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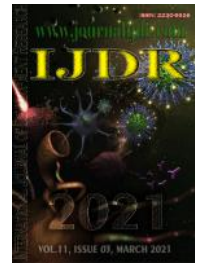
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RESEARCH ARTICLE

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PEDIATRIC SEPSIS PROTOCOL: EVALUATION BEFORE AND AFTER IMPLEMENTATION IN A UNIVERSITY PUBLIC HOSPITAL

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ABSTRACT

Objective: to analyze the profile of sepsis care and the impact of implementing the pediatric sepsis managed protocol on them. **Materials and method:** quantitative study conducted from September 2016 to August 2017 and from September 2017 to August 2018 in a public university hospital, Paraná-BR. Data were extracted from medical records of children diagnosed with healthcare-related infection and analyzed using SPSS®, by calculating the chi-square values and bivariate analysis, with a 95% confidence interval. **Results:** 106 medical records were analyzed, of which 51 (48,1%) had sepsis and 27 (25,4%) had two or more episodes of sepsis, the main infectious foci were pneumonia and associated or related bloodstream infection of the catheter, in addition the use of orotracheal tube and tracheostomy favored the evolution to sepsis. The most common signs of sepsis were changes in temperature, increased respiratory rate and signs of organ dysfunction with oxygen desaturation. There was a reduction in hospitalization time, re-hospitalization rates and death after the implementation of the protocol. **Conclusion:** the use of the protocol allowed improvements in care after its implementation. In this study, the importance of improving the records in the medical record for the assessment of possibility of positive changes in care.

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INTRODUCTION

Sepsis, an exacerbated and severe inflammatory response, originating from one or more infectious foci in the body, is one of the main causes of mortality in children worldwide (LATIN AMERICAN SEPSIS INSTITUTE, 2019; UNICEF, 2017). The global prevalence of severe sepsis in children under eighteen years of age is 8,2%, with hospital mortality equal to 25%, mainly secondary to an outbreak of respiratory tract infection or primary bloodstream (WEISS *et al.*, 2015; SOUZA, 2016).

The Latin American Sepsis Institute (LASI) and the Brazilian Society of Pediatrics recommend that systematic care strategies for sepsis be carried out, such as the use of managed protocols that take into account the collection of laboratory tests, volume replacement and antimicrobial administration as early as possible (LATIN AMERICAN SEPSIS INSTITUTE, 2015; BRAZILIAN SOCIETY OF PEDIATRICS, 2019). The increase in the length of hospital stay, hospital costs, time of antimicrobial therapy and length of stay in the Intensive Care Unit can be prevented when adhering to the procedures proposed by sepsis protocols (BARRETO *et al.*, 2016; KOENING *et al.*, 2010; SCHEIDT *et al.*, 2018; BALAMUTH *et al.*,

multiple organ dysfunction, its adherence promotes benefits for children and for the institution (WEISS *et al.*, 2015; BALAMUTH *et al.*, 2016, BALAMUTH *et al.*, 2017; KORTZ *et al.*, 2017).

In view of the above, the objective was to analyze the profile of sepsis care and the impact of the implementation of the pediatric sepsis managed protocol on them.

MATERIALS AND METHOD

This is a study of the type before and after, with retrospective analysis of medical records carried out in a public university hospital, including children from 0 to 12 years of age who developed nosocomial infection and sepsis. The institution under study is a reference for highly complex care, has emergency room beds and an infirmary for the treatment of clinical, surgical, burned and intensive care cases.

In 2017, the Pediatric Sepsis Managed Protocol was developed and implemented based on the recommendations for the management of sepsis in LASI children and reference values for vital signs of the seriously ill child of the American Heart Association, both from 2016 (LATIN AMERICAN SEPSIS INSTITUTE, 2019; AHA, 2016).

The source of data were hospital infection notification forms, completed by the team of the Hospital Infection Control Commission (HICC) that assesses children with infectious diseases in the sectors of Pediatric Emergency Care, Pediatrics, Pediatric Infectious Diseases and Pediatric Intensive Care Unit, for the diagnostic definition of healthcare-related infection (HRI), each patient suspected of HRI has an open notification form. In this form, the child's personal data are filled in, as well as the hospitalization and infections presented by the child. With regard to information on infections, the infectious diagnosis and its evolution to sepsis are described. The medical records were analyzed in full according to the selection of notification forms for children with HRI on the dates from September 1, 2016 to August 31, 2017 and September 1, 2017 to August 31, 2018, characterizing the first period before the implementation of the protocol and the second after implantation.

