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Original article

Sepsis Epidemiology and Outcomes in Pediatric Intensive Care Unit of Alkhadra Hospital, Tripoli, Libya

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ABSTRACT

Despite the various interventions and therapies that have been implemented to improve the quality of life for children with sepsis, the prevalence and death rates continue to increase. This issue is a major public health problem that requires the continuous improvement of the guidelines and the identification of new strategies. The aim of the study was to identify the prevalence and outcomes of severe sepsis among children admitted to the Pediatric Intensive Care Unit (PICU). This study was conducted in PICU of Alkhadra Hospital in 2023 as a hospital-based retrospective study. All children who were admitted to the PICU from 2017 to 2022 were included. Data was collected from hospital file records, which included the following: age of patient, gender, comorbidities of patients, and source of admission; origin of sepsis; type of PICU admission; primary site of infection; organ dysfunction present at screening; and patient outcomes. Of the 1284 total admissions to the PICU, 128 patients (9.96%) met the definition of sepsis. Most patients (78.9%) were less than 6 years old. Respiratory problems and congenital malformations were the most common co-morbidities, with reported rates of 18.8% and 10.2%, respectively. The emergency department was the most common source of admission (67.2%). Nearly all patients had good overall performance, whereas (21.1%) of the patients were in a coma. 77.3% discharged during the study, and 22.7% died. Although decreasing the incidence through preventive measures is ideal, early recognition and treatment of sepsis will decrease both short- and long-term complications and related mortality of at-risk infants and children.

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INTRODUCTION

Sepsis is a major cause of hospital admission, morbidity, and mortality in children, and the pathophysiology of sepsis is complex, involving an altered inflammatory response to infection, paired with derangements in coagulation, cardiovascular, immune, metabolic, hormonal and neuronal responses [1]. A subset of sepsis, septic shock, is associated with higher mortality and can be defined as sepsis accompanied by significant circulatory, cellular and metabolic abnormalities [2]. In the meantime, pediatric sepsis continues to be discussed in terms of the systemic inflammatory response syndrome (SIRS) criteria, defined as the presence of at least two of the following four criteria, one of which must be abnormal temperature or leucocyte count [3]. Systemic inflammatory response syndrome in the presence of a known or suspected infection is considered diagnostic of sepsis. When cardiovascular organ dysfunction exists in the presence of sepsis, the child is considered to be in septic shock [4].

Epidemiological data on pediatric sepsis in developing countries, however, are still scarce and incomplete. In 2015, World Health Organization (WHO) reported that nearly 5.9 million deaths occurred in children under 5 years of age. Most of these deaths occurred in developing countries and were related to severe infectious diseases, such as pneumonia, diarrhea, and malaria, where the term "severe" is used to describe conditions presenting with signs of poor perfusion, such as acidosis and hypotension, hallmarks of severe sepsis and septic shock [5]. These data suggest that sepsis is the leading cause of death in children in developing countries. Although children <12 months old have the highest risk of death from sepsis, much of this mortality is driven by the high incidence of sepsis and the high rate of sepsis-related mortality in infants born very prematurely [6].

Compared with older children, infants have the highest incidence of severe sepsis but much of it is viral and most will survive hospitalization. A higher mortality among male patients, suggested by studies in adult patients and animals, appears less prominent in children, although males are more likely to be hospitalized in infancy for severe infections [6,7]. The incidence of malignancies and other chronic respiratory and cardiac conditions in children rises with age and contributes to sepsis-related mortality; the majority of older children hospitalized with sepsis have underlying conditions impairing their immune or cardiorespiratory systems [3]. Site of infection also is related to likelihood of severe sepsis and death, with endocarditis and CNS infections associated with the highest mortality rates (21.1% endocarditis, 17.1% CNS infections) [6].

