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Research Article

The challenges of compliance with sepsis management protocols in low and low-middle income countries – A cross-sectional study

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ABSTRACT

Aim: There is a need to understand the resources available to manage sepsis in Low & Low Middle-Income Countries (L&LMIC). We explored sepsis management in L&LMIC hospitals in the context of international sepsis guidelines.
Methods: Cross-sectional study. A 17-question electronic survey was self-administered to a purposive sample of critical care nurses from L&LMIC. Primary questions included general demographics sepsis recognition tools, available resources and timing to respond.
Findings: Our sample comprised of 93 respondents from 66 hospitals in 24 L&LMIC. Hospital in-patient and ICU bed capacity was an average (SD) of 685.14 (1157.34), and 21 (23.97), respectively. Hospitals early warning system for patient deterioration was identified by 38 % of respondents, while 72.3 % worked in hospitals equipped with a central oxygen supply. Pulse oximeters were available in 93.6 % of ICUs and 79.8 % of wards. Broad spectrum antibiotics were available in almost all hospitals; however, lactate tests, and culture testing were unavailable in 19 %, and 11 % of hospitals, respectively. Lack of resources resulted in staff asking families to seek these items externally at their own expense or simply doing without, resulting in a compromised level of care.
Conclusion: Many L&LMIC hospitals can comply with sepsis guidelines, however this is not consistent nor sustained. We identify substantial delays for patients with sepsis receiving fundamental tests and treatments in L&LMIC and recognise the ongoing need to bridge the sepsis care gap between L&LMIC and High-Income Countries.
Implications for Clinical Practice: Further efforts to identify, test, evaluate and refine effective responses to the prevention and management of sepsis in L&LMIC are urgently needed. We have identified in some L&LMIC that good practice can be achieved but timeliness and consistency of good practice is challenging. Finding common approaches, tools and protocols that enable consistent effective practice and outcomes in L&LMIC must be an ongoing ambition.

Introduction

Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection [1]. Fifty million people contract sepsis globally each year and 11 million die from the disease, 85 % of cases and death occur in low and low-middle income countries (L&LMIC) [2]. Sepsis management is suboptimal in L&LMIC due to limited resources accompanied by weaker health systems, shortage of critical staff and challenges to improve sepsis management [3,4].

Access to intensive care beds is also significantly reduced in L&LMIC. The ratio of intensive care unit (ICU) beds per 100,000 population in Bangladesh is 0.3, in Sri Lanka 2.5 and in sub-Saharan Africa 0.1–0.2 ICU beds per 100,000 population [3], compared to approximately 25 in the USA, and an average of 12 in High Income Countries (HIC) overall [4,5]. Patients from L&LMIC are less likely to receive mechanical ventilation or renal replacement therapy in the ICU and have a greater risk of in-hospital death compared with HIC [6].

Several reasons may explain increased sepsis mortality in L&LMIC, including low availability of complex ICU care, low sepsis awareness among lay people and delayed hospital presentation, low knowledge

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among healthcare workers, and high incidence of nosocomial infections [7,8]. Furthermore, inadequate implementation or transferability of sepsis guidelines from HIC to L&LMIC may contribute to the poor response to sepsis in L&LMIC [3]. The World Health Organization [9] and the World Federation of Critical Care Nurses (WFCCN) [10] have both identified further research and action towards understanding and improving sepsis management as a critical priority in health care globally.

Although guidelines exist to inform sepsis management, such as the Surviving Sepsis Campaign guidelines [11] they are heavily biased towards HIC medical evidence and resource availability. The nursing contribution to the management of sepsis in L&LMIC is much less evident in the literature. Nurses are the most prevalent and immediate care providers in L&LMIC and yet they are an often-overlooked resource [12,13]. There is a need to understand sepsis response in L&LMIC from the perspective of nurses. Therefore, we explore the challenges of compliance with sepsis management protocols and related resource constraints in L&LMIC hospitals with reference to international practice standards utilising the knowledge and perspective of critical care nurse managers from L&LMIC.