After selecting the files and analyzing the medical records, the data were distributed according to the child's characterization, hospitalization, diagnoses and procedures adopted after infection, in addition to the suspicion or not of sepsis. In this same context, the presence or absence of the signs of Systemic Inflammatory Response Syndrome (SIRS) and organ dysfunction were presented, as proposed by LASI (LATIN AMERICAN SEPSIS INSTITUTE, 2019), identifying possible infectious foci based on the diagnosis and date and time of collection of laboratory tests. Subsequently, the prescribed antimicrobials, dose, administration interval, date and time of the first immediate administration to the diagnosis of infection or suspected sepsis, volume expansion and / or vasoactive drug, as well as the presence or not of previous antibiotic therapy.

In order to identify the presence of organic dysfunction, data on hypotension, altered perfusion, elevated lactate, creatinine and serum bilirubins, a change in the value of the Glasgow coma scale greater than three points in relation to baseline and the need for supplemental oxygen were recorded. Based on the suspicion of sepsis, the procedures used during hospitalization, evolution to discharge, transfer or death, and the need for re-admission to the same service were evaluated.

The analysis was performed using the Statistical Package for the Social Sciences - SPSS version 2.0 program, for association analysis, chi-square values with a p-value <0,05 and bivariate regression for variables with a p-value 0,20, and Confidence Interval equal to 95%, admitting as reference variables: age 5 years, male, having been readmitted, death, having an infectious focus, using the invasive procedure and having presented the sign of SIRS or organic dysfunction.

This research was carried out after approval by the Research Ethics Committee of the State University of Londrina with CAAE: 43013315.8.0000.5231.

RESULTS

In this study 106 medical records of children with HRI were analyzed, of which 51 (48,1%) were reported with sepsis, however 27 (25,4%) children had more than one infection and sepsis, referred to in this research as the New Episode of Sepsis (NES).

Table 1. Relation of demographic and hospitalization characteristics of children with infection related to health care and sepsis, September 1, 2016 to September 31, 2018, pediatric units of the Londrina University Hospital, Londrina-PR

Variable	Total		With sepsis		Without sepsis		p	OR (CI 95%)
	n	%	n	%	n	%		
Faixa etária							0,182	
<1 year	39	36,8	22	20,8	17	16,0		2,37 (0,92 – 6,11)
1 year and <5 years	33	31,1	17	16,0	16	15,1		1,94 (0,73 – 5,19)
5 years	34	32,1	12	11,3	22	20,8		
Sex							0,111	0,53 (0,24 – 1,15)
Female	48	45,3	19	17,9	29	27,4		
Male	58	54,7	32	30,2	26	24,5		
Readmission							0,029	2,40 (1,09 – 5,27)
Yes	47	45,8	17	16,0	30	28,3		
No	59	54,2	34	32,1	25	23,6		
Outcome							0,048	
Hospital discharge	88	83,0	38	35,8	50	47,2		0,20 (0,05 – 0,79)
Transfer	4	3,8	2	1,9	2	1,9		0,27 (0,02 – 2,82)
Death	14	13,2	11	10,4	3	2,8		

Source: The author himself. N: 106. OR: Odds Ratio; CI: Confidence Interval.

Table 2: Relation between the signs of sepsis and the presence of sepsis in children with infection related to health care in pediatric units, September 1, 2016 to August 31, 2018, Hospital Universitário de Londrina, Londrina-PR

