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Knowledge, Attitudes, and Practices of Healthcare Workers Regarding Sepsis in Lubumbashi, Democratic Republic of the Congo

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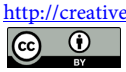
Abstract

Background: Optimizing sepsis management and developing training programs for healthcare workers depend on identifying areas for improvement. This study assesses the interrelationship between healthcare workers' knowledge, attitudes, and practices regarding sepsis in Lubumbashi, Democratic Republic of the Congo (DRC). **Results:** The study involved 179 healthcare workers, with 169 completing a questionnaire. The majority were physicians (83.43%) with a male predominance (79.29%). Physicians under 40 years old represented 53.85%, while most nurses were women (83.29%), aged 40 to 50 years (81.71%) with more than 10 years of experience (42.86%). Most worked in public hospitals (55.32%). Although 81% of physicians and 52% of nurses reported knowing the definition of sepsis, only 34% of physicians correctly identified it, with none of the nurses doing so. Regarding diagnosis, 49% of physicians mentioned CRP as a key marker, and 61% used the infection-SIRS association, compared to 29% of nurses. Only 26.42% of physicians knew that tachycardia was not part of the qSOFA score. The results revealed that 46.60% of respondents had low knowledge, 37.46% had moderate knowledge, and



only 15.94% had good knowledge. Physicians had slightly better knowledge than nurses ($p < 0.001$), emphasizing the need to improve sepsis training. **Conclusion:** This study highlights the urgent need for comprehensive training on sepsis and standardized care strategies (SSC) in DRC.

Keywords

Sepsis, Healthcare Workers, Knowledge, Attitudes, Practices, Lubumbashi

1. Introduction

Sepsis is defined as a life-threatening syndrome associated with immune, endocrine, cardiovascular, and metabolic disturbances resulting from an extreme reaction of the body to an infection, leading to organ failure and death if not treated promptly [1]-[5]. It is a major cause of morbidity and mortality in intensive care units (ICUs) worldwide [6]. In resource-limited countries, such as the Democratic Republic of the Congo (DRC), its management is complicated by inadequate healthcare infrastructure, a shortage of trained personnel, and limited access to treatments. In Lubumbashi, the second-largest city in the country, the situation remains concerning due to these constraints.

Healthcare workers play a critical role in the early detection and effective management of sepsis. In the DRC, practitioners in both the public and private sectors, with varying levels of knowledge about sepsis, deliver primary care. Doctors and nurses in these settings are particularly crucial for the prompt identification and treatment of sepsis, as many patients initially seek care at these facilities. However, studies conducted in contexts similar to the DRC indicate that errors in sepsis management are prevalent. These errors are often linked to a lack of awareness of current diagnostic criteria, inappropriate clinical attitudes, and delays or improper application of treatments. Therefore, gaps in the knowledge, attitudes, and practices of healthcare workers may impact sepsis management in Lubumbashi, underscoring the need for a comprehensive examination of these issues.

Sepsis is a leading cause of death in intensive care, with high mortality rates in developing countries. Although tools such as the qSOFA score allow for the rapid identification of at-risk patients, their use remains limited in low-resource settings. Sepsis management can be influenced by several factors, including knowledge, attitudes, and practices [7]. Indeed, significant gaps in knowledge regarding identification and management, negative attitudes, and poor practices may hinder efforts to combat high mortality, particularly in sub-Saharan Africa. Studies have revealed substantial gaps in knowledge, attitudes, and practices concerning sepsis, especially in sub-Saharan Africa, where these deficits hinder efforts to combat high mortality rates [8]-[11].

Although sepsis is globally recognized as a major cause of mortality, its management remains inadequate in many resource-limited countries, including the DRC. In Lubumbashi, sepsis mortality rates remain high despite theoretical pro-

gress. Sepsis management is hindered by gaps in healthcare professionals' training, inappropriate clinical practices, and a lack of resources. These errors may be due to insufficient knowledge of diagnostic criteria, inappropriate clinical attitudes, and delayed treatments, but these factors have not been sufficiently studied. Therefore, an assessment of healthcare providers' knowledge and practices in Lubumbashi is crucial to identify obstacles and propose tailored solutions.

Sepsis is a major issue in Lubumbashi, with serious consequences in terms of mortality and morbidity. Early and appropriate management can reduce this mortality, but this requires adequate healthcare professional training, good knowledge of diagnostic criteria, and treatment protocols. Assessing their knowledge and practices will help identify the gaps in Lubumbashi and provide recommendations to improve sepsis management while strengthening ongoing education and monitoring systems in hospitals. The aim of this study is to evaluate the knowledge, attitudes, and practices (KAP) of healthcare workers regarding sepsis management in Lubumbashi, DRC. This will help us better understand existing gaps in sepsis care and identify training needs to improve clinical outcomes in local healthcare facilities.

2. Materials and Methods

2.1. Study Design

This is a descriptive cross-sectional study that was conducted in several hospitals in Lubumbashi, covering all services over a period of three months, from March to May 2023. A questionnaire was used to collect data on healthcare workers' knowledge, attitudes, and practices related to the diagnosis and treatment of sepsis.

2.2. Target Population

The target population for this study includes healthcare workers from various health facilities in Lubumbashi, Haut-Katanga province, in the DRC. These facilities include public, private, and university hospitals. The participants, primarily doctors and nurses, have various qualifications: general practitioners or specialists (medical professionals who obtained a medical degree), and nurses (health professionals with a nursing degree at any level).

The inclusion criteria were:

- Be a healthcare professional (doctor or nurse).
- Have at least 6 months of experience in managing patients with sepsis.
- Agree to participate in the study by completing the questionnaire.

The exclusion criteria were:

- Healthcare professionals with less than 6 months of experience in caring for septic patients.
- Healthcare professionals who had previously participated in similar studies within the last 6 months.

2.3. Sample Size and Type

A non-exhaustive sample was formed based on the voluntary participation of

healthcare professionals. The sample size was determined by the response rate from participants. By the conclusion of the study period, 169 out of 179 participants had consented to participate in the study.

