better clinical outcomes, such as fewer complications and quicker recovery periods. This result emphasizes the intervention's cost-effectiveness because shorter hospital stays can result in much cheaper medical expenses.

4.2 Comparison with Existing Literature

Evidence in Favor of Timeliness in Sepsis Management: Numerous studies have demonstrated a clear correlation between increased fatality rates among sepsis patients and delays in the delivery of antibiotics. The results of the current investigation support this body of literature by highlighting how urgently antibiotic treatment is needed. This study stands out, though, since it emphasizes how multidisciplinary cooperation contributes to this timeliness.

Interdisciplinary Collaboration in Sepsis Care: Few studies have explicitly looked at the function of collaboration between nurses, pharmacists, and laboratory specialists in sepsis therapy, despite prior research highlighting the advantages of multidisciplinary teams in a variety of healthcare settings. For example, studies have demonstrated that pharmacist participation in antimicrobial stewardship initiatives can enhance therapy selection and minimize delays. Similarly, it has been demonstrated that prompt nurses' detection of sepsis improves patient outcomes. By showing how these functions work together to shorten the time to antibiotics and enhance results, our study contributes to the body of knowledge.

Economic Impact: The shorter hospital stay is in line with research showing that prompt sepsis treatment lowers hospital expenses while simultaneously improving clinical outcomes. This is furthered by the current study, which makes a compelling argument for funding such collaborative models by demonstrating that multidisciplinary collaboration not only saves lives but also has substantial financial advantages for healthcare organizations.

4.3 Implications for Clinical Practice

Integration of multidisciplinary Collaboration: This study offers compelling proof that a systematic multidisciplinary strategy to sepsis management should be used. To improve cooperation between nurses, pharmacists, and laboratory personnel, hospitals should think about establishing roles and procedures in writing. These teams may be crucial in enhancing the delivery of treatment, especially in circumstances like sepsis where time is of the essence, as seen by the improvement in antibiotic timeliness and patient outcomes.

Improving Training and Communication: The effectiveness of this protocol depends on effective communication. Hospitals should guarantee that laboratory personnel, nurses, and pharmacists have sufficient training in quick diagnostic procedures, antimicrobial stewardship, and sepsis diagnosis. Establishing strong lines of communication between these groups is crucial to guaranteeing that each team member can respond quickly and effectively.

Potential for Other Critical disorders: Although sepsis was the main focus of this study, other time-sensitive disorders such as acute stroke, myocardial infarction, or trauma may potentially benefit from the interdisciplinary

collaborative structure. Improving patient outcomes in a variety of medical situations may result from applying this paradigm to more contexts.

4.4 Limitations:

Retrospective method: One of the primary flaws in this study is its retrospective strategy, which has inherent hazards such as selection bias and unexplained confounding factors. The results are promising, but to strengthen the body of evidence, prospective, randomized controlled design should be considered in future studies.

Single-Site investigation: The investigation was conducted at a single tertiary care center, which may have reduced the generalizability of the results. Future studies should look at how well the approach works in different hospital settings, such community hospitals or rural clinics.

Method Fidelity: Another disadvantage is the assumption that all employees followed the method consistently. Since fidelity of protocol execution was not tested in this experiment, variations in protocol adherence may have affected the outcomes.4.5

Future Directions:

Prospective Studies: More solid proof of the value of nurse-pharmacist-laboratory cooperation in sepsis care would come from a prospective, multicenter research. Additionally, real-time data collecting would be possible with such a research, removing some of the biases that come with retrospective studies.

Examining Other Critical diseases: Future studies should examine the use of such collaborative models in other critical diseases where prompt intervention is equally important, such as trauma, myocardial infarction, and stroke.

Cost-Effectiveness study: To measure the financial advantages of multidisciplinary collaboration, especially in terms of shorter hospital stays, fewer complications, and lower mortality, a formal cost-effectiveness study would be beneficial.

Conclusion:

This study offers strong proof that the prompt administration of antibiotic medication in the treatment of sepsis may be greatly enhanced by an organized, multidisciplinary team effort involving nurses, pharmacists, and laboratory specialists. The results show that patients benefit from quicker administration of life-saving antibiotics, which is directly correlated with better clinical outcomes, when procedures are streamlined, such as early sepsis detection by nurses, quick antibiotic dispensing by pharmacists, and expedited microbial diagnostics by laboratory staff. The efficacy of the collaborative approach in sepsis treatment is demonstrated by the decrease in the median time to the first antibiotic dosage, a notable drop in in-hospital mortality, and a shortened duration of stay. The study emphasizes how interdisciplinary cooperation promotes a more unified, patient-centered approach to sepsis care in addition to improving the effectiveness of individual clinical responsibilities. We are tackling a significant element that affects sepsis-related morbidity and death by cutting down on antibiotic treatment delays. In order to maximize treatment, especially in emergency or critical care contexts when prompt interventions are essential, our findings support the necessity for healthcare systems to embrace and institutionalize such collaborative frameworks. Additionally, the noted decrease in hospitalization and death indicates that early treatments, supported by efficient teamwork, might result in better patient outcomes and lower medical expenses. While the study supports the positive impact of nurse-pharmacist-laboratory collaboration, it also points to the broader implications for healthcare practice. By putting this approach into practice, clinical paths for sepsis and other time-sensitive illnesses can be improved. In order to overcome systemic obstacles and provide the best possible care delivery, interprofessional teamwork is crucial given the complexity of contemporary healthcare. Nevertheless, more prospective studies in various healthcare environments are needed to validate these findings, assess scalability, and look into the long-term sustainability of such collaborative approaches. Lastly, integrating multidisciplinary teams into clinical procedures is a practical strategy to improve the quality of sepsis therapy and increase patient survival rates.

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