Sepsis sign	Total		With sepsis		Without sepsis		p	OR (CI 95%)
	n	%	n	%	n	%		
Tachycardia								
Yes	53	50,0	30	28,3	23	21,7	0,082	0,50 (0,23 – 1,09)
No	53	50,0	21	19,8	32	30,2		
Tachypnea								
Yes	59	55,7	32	30,2	27	25,5	0,159	0,57 (0,26 – 1,24)
No	47	44,3	19	17,9	28	26,4		
Fever or hypothermia								
Yes	70	66,0	42	39,6	28	26,4	0,001	0,22 (0,09 – 0,54)
No	36	34,0	9	8,5	27	25,5		
Uninformed	3	2,8	2	1,9	1	0,9		
Organ dysfunction sign								
Yes	66	62,3	39	36,8	27	25,5	0,004	0,29 (0,12 – 0,68)
No	40	37,7	12	11,3	28	26,4		
Perfusion change								
Yes	8	7,5	6	5,7	2	1,9	0,134	0,28 (0,05 – 1,47)
No	98	92,5	45	42,5	53	50,0		
Desaturation in ambient air								
Yes	53	50,0	34	32,1	19	17,9	0,001	0,26 (0,11 – 0,59)
No	53	50,0	17	16,0	36	34,0		

Source: The author himself. N: 106.

Children with NES had at least 02 and at most 09 cases of sepsis during hospitalization, resulting in an average of 3,25 cases of sepsis per patient. Of the 106 children attended, the majority were under one year of age and male. Most patients were hospitalized for less than 31 days, approximately half of the cases required re-hospitalization and the death rate was 13,2%.

With regard to children with sepsis, the main age group represented was also that of children under one year old, with 2,3 more chances of having sepsis, when compared to children older than or equal to five years. The predominant sex was male and almost all deaths occurred in children who had sepsis, as shown in Table 1.

The main HRIs identified in this study were, in decreasing order, pneumonia (59 – 55,7%), urinary tract infection (21 – 19,8%), surgical wound (19 – 17,9%), current blood associated or related to the catheter (17 – 16,0%), abdominal infection (9 – 8,5%), meningitis (7 – 6,6%), skin and soft tissue infection (6 – 5,7%) , and without a defined focus (6 – 5,7%).

In the case of infections that progressed to sepsis, the main infectious foci were pneumonia (33 – 31,1%; OR 0,48; 95% CI 0,22-1,06) and catheter-related or related bloodstream infection (13 – 25,5%; OR 0,22; 95% CI 0,06-0,75), with a p-value equal to 0,073 and 0,016 respectively.

Table 3. Relation of sepsis management characteristics before (September 1, 2016 to August 31, 2017) and after (September 1, 2017 to August 31, 2018) the implementation of the pediatric sepsis protocol for children with infection related to health care, Hospital Universitário de Londrina, Londrina – PR

Variable	Total		Before the protocol		After the protocol		p
	n	%	n	%	n	%	
Diagnosis of sepsis in the medical record							0,906
Yes	22	20,8	12	11,3	10	9,4	
No	84	79,2	47	44,3	37	34,9	
Collection of exams before antimicrobial							0,326
Yes	76	71,7	44	41,5	32	30,2	
No	23	21,7	13	12,3	10	9,4	
Not collected	7	6,6	2	1,9	5	4,7	
Prescribed volume expansion							0,707
Yes	29	27,4	17	16,0	12	11,3	
No	77	72,6	42	39,6	35	33,0	
Prescribed vasoactive drug							0,774
Yes	17	16,0	10	9,4	7	6,6	
No	89	84,0	49	46,2	46	37,7	
Readmission							0,264
Yes	47	44,3	29	27,4	18	17,0	
No	59	55,7	30	28,3	29	27,4	
Length of stay							0,345
1 day e <31 days	60	56,6	31	29,2	29	27,4	
31 days	46	43,4	28	26,4	18	17,0	
Outcome							0,546
Hospital discharge	88	83,0	47	44,3	41	38,7	
Transfer	4	3,8	3	2,8	1	0,9	
Death	14	13,2	9	8,5	5	4,7	

Source: The author himself. N: 106.