2.4. Data Collection Tool

The primary data collection instrument was a structured questionnaire consisting of multiple-choice questions and Likert scales to assess attitudes and practices. The questionnaire was developed based on the recommendations of the *Surviving Sepsis Campaign* [12] [13] and by reviewing existing literature on healthcare professionals' knowledge, attitudes, and practices concerning sepsis [8] [14]. To ensure validity, the questions were compared with those from similar studies and adapted to fit the objectives of this study. Study supervisors received a copy of the questionnaire for review, modification, and corrections if necessary. The questionnaire was divided into four sections.

Section 1: Demographic and professional information (age, gender, specialty, years of experience, level of education).

Section 2: Knowledge about sepsis (questions about the definition of sepsis, diagnostic criteria, and risk factors).

Section 3: Attitudes and practices related to sepsis management (questions concerning recommended clinical practices, including the management of diagnostic tests, antibiotic administration, and blood cultures).

Section 4: Practices related to sepsis management (questions about identified clinical signs, infections leading to sepsis, diagnostic tests used, and management practices such as the administration of crystalloids and the use of vasopressors).

2.5. Data Collection Methods

Google Forms was utilized to develop an electronic form and a self-administered questionnaire. The questionnaire was subsequently disseminated to healthcare professionals working in Lubumbashi through different WhatsApp forums for doctors and nurses, utilizing a link generated by the software. All participant responses were automatically gathered on the same platform and extracted using Microsoft Excel 365®.

2.6. Data Analysis Methods

The collected data were analyzed descriptively using SPSS software version 23. The responses were expressed in percentages and frequencies. A comparison of knowledge, attitudes, and practices between doctors and nurses was conducted using the Chi-square test to determine the significance of the observed differences.

2.7. Ethical Considerations

The study received approval from the Medical Ethics Committee of the University of Lubumbashi (ethical approval number UNILU/CEM/030/2021). The questionnaire was filled out anonymously, ensuring no link between the respondents' identities and their responses.

3. Results

3.1. Demographic Characteristics of Participants

A total of 179 healthcare workers participated in the study, of whom 169 (98.44%) completed the questionnaire. Sociodemographic data, such as age, gender, length of service, educational background, and specialization, are presented in Table 1. Most participants were physicians (83.43%), with a male predominance (79.29%). The age group under 40 years was the most represented among physicians (53.85%) ($p = 0.03$), while most nurses were women (83.29%) ($p = 0.1$), aged between 40 and 50 years (81.71%) and with more than 10 years of professional experience (42.86%). Most respondents worked in public hospitals (55.32%), followed by university clinics in Lubumbashi (29.79%). More than half of the participants were assigned to the general medicine department.

Table 1. Demographic characteristics of study participants.

		Medical title	
Characteristics	Total, N (%)	Physicians, n = 141 (83.43%)	Nurses, n = 28 (16.56%)
Gender			
Male	136 (79.29)	111 (77.62)	3 (16.71)
Female	33 (20.63%)	30 (22.38)	25 (83.29)
Age, years			
<40	91 (53.85)	78 (55.32)	5 (17.86)
40 - 50	53 (31.36)	41 (29.07)	23 (82.71)
≥50	25 (14.79)	22 (15.60)	0 (0.00)
Years of work experience			
<5	53 (31.36)	41 (29.07)	7 (25.00)
5 - 10	89 (52.66)	80 (56.74)	9 (32.14)
>10	27 (15.97)	20 (14.18)	12 (42.86)
Type of hospital			
Public hospitals	89 (55.80)	78 (55.32)	11 (39.29)
Private hospitals	39 (23.01)	21 (14.89)	8 (28.57)
University teaching hospital	41 (24.26)	42 (29.79)	9 (32.14)
Wards			
Surgery	21 (12.43)	21 (14.89)	0 (0.00)
Obstetrics and gynecology	16 (9.47)	12 (8.51)	4 (14.29)
General medicine	62 (36.69)	50 (35.46)	12 (42.85)
Internal medicine	24 (14.20)	21 (14.89)	3 (10.71)
Paediatrics	18 (10.65)	14 (9.92)	4 (14.29)
Intensive care units	24 (14.20)	19 (13.47)	5 (17.86)
Emergency room	4 (2.37)	4 (2.84)	0 (0.00)

Five types of knowledge were assessed: 1) knowledge of the definition of sepsis; 2) the definition of sepsis according to Sepsis-3 criteria; 3) criteria associated with infection for sepsis diagnosis; 4) sepsis scores for diagnosis; 5) components of the qSOFA score. Most participants reported knowing the definition of sepsis (81% of physicians and 52% of nurses). However, only 34% of physicians correctly identified the current definition, and none of the nurses did. Regarding diagnosis, 49% of physicians mentioned CRP as the primary marker, while 68% of nurses also cited it. Furthermore, 61% of physicians reported using the infection-SIRS association for diagnosis, compared to 29% of nurses. Finally, only 26.42% of physicians correctly noted that tachycardia is not part of the qSOFA score (Table 2).

Table 2. Participants' knowledge of sepsis.