Method

We conducted a cross-sectional study using purposive sampling [14] of critical care nurses from L&LMICs known or introduced to us through the World Federation of Critical Care Nurses. The study used a self-administered electronic survey to describe the resources and tools available to manage sepsis in L&LMIC. The study received ethics approval from the University of Alberta Research Ethics Board, Canada. To protect the privacy of participants, all collected data were anonymous and identifying information of respondents and institutions remain confidential. Participants were informed that they could cease participation at any time without fear of consequence; hence, incomplete surveys were excluded from data analysis. No patient data were collected.

Setting

Critical care nurse managers from ICUs, emergency departments (EDs), and ward units involved in sepsis response from L&LMIC were invited to participate. The World Bank income classification of countries was used to identify countries belonging to L&LMIC [15]. For the purposes of this study, we chose to include those countries belonging to the World Bank classifications of low income < $1045 USD per capita and lower middle income $1046–4095 USD per capita [16].

Sample

Dissemination of the survey occurred through nurse leaders on the WFCCN contact list, who, in turn, used purposive sampling to recruit senior critical care nurses in each country to participate in the survey. A purposive sampling allowed information to be gathered from those who had experience of providing sepsis care in the L&LMIC settings [14]. All respondents were from L&LMIC. Individuals must have been proficient in English or Spanish, or alternatively, could consult a colleague competent in those languages to aid in the translation and completion of the survey.

We extended personal invitations to nursing leaders from 38 L&LMIC. Following this, the invited leaders further distributed the invitation to participate, the consent form, and the survey link to critical care nurse managers within their respective countries.

Data collection

A 17-question online survey was specifically developed for this study based on literature reviews of sepsis management, best practices, and consensus by a group of experts containing three academics with substantial experience in sepsis practice, research and publication, six critical care nurse leaders from L&LMIC, and four L&LMIC critical care nurse managers all with considerable practice experience caring for patients with sepsis in their respective settings. The groups of experts read and completed the draft survey tool providing feedback on language readability and clarity, relevance and ease of completion. The experts were from different regions, cultures and language groups. All spoke English and/or Spanish fluently. Of the 17 questions, six were generic demographic questions and eleven sepsis specific questions [see A ppendix]. We used open-ended questions to gather additional comments and common approaches about workarounds in the case of shortage of supplies, and/or lack of established procedures.

REDCap, was used to collect and manage the data [17] from May to November 2022. Prior to data collection commencement we held several meetings with senior critical care nurses from L&LMICs to explain the purpose of the study and the data collection process.

Tool development

The survey questionnaire was pre-tested for appropriateness by expert critical care nurse clinicians, managers and academics, with experience in running survey studies in critical care, including the research team and a critical care physician with research experience in global health in L&LMIC. The survey was considered comprehensive, with all items deemed highly relevant and appropriate for L&LMIC settings, supporting its face and content validity. Respondents' feedback was incorporated to refine specific items and enhance their suitability for low-resource settings. After revision, the survey was forward-translated into Spanish by a bilingual member of the research team with experience in translation of study protocols and tools. Back-translation was not available to the research team due to time, cost and capacity constraints. The tool was further piloted in a sample of 12 critical care leaders (5 Spanish speaking, 7 English speaking) with profiles similar to the target audience and different individuals to those in the pre-test group. Content validity was strongly supported through both pre-test and pilot phases. Due to differences in country-specific terminology and language, the names of procedures and therapeutics vary. Demographic data responses could not be inclusive of all nuanced categories, we therefore use the option of "other" for those questions with innumerable options available, eg ICU Type. The pilot round, conducted with the 12 critical care nurse leaders, was instrumental in refining the English and Spanish wording of the survey to ensure clarity and comprehensibility across diverse countries. For most questions, respondents "agreed" or "strongly agreed" that the questions were relevant and clear, and modifications were made according to participants' recommendations. At the pilot phase, the survey's reliability of internal consistency was 0.76 for sepsis-specific questions.

