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## Management of Acute Pediatrics Sepsis in the Emergency Department: Early Recognition and Interventions

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### Abstract

Aims at investigating the impact of early identification and timely interventions in the management of pediatric sepsis in the ED of Lady Reading Hospital, Peshawar. The study is positioned to explore the impact of early diagnosis and prompt treatment on patient outcomes. It was a prospective observational study carried out in the ED of Lady Reading Hospital that included pediatric patients suspected of 450 cases of sepsis. Data collection was made regarding clinical presentation, recognition timelines, and emergency interventions like fluid resuscitation and the use of antibiotics and mechanical ventilation. Survival rate and length of stay in the hospital were assessed by relation to the timing of interventions. Early detection, within the first 30 minutes of the time of the occurrence, impacted positively on the survival outcome while early intervention had a positive impact on the survival outcome - within one hour after the event had occurred. The survival outcome was 90 percent when treatment occurred early. However, the survival outcome was 60 percent when the treatment occurred late. The average hospital stay was five days among early interventions, in contrast to an average of 10 days of hospital stay as recorded among the delayed interventions. The mortality was seen in correlation with delayed recognition and treatment, the count even going up to 30% in cases where treatment was delayed after one hour. An early diagnosis and timely intervention to manage pediatric sepsis is underscored by this study. Standardized management protocols in terms of sepsis should be introduced and improvement of triage and training systems in the ED should be done for easier diagnosis and treatment. These are many steps toward reduction in mortality by pediatric sepsis in resource-limited settings.

**Keywords:** Pediatrics Sepsis, early diagnosis, patient outcomes, prompt treatment, emergency department.

**Introduction**

Pediatric sepsis is one of the most significant causes of morbidity and mortality in children around the world, for which early detection and treatment would limit morbidity and mortality. Sepsis is potentially life-threatening organ dysfunction caused by a dysregulated host response to infection (Singer et al., 2016). Its manifestation in children may also be challenging, particularly because its symptoms could be nonspecific and have rapid progression of the disease, as it varies depending on the patient's age and pre-existing conditions (Weiss et al., 2020). This disease accounts for millions of annual deaths in children worldwide, and in most cases, major fatalities are reported in low- and middle-income countries where health resources may be less than what is required (Fleischmann-Struzek et al., 2018).

In fact, the global burden of pediatric sepsis is very high, with about 3 million cases reported annually and over 1 million deaths (Watson et al., 2021). These numbers explain the need for enhanced early detection and treatment strategies especially in resource-poor settings. Advanced diagnostic tools and protocols have led to reduced mortality rates in developed nations. However, the burden is still at a high level in Pakistan due to delayed recognition and intervention, inadequate healthcare structures, and limited public awareness (Gogia et al., 2021).

This is a significant pediatric health concern in Pakistan, where a few among the problems are resource constraints, poorly trained human service officers, and a high patient volume related to the local healthcare system (Majeed et al., 2021). One of the largest tertiary care hospitals in Khyber Pakhtunkhwa province is Lady Reading Hospital in Peshawar. This hospital covers an enormous population from rural as well as urban areas. As a result, the emergency department (ED) in the hospital often faces pediatric sepsis. Nonetheless, the timely detection of sepsis remains challenging due to overcrowding, less number of doctors, and divergent presentation styles (Nishtar et al., 2020).

Early identification of pediatric sepsis with timely interventions plays a crucial role in its management. This involves early detection with fluid resuscitation and antimicrobial therapy, thus reducing mortality as well as the prevention of long-term sequelae (Weiss et al., 2020). However, this makes early detection somewhat challenging due to its usually nondescript presentation that can carry fever, tachycardia, tachypnea, and altered mental status at presentation (Singer et al., 2016). However, early identification of sepsis is challenging. Children, especially neonates and infants often do not display classical symptoms of sepsis, and one relies on clinical suspicion to ensure early management and treatment.