Knowledge	Percentage of correct answers	
1. Do you know the current definition of sepsis?	Doctor	Nurses
	(n = 141)	(n = 28)
Yes	81%	52%
Not	19%	48%
2. Have you ever heard of the third international consensus on the definitions of sepsis and septic shock (sepsis-3) and qSOFA?		
Yes	46.00%	25.00%
Not	54.00%	75.00%
3. In your opinion, what is the most appropriate definition of sepsis?		
a. Contamination of the blood by a microbe	6.92%	71.00%
b. Life-threatening organ dysfunction caused by a dysregulated host response to infection.	33.96%	0.00%
c. Systemic inflammatory response associated infection	59.12%	29.00%
4. Among the following criteria associated with the infection, which ones do you use for the diagnosis of sepsis?		
SRIS ↑	24.00%	23.00%
CRP ↑	49.00%	68.00%
Score SOFA ↑	8.00%	3.00%
Score qSOFA ↑	10.00%	4.00%
Procalcitonins ↑	9.00%	2.00%
5. What definition do you use for the diagnosis of sepsis?		
Infection + SRIS	75.00%	56.00%
Infection + SOFA	10.00%	-
Infection + qSOFA	15.00%	20.00%
6. What do you think is the element that is not part of the qSOFA score?		
a. Glasgow Coma Scale < 15	41.51%	3.00%
b. Respiratory rate ≥ 22 c/min	10.69%	60/00%
c. Tachycardie > 90 battements/min	26.42%	-
d. Systolic blood pressure ≤ 100 mmH	21.38%	-

In this survey, as illustrated in Figure 1, the majority of respondents displayed varying levels of knowledge about sepsis, ranging from low (46.60%) to moderate (37.46%), with only 15.94% demonstrating a good level of knowledge. Physicians exhibited a slightly higher level of knowledge (43.50% low, 38.07% moderate, and 18.43% good) compared to nurses (55.50% low, 35.07% moderate, and 8.43% good). This difference was statistically significant ($p < 0.001$).

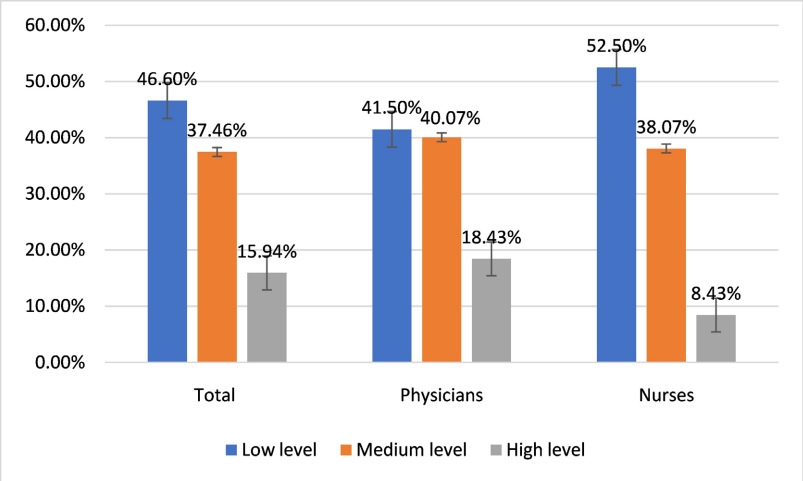


Figure 1. Level of knowledge on sepsis.

T-Reactive Protein; SOFA: Sepsis-related Organ Failure Assessment; SIRS: Systemic Inflammatory Response Syndrome.

3.2. Attitudes

Most participants correctly indicated that in cases of suspected sepsis, a blood culture should be requested (95% of physicians and 60% of nurses). More than half of the physicians (50.31%) and one-third of the nurses (34%) reported that this test is sometimes available (Table 3).

Regarding patient monitoring, 48.30% of physicians stated that patients admitted to the emergency department with a severe infection should be monitored for sepsis risk. In contrast, more than half of the nurses (55.32%) were unaware of which type of patient required monitoring (Table 3).

For management components, 47.61% of physicians identified blood culture sampling and broad-spectrum antibiotic therapy as urgent measures, along with large-bore intravenous access (31.14%). Among nurses, 36.28%, 29.4%, and 28% mentioned securing intravenous access, initial resuscitation with crystalloids in cases of hypotension, and maintaining adequate oxygen saturation, respectively, as urgent measures (Table 3).

Comparing the level of attitudes between the two participant groups, the survey results (illustrated in Figure 2) show that most respondents displayed attitudes ranging from poor (50.23%) to moderate (37.46%), with only 12.31% demonstrating good attitudes. Physicians exhibited a slightly higher proportion of moderate (64.00%) and good (7.50%) attitudes compared to nurses (56.00%, 42.07%, and

2.00%, respectively). This difference is considered statistically significant ($p < 0.001$) (Figure 2).

Table 3. Healthcare providers' attitudes toward sepsis management.

Attitudes	Percentage of correct answers	
1. A blood culture must be requested in case of suspicion of sepsis.	Physician ($n = 141$)	Infirmier ($n = 28$)
False	4.40%	40.00%
True	95.59%	60.00%
2. Is the blood culture examination?		
Never Available	16.36%	30.00%
Occasionally available	16.36%	10.00%
Sometimes available	50.31%	34.00%
Always available	16.98%	0.00%
3. Which patients do you think should be monitored for the onset of sepsis?		
a. Patients with tuberculosis	1.46%	7.10%
b. Patients admitted to the emergency department for serious infection	48.30%	15.24%
c. HIV-infected patients	2.28%	5.26%
d. All patients	46.71%	22%
e. I don't know	1.25%	55.32%
4. Which of the following are urgent for the management of sepsis?		
a. Secure venous access to wholesale free	31.14%	36.28%
b. In case of hypotension, initially resuscitate with crystalloid	19.49%	29.4%
c. Collect blood for blood culture and start broad-spectrum antibiotic therapy	47.44%	6.25%
d. Maintain good oxygen saturation	2.13%	28.00%

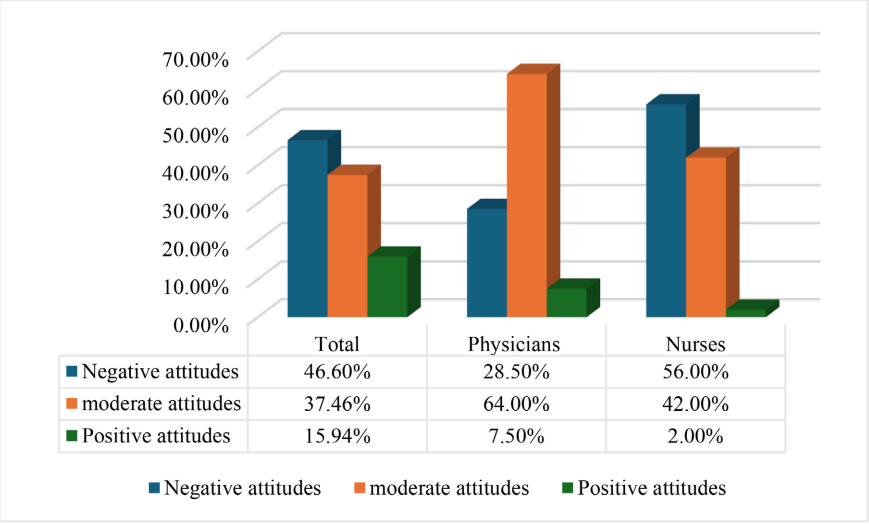


Figure 2. Level of attitudes towards sepsis.