While testing Cronbach's alpha for a survey is common, it has limitations for multi-construct surveys like ours, as it assumes all items measure the same underlying construct and have equal variances—conditions that are rarely met. For uni-dimensional scales, Cronbach's alpha values above 0.7 are generally considered appropriate; however, no universally accepted minimum alpha value exists for surveys [18]. Therefore, we considered alpha values close to 0.7 as indicative of good internal consistency reliability.

Data analysis

We explored proportions, means and standard deviations (SD). Non-parametric comparisons and Kaplan Meier time to event analyses were used to compare times of acquiring culture, sensitivity, blood gases and electrolyte results between L&LMIC, public versus private hospitals, large (>300 beds) versus small hospitals, and large (>10 beds) versus small ICUs. Data were analysed in SPSS v 29.0.

Where available, qualitative comments were analysed through

conventional content analysis [19]. Responses in Spanish were minimal and easily translated into English through DeepL.com Translator. All responses were compiled in a table format, including columns for item, country and participant code. After familiarization with the data, we created codes for common themes per item of questionnaire, and responses were grouped. The most common themes were reported. Due to the sparsity of open-ended remarks, analysis was conducted manually, without the use of text analysis software. Open ended comments were used to clarify how respondents "work around" deficits, the analysed content is presented at the end of the corresponding section under the results heading, when appropriate.

Results

Countries represented

Although 365 respondents initiated the survey, only 93 surveys were fully completed and submitted. Surveys with unanswered questions were excluded, resulting in a response rate of 25.75 %.

The respondents hailed from 24 L&LMIC, accounting for almost one third of listed L&LMIC countries. Table 1 illustrates the distribution of completed surveys by country. Notably, the Philippines (with 15 responses) and Cambodia (with 7 responses) contributed the highest number of completed surveys per country.

Respondent and clinical unit characteristics

The majority of respondents (58.5 %) were "ICU Nurses", with 30.9 % holding positions such as "ICU Manager" or "Nurse in Charge" (Table 2). The ICUs where respondents worked were predominantly "General ICU" (29.8 %) and mixed adult/pediatric ICUs (20.2 %), with an average of 21 beds (SD = 23.97) (Table 2).

Respiratory support systems were available in 92.6 % of ICUs, including 85 % with invasive mechanical ventilation (IMV) (Table 2). In contrast, the presence of mechanical ventilation in emergency departments (ED) was 57.4 % for both IMV and non-invasive mechanical ventilation (NIMV) (Table 2). The availability of respiratory support in hospital wards was reported at 84 %, with 27.7 % for NIMV and 18.1 % for IMV, respectively (Table 2). Among the hospitals surveyed, 72.3 %

Table 1
Participating countries and number of completed surveys per country (N = 93).

Country	Frequency	Percentage
Azerbaijan	1	1.1
Bolivia	5	5.3
Cambodia	7	7.4
Cameroon	4	4.3
El Salvador	1	1.1
Ethiopia	6	6.4
Ghana	3	3.2
Honduras	3	3.2
India	5	5.3
Kenya	3	3.2
Liberia	3	3.2
Morocco	4	4.3
Myanmar	1	1.1
Nepal	2	2.1
Nigeria	4	4.3
Palestine	3	3.2
Papua New Guinea	5	5.3
Philippines	15	16.0
Rwanda	3	3.2
Sierra Leone	1	1.1
Sri Lanka	5	5.3
Sudan	2	2.1
Tanzania	3	3.2
Uganda	2	2.1
Yemen	2	2.1
Total	93	100

Table 2
Respondent and Clinical unit characteristics (N = 93).