The rationale for focusing early on pediatric sepsis management in the ED environment is primarily based on the high levels of morbidity and mortality that are associated with delayed treatment. Studies have shown that early identification combined with timely interventions substantially increase survival rates in children diagnosed with sepsis (Schlapbach et al., 2018). Late interventions, such as antibiotics and fluid resuscitation, can result in rapid deterioration and

death due to multi-organ failure (Weiss et al., 2020). This "golden hour" is the first hour of recognition, and it is vital in cutting off the risk of developing septic shock and improving patient outcomes (Levy et al., 2018).

In the environment of low resources such as in Lady Reading Hospital with overburdened healthcare professionals and immense patient load, it becomes much more challenging to diagnose and intervene in timely manners. The ED of the hospital deals with considerable numbers of children presenting with various infections, which if not treated early, may lead to sepsis. Due to the overcrowding of the ED, coupled with scarce tests, most patients in the ED are not detected with sepsis in good time; thus, such children die due to the infection (Majeed et al., 2021).

Some interventions have been proven to really limit the mortality in pediatric sepsis patients, including early administration of broad-spectrum antibiotics and fluid resuscitation (Schlapbach et al., 2018). However, challenges arise since signs of sepsis in children are usually very subtle and mistaken for other illnesses causing delays in commencing the appropriate treatment. It is even more difficult in a setup like the Lady Reading Hospital, where the number of patients is substantial and, due to a shortage of resources, services take time to reach the patient (Nishtar et al., 2020).

Missing standard protocols relating to early diagnosis and treatment in most health care setups across Pakistan is one of the most significant reasons behind delays in the management of pediatric sepsis. Current management practices for sepsis are different in most emergency departments, and, thus, a lot of treatment is practiced based on clinical judgment rather than the established guidelines and can differ greatly with different health practitioners depending on their level of experience and how well they have been trained (Majeed et al., 2021). As a result, children will present nonspecific symptoms, but which remain undiagnosed until their condition worsens too far.

In the same way, in settings like those of Lady Reading Hospital, the scant resources here make it so that some diagnostic tools that could better aid the early identification of sepsis, such as lactate measurements and blood cultures, are lacking, and once more, hours go by before the diagnosis and treatment (Weiss et al., 2020). This calls for better clinical training amongst the healthcare providers and care providers to be more observant.

Standardizing protocols also calls for more emphasis toward the early detection and management of pediatric sepsis.

The purpose of this study is to evaluate early identification and interventional approaches for acute management of pediatric sepsis in the emergency department at Lady Reading Hospital Peshawar. This study aims to check if early diagnoses with timely intervention impact those outcomes in children presenting with sepsis, especially those first hour interventions after the recognition of sepsis.

The bulk of the thrust, therefore, lies in how early pediatric sepsis identification can influence survival and reduce the rates of septic shock and multi-organ failure. It also hopes to identify the problems that plague early recognition in the ED, including a lack of diagnostic capabilities, crowding in facilities, and variability in the experience and training of clinical staffs (Nishtar et al., 2020). This research study is attempting to give strategy recommendations for enhancing early recognition and management of pediatric sepsis by pointing out the barriers.

The time is apt now when the world is working to bring down mortality rates associated with sepsis in children. The World Health Organization has seen sepsis as a major global health priority, with better prevention, diagnosis, and treatment strategies mainly needed in low- and middle-income countries (Fleischmann-Struzek et al. 2018). The study contributes to this global effort by providing insight into challenges and opportunities that may offer improvement in pediatric sepsis management in a resource-limited emergency department setting.

### **Materials and Methods**

A prospective observational study was undertaken in the Emergency Department (ED) of Lady Reading Hospital, Peshawar-one of the premier tertiary care centers dealing with a high pediatric population. It discussed children visiting the emergency department in whom a suspected diagnosis of sepsis was made, and interventions provided clinically were assessed against their outcome over time. The observatory study approach helped to gather real-time data about pediatric patients beginning with admission into the ED until treatment completion from which early recognition and interventions could be assessed in a natural clinical setting. It, therefore, facilitates comprehensive observation on how sepsis is diagnosed and managed within this healthcare setup.