Table 4. Relation of hospitalization and sepsis management variables before (September 1, 2016 to August 31, 2017) and after (September 1, 2017 to August 31, 2018) the implementation of the Pediatric Sepsis Managed Protocol, of children with a new episode of sepsis in the pediatric units of the Hospital Universitário de Londrina, Londrina-PR

Variable	Total		Before the protocol		After the protocol		p
	n	%	n	%	n	%	
Diagnosis of sepsis in the medical record							0,326
Yes	9	33,3	8	29,6	1	3,7	
No	18	66,7	13	48,1	5	18,5	
New sepsis episode							0,557
2 e <4 cases	20	74,1	15	55,6	5	18,5	
4 cases	7	25,9	6	22,2	1	3,7	
Collection of exams before antimicrobial							0,356
Yes	21	77,8	16	59,3	5	18,5	
No	4	14,8	4	14,8	0	0,0	
Not collected	2	7,4	1	3,7	1	3,7	
Prescribed volume expansion							0,21
Yes	11	35,5	5	18,5	3	11,1	
No	20	64,5	16	51,6	4	12,9	
Prescribed vasoactive drug							0,148
Yes	4	14,8	2	7,4	2	7,4	
No	23	85,2	19	70,4	4	14,8	
Length of stay							0,458
1 day e <31 days	6	22,2	4	14,8	2	7,4	
31 days	21	77,8	17	63,0	4	14,8	
Readmission							0,080
Yes	13	48,1	12	44,4	1	3,7	
No	14	51,9	9	33,3	5	18,5	
Outcome							0,430
Hospital discharge	18	66,7	15	55,6	3	11,1	
Transfer	1	3,7	1	3,7	0	0,0	
Death	8	29,6	5	18,5	3	11,1	

Source: The author himself. N: 27.

It is noteworthy that in this study, of the 106 children analyzed 61 (57,5%; OR 0,48; 95% CI 0,22-1,05) used orotracheal tube and 14 (13,2%; OR 0,12; 95% CI 0,02-0,58) for tracheostomy for ventilatory support and 65 (61,3%; OR 0,27; 95% CI 0,12-0,63) used some central venous device (central catheter) peripheral insertion, double lumen and phlebotomy). Regarding the signs of sepsis, the most common signs of SIRS were changes in temperature and increased respiratory rate, most patients showed signs of organic dysfunction, the main manifestation of which was oxygen desaturation in ambient air, shown in Table 2. Regarding the collection of laboratory tests before the administration of the antimicrobial, the results were unfavorable when comparing the numbers before and after the implementation of the protocol, represented in Table 3, as well as the presence of the description of the diagnosis of sepsis in the medical record. It should be noted that in this study there was a reduction of 10,4% and 3,8% in the rates of re-hospitalization and death respectively after the implementation of the protocol.

Table 4 shows the relationship between the characteristics of hospitalization and sepsis management before and after the implementation of the protocol, of the 27 children with NES, that is, those who presented two or more cases of sepsis during hospitalization. Of the children with NES, most had 2 and 3 cases, however 7 (25,9%) children had 4 or more cases of sepsis during hospitalization. There were no positive changes with regard to the collection of laboratory tests and diagnostic description in the medical record after the implementation of the protocol, nor in the medical prescriptions of volume expansion and vasoactive drugs. On the other hand, there was a reduction in hospitalization rates greater than or equal to 31 days, re-hospitalization and death.

DISCUSSION

Children under one year of age were the most affected by sepsis at the study institution, Taniguchi *et al.*, and Mangia *et al.*, reported that mortality from sepsis is higher in early childhood, characterizing a risk to these children after diagnosis (TANIGUCHI *et al.*, 2014; MANGIA *et al.*, 2011). The main sources of infection found were pneumonia and primary bloodstream infection, children who were not diagnosed with these conditions had 52% and 78% less chance of having sepsis, compared to those who had these diagnoses. In a global prevalence study carried out in 26 countries, the airways accounted for 40% and blood for 19% as infectious foci of sepsis cases (weiss *ET AL.*, 2015). In Ceará-RN, Cavalcante demonstrated a 57,7% prevalence of sepsis cases pulmonary focus in children admitted to a tertiary hospital (CAVALCANTE, 2018). This study identified that there is a 52% lower probability of children who did not use an orotracheal tube and 88% less of those who did not use a tracheostomy to develop sepsis compared to those who underwent these procedures. Weiss *et al.*, reported in their research that 74% of patients with sepsis used mechanical ventilation, in addition the use of invasive procedures is associated with worsening sepsis and ventilatory and technological support increase the need for readmissions as demonstrated in a study carried out in pediatric intensive care in Brazil (WEISS *et al.*, 2015; CAVALCANTE, 2018; BARROS; MAIA; MONTEIRO, 2016; SILVA; FONSECA, 2019). The change in temperature and the change in respiratory rate (tachypnea) represented the main signs of SIRS in children with sepsis at the institution under study. Most patients with sepsis showed signs of organ dysfunction, the most prevalent being respiratory dysfunction with drop in oximetry in room air, with statistically significant p values, a data also pointed out in another study in which 67% of patients had organic dysfunction, its presence is reduced when using an assistance protocol (WEISS *et al.*, 2015; BALAMUTH *et al.*, 2016).

