

Clinical Profile And Outcomes Of Shock In Children Aged 1 Month To 5 Years At A Tertiary Care Hospital

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ABSTRACT

Background: Pediatric shock represents a critical medical emergency characterized by inadequate tissue perfusion and cellular oxygen delivery, with particularly high mortality in young children. The clinical presentation varies significantly across age groups, with infants and young children demonstrating subtle signs that may mask severity until sudden decompensation occurs.

Objectives: To evaluate the clinico-etiological profile, laboratory correlations, and clinical outcomes of shock in children aged 1 month to 5 years admitted to a tertiary care hospital.

Methods: A prospective observational study was conducted over 24 months (March 2023 to February 2025) involving 77 children aged 1 month to 5 years presenting with shock. Shock was identified by presence of tachycardia and/or hypotension with signs of systemic hypoperfusion. Detailed clinical assessment, laboratory investigations, and outcome monitoring were performed. Data were analyzed using SPSS version 20.

Results: The study cohort comprised 77 children with mean age of 1.8±1.4 years and male predominance (51.9%). Septic shock was most prevalent (63.6%), followed by cardiogenic (20.8%) and distributive shock (15.6%). Fever was the commonest presentation (40.3%), followed by labored breathing (19.5%). Malnutrition was present in 14.3% of cases. All patients exhibited tachycardia and delayed capillary refill time, while hypotension was documented in 33.8%. Laboratory evaluation revealed elevated inflammatory markers (mean CRP 98.2 mg/L, procalcitonin 17.2 ng/mL, lactate 2.3 mmol/L). Respiratory infections constituted the leading cause of septic shock (32.7%), followed by acute gastroenteritis (18.4%). Mechanical ventilation was required in 54.5% of patients, with 63.6% needing multiple inotropes. The overall mortality rate was 24.7%, significantly associated with multiple inotrope use ($p < 0.001$), altered sensorium on admission ($p = 0.002$), and higher SOFA scores. Mean PICU and hospital stays were 8.9±7.8 and 15.6±11.2 days respectively.

Conclusion: Septic shock predominates in young children with significant mortality. Early recognition of compensated shock, prompt antimicrobial therapy, judicious fluid management, and appropriate inotropic support are essential for improved outcomes in this vulnerable population.

Keywords: Pediatric shock, septic shock, infants, young children, mortality, tertiary care, clinical outcomes, SOFA score, inotropes

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INTRODUCTION

Shock represents one of the most challenging and life-threatening conditions in pediatric emergency medicine, characterized by acute circulatory failure resulting in inadequate tissue perfusion and cellular oxygen delivery. This critical condition demands prompt recognition and immediate intervention, as delays in diagnosis and treatment can lead to irreversible organ damage and

increased mortality.[1] In pediatric populations, particularly in infants and young children, the presentation and progression of shock can be especially deceptive due to children's remarkable compensatory mechanisms, which may temporarily mask the severity of their condition until sudden decompensation occurs. The immature immune systems, limited physiological reserves, and challenges in early recognition of clinical

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deterioration make this age group particularly vulnerable to shock states.

The etiology of pediatric shock in young children is diverse and complex, encompassing various pathophysiological mechanisms that manifest differently compared to older children and adults. While hypovolemic shock remains the most common type globally, particularly in developing nations due to severe dehydration from gastroenteritis, other forms including septic, cardiogenic, and distributive shock present significant challenges in pediatric emergency care.[2] Understanding the specific etiology is crucial as it directly influences treatment approaches and ultimate patient outcomes. The global burden of pediatric shock is substantial, with particularly high mortality rates in resource-limited settings. Recent epidemiological studies indicate that shock affects approximately 2% of all pediatric emergency department visits in developed countries, with significantly higher rates in developing nations.[3] Septic shock alone carries a mortality rate ranging from 5% to 40%, depending on geographical location and available healthcare resources.