Despite the various interventions and therapies that have been implemented to improve the quality of life for children with sepsis, the prevalence and death rates continue to increase. This issue is a major public health problem that requires the continuous improvement of the guidelines and the identification of new strategies [5]. One of the most important factors that can affect a patient's survival rate is their comorbidities. This is because their organs are more prone to injury. In addition, children who are undergoing chemotherapy are more prone to developing opportunistic infections [8].

According to reports, sepsis-related pediatric deaths are underreported, thus it's critical to make more of an effort to determine the true impact of sepsis on global children mortality [9]. The 2015 the Sepsis Prevalence, Outcomes, and Therapies (SPROUT) Study, which included 128 pediatric intensive care units (PICUs) across 26 countries, showed a sepsis point prevalence of 8.2%, with an overall mortality of 25%. PICU mortality varied among regions: 21% in North America, 29% in Europe, 32% in Australia/New Zealand, 40% in Asia, 11% in South America, and 40% in Africa [10]. The aim of the study was to identify the prevalence, and outcomes of severe sepsis pediatric intensive care unit (PICU) at Alkhadra Hospital, Tripoli, Libya.

METHODS

Study design and setting

A hospital-based observation study was conducted in the PICU at Alkhadra Hospital, during a 6-month period, starting from January 2023 to June 2023.

Study population

During the study period, 1284 patients were admitted to the PICU; 128 patients met the sepsis diagnosis criteria, which were reviewed retrospectively from the file records at PICU in Alkhadra Hospital, Tripoli, starting in January 2017 and ending in December 2022.

Inclusion criteria

The study included pediatric patients aged younger than 17 years who had been admitted to the unit during the defined period and met the definition of Sepsis, and all patients were screened and evaluated for sepsis.

Exclusion criteria

Infants less than 29 days, not admitted to the PICU, and who have no sepsis. Patients with missing medical records or incomplete data were excluded.

Study tool

The data collected using a case sheet was prepared to collect data from file records, which included the following: socio-demographic; age of patient, gender, comorbidities of patients, and source of admission, origin of sepsis, type of PICU admission, primary site of infection, and organ dysfunction present at screening laboratory data.

Data management

Data entry and analysis were performed by the statistical package for social science (SPSS) software version 25.

RESULTS

During the study period, 1284 patients were admitted to the PICU; 1156 were excluded because they did not meet the sepsis diagnosis criteria and due to missing data. Ultimately, 128 patients yielding a point prevalence 9.96%. The age of the patients ranged from < 1 month to 17 years, with a median of 13.5 months. Twenty-one (16.4%) were younger than one month, above a quarter (26.6%) were 1 month to < 1 year old, forty-six (35.9%) were between 1 year and 6 years old, and only 21.1% were between 7 and 17 years old. as shown in table 1. Out of 128 patients, 69 (53.9%) were male and 59 (46.1%) were female (Figure 1).

Table 1. Distribution of patients according to their age (N= 128)

Age group	Frequency	Percentage
< 1month	21	16.4%
1month to < 1 year	34	26.6%
1 - 6 years	46	35.9%
7 - 17 years	27	21.1%