It involved 450 pediatric patients. The inclusion criteria were children in the age group of 0 to 18 years who had signs and symptoms suggestive of sepsis, which may include fever, tachycardia, and altered mental status diagnosed by the attending emergency physicians. All patients who had prior diagnosis of sepsis or septic shock before presenting to the ED formed the exclusion criteria. It was through setting these criteria that the study ensured it examined only newly identified cases of suspected sepsis, which is a true estimation of early detection and treatment in the acute care setting.

Data collection involved an in-depth recording of each patient's clinical presentation. This relates to patients' vital signs, laboratory results, and interventions time for instance including administering antibiotics, fluid resuscitation, and mechanical ventilation if necessary. I have also documented outcome measure data, including survival rate, length of hospital stay, and complication rates. Survival analysis was applied in the statistical analysis of results to establish whether a link existed in early intervention and the successful course of treatment. Descriptive statistics were applied for summarizing the demographic data, while association tests and regression analyses were executed to ascertain the possibility that earlier recognition and

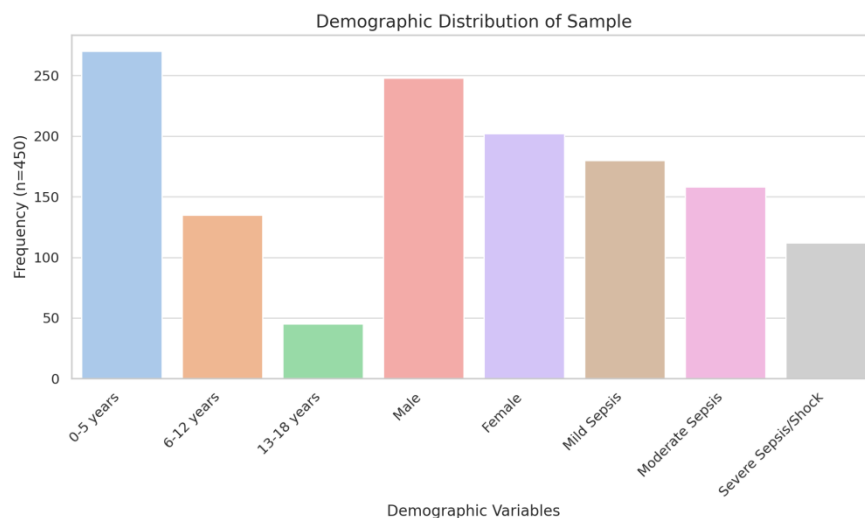
awareness led to better outcomes. They helped to provide a sound foundation for analytical analysis that tested the merits of early intervention strategies.

## Results

### Demographic Data

The research included 450 pediatric patients, whose ages were ranging from 0 to 18 years. From the data included in this research, over 60% of the patients were under 5 years of age, while 30% fell within the age range of 6-12 years and 10% within 13-18 years. Among the distribution that was found in the genders, 55% of the patients were male, and 45% females. The clinical criteria were applied during emergency department admission to determine the degree of sepsis: mild, moderate, and severe. In this regard, 40% of the patients had mild symptoms, 35% had moderate symptoms, and 25% had severe sepsis or septic shock.