3.3. Practice

3.3.1. Practice Related to Diagnosis

More than 95.59% of physicians identified fever as the primary sign for diagnosing sepsis. Other signs, such as loss of consciousness (88.09%), hypothermia (73.81%), tachycardia (84.09%), and hypotension, were also mentioned by most physicians. In contrast, fever was the only sign correctly identified as indicative of sepsis by all nurses. (Table 4).

Table 4. Participants' practice related to clinical diagnosis.

		Physicians (n = 141)	Nurses (n = 28)
	Uncertain	1.26%	-
Fever	Not	1.26%	-
	Yes	95.59%	100%
	No answer	1.89%	-
	Uncertain	12.70%	5.00%
Hypothermia	Not	73.81%	64.53%
	Yes	11.11%	20.50%
	No answer	2.38%	10%
	Uncertain	4.76%	34.60%
Tachycardia	Not	6.35%	46.35%
	Yes	84.93%	6.02%
	No answer	3.96%	13.03%
	Uncertain	6.34%	42.12%
Tachypnea	Not	54.71%	33.34%
	Yes	32.08%	11.20%
	No answer	9.43%	13.34%
	Uncertain	7.93%	14.53%
Hypotension	Not	61.01%	34.31%
	Yes	20.72%	32.64%
	No answer	12.58%	18.52%
	Uncertain	8.74%	28.43%
Alteration conscience	Not	2.38%	16.52%
	Yes	88.09%	20.24%
	No answer	0.79%	34.81%

3.3.2. Practice Related to the Entry Site

Regarding the primary sites of infection leading to sepsis, most physicians identified respiratory infection (42%) as the main cause, followed by skin and mucosal infections (33%). In contrast, most nurses identified skin infection (44%) as the primary cause, followed by abdominal infection (27%) and urinary tract infection (24%) (Figure 3).

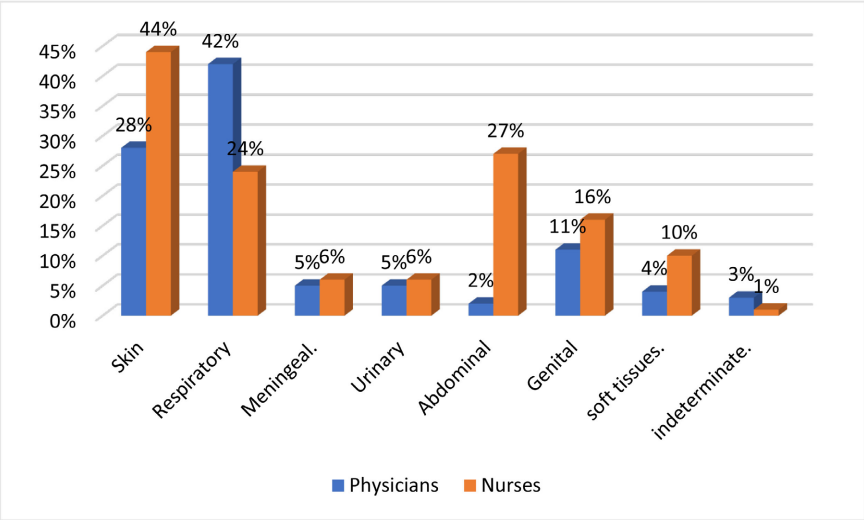


Figure 3. Source of infection.

3.3.3. Practice Related to Initially Requested Laboratory Tests

When asked about the first test to be requested in the case of suspected sepsis, most physicians (73.98%) and nurses (50.35%) indicated that blood cultures are the initial test to perform in order to identify the aetiology of suspected sepsis (**Figure 4**).