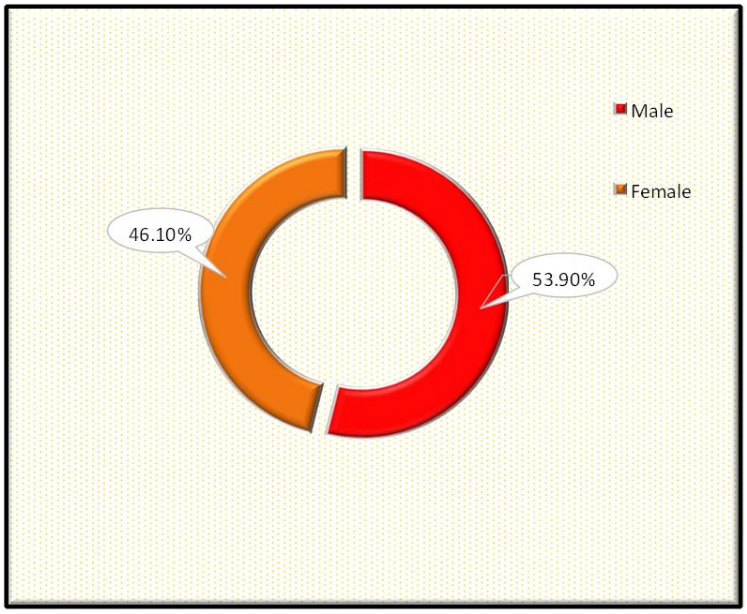

Figure 1. Distribution of patients according to their gender (N= 128)

According to data in table 2, majority of patients suffered from respiratory or various congenital malformation co-morbidities (18.8%,10.2%) respectively. Other patients were also suffering from different neurological conditions (8.6%), cardiology (3.1%), hematology (2.3%), and oncology co-morbidities (1.6%).

Table 2. Distribution of patients according to their comorbidities (N= 128)

Comorbidity	Frequency	Percentage
Oncological	2	1.6%
Hematological	3	2.3%
Respiratory	24	18.8%
Neurology	11	8.6%
Cardiology	4	3.1%
Congenital Anomalies	13	10.2%
Other	71	55.5%

The most common source of admission for sepsis was the emergency department in 86 (67.2%) patients, followed by the hospital floor in 17 (13.3%), other public hospitals in 10 (7.8%), operating rooms in 8 (6.3%), and other private hospitals in 6 (4.7%). as shown in figure 2.

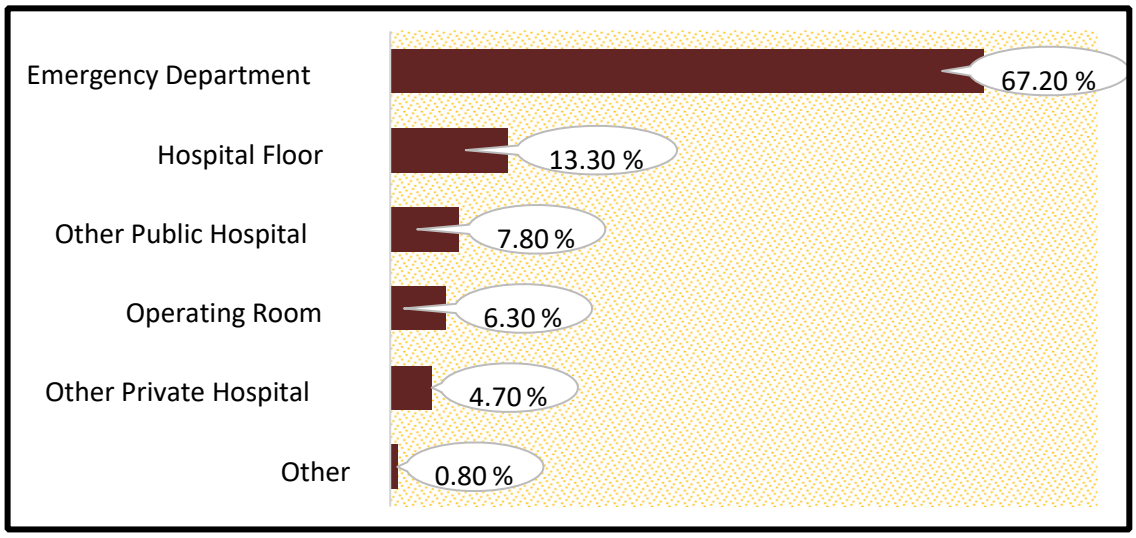

Figure 2. Distribution of patients according to source of admission.

Figure 3 revealed that the majority of patients, 91(71.1%), acquired sepsis in the community, while 37(28.9%) acquired it in the hospital.