The exams were not collected as determined by the institutional protocol either before or after its implantation, nor did it follow the Latin American recommendations for sepsis management in which the collection of exams with cultures should be performed in the first hour of preference before the administration of the antimicrobial

(LATIN AMERICAN SEPSIS INSTITUTE, 2015). This institutional behavior goes against the quality criteria of care provided to septic patients (ODETOLA *et al.*, 2017). In addition, performing the recommended actions within one hour after the suspicion of sepsis decreases hospital mortality, which would improve the indicators of the institution under study (ODETOLA *et al.*, 2017; EVANS *et al.*, 2018).

The presence of sepsis during hospitalization increases the length of hospital stay and the use of care protocols favors the reduction of this time, in this study there was a decrease in hospitalization time after the implantation of the protocol, as revealed in research carried out in Bangladesh that demonstrated reduction in this time one year before and one year after the use of the sepsis protocol in children (KORTZ, 2017). Children who were discharged were 80% less likely to have been diagnosed with sepsis during hospitalization compared to those who died, in a pediatric hospital in Colombia, sepsis represented the third cause of death in ten years of study, with a rate equal to 12,3% (IBÁÑES *et al.*, 2015). Hospital stay is an important category in institutional mortality, since it increases as hospitalization time increases, demonstrating that the use of protocols can indirectly favor the local death rate (JUNCAL *et al.*, 2011; LAGUNA-PÉREZ *et al.*, 2012; BARROS; MAIA; MONTEIRO, 2016). The presence of sepsis is considered a predictive factor for rehospitalization, in this research there was a 10,2% reduction in rehospitalization rates after the implementation of the protocol, characterizing advantages for the patient and the hospital unit (JAPIASSÚ, 2009). Studies report that the use of a sepsis care protocol promotes a reduction in hospital mortality, as occurred in the analyzed institution, with the difference that only pediatric patients were checked (KOENING *et al.*, 2010; PEREIRA *et al.*, 2008).

The diagnostic description of sepsis in the medical record was reduced both before and after the implementation of the protocol. The description of the presence of sepsis by the HICC and not reported by the clinical team, may be associated with the lack of obligation to exclude this diagnosis from the medical record. No studies were found regarding this behavior associated with the use of protocols, however, the importance of having faithful records of clinical complications and measures taken against them is emphasized, since the adequate record of the patient's needs and assistance provided favors better communication between the health team and allows continuity of quality care (VASCONCELLOS; GRIBEL; MORAES, 2008; ADAMS; MANN; BAUCHNER, 2003; ALVES; SZPILMAN; POTON 2015).

It is concluded that pneumonia and the primary blood infection associated or related to the catheter were the most prevalent infectious foci, associated with this is the use of invasive procedures that are strictly linked to these infections and the presence of sepsis. The systematic use of protocols for treating pneumonia associated with mechanical ventilation and bloodstream infection associated with or related to the central venous catheter can reduce pediatric sepsis. The main signs of SIRS and organ dysfunction of the population served were identified, promoting to those interested which sign should be given more attention during the visits, which may favor the early identification of sepsis in this institution. The use of the sepsis protocol was associated with a shorter hospital stay and reduced hospital re-hospitalization, helping with the reduction of institutional expenses and complications, in addition to improvements in sepsis assistance.

The conduct proposed by SALI and the local protocol was followed, however, not systematically described by the professionals involved in the daily care of children with sepsis. Another inconsistency observed in the study was the probable non-adherence to the time of administration of antimicrobials in the first hour of care, as well as the failure to collect laboratory tests in a timely manner, which is not justified by the lack of human resources, structure or availability of drugs, since in the evaluated sectors the "sepsis box" with materials for collecting exams and the main antimicrobials used is available.

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