Laboratory evaluation plays a pivotal role in both diagnosis and monitoring of shock states in young children. The correlation between clinical presentation and laboratory parameters provides valuable insights into the severity of illness and helps guide therapeutic interventions. Recent advances in point-of-care testing have revolutionized the rapid assessment of crucial parameters such as blood gases, lactate levels, and coagulation profiles, enabling more timely and targeted interventions.[4] This study aims to comprehensively evaluate the clinical-etiological profile of pediatric patients aged 1 month to 5 years presenting with shock in a tertiary care setting, while investigating the correlation between laboratory parameters and clinical outcomes, thereby contributing to improved management strategies for this vulnerable population.

METHODOLOGY

This prospective observational study was conducted in the Pediatric Intensive Care Unit (PICU) and pediatric wards at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India, over a 24-month period from March 2023 to February 2025. Following approval from the Institutional Scientific and Ethics Committee, children aged between 1 month and 5 years presenting with shock were enrolled after obtaining informed consent and assent in English or Marathi from their parents or legal guardians.

The sample size of 77 patients was calculated using the formula $n = Z^2_{(1-\alpha/2)} \times p \times (1-p) / d^2$, considering a prevalence rate of shock of 9% with an acceptable difference of 5% and 95% confidence interval. Shock was identified by the presence of at least one of the following parameters: tachycardia (>160 beats/min in infants, >140 bpm in toddlers, >120 bpm in preschoolers) and/or hypotension (systolic BP <70 mmHg in infants, <70 mmHg + 2×age in years for older children), along with signs of systemic hypoperfusion including abnormal pulse volume, delayed capillary refill time (>2 seconds), altered skin temperature/color, altered level of consciousness, or reduced urine output. Patients who had received treatment for shock prior to admission were excluded from the study.

Comprehensive clinical assessment was performed for all enrolled patients, including detailed history of present illness, past medical history, immunization status, developmental and dietary history, family history, and socioeconomic background. Physical examination included measurement of vital parameters (heart rate, respiratory rate, blood pressure, temperature), anthropometric measurements, and detailed systemic examination with particular attention to perfusion parameters, mental status, signs of dehydration or fluid overload, and evidence of organ dysfunction. Glasgow Coma Scale (GCS) scoring was documented at presentation.

Laboratory investigations performed at admission and repeated as clinically indicated included complete blood count, blood glucose, serum electrolytes, blood urea and creatinine, arterial blood gas analysis, acute phase reactants (C-reactive protein, erythrocyte sedimentation rate), serum lactate, procalcitonin, and coagulation profile. Specific investigations based on suspected etiology included blood, urine, and other relevant cultures with sensitivity testing, chest radiography, electrocardiogram, echocardiogram, cerebrospinal fluid analysis, polymerase chain reaction tests for organism identification, and other radiological and special investigations as deemed necessary. Sequential Organ Failure Assessment (SOFA) scores were calculated to assess organ dysfunction severity.

Based on clinical presentation, physical examination findings, and laboratory parameters, patients were categorized into hypovolemic, cardiogenic, distributive, or septic shock. All patients received treatment according to standard institutional protocols, including initial stabilization, fluid resuscitation with judicious monitoring for fluid overload using clinical assessment and point-of-care ultrasound when available, inotropic support, specific therapy for underlying causes, supportive

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care, prevention of complications, and rehabilitation measures. Continuous monitoring was performed with documentation of vital parameters, clinical response to interventions, laboratory parameter trends, complications, duration of shock, need for mechanical ventilation, duration of intensive care stay, and final outcomes.

Data were entered in Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics included means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Chi-square test was used to determine associations between variables, with statistical significance set at $p < 0.05$ at 95% confidence interval.

RESULTS

Patient Demographics and Clinical Presentation

The study analyzed 77 children aged 1 month to 5 years presenting with shock over the 24-month study period. Table 1 presents the demographic characteristics and clinical features of the study population. The mean age was 1.8 ± 1.4 years, with infants (<1 year) constituting the largest proportion (59.7%, $n=46$). Males slightly predominated with 51.9% ($n=40$) compared to females at 48.1% ($n=37$).