Variable	Percentage (%) (N) *(Mean (Median) ± Standard Deviation)*
Respondent's role	
ICU Nurse	58.5 (55)
ICU Physician	2.2 (2)
ICU Manager	16 (15)
Nurse in Charge	14.9 (14)
ICU Instructor	2.2 (2)
Academic Faculty	3.3 (3)
Other	9.9 (9)
Hospital Type	
Public	66 (62)
Teaching	27.7 (26)
Community	3.2 (3)
Rural	2.1 (2)
Non-for-profit	6.4 (6)
Other	2.1 (2)
ICU Type	
Adult	19.1 (18)
Pediatric	3.2 (3)
Neonatal	1.1 (1)
Mixed Adult/Pediatric	20.2 (19)
General ICU	29.8 (28)
Surgical ICU	4.3 (4)
Trauma	3.2 (3)
Coronary/Cardiovascular	2.1 (2)
Cardiac/Cardiothoracic	2.1 (2)
High Dependency	2.1 (2)
Other	9.6 (9)
No Response	3.2 (3)
Number of Beds	
Total In-Patient Beds (Hospital)	*685.14 (350) ± 1157.34*
Intensive/Critical Care Beds (Unit)	*21.14 (14.00) ± 23.974*
Beds with Mechanical Ventilator (Hospital)	*54.99 (15.00) ± 216.199*
Respiratory Support: ICU	
Availability of Respiratory Support	
Yes	92.6 (87)
No	1.1 (1)
Missing	6.4 (6)
Type of Oxygen Support	
Facial Mask	91.5 (86)
Nasal Prongs	86.2 (81)
Non-Invasive Mechanical Ventilation	77.7 (73)
Invasive Mechanical Ventilation	85.1 (80)
Respiratory Support: Emergency Department	
Availability of Respiratory Support	
Yes	92.6 (87)
No	2.1 (2)
Missing	5.3 (5)
Type of Oxygen Support	
Facial Mask	87.2 (82)
Nasal Prongs	83 (78)
Non-Invasive Mechanical Ventilation	57.4 (54)
Invasive Mechanical Ventilation	57.4 (54)
Respiratory Support: Ward	
Availability of Respiratory Support	
Yes	84 (79)
No	9.6 (9)
Missing	6.4 (6)
Type of Oxygen Support	
Facial Mask	81.9 (77)
Nasal Prongs	79.8 (75)
Non-Invasive Mechanical Ventilation	27.7 (26)
Invasive Mechanical Ventilation	18.1 (17)
Hospital Oxygen Supply	
Central oxygen pipeline	72.3 (68)
Compressed oxygen cylinder	73.4 (69)
Bedside oxygen concentrator	64.9 (61)
Availability of Pulse Oximeter	
ICU	93.6 (88)
Emergency Department	93.6 (88)
Ward	79.8 (75)

(*continued on next page*)

Table 2 (*continued*)

Variable	Percentage (%) (N) *(Mean (Median) ± Standard Deviation)*
Not Available	1.1 (1)
Human Resources	
Acute nursing staff shortage*	83 (78)
Acute medical staff shortage*	68.1(64)
Acute allied health staff shortage*	69.1(65)
Chronic staff shortages	74.5(70)

Note: **Acute shortages experienced during the COVID-19 pandemic*.
Abbreviation: ICU, Intensive Care Unit.

were equipped with a central oxygen supply, and while 93.6 % of ICUs had access to pulse oximeters, this availability dropped to 79.8 % in the wards (Table 2). When inquired about their strategies to compensate for the absence of oxygen therapy, respondents indicated that they rely on nurses' assessments of patient condition, and transfer patients either to the ICU or to another hospital, as needed.

Early response systems

Among the hospitals represented by the respondents, 38.3 % (n = 36) had implemented an early warning system (Table 3). Additionally, 27.7 % (n = 26) of respondents reported the presence of an ICU outreach team comprised of a mix of nurses, physicians, and other healthcare professionals, with only one respondent indicating the team consisted solely of nurses.

Implementing sepsis management Guideline Components

Timeliness of Respiratory support

Although 75.5 % of participants indicated that their ICUs could provide respiratory support within less than 30 min of presentation, in 12.8 % of the units, initiating respiratory support took more than three hours (Table 3). In the ED, 69.1 % could initiate support in under 30 min; however, over 22 % required between 1 to more than 3 h to begin respiratory support, and in the wards, the respective figures were 48.9 % and 35 % (Table 3).