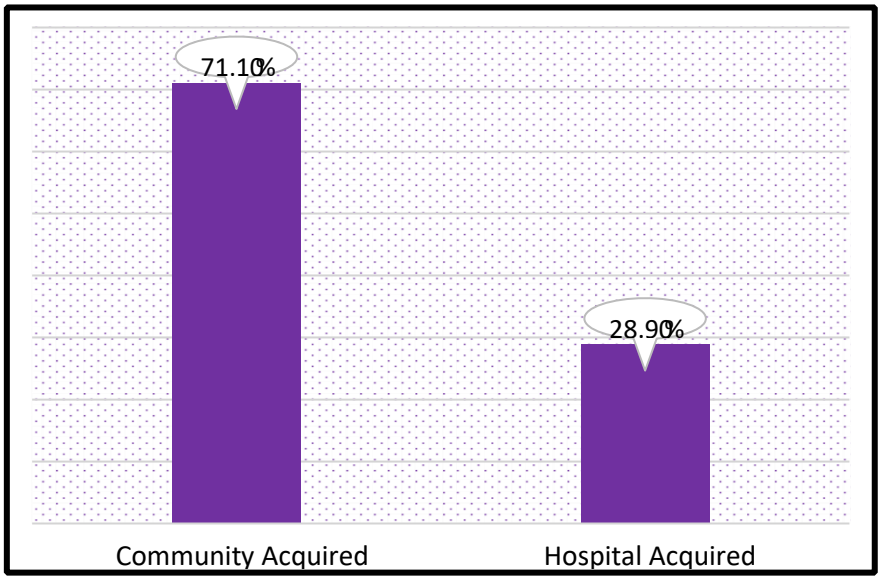

Figure 3. Distribution of patients according to their sepsis origin

The majority of admission status 115(89.8%) for pediatric intensive care units were medical, while minority were surgical, unscheduled 6(4.7%), surgical, scheduled 5(3.9%) and only two patients were trauma (figure 4).

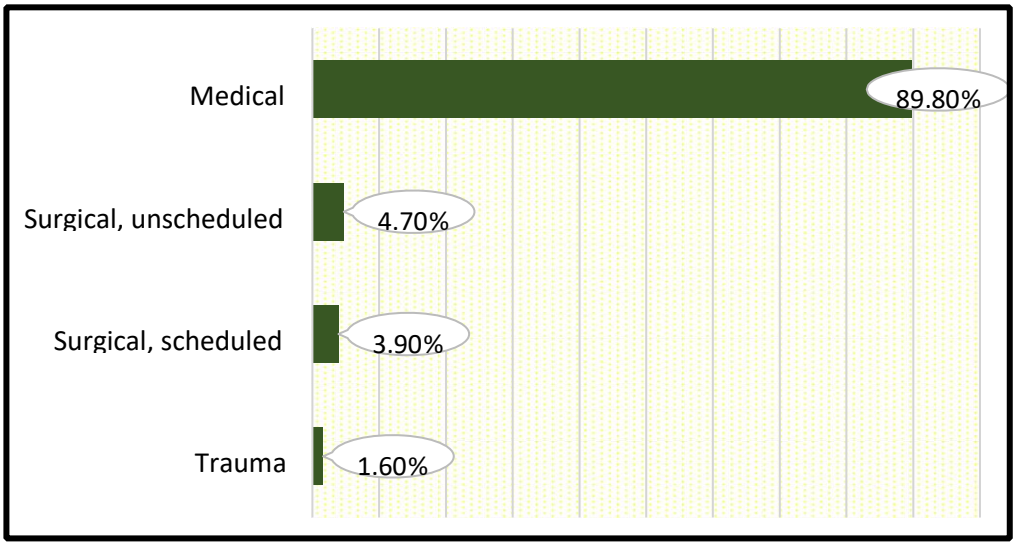

Figure 4. Type of PICU admission

The most common primary site of infection was the respiratory tract (43.8%), followed by blood stream (18.0%). CNS made up 12.5%, genitourinary 9.4%, and abdominal was 7.8%, as shown in table 3.