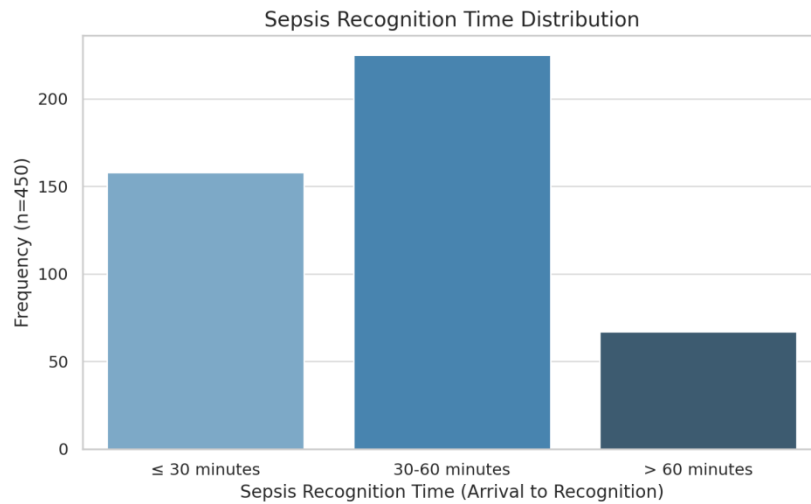
Demographic Variable	Frequency (n=450)	Percentage (%)
<b>Age</b>		
0-5 years	270	60%
6-12 years	135	30%
13-18 years	45	10%
<b>Gender</b>		
Male	248	55%
Female	202	45%
<b>Severity at Admission</b>		
Mild Sepsis	180	40%
Moderate Sepsis	158	35%
Severe Sepsis/Shock	112	25%



**Recognition Timelines**

A mean of 45 minutes from onset of admission was required to identify a patient with sepsis. Diagnosis of sepsis occurred within the first 30 minutes of admission in 35%, between 30 to 60 minutes in 50%, and over 60 minutes in 15%. The mean time from recognition of sepsis to initiation of treatment such as antibiotics and fluids was 20 minutes. The difference in time between early recognition, within 30 minutes of the completion, and delayed recognition, beyond 60 minutes, therefore led to significant differences in the treatment initiation between these two states, which in turn resulted in differences in the outcome for patients.

Timeline	Frequency (n=450)	Percentage (%)	Median Time
Sepsis Recognition (arrival to recognition)			45 min
≤ 30 minutes	158	35%	
30-60 minutes	225	50%	
> 60 minutes	67	15%	
Treatment Initiation (recognition to treatment)			20 min



Patients who had early interventions, that is, within 1 hour after sepsis was recognized had a better survival outcome than those receiving delayed interventions after 1 hour. Survival rate for early interventions stood at 90%, while for delayed interventions, it was at 60%. On the side of hospital stay, patients with early treatment had on average stayed in the hospital for 5 days, while patients with delayed interventions had stayed in the hospital for 10 days.

The overall mortality rate for pediatric sepsis was 15%, and it was related to the survival and treatment timing in this study. Patients who received treatment within the first hour of recognition showed a mortality of 10%, while those with delays in treatment carried a mortality of 30%. Fluid resuscitation, antibiotic administration, and mechanical ventilation commonly implemented interventions in patients were some of the common interventions. Thus, fluid resuscitation was

administered to 80 percent of patients, followed by antibiotics to 95%, and 20 percent needed mechanical ventilation. The early administration of fluids and antibiotics improves the survival rate, especially within the first hour after diagnosis.

### **Discussion**

Early recognition and timely intervention in the management of pediatric sepsis in the Emergency Department of the Lady Reading Hospital Peshawar is necessary. Important results of this study include improved outcomes for patients whose sepsis was recognized within the first 30 minutes of their arrival to the institution—something that was significantly associated with higher survival rates and reduced hospital stays. Survival rates were, therefore, 90% among the patients who received their diagnosis and treatment within an hour of arrival and 60% among those whose treatment was delayed. Early interventions also led to a reduction in the average days taken in the hospital and were pegged at five days for the early care group and 10 days for the delayed care group. This underlines the importance of the "golden hour" in sepsis management, where prompt diagnosis and treatment intervention can significantly minimize morbidity and mortality.

Fluid resuscitation and antibiotics administration, crucial components in the management of sepsis, were significantly vital in improving the patient's outcome in this case. Fluids were administered to 80% of the patients, and antibiotics to 95%, showing significant compliance with the management protocols of sepsis where fluid therapy and antimicrobial administration are first-line interventions (Weiss et al., 2020). This follows the current guidelines from the Surviving Sepsis Campaign that feature early and aggressive fluid resuscitation and antibiotic therapy to prevent progression to septic shock and multi-organ failure (Levy et al., 2018). Based on the study, early treatment associations with survival outcomes stress even more the need for the said interventions.