Lactate testing

Of participants, 19 % noted that lactate testing was unavailable in their hospitals, with its availability in ICUs, EDs, and wards being 70.2 %, 52.1 %, and 28.7 %, respectively (Table 3). When asked about their approaches to counter the unavailability of lactate testing, respondents stated that they depend on clinical evaluations of patient condition or other clinical markers, such as acid-base abnormalities, and, at times, resort to external or private laboratories, with costs sometimes borne by the patients themselves.

Physicians predominantly ordered lactate tests (Table 3). In about 40 % of hospitals, a sample could be taken immediately after ordering a lactate test, with results available in under an hour. However, 17 % of respondents reported it could take 2 or more hours to receive lactate test results.

Initiation of antibiotic therapy

All respondents confirmed the availability of broad-spectrum antibiotics in their hospitals, with higher availability in the ICUs (94.7 %) and EDs (89.4 %) (Table 3). Physicians were the most common prescribers of antibiotics. Nurses were responsible for prescribing antibiotics 8.5 % and 6.4 % of the time in the ICU and ED, respectively (Table 3). The initiation of antibiotic therapy occurred within one hour in the ICU (64.9 %) and the ED (59.6 %); however, initiating antibiotics could take from two to more than three hours in 7.4 % of ICUs and 6.4 % of EDs, with the wards showing slower response times (Table 3).

Table 3
Sepsis diagnosis and management responses (N = 93).

Variable	Percentage (%) (N)
Early Warning Scoring System	
Yes	38.3 (36)
No	56.4 (53)
Missing	5.3 (5)
ICU Outreach Team	
Yes	27.7 (26)
No	64.9 (61)
Missing	7.4 (7)
Implementation Time of Respiratory Support	
ICU	
< 30 min	75.5 (71)
< 1 h	2.1 (2)
2 – 3	1.1 (1)
> 3 h	12.8 (12)
No Response	8.5 (8)
Emergency Department	
< 30 min	69.1 (79)
< 1 h	10.6 (10)
2 – 3	2.1 (2)
> 3 h	9.6 (9)
No Response	8.5 (8)
Ward	
< 30 min	48.9 (46)
< 1 h	20.2 (19)
1 – 2 h	5.3 (5)
2 – 3	2.1 (2)
> 3 h	7.4 (7)
No Response	16 (15)
Lactate Test Availability	
ICU	70.2 (66)
Emergency Department	52.1 (49)
Ward	28.7 (27)
Not available hospital-wide	19.1 (18)
Ordering Lactate Tests	
ICU	
Nurse	13.8 (13)
Physician	67 (63)
Other Practitioner	11.7 (11)
Emergency Department	
Nurse	3.2 (3)
Physician	51.1 (48)
Other Practitioner	4.3 (4)
Ward	
Nurse	2.1 (2)
Physician	26.6 (25)
Other Practitioner	1.1 (1)
Time to Acquire Sample after Test Ordered	
Immediately	42.6 (40)
Within 1 h	19.1 (18)
2 – 3 h	3.2 (3)
> 3 h	6.4 (6)
Time to Obtain Results after Test Ordered	
< 1 h	38.3 (36)
Within 1 h	16 (15)
2 – 3 h	8.5 (8)
> 3 h	8.5 (8)
Availability of broad-spectrum antibiotics	
ICU	94.7 (89)
Emergency Department	89.4 (84)
Ward	83 (78)
Not available hospital-wide	0
Ordering Broad-Spectrum Antibiotics	
ICU	
Nurse	6.4 (6)
Physician	92.6 (87)
Other Practitioner	10.6 (10)
Emergency Department	
Nurse	8.5 (8)
Physician	84 (79)
Other Practitioner	6.4 (6)
Ward	
Nurse	3.2 (3)
Physician	77.7 (73)
Other Practitioner	6.4 (6)

(*continued on next page*)

Table 3 (*continued*)