Table 3. Primary Site of Infection

Primary site of infection	Frequency	Percentage
Respiratory	56	43.8%
Primary bloodstream	23	18.0%
Abdominal	10	7.8%
CNS	16	12.5%
Genitourinary	12	9.4%
Skin	3	2.3%

It is obvious that respiratory system was the most common organ system in which dysfunction was observed (43.8%). Cardiovascular and neurological dysfunctions (14.8%) were the second most common organ dysfunctions during screening, followed by hematology (10.9%), renal (9.4%), and hepatic (6.3%).

Table 4. Organ dysfunction present at screening

Organ dysfunction present at screening	Frequency	percentage
Respiratory	56	43.8%
Cardiovascular	19	14.8%
Hematologic	14	10.9%
Hepatic	8	6.3%
Neurologic	19	14.8%
Renal	12	9.4%

According to the findings, which are presented in Table 3, 59 (46.1%) of the patients reported having lactate in their blood according to laboratory results, 49 (38.3%) had PAO2/FIO2, and 7.8% had both a Prism III score and a PELOD score.

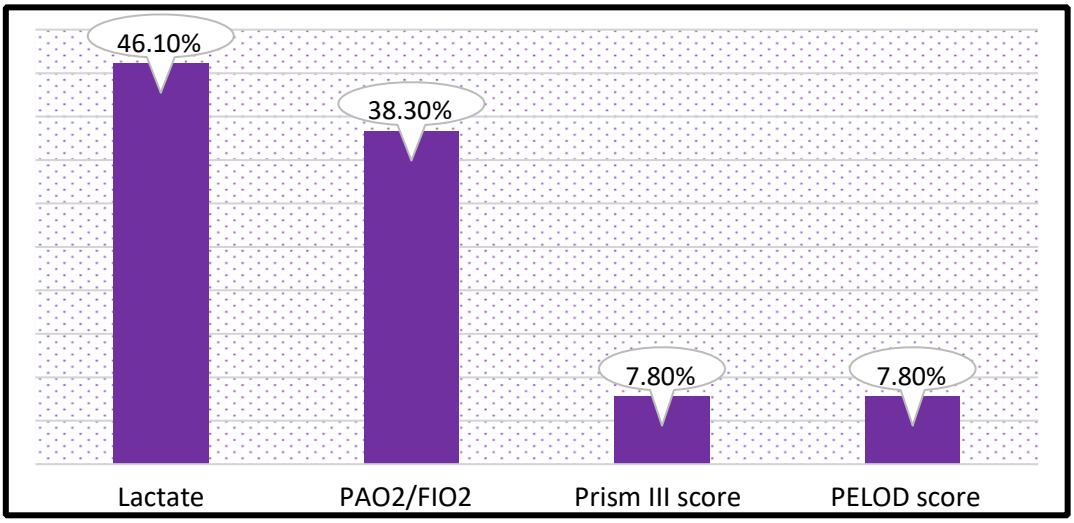

Figure 5. Distribution of patients according to their laboratory data.

Among the 92 patients (71.9%) who had good overall performance, whereas 27 (21.1%) of the patients were in a coma. Five patients (3.9%) had mild disabilities, three patients (2.3%) had severe disabilities, and just one patient had a moderate disability.as shown in table 5.

Table 5. Pediatric Overall Performance

Pediatric overall performance	Frequency	Percentage
Good Performance	92	71.9%
Mild Disability	5	3.9%
Moderate Disability	1	0.8%
Sever Disability	3	2.3%
Coma	27	21.1%

Figure 6 indicate that more than three quarter of the patients (77.3%) discharged during the study and twenty-nine (22.7%) were died.