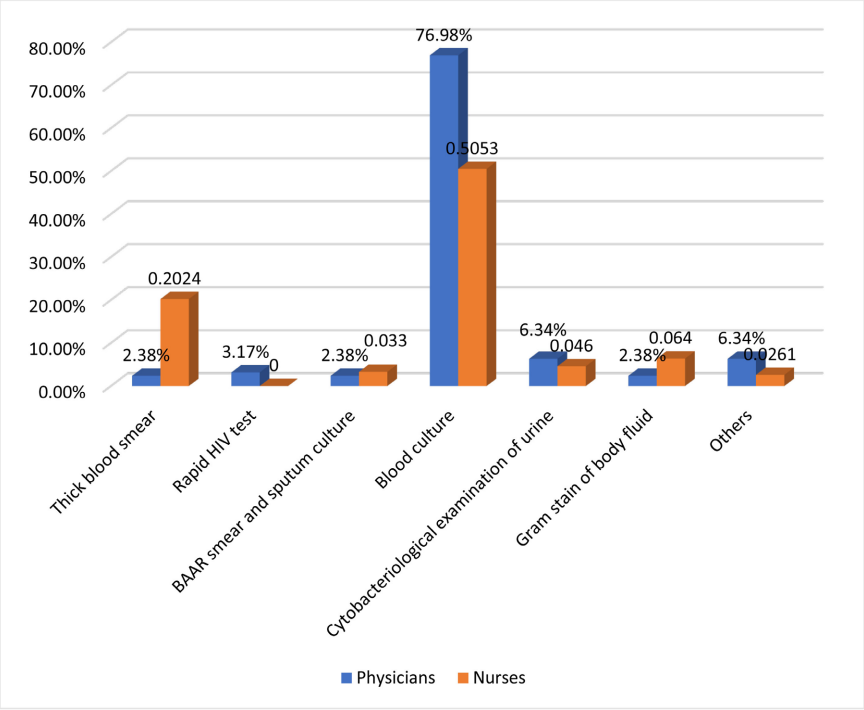
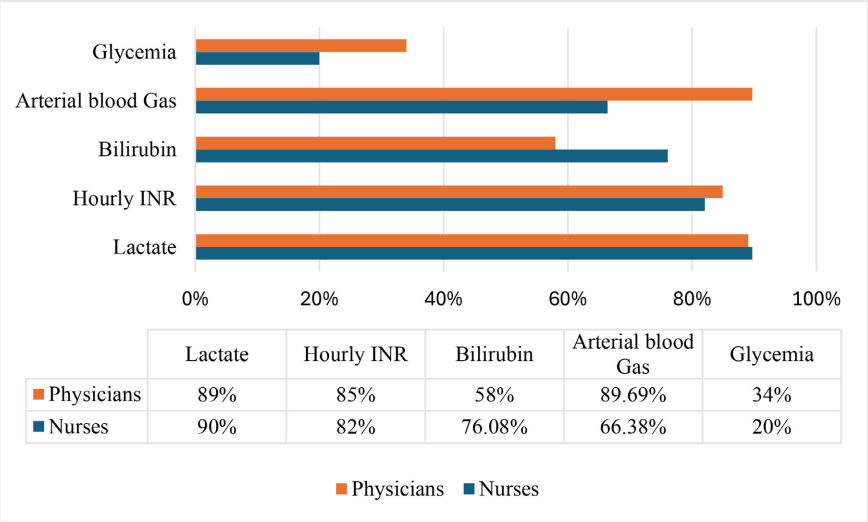


Figure 4. Laboratory tests initially requested.

3.3.4. Practice Related to the Availability of Laboratory Tests

In our survey concerning the availability of paraclinical tests for sepsis management, participants indicated that certain tests were more accessible. Arterial blood gas analysis, bilirubin, INR, and lactate/glucose measurements were reported as

available at rates of 66%, 76.08%, 82.03%, and 34%, respectively. On the other hand, arterial blood gas analysis, INR measurement, and blood lactate levels were less accessible, with availability rates of 10.31%, 15.08%, and 10.31%, respectively (Figure 5).



	Lactate	Hourly INR	Bilirubin	Arterial blood Gas	Glycemia
Physicians	89%	85%	58%	89.69%	34%
Nurses	90%	82%	76.08%	66.38%	20%

Figure 5. Availability of tests at patient admission.

3.3.5. Practice Related to Antibiotic Prescription, Monitoring, and Use of Vasopressors

Physicians and nurses identified the combination of Piperacillin/Tazobactam (36.51%) and Ceftriaxone/Metronidazole (29.37%) as the most frequently prescribed antibiotics in cases of suspected sepsis. Most participants (59.11% of physicians and 69.42% of nurses) reported that these antibiotics are generally available.

For fluid resuscitation, 0.9% saline was the most used (52.20% of physicians and 63.10% of nurses), followed by Ringer's Lactate (29.58% of physicians and 24.05% of nurses).

The main variables used to assess fluid resuscitation in the progression of sepsis to septic shock were systolic blood pressure (60.34% and 66.62%) and urine output (33.33% and 17.01%). Regarding vasopressors used for septic shock refractory to fluid resuscitation, adrenaline was mentioned as the most used (62% and 83%), followed by dopamine (23% and 10%) (Table 5).

4. Discussion

Our study serves as an initial analysis to enhance the quality of sepsis management in Lubumbashi. The aim is to evaluate the knowledge, attitudes, and practices of healthcare professionals across various levels concerning this condition. To our knowledge, this is the inaugural study of its nature in the DRC. Substantial deficiencies in comprehending and handling sepsis among these professionals were pinpointed. This investigation offers fresh insights to steer the development and execution of focused educational interventions.

Table 5. Antibiotic prescription, monitoring and use of vasopressors.

		Medical title	
		Nurse, (%)	Physician, (%)
What type of antibiotic therapy do you prescribe for suspected or confirmed sepsis? Is it?	Amoxy + acide clav	0.79	8.11
	Amoxicillin	1.59	1.39
	Ampicillin + ceftriaxon + gentamycin	1.79	11.21
	Amykacin	0.79	15.02
	Bactrim (Co-trimoxazol)	0.79	4.66
	Ceftriaxon	7.94	6.02
	Ceftriaxon/ciprofloxacin	0.59	5.12
	Ceftriaxon/metronidazole	29.37	29.21
	Ceftriaxone/tazobactam	0.59	6.18
	Gentamycin	0.59	3.21
	Ceftriaxon/gentamycin	15.08	3.21
	Meropenem/imipenem	3.10	2.14
	Pipéracilline/tazobactam	36.51	4.52
The availability of antibiotics (antimicrobials) when diagnosing sepsis.	Commonly available	59.11	69.42
	Never available	0.63	8.11
	Occasionally available	10.06	6.24
	Rarely available	8.18	6.15
	Always available	22.06	10.08
In the case of vascular filling, which solution do you use as a first-line treatment?	Colloids	11.94	3.64
	Blood	3.14	4.11
	G5% or 10% serum	1.25	5.10
	Ringer lactate	29.58	24.05
	Nacl 0, 9%	52.20	63.1
What are the parameters for assessing vascular filling in the event of septic shock?	Diuresis	33.33	17.1
	Heart rate	3.17	5.43
	Mean blood pressure	0.17	2.00
	Dialectic arterial pressure	60.34	66.62
	I don't know	1.58	6.64
	Central venous pressure	0.79	2.21
What vasopressors do you use for septic shock?	Adrenaline	62.00	83.00
	Dobutamine	5.44	0.00
	Dopamine	23.01	10.00
	Ephedrine	5.55	0.00
	Norepinephrine	4.00	7.00