Variable	Percentage (%) (N)
Time to Initiate First Dose	
ICU	
< 1 h	64.9 (61)
1 – 2 h	19.1 (18)
2 – 3 h	4.2 (4)
> 3 h	3.2 (3)
No Response	8.5 (8)
Emergency Department	
< 1 h	59.6 (56)
1 – 2 h	21.3 (20)
2 – 3 h	3.2 (3)
> 3 h	3.2 (3)
No Response	12.8 (12)
Ward	
< 1 h	42.6 (40)
1 – 2 h	17 (16)
2 – 3 h	14.9 (14)
> 3 h	6.4 (6)
No Response	19.1 (18)
Crystalloid Solution Availability in Hospital	
Yes	98.9 (93)
No	1.1 (1)
No Response	0
Crystalloid Solution Availability	
ICU	94.7 (89)
Emergency Department	93.6 (88)
Ward	86.2 (81)
Colloid Solution Availability in Hospital	
Yes	84 (79)
No	7.4 (7)
No Response	8.5 (8)
Colloid Solution Availability	
ICU	78.7 (74)
Emergency Department	72.3 (68)
Ward	55.3 (52)
Time to Initiate Fluids	
ICU	
Immediately	78.7 (74)
Within 1 h	12.8 (12)
2 – 3 h	4.3 (4)
> 3 h	0
No Response	4.3 (4)
Emergency Department	
Immediately	78.7 (74)
Within 1 h	13.8 (13)
2 – 3 h	2.1 (2)
> 3 h	0
No Response	5.3 (5)
Ward	
Immediately	40.4 (38)
Within 1 h	35.1 (33)
2 – 3 h	9.6 (9)
> 3 h	1.1 (1)
No Response	13.8 (13)
Availability of Vasopressors	
ICU	94.7 (89)
Emergency Department	87.2 (82)
Ward	43.6 (53)
Not available hospital-wide	1.1 (1)
Types of Vasopressors Available	
Norepinephrine	85.1 (80)
Vassopressin	52.1 (49)
Epinephrine	87.2 (82)
Dopamine	86.2 (81)
Phenylephrine	40.4 (38
Dobutamine	81.9 (77)
Other	5.3 (5)
Time to Initiate Vasopressors	
Immediately	71.3 (67)
Within 1 h	21.3 (20)
2 – 3 h	1.1 (1)
> 3 h	1.1 (1)
No Response	5.3 (5)
Supplies Necessary for Obtaining Cultures	
Blood Culture	
ICU	88.3 (83)
Emergency Department	72.3 (68)
Ward	74.5 (70)
Not available hospital-wide	10.6 (10)
Urine Culture	
ICU	83 (78)
Emergency Department	67 (70)
Ward	68.1 (68)
Not available hospital-wide	10.6 (10)
Swab Culture	
ICU	81.9 (77)
Emergency Department	67 (63)
Ward	68.1 (64)
Not available hospital-wide	10.6 (10)
Other Culture	
ICU	59.6 (56)
Emergency Department	36.2 (34)
Ward	41.5 (39)
Not available hospital-wide	7.4 (7)
Ordering Cultures	
ICU	
Nurse	10.6 (10)
Physician	87.2 (82)
Other Practitioner	11.7 (11)
Emergency Department	
Nurse	5.3 (5)
Physician	75.5 (71)
Other Practitioner	10.6 (10)
Ward	
Nurse	5.3 (5)
Physician	75.5 (71)
Other Practitioner	8.5 (8)
Time to Obtain Culture Sample Once Ordered	
ICU	
Immediately	29.8 (28)
Within 1 h	37.2 (35)
2 – 3 h	12.8 (12)
> 3 h	9.6 (9)
Emergency Department	
Immediately	24.5 (23)
Within 1 h	31.9 (30)
2 – 3 h	16 (15)
> 3 h	4.3 (4)
Ward	
Immediately	12.8 (12)
Within 1 h	33 (31)
2 – 3 h	17 (16)
> 3 h	12.8 (12)
Availability of Test Results	
Blood Culture	88.3 (83)
Blood Culture Sensitivity Test	79.8 (75)
Urine/Wound Culture and Sensitivity Test	80.9 (76)
Blood Gases	80.9 (76)
General Electrolytes	87.2 (82)