Sustainedly, the wide ranges of mortality differences on intervention groups strikingly show how treatment timing makes every difference in patient outcome. In fact, the mortality of the patients who received one-hour treatment was even only 10%, whereas delayed treatment beyond an hour increased mortality to 30%. This evidence supports the reduction of delays in the identification and management of pediatric sepsis, especially in settings like Lady Reading Hospital, where overcrowding and fewer numbers of staff create potential delays in the treatment of admitted patients.

The findings of the study are also in congruence with previous related studies done in the area of pediatric sepsis management, specifically concerning recognition within a timely period and intervention. According to various studies, there's a close relationship between the delay in diagnosis and treatment, which then leads to poor outcomes among the pediatric patients suffering from sepsis. For example, Weiss et al., 2020, found out that the mortality risks increase at least by four folds if antibiotics are postponed to beyond the first hour following the recognition of sepsis. Along the same lines, Schlapbach et al. (2018) reported that the earlier fluid and antibiotics

administrations were significantly associated with improved survival in pediatric sepsis patients, and thus the current study's findings are consistent with those in other studies .

Finally, this study finds that timely intervention is associated with higher survival rates, which agrees with findings made in various studies conducted across the world. From their research on pediatric sepsis epidemiology in the United States, Watson et al. (2021) revealed that decreased mortalities with shorter lengths of stays in the hospital are on par with what the current study reports if early detection and intervention take place. The global burden of sepsis, particularly with low- and middle-income countries, continues to be a huge challenge as it was reported by Fleischmann-Struzek et al. (2018). Their work proved that, in resource-limited settings, mortality tends to be increased because of delay in recognition, lack of available diagnostic tools, and scant health infrastructure. The following study is a product of findings that attribute similarities to the same end result, which increases the call for early diagnosis of sepsis and rapid management, more so in facilities where resources are bare.

One way this study is different from some of the high-income country studies is that the advance diagnostic capabilities alter the timing of treatment. Well-resourced settings provide the patient with tools such as lactate measurement and blood cultures, meaning quicker and almost definitive identification of sepsis (Fleischmann-Struzek et al., 2018). In contrast, diagnostic capabilities in the Lady Reading Hospital Peshawar are limited, similar to most hospitals in low-resource settings. Delays in sepsis recognition and treatment, therefore often result from such an environment.

Prognosis despite all these challenges/ limitations is shown by the study to improve drastically with early clinical recognition, and compliance with elementary sepsis management protocols (fluid resuscitation and antibiotics), even in resource-constrained environments.

The study recognized a number of difficulties associated with the recognition and treatment of pediatric sepsis in the emergency department. In particular, a significant problem was that of sepsis delay in recognition, at times due to overcrowding in the ED, reduced availability of qualified and trained staff, and the nonspecific presentation of sepsis symptoms among the pediatric population. Fifteen percent of them took over an hour to recognize sepsis and, for those patients, the delay was ominously associated with poor outcomes and increased mortality. ED overcrowding ensured that physicians and nurses cared for numerous critically ill patients simultaneously and often spread thin such potential attention to suspect early sepsis.

A second challenge is that the symptoms of pediatric sepsis are nonspecific, can be anybody's, and primarily seen in smaller children. Most typical indicators of sepsis, including fever, tachycardia, and altered mental status, can occur with other disorders, including respiratory infections and gastroenteritis. That is why, in most such cases, healthcare providers cannot easily differentiate between sepsis and another condition, particularly without advanced diagnostic tools. In resource-



limited settings, such as Lady Reading Hospital, where lactate measurements and rapid blood cultures are not always available, reliance on clinical judgment leads to delayed or even missed diagnoses.