According to our results, the majority of participants (81% of physicians and 52% of nurses) reported knowing the definition of sepsis, while only 53% of physicians and 25% of nurses were aware of the updated definition. This contrasts with a study conducted in Switzerland, where only 12.9% of professionals provided the correct definition [15]. In comparison, in South Africa, knowledge ranged from 31% to 48% [16]. Other studies on previous sepsis definitions have also revealed gaps in the recognition and management of sepsis among doctors and nurses [1]-[3]. Despite healthcare professionals claiming to know the definition of sepsis, a significant proportion, especially among nurses, are not up to date with the latest definitions, which could impact their ability to promptly detect and respond to this condition.

When asked about diagnostic markers for sepsis, 49% of doctors cited C-reactive protein (CRP), while 68% of nurses also mentioned the Systemic Inflammatory Response Syndrome (SIRS). Knowledge of the elements of the qSOFA score was low, with only 26.42% of doctors identifying tachycardia as irrelevant in this context. This result aligns with a Gabonese study that also observed a recognition rate of 26.6% [9]. In contrast, an Indonesian study found that 64% of nurses were able to identify all elements of the qSOFA score [17]. This score was designed for an initial assessment to avoid missing high-risk sepsis patients, as a simple and non-invasive tool for rapid screening [18]. It is important to highlight, considering our findings, that despite its advantages, recent SSC recommendations specify that it should not be used as the sole tool for sepsis screening or exclusion, making its use controversial [13] [19]-[21]. However, mastering this simple score, applied at the patient's bedside, allows for the rapid identification of adults suspected of infection at risk of severe sepsis complications, in the emergency department, intensive care, or general hospital wards. Thus, it allows for the quick exclusion of sepsis cases and is an essential tool that clinicians must master [22].

In this study, most participants had a knowledge level of sepsis ranging from low (46.60%) to moderate (37.46%), with only 15.94% having a good level of knowledge. Doctors had a slightly higher level (43.50% with low knowledge, 38.07% with moderate, and 18.43% with good) compared to nurses (55.50%, 35.07%, and 8.43%, respectively). These results align with a study conducted in Palestine [23]. In contrast, a study in Iraq found that most nurses had a good level of knowledge about sepsis [24], while a study in northern Italy showed that a large majority of healthcare professionals had excellent knowledge of this pathology [8].

Most participants correctly identified the need for blood cultures when sepsis is suspected, with 95% of doctors and 60% of nurses recognizing this. These results are consistent with Gabonese (85%) [9] and Pakistani (96%) [25] studies, which emphasize the importance of this step in managing sepsis. It is recommended to perform blood cultures immediately upon the arrival of high-risk patients, as obtaining them, along with the administration of appropriate antimicrobials, is a cornerstone of sepsis management [13] [26].

More than half of the essential diagnostic tests for sepsis were unavailable, presenting a challenge in its management in numerous African countries due to the lack of necessary resources such as appropriate antimicrobials [27]. Among the participants, 48.30% of doctors highlighted the importance of monitoring patients admitted to the emergency room with severe infections for potential sepsis. In contrast, 55.32% of nurses were unsure about which patients needed such monitoring. Sepsis is notably prevalent in tuberculosis patients, particularly those co-infected with HIV, but it can also manifest in tuberculosis patients without HIV. Vigilant monitoring is vital as sepsis can lead to rapid fatality, often within the initial five days [28]. Studies in Southern Africa indicate that even patients on antiretroviral therapy are susceptible to sepsis [29]. A meta-analysis demonstrated that HIV and tuberculosis are among the primary causes of sepsis in sub-Saharan Africa, typically with a poor prognosis [27].

Regarding sepsis management interventions, 47.61% of doctors and 31.14% of nurses mentioned blood cultures, broad-spectrum antibiotics, and large-caliber intravenous access as urgent interventions. In contrast, 36.28% of nurses highlighted securing venous access, resuscitation with crystalloids in case of hypotension, and maintaining adequate oxygen saturation as priorities. These results are similar to those of a Gabonese study [9] but differ from the conclusions of a Swiss study, which found that a majority of doctors considered intravenous access, broad-spectrum antibiotic administration, and fluid resuscitation as immediate interventions once sepsis was suspected [15].

In diagnostic practices for sepsis, more than 95.59% of doctors identified fever as the primary sign, followed by loss of consciousness (88.09%), tachycardia (84.09%), and hypotension. However, only fever was correctly recognized by all nurses, while 55% and 61.01% of participants did not identify hypothermia and hypotension as signs of sepsis. These results are consistent with other studies [9] [30]. It is important to note that body temperature is not a reliable indicator of sepsis, especially in immunocompromised patients [31], where hypothermia may be present and associated with high mortality rates [32]. Rapid recognition of signs and symptoms is crucial for proper diagnosis and effective sepsis management [17].

Regarding the primary infection leading to sepsis, most doctors identified respiratory infection (42%) as the main cause, followed by skin and mucosal infections (33%). In contrast, most nurses cited skin infection (44%), followed by abdominal infection (27%) and other infections (24%). These results are similar to a Palestinian study, where 41.6% of participants also identified the respiratory tract as the main source of infection in sepsis [23]. Identifying the source of infection during suspected sepsis is essential to optimize antibiotic choice, guide adjunctive treatments, and allow interventions to control the source of infection, which is integral to effective sepsis management [33].

Based on the study results, 73.98% of participants identified blood cultures as the initial test to perform in suspected sepsis to determine the aetiology of infec-

tion. This finding aligns with studies conducted in Gabon [9] and Jamaica [34]. Microbial culture is widely recognized as the most effective and reliable method for diagnosing sepsis. However, it has the drawback of not allowing for rapid detection or early treatment. This highlights the need to explore other diagnostic modalities to improve sepsis management [30].