Table 1: Demographic Characteristics and Clinical Features (n=77)

Parameter	Category	Frequency	Percentage
Age Distribution	<1 year	46	59.7%
	1-3 years	21	27.3%
	3-5 years	10	13.0%
Gender	Male	40	51.9%
	Female	37	48.1%
Duration of Symptoms	Acute (≤ 7 days)	53	68.8%
	Chronic (>7 days)	24	31.2%
Chief Complaints	Fever	31	40.3%
	Labored breathing	15	19.5%
	Loose stools	10	13.0%
	Seizures	9	11.7%
	Others	12	15.6%
Co-morbidities	Present	27	35.1%

Regarding symptom duration, 68.8% ($n=53$) presented with acute onset symptoms (within 7 days), while 31.2% ($n=24$) had chronic presentation (>7 days). Fever emerged as the most common presenting complaint in 40.3% ($n=31$) of cases, followed by labored breathing in 19.5% ($n=15$), loose stools in 13% ($n=10$), and seizures in 11.7% ($n=9$). Co-morbidities were present in 35.1% ($n=27$) of patients, with malnutrition (Severe/Moderate Acute Malnutrition and Failure to Thrive) being most prevalent at 14.3% ($n=11$), followed by congenital heart disease in 6.5% ($n=5$) and other conditions including cerebral palsy, Down syndrome, and hydronephrosis.

On initial assessment, Glasgow Coma Scale scores revealed that 46.8% ($n=36$) had GCS 9-12, 28.6% ($n=22$) had GCS 13-15, and 24.6% ($n=19$) had GCS 3-8, indicating varying degrees of neurological compromise. All patients (100%) exhibited tachycardia and delayed capillary refill time on presentation, while systolic hypotension was documented in 33.8% ($n=26$) of cases. Respiratory rate abnormalities were present in 31.2% ($n=24$) of patients, reflecting the compensatory mechanisms and underlying pathophysiology of shock states in this population.

Parameter	Category	Frequency	Percentage
	Malnutrition (SAM/MAM/FTT)	11	14.3%
	Congenital Heart Disease	5	6.5%
	Others	11	14.3%
GCS on Admission	3-8	19	24.6%
	9-12	36	46.8%
	13-15	22	28.6%
Hemodynamic Parameters	Tachycardia	77	100%
	Hypotension	26	33.8%
	Delayed CRT	77	100%
	Abnormal RR	24	31.2%

Shock Classification and Etiological Profile

Table 2 demonstrates the distribution of shock types, etiological factors, and microbiological profile in the study population. Septic shock emerged as the most prevalent type, accounting for 63.6% ($n=49$) of all cases, followed by cardiogenic shock at 20.8% ($n=16$) and distributive shock at 15.6% ($n=12$). Among the 49 patients with septic

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shock, respiratory infections (lobar pneumonia/bronchopneumonia) constituted the leading etiology in 32.7% (n=16), followed by acute gastroenteritis in 18.4% (n=9), central nervous system infections (meningitis/encephalitis) in 14.3% (n=7), and pleural effusion in 8.2% (n=4) of cases.

Microbiological confirmation was achieved in 46.8% (n=36) of cases overall. Among identified pathogens, bacterial organisms predominated at 31.2% (n=24), viral pathogens were isolated in 14.3% (n=11), and fungal pathogens in 1.3% (n=1). The most frequently isolated bacterial pathogens included Escherichia coli in 6.5% (n=5), Methicillin-Resistant Staphylococcus aureus (MRSA) in 5.2% (n=4), Acinetobacter baumannii in 5.2% (n=4), and Streptococcus pneumoniae in 3.9% (n=3) of cases. Dengue virus was the predominant viral pathogen, identified in 13% (n=10) of all patients, reflecting its endemicity in the region.

The systolic blood pressure distribution across shock types revealed that cardiogenic shock patients maintained normal blood pressure in 87.5% (n=14) of cases compared to hypotension in 12.5% (n=2). In distributive shock, 50% (n=6) presented with hypotension while 50% (n=6) maintained normal systolic blood pressure. Among septic shock patients, 69.4% (n=34) had normal blood pressure on presentation while 30.6% (n=15) demonstrated hypotension, highlighting the importance of recognizing compensated shock states in pediatric populations (p=0.08, not statistically significant).