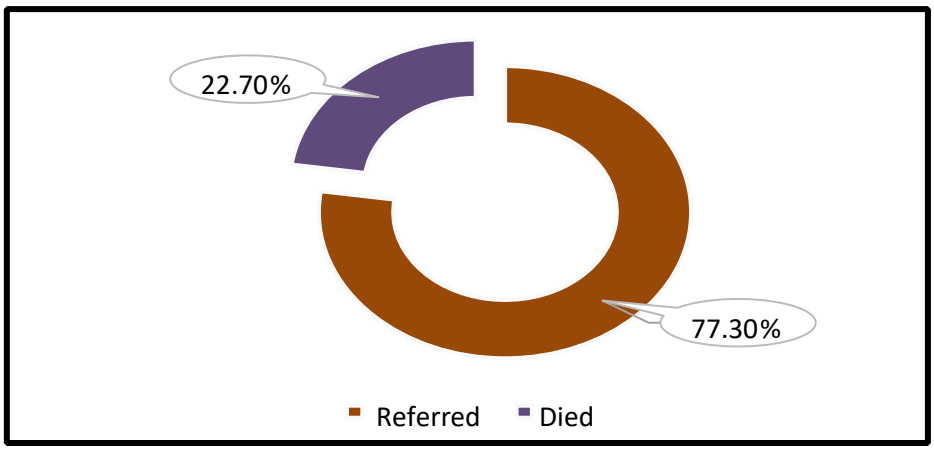

Figure 6. Patient outcome

DISCUSSION

Sepsis and septic shock continue to be a major cause of morbidity and mortality in infants and children worldwide. Mortality can be over 10%, and influenced by the child's age and comorbidities, source of infection, causative organism and management [11,12]. This study was a retrospective review of the medical records of children who were admitted to the PICU at Alkhadra Hospital from 2017 to 2022. It was found that the prevalence of sepsis was 9.96%. A study conducted by Wiess et al. found that 6,925 children were screened, and 569 met consensus criteria for severe sepsis, yielding a point prevalence of 8.2% [13]. Christoph et al. conducted a study in 2012 on 99,796 children in North America

and found that the point prevalence of sepsis was 14.6% [12]. In comparison with previous findings across regions, The prevalence of sepsis was 7.7% in North America, 6.2% in Europe, 6.8% in Australia and New Zealand, 15.3% in Asia (11.7–19.5%), 16.3% in South America, and 23.1% in Africa [13].

The prevalence of sepsis in children according to age was studied, and it was found that one-year-olds to six-year-olds (35.9%) and one-month-olds to less than one-year-olds (26.6%) had the highest prevalence. According to a study done by Sediqi, M. S. et al., it was found that two-month-olds to one-year-olds (37.94%) and one-year-olds to three-year-old (34.98%) had the highest prevalence of sepsis [14]. Another study by Humoodi M. and his colleagues at a tertiary care hospital in Saudi Arabia, carried on 113 patients met the definition of Sepsis-3: most of the children were 1 to < 6-year-old (35.4%), and < 1 year old (30.9%), which had the highest prevalence of sepsis [15]. Over two-thirds of patients transferred to the PICU from emergency department other than from hospital locations. This finding suggests that sepsis need improvement efforts, and overwhelmingly focused on the emergency department setting, may need to be expanded in scope.

A high percentage of the children admitted to the PICU have respiratory problems as a co-morbidity. This explains the high number of patients with comorbidities enrolled in the study. Previous studies conducted by Wolfler et al. and Watson RS et al. have suggested patients with malignancies are more likely to die of sepsis than those without malignancies [16,17]. In contrast with the study conducted, Pound et al. found no such association [18]. The most frequent main site of infection (43.8%) was the respiratory tract, which was followed by the bloodstream (18%). This result is consistent with research by Weiss et al., respiratory (40%) and bloodstream (19%) infections were the most common sources of infection [13]. In another study, the respiratory system was the most often identified main source of infection (57.5%) among 113 patients who met the criteria for sepsis-3, according to Humoodi M.O. et al.'s study done in Saudi Arabia [15].