Many study participants reported that blood glucose and bilirubin tests were available, while tests for blood gases, lactate, and INR were challenging to obtain in their work environments. Blood glucose measurement is crucial in septic patients, as hyperglycemia can increase the risk of tissue hypoperfusion, which is an indicator of disease severity. Strict glucose control could potentially reduce mortality [35]. Conversely, blood gas analyses, though vital for diagnosing metabolic complications like lactic acidosis [36], are not readily accessible in many hospitals in low-resource settings [37]. The INR is also crucial for identifying coagulation disorders, such as disseminated intravascular coagulation, commonly seen in septic patients [38]. It is considered a promising biomarker for early sepsis detection [19].

The most frequently prescribed antibiotics in suspected sepsis are the Piperacillin/Tazobactam combination (36.51%) and the Ceftriaxone/Metronidazole combination (29.37%). Most doctors (59.11%) and nurses (69.42%) confirmed that these antibiotics are generally available. A similar study in Kenya found that the Ceftriaxone/Metronidazole combination was also frequently prescribed, with 85% of participants reporting its availability [39]. Rapid antibiotic prescription, following blood culture sampling, is crucial for sepsis management, contributing to reduced mortality, in alignment with the Surviving Sepsis Campaign guidelines, which recommend empiric broad-spectrum therapy [13] [40].

More than half of doctors (52.20%) and nurses (63.10%) primarily use 0.9% NaCl solution for vascular filling in sepsis, followed by Ringer's Lactate (29.58% for doctors and 24.05% for nurses). An American study found that 95.6% of participants began fluid resuscitation with 0.9% saline [11], while a Pakistani study showed that few participants recognized crystalloids as resuscitation fluids [41]. Vascular filling is crucial in sepsis management, as recommended by the Surviving Sepsis Campaign, which advocates administering 30 ml/kg of crystalloids for patients showing signs of hypoperfusion [13]. However, it is acknowledged that the clinical variability of sepsis necessitates an individualized approach based on the assessment of physiological response [42]-[44].

The most observed variables for assessing vascular filling during the progression of sepsis to septic shock are systolic blood pressure (reported in 60.34% to 66.62% of cases) and urine output (33.33% and 17.01%, respectively). These results corroborate the study conducted in Kenya [39]. Monitoring clinical signs during fluid resuscitation in septic patients is essential, as clinical assessment is necessary to measure the response to vascular filling. Blood pressure, skin mottling, and capillary refill time are important indicators of resuscitation progress [45]. Although controversial, urine output is also considered a relevant criterion,

as a decrease in urine output is associated with high mortality rates in severely ill patients [46] [47].

Adrenaline (used in 62% to 83% of cases) and dopamine (23% to 10%) are the most frequently employed vasopressors in refractory septic shock. In the Kenyan study, 47% of intensive care providers reported using norepinephrine, while 75% of emergency professionals chose adrenaline as the vasopressor [39]. Vasopressors, particularly norepinephrine, are essential for patients with refractory septic shock to fluid resuscitation. Other options, such as adrenaline, dobutamine, and vasopressin, may be considered in cases of septic shock associated with low cardiac output [48].

Sepsis remains a significant challenge, particularly in low-resource settings, with gaps in recognition and management among healthcare professionals. Our study found low awareness of the updated definition of sepsis, particularly among nurses. Additionally, the limited recognition of diagnostic tools like the qSOFA score, crucial for early identification of high-risk patients, highlights a significant knowledge gap. The availability of essential diagnostic tests, such as blood cultures and lactate measurements, was often limited, further hindering effective management. While most participants recognized the importance of timely antibiotic administration, variations in fluid resuscitation practices and vasopressor use underscore the need for localized training. The unavailability of key tests, such as blood gas analysis, reinforces the importance of incorporating clinical signs and laboratory data into decision-making for better sepsis outcomes.

This study is the first of its kind in Lubumbashi, focusing on the knowledge, attitudes, and practices (KAP) related to sepsis care. It provides essential baseline data to inform efforts aimed at improving sepsis management. The sample includes doctors and nurses from various sectors of the city's healthcare system. However, several limitations must be acknowledged: the survey relies on self-reported perceptions and practices of healthcare workers, which may not accurately reflect actual behaviors. Furthermore, the sample size is relatively small, and the survey was conducted via WhatsApp without a prior calculation of the sample size, which limits the generalizability of the findings. Additionally, the study does not explore the underlying factors contributing to the identified KAP gaps, such as training opportunities, resource availability, and institutional barriers, which would offer a more comprehensive understanding. Finally, the study does not validate the conformity of self-reported practices to existing guidelines.

5. Conclusion

In conclusion, this preliminary study reveals gaps in the knowledge, attitudes, and practices of healthcare professionals in Lubumbashi regarding sepsis management, a major issue in the DRC. Despite recognizing the importance of early diagnosis and treatment, deficiencies persist in understanding diagnostic markers and management strategies. The low recognition of certain symptoms and limited

resources highlight the challenges in low-resource settings. The results suggest the need for targeted training on sepsis, diagnostic tools such as the qSOFA score, and management protocols. It is also crucial to strengthen access to diagnostic tests and treatments for vulnerable patients, particularly those with tuberculosis or HIV. Due to the study's limitations, broader research is necessary to better understand these gaps and guide improvement strategies. This study represents a first step toward developing health policies aimed at improving sepsis management in the DRC. Furthermore, future research could explore the epidemiological and clinical characteristics of sepsis in intensive care units in Lubumbashi, focusing on understanding the specific challenges faced by healthcare workers in this region and assessing the effectiveness of targeted interventions to improve sepsis management in critical care settings.