Table 2: Shock Classification, Etiology, and Microbiological Profile (n=77)

Parameter	Category	Frequency	Percentage
Type of Shock	Septic	49	63.6%
	Cardiogenic	16	20.8%
	Distributive	12	15.6%
Etiology of Septic Shock (n=49)	Respiratory infections	16	32.7%
	Acute gastroenteritis	9	18.4%
	CNS infections	7	14.3%
	Pleural effusion	4	8.2%
	Others	13	26.5%
	Organism Isolation	No growth	41
	Bacterial	24	31.2%

Parameter	Category	Frequency	Percentage
	Viral	11	14.3%
	Fungal	1	1.3%
Common Bacterial Pathogens	E. coli	5	6.5%
	MRSA	4	5.2%
	Acinetobacter baumannii	4	5.2%
	Streptococcus pneumoniae	3	3.9%
	Others	8	10.4%
Viral Pathogens	Dengue	10	13.0%
	Chikungunya	1	1.3%
SBP Status by Shock Type			
	Cardiogenic - Normal SBP	14	87.5%
	Cardiogenic - Hypotension	2	12.5%
	Distributive - Normal SBP	6	50.0%
	Distributive - Hypotension	6	50.0%
	Septic Normal SBP	34	69.4%
Septic Hypotension	15	30.6%	

Laboratory Parameters and Organ Dysfunction Assessment

Table 3 presents the laboratory findings and organ dysfunction markers in the study cohort. Inflammatory markers demonstrated significant elevation across the study population. The mean C-reactive protein (CRP) level was 98.2±76.8 mg/L, with 92.2% (n=71) of patients showing elevated values. Mean serum lactate was 2.3±2.6 mmol/L, and mean procalcitonin was 17.2±10.5 ng/mL,

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reflecting the severity of systemic inflammation and tissue hypoperfusion characteristic of shock states.

Comparative analysis of laboratory parameters across different shock types revealed interesting patterns. Mean lactate levels were highest in cardiogenic shock (2.7 ± 2.5 mmol/L), followed by septic shock (2.4 ± 2.8 mmol/L) and distributive shock (1.6 ± 1.7 mmol/L), though these differences did not reach statistical significance ($p=0.41$). Procalcitonin levels showed elevation in septic shock (mean 19.2 ± 9.5 ng/mL) and cardiogenic shock (mean 18.8 ± 12.3 ng/mL) compared to distributive shock (mean 11.1 ± 8.8 ng/mL), $p=0.21$. C-reactive protein demonstrated highest mean values in distributive shock (118.6 ± 110.2 mg/L) and cardiogenic shock (115.3 ± 78.2 mg/L) compared to septic shock (88.4 ± 65.1 mg/L), $p=0.19$.

Organ dysfunction assessment revealed multi-system involvement. Coagulation abnormalities were most prevalent, present in 67.5% ($n=52$) of patients, followed by liver function derangements in 62.3% ($n=48$), while renal function abnormalities were documented in 40.3% ($n=31$) of cases. Mean Sequential Organ Failure Assessment (SOFA) scores were 8.2 ± 3.4 for septic shock, 8.8 ± 3.7 for cardiogenic shock, and 7.1 ± 3.4 for distributive shock, with no statistically significant difference between groups ($p=0.31$), indicating similar severity of organ dysfunction regardless of shock etiology.

Table 3: Laboratory Parameters and Organ Dysfunction (n=77)

Parameter	Value	Percentage
Inflammatory Markers (Mean±SD)		
CRP (mg/L)	98.2 ± 76.8	-
CRP Elevated	71	92.2%
Serum Lactate (mmol/L)	2.3 ± 2.6	-
Procalcitonin (ng/mL)	17.2 ± 10.5	-
Laboratory Parameters by Shock Type (Mean±SD)		
Lactate - Cardiogenic	2.7 ± 2.5	$p=0.41$
Lactate - Septic	2.4 ± 2.8	
Lactate - Distributive	1.6 ± 1.7	
Procalcitonin - Cardiogenic	18.8 ± 12.3	$p=0.21$
Procalcitonin - Septic	19.2 ± 9.5	
Procalcitonin - Distributive	11.1 ± 8.8	
CRP - Cardiogenic	115.3 ± 78.2	$p=0.19$