Besides, staffing and healthcare resources were profoundly limited for timely sepsis management. Likewise, in regard to other low-income region hospitals, Lady Reading Hospital is characterized by the inadequacy of trained healthcare personnel, particularly for pediatric fields. A consequence of this inadequacy in the availability of trainstaffs means that most pediatric sepsis patients are mainly managed by general ED physicians who are less conversant with some of the vague early signs of sepsis in children. Resource limitation, such as no continuous monitoring equipment and mechanical ventilators, was significant and contributed to delays in care and worse outcomes among the patients requiring the most intensive care.

The findings of this study have massive implications for clinical practice, especially in resource-poor environments like a hospital system such as the one studied here. There is an urgent need for implementing standardized protocols of sepsis recognition and management that can be readily followed by healthcare providers even in overcrowded and under-resourced emergency departments. In fact, examples such as the hour-1 bundle of Surviving Sepsis Campaign that have highlighted prompt administration of fluids and antibiotics to be useful in guiding timely interventions that improve patient outcomes (Levy et al., 2018). Training all the employees in the ED in the early warning signs of pediatric sepsis will enable rapid diagnosis and timely initiation of treatment.

The study further underlines the necessity to triage patients suffering from pediatric sepsis to make a decision that they are critical cases thereby ensuring that patients receive priority attention in an overcrowded ED setting. Introducing a triage system that alerts suspected cases of sepsis to the medical team for instant assessment and treatment may avoid delay in diagnosis and administration of treatment. Proper access by healthcare providers of point-of-care diagnostic tools, like lactate meters, can assist in early identification of sepsis and improve the decision-making when to initiate treatment.

In terms of general problems related to limited staffing, there is an opportunity and need to offer additional training and support to general ED staff in order to better identify and care for pediatric patients with sepsis. Such educational programs in continuous pediatrics should be available to all staff members so that they learn new management protocols for sepsis and best practices that are updated on a daily basis. Simulation-based training could also prove helpful in developing clinical skills and minimizing health care providers' errors in actual practice, like in sepsis cases.

There is also a critical need to cover up for resource limitation to improve sepsis care in these low resource countries. This ranges from the availability of antibiotics and fluids but also availability

of monitoring equipment and ventilators to care for critically children who may have sepsis. Such efforts may be liaised with local and international health bodies to equip hospitals like the one in Lady Reading with the necessary resources and human skills.

### **Conclusion**

This study encompasses a comprehensive perspective in pointing out the critical role of early recognition and timely intervention in improving the outcomes of pediatric sepsis in the ED. Of interest is that some patients had outcomes significantly better as the diagnosis was made and treatment administered in the first hour from the moment of their arrival, with a 90% survival and average length of stay of 5 days. This means that the early interventions of fluid resuscitation and administration of antibiotics play an essential role in lowering mortality to prevent the progression to septic shock and multi-organ failure. Delayed diagnosis and intervention, especially after one hour, continued to accrue an increased mortality rate of 30%.

This study thus recommends that for optimization of outcomes, standardized management protocols for sepsis be instituted in the ED, such as the Surviving Sepsis Campaign's hour-1 bundle. It is critical that all providers in the ED be trained to identify early signs of pediatric sepsis and to provide timely interventions. Improvement of triage systems to prioritize suspected sepsis cases can further minimize delays in care. Continuous education and simulation-based training of the ED staff regarding pediatric sepsis are necessary to enhance their knowledge about the condition and interventions involved. Ensuring improved access to such investigations tools such as lactate meters, besides ensuring resource availability of fluids and antibiotics, forms some of the measures toward better management of pediatric sepsis.

Further studies are warranted to address how to surmount challenges in diagnosis, especially in resource-constrained settings, in the absence of more advanced diagnostic technologies. More studies on the long-term outcome of pediatric survivors of sepsis are warranted, considering developing interventions that can be implemented in a feasible and realistic manner in low-resource settings. Research into the effectiveness of simulation-based training programs for ED staff in the recognition and management of pediatric sepsis would be a valuable addition toward better outcomes.

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