Authors' Contributions

Manika MM, Iteke IR, Situakibanza NTH, and Kapend KL designed the study and revised the manuscript. All other authors read and approved the final version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Survey of Knowledge, Attitudes and Practices on Sepsis in Lubumbashi, DRC

We therefore carried out an anonymous questionnaire aimed at assessing the knowledge of sepsis and its management among healthcare workers.

All completed questions will be confidential.

Beyond the use of your time, there is no anticipated risk associated with your participation in this survey.

No individual was identified. If you choose to participate, please DO NOT put your name on this questionnaire.

We thank you in advance for taking a few minutes (about 10) to answer this questionnaire.

Section I: General information

1. You are:

One man ☐ one woman ☐

2. Which of the following best describes you?

Doctor ☐ Nurse ☐

3. What type of health facility you work in?

Provincial General Referral Hospital ☐ General Referral Hospital (Health Zone) ☐

Reference Health Center Private Polyclinic Research Health Center

University Clinics ☐ Military Hospital ☐ ☐ Other .....

Article 5**. How many years have you been working as a health professional?**

1 - 4 years 5 - 9 years 10 - 14 years ≥15 years

4. What is your home service?

General medicine ☐ Gynaecology and obstetrics ☐ Surgery ☐ Internal medicine Ophthalmology ☐

Resuscitation or Intensive Care ☐ ☐ Other: .....

Section II: Knowledges

5. Do you know the current definition of sepsis?

Yes ☐ No☐

6. Have you ever heard of the third international consensus on the Definitions of Sepsis and Septic Shock (Sepsis-3) and qSOFAa?

7. If so, what do you think is the most appropriate definition of sepsis?

☐ Contamination of the blood by a microbe

☐ Life-threatening organ dysfunction caused by a dysregulated host response to infection

☐ Systemic inflammatory response caused by infection

☐ Allergic reaction against germs

☐ Other:.....

8. Which of the following criteria associated with the infection can be used for the diagnosis of sepsis?

	Yes	No	I don't know
SRIS ↑	o	o	o
Quick SOFA ↑	o	o	o
SOFA ↑	o	o	o
CRP ↑		o	o
Procalcitonins ↑	o	o	o
Lactate ↑	o	o	o

Section III: Attitudes

9. **Suppose a patient presents to your department with symptoms suggestive of sepsis. What is the first examination or test that you would perform? (Please circle one option**)

Malaria test ☐ Rapid HIV test ☐ AFB smear and culture of sputum ☐ Blood Culture ☐ Urinalysis or microscopy for leukocytosis ☐ Gram stain of relevant body fluid ☐ ☐ Autre:……

10. Blood culture must be requested if sepsis is suspected.

True ☐ False☐

11. Is the Blood Culture Examination?

Never Available ☐ Sometimes Available ☐ Occasionally ☐ Available ☐ Always available ☐

12. Which patients do you think should be monitored for the onset of sepsis?

Tuberculosis patients ☐ Patients admitted to the emergency department for severe infection ☐ HIV-infected patients ☐ All patients ☐ Don't know ☐

13. Which of the following are urgent for the management of sepsis?

☐ Secure large-caliber intravenous access

☐ If hypotension occurs, initially resuscitate with crystalloids

☐ Collect blood for blood culture and start broad-spectrum antibiotic therapy

☐ Maintain good oxygen saturation

Section IV: Practices

14. Do you think the following symptoms and signs are associated with sepsis?

	Never	Rarely	Occasionally	Frequently	Always
Fever (more than 38.3 (C)	o	o	o	o	o
Tachycardia (more than 90/minutes)	o	o	o	o	o
Tachypnea (more than 20 breaths/minute)	o	o	o	o	o
Hyperglycemia	o	o	o	o	o

15. What is the most common cause of infection in the majority of your septic patients?

Respiratory tract infections ☐ Urinary tract infections ☐
Intra-abdominal infections ☐ Central nervous system infections ☐
Musculoskeletal and skin infections ☐ ☐ Other :.....

16. **Suppose a patient presents to the hospital unit where you work with symptoms suggestive of sepsis and you need to do additional tests. How often are the following laboratory tests available for your use?**

	Never available	Rarely available	Occasionally available	Frequently available	Always available
Blood Sugar	☐	☐	☐	☐	☐
Blood gas analysis	☐	☐	☐	☐	☐
Bilirubin	☐	☐	☐	☐	☐
Prothrombin time/ INR	☐	☐	☐	☐	☐
Serum Lactate	☐	☐	☐	☐	☐
Other coagulation tests	☐	☐	☐	☐	☐

17. Do you think the following practice could be helpful in managing sepsis?

	Yes	Not	Uncertain
Use of antibiotics	☐	☐	☐
Use of crystalloids	☐	☐	☐
Use of vasopressors	☐	☐	☐
Previous identification of the source of infection	☐	☐	☐

18. What type of antibiotic therapy do you prescribe in cases of suspected or confirmed sepsis? Is it:

Amoxycilline ☐ Bactrim(Co-trimoxazol) ☐ Ceftriaxone ☐ Ceftriaxone/Métronidazole ☐
Métronidazole ☐ Ceftriaxone/Gentamycine ☐ Gentamycine ☐ Pipéracilline/Tazobactam ☐
Meropenem ☐ Ciprofloxacin ☐ ☐ Other: .....

19. The availability of antibiotics (antimicrobials) when diagnosing sepsis

Never Available ☐ Rarely Available ☐ Occasionally Available ☐
Commonly available ☐ Always available ☐

20. In case of vascular filling, which solution do you use as a first-line solution?

Blood ☐ G5% or 10% Serum ☐ Ringer Lactate Serum ☐ Nacl Serum ☐ Colloids ☐

21. How can we assess the filling of your septic patient? With:

Systolic Blood Pressure ☐ Heart Rate ☐ Passive Leg raise ☐ Diuresis ☐ ☐ Other: .....

22. When sepsis progresses to septic shock, which vasopressor do you prefer as a first-line treatment?

Dopamine ☐ Adrenaline ☐ Norepinephrine ☐ Dobutamine ☐ Ephedrine ☐