Parameter	Value	Percentage
CRP - Septic	88.4 ± 65.1	
CRP - Distributive	118.6 ± 110.2	
Organ Dysfunction		
Coagulation abnormalities	52	67.5%
Liver function derangement	48	62.3%
Renal function derangement	31	40.3%
SOFA Scores (Mean±SD)		
Septic shock	8.2 ± 3.4	$p=0.31$
Cardiogenic shock	8.8 ± 3.7	
Distributive shock	7.1 ± 3.4	

Treatment Modalities and Clinical Outcomes

Table 4 summarizes the treatment interventions and clinical outcomes of the study population. Mechanical ventilation was required in 54.5% ($n=42$) of patients, reflecting the severity of respiratory compromise in this age group. Inotropic support was necessary for all patients, with adrenaline being the most commonly used agent in 74% ($n=57$) of cases, followed by noradrenaline in 72.7% ($n=56$), milrinone in 10.4% ($n=8$), and dobutamine in 5.2% ($n=4$) of patients. Multiple inotropes were required in 63.6% ($n=49$) of cases, indicating severe cardiovascular compromise. The mean duration of inotropic support was 3.1 ± 1.8 days.

Analysis of outcomes revealed that multiple inotrope use was significantly associated with mortality ($p<0.001$). Among patients who died, 94.7% ($n=18$) required multiple inotropes compared to 53.4% ($n=31$) of survivors. Altered sensorium on admission was also significantly associated with poor outcomes ($p=0.003$), present in 57.9% ($n=11$) of non-survivors compared to 24.1% ($n=14$) of survivors. Mean PICU stay was 8.9 ± 7.8 days, and mean total hospital stay was 15.6 ± 11.2 days. Higher SOFA scores were significantly associated with prolonged PICU stays ($p=0.006$), with mean scores of 7.4 ± 3.4 for stays <15 days, 10.9 ± 3.1 for stays 15-30 days, and 10.5 ± 0.7 for stays >30 days.

The overall mortality rate in this age group was 24.7% ($n=19$), with 2.6% ($n=2$) leaving against medical advice, and 72.7% ($n=56$) being successfully discharged. Mortality rates varied by shock type: septic shock demonstrated 26.5% ($n=13$) mortality, cardiogenic shock 25% ($n=4$), and distributive shock 16.7% ($n=2$), though these differences were not statistically significant ($p=0.69$). Among clinical signs of multi-organ

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involvement on admission, altered sensorium, reduced urine output, and lethargy were more commonly observed in non-survivors, with altered sensorium showing the strongest association with mortality.

Table 4: Treatment Modalities and Clinical Outcomes (n=77)

Parameter	Category	Frequency	Percentage	p-value
Mechanical Ventilation	Required	42	54.5%	-
	Not required	35	45.5%	
Inotropes Used	Adrenaline	57	74.0%	-
	Noradrenaline	56	72.7%	
	Milrinone	8	10.4%	
	Dobutamine	4	5.2%	
	Multiple inotropes	49	63.6%	
Inotrope Duration (days)	Mean±SD	3.1±1.8	-	-
Multiple Inotropes vs Outcome				<0.001
Deaths requiring multiple inotropes	18/19	94.7%		
Survivors requiring multiple inotropes	31/58	53.4%		
Altered Sensorium vs Outcome				0.003
Deaths with altered sensorium	11/19	57.9%		
Survivors with altered sensorium	14/58	24.1%		

Parameter	Category	Frequency	Percentage	p-value
PICU Stay (days)	Mean±SD	8.9±7.8	-	-
Hospital Stay (days)	Mean±SD	15.6±11.2	-	-
SOFA Scores by PICU Stay				0.006
	<15 days	7.4±3.4	-	
	15-30 days	10.9±3.1	-	
	>30 days	10.5±0.7	-	
Final Outcome	Discharged	56	72.7%	-
	DAMA	2	2.6%	
	Death	19	24.7%	
Mortality by Shock Type				0.69
Septic shock	13/49	26.5%		
Cardiogenic shock	4/16	25.0%		
Distributive shock	2/12	16.7%		