The reported pediatric sepsis mortality rate varies significantly among different studies, particularly between developed and developing countries. In our study, the overall rate of mortality among children with sepsis was 22.7%. This result is consistent with a study conducted in Italy by Wolfler et al. on paediatric sepsis in PICUs, which found that 17.8% of patients died from severe sepsis [19]. Another study conducted in China by Xiao C et al. found that the major PICU facilities in southwest China had an 18.8% fatality rate from severe sepsis [20]. This prevalence in our study is significantly higher than the results of a previous study carried out in Egypt by Bekhit et al., which reported that among the outcomes of patients admitted to the PICU at Fayoum University Hospital, the reported mortality rate of sepsis was 8.8% [21]. We additionally observed that the rate of severe sepsis and septic shock among Chinese children was higher (34.6%) in that study compared to ours [22].

CONCLUSION

In this study, the prevalence of sepsis was 9.96% in hospitalized patients, and was high (35.9%) among the age range of 1 year and 6 years old, with mortality rate of 22.7%. Although decreasing the incidence through preventive measures is ideal, early recognition and treatment of sepsis will decrease both short- and long-term complications and related mortality of at-risk infants and children.

Conflict of interest.

We declared no conflict of interest with this work.

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وبائيات تعفن الدم ونتائجها في وحدة العناية المركزة للأطفال في مستشفى الخضراء، طرابلس، ليبيا

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المستخلص

على الرغم من التدخلات والعلاجات المختلفة التي تم تنفيذها لتحسين نوعية حياة الأطفال المصابين بالتعفن، إلا أن معدلات الانتشار والوفيات تستمر في الارتفاع. هذه المشكلة هي مشكلة صحية عامة رئيسية تتطلب التحسين المستمر للمبادئ التوجيهية وتحديد استراتيجيات جديدة. كان الهدف من الدراسة هو تحديد انتشار ونتائج التعفن الشديد بين الأطفال الذين تم إدخالهم إلى وحدة العناية المركزة للأطفال. أجريت هذه الدراسة في وحدة العناية المركزة للأطفال في مستشفى الخضراء في عام 2023 كدراسة استرجاعية قائمة على المستشفى. تم تضمين جميع الأطفال الذين تم إدخالهم إلى وحدة العناية المركزة للأطفال من عام 2017 إلى عام 2022. تم جمع البيانات من سجلات ملفات المستشفى، والتي تضمنت ما يلي: عمر المريض والجنس والأمراض المصاحبة للمرضى ومصدر القبول؛ أصل التعفن؛ نوع القبول في وحدة العناية المركزة للأطفال؛ الموقع الأساسي للعدوى؛ خلل الأعضاء الموجود عند الفحص؛ ونتائج المرضى. من إجمالي 1284 حالة دخول إلى وحدة العناية المركزة للأطفال، استوفى 128 مريضًا (9.96%) تعريف التعفن. وكان معظم المرضى (78.9%) أقل من 6 سنوات. وكانت مشاكل الجهاز التنفسي والتشوهات الخلقية هي الأمراض المصاحبة الأكثر شيوعًا، حيث بلغت المعدلات المبلغ عنها 18.8% و10.2% على التوالي. وكان قسم الطوارئ هو المصدر الأكثر شيوعًا للقبول (67.2%). وكان أداء جميع المرضى تقريبًا جيدًا بشكل عام، في حين كان (21.1%) من المرضى في غيبوبة. وخرج 77.3% من المرضى أثناء الدراسة، وتوفي 22.7%. وعلى الرغم من أن تقليل حدوث التعفن من خلال التدابير الوقائية أمر مثالي، فإن التعرف المبكر على التعفن وعلاجه سيقلل من المضاعفات قصيرة وطويلة الأمد والوفيات المرتبطة به بين الرضع والأطفال المعرضين للخطر.

الكلمات المفتاحية. التعفن ، النتائج، وحدة العناية المركزة للأطفال، ليبيا.