DISCUSSION

The present study examined 77 children aged 1 month to 5 years presenting with shock, revealing several clinically significant findings. The age distribution demonstrated that infants under 1 year constituted 59.7% of cases, which aligns with findings from Sankar et al., who observed 38.3% of shock cases in children under 1 year.[5] This high vulnerability of infants can be attributed to their immature immune systems, limited physiological reserves, higher metabolic demands, and challenges in early clinical recognition. The nearly equal gender distribution (51.9% male, 49.2% female) in our cohort differs from some previous studies like Kurade A et al., who reported female predominance (53.5%),[6] but is consistent with findings suggesting that biological sex may not significantly influence shock susceptibility in this young age group. The predominance of acute presentations (68.8%) underscores the typically rapid progression of shock in young children and emphasizes the

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critical importance of early recognition and prompt intervention to prevent irreversible organ damage.

Septic shock emerged as the most prevalent type (63.6%), consistent with findings from Jat et al. (65%)[7] and Carvalho et al. (69.4%)[8] from similar developing country settings. Respiratory infections, particularly bronchopneumonia, were the leading cause (32.7%), followed by acute gastroenteritis (18.4%) and CNS infections (14.3%). This etiological pattern reflects the high burden of infectious diseases in young children in resource-limited settings. The microbiological profile showed bacterial isolation in 31.2% of cases, with *E. coli* and MRSA being most common (6.5% and 5.2% respectively), alongside dengue virus in 13% of cases. The concerning presence of MRSA (5.2%) and *Acinetobacter baumannii* (5.2%) highlights the increasing burden of antimicrobial-resistant pathogens, as emphasized by Fleischmann-Struzek et al.,[9] necessitating robust antibiotic stewardship programs. Laboratory parameters demonstrated significant elevation of inflammatory markers, with mean CRP of 98.2 mg/L and procalcitonin of 17.2 ng/mL, consistent with findings by Fatima I et al.[10] Interestingly, systolic hypotension was present in only 33.8% of patients, reinforcing Carcillo et al.'s observation that children can maintain blood pressure until late shock stages,[11] making tachycardia and delayed capillary refill more reliable early indicators in this age group.

The mortality rate of 24.7% in our cohort, though concerning, compares favorably with Kidanu MG et al.'s report of 45.5% mortality[12] but is higher than rates from developed nations. Multiple inotrope requirement ($p < 0.001$) and altered sensorium on admission ($p = 0.003$) emerged as significant predictors of poor outcome, consistent with observations by Ventura et al.[13] and Schlapbach et al.[14] The mean PICU stay of 8.9 days and hospital stay of 15.6 days reflect the extended critical care required, with higher SOFA scores significantly associated with prolonged PICU stays ($p = 0.006$), validating SOFA as a useful prognostic tool as demonstrated by Ferreira FL et al.[15] The high prevalence of malnutrition (14.3%) as a comorbidity significantly impacts outcomes, as malnourished children have impaired immune function and reduced physiological reserves, creating a vicious cycle as emphasized by Bhutta et al.[16] The need for mechanical ventilation in 54.5% of patients and the requirement for multiple inotropes in 63.6% underscore the severity of illness in this population. Our findings emphasize that early recognition of compensated shock, prompt appropriate antimicrobial therapy, judicious fluid resuscitation with continuous monitoring for fluid overload using clinical assessment and point-of-care

ultrasound, and timely initiation of inotropic support are essential interventions. The integration of nutritional rehabilitation in management protocols, particularly in resource-limited settings, is crucial for improving outcomes in this vulnerable pediatric population.

CONCLUSION

This study provides comprehensive insights into the clinical profile and outcomes of shock in children aged 1 month to 5 years. Septic shock predominated (63.6%), primarily caused by respiratory infections and acute gastroenteritis, with concerning prevalence of antimicrobial-resistant organisms. The young age group demonstrated unique challenges including subtle presentations, high prevalence of malnutrition, and significant mortality (24.7%). Critical predictors of poor outcome included requirement for multiple inotropes, altered sensorium on admission, and higher SOFA scores. Early recognition of compensated shock, prompt antimicrobial therapy, judicious fluid management, appropriate inotropic support, and integration of nutritional interventions are essential for improving outcomes in this vulnerable population.

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