Abbreviation: ICU, Intensive Care Unit;

Fluid and vasopressor therapy

Nearly all respondents indicated that crystalloid solutions were readily accessible (ICU 94.7 %, ED 93.6 %, wards 86.2 %). Most respondents (78.7 %) could administer intravenous fluids immediately in ICU and ED and 40.4 % of the time on wards (Table 3). The availability of vasopressors was high in the ICU (94.7 %) and ED (87.2 %), but significantly lower in the wards at 43.6 %. Most could initiate vasopressors immediately (71.3 %) or "within 1 h" (21.3 %). One respondent highlighted that the patients' families were asked to purchase when it was necessary to mitigate the lack of specific vasopressors.

Cultures and laboratory test results

The availability of supplies for blood, urine, and swab cultures was high across ICUs (over 81 %), EDs (67 % or higher), and wards (68 % or higher) (Table 3). Nevertheless, 10.6 % of respondents reported a lack of availability for (blood, urine, swab) culture supplies in their hospitals and these respondents indicated that they rely on clinical signs and

either request patients' families to purchase or have the cultures conducted outside the hospital when lacking culture supplies, and/or they initiate symptomatic treatment on a "trial and error basis". Physicians were the most frequent prescribers of cultures, but nurses also ordered cultures in about 10 % of ICUs, 5.3 % of EDs and wards (Table 3).

The time required to obtain a culture once ordered was reported as "immediately" by 29.8 % of ICUs and 24.5 % of EDs, with a further 37.2 % in ICUs and 31.9 % in EDs obtaining cultures within one hour. However, in approximately 9 % of ICUs and 4 % of EDs, acquiring a culture took more than three hours. The process was slower in the wards, where about 29.8 % of respondents indicated it took two to more than three hours to obtain a culture (Table 3).

Hospitals had access to blood culture results and sensitivity tests (88.3 %, 79.8 %), urine and wound culture and sensitivity results (80.9 %), blood gases results (80.9 %) and electrolyte test results (87.2 %) (Table 3). When available, the median time to obtain blood gas results was 10 min, and to obtain electrolyte results one hour. When blood gas tests were unavailable due to a lack or malfunction of equipment, respondents reported asking families to have the tests conducted at an external lab, which could be costly. Moreover, as part of additional comments, respondents emphasized the importance of gaining quicker access to lab results, and of having 24 h laboratory service in the hospital.

The time to obtain blood culture results was reported as an average of 3.59 days (SD: 2.12; Max: 10 days) by 27 respondents, and as an average of 30.38 h (SD: 30.45; Max 72 h) by 8 respondents (overall median: 3 days), while the rest did not report times. The time to obtain blood culture sensitivity results was reported as an average of 3.69 days (SD: 1.77; Max: 7 days) by 26 respondents, and as an average of 36 h (SD:28.44; Max: 72 h) by 7 respondents (overall median: 3 days), while the rest did not report times.

Regarding the time to obtaining results of a culture, sensitivity, blood gases and electrolytes, there was no difference between low and low to middle income countries, public versus private hospitals, or according to the size of hospital or ICU (results not shown).

When invited to offer further remarks, most respondents emphasized the necessity of enhanced education and support for nursing staff, including training in the early detection of sepsis. Some also highlighted the importance of increased nurse to patient ratios, increased funding and pointed out the negative impacts of political and economic instability, as well as conflict, on healthcare. Respondents from countries affected by military conflicts frequently reported that access to various tests had become unavailable due to the ongoing conflict, with no mitigation strategies provided to address this issue.

Discussion

This study provides an insight into sepsis management practices in L&LMIC hospitals and describes constraints in meeting established therapeutic standards. Physical equipment such as ICU bed availability, IMV, NIMV and pulse oximeters exist in these health settings, but rationing is necessary when ICU beds or respiratory equipment are limited. Although we were unable to delve deeper into the methods used to ration this equipment it is understood that this is a clinician-led process and, in some instances, may involve transferring the patient to another hospital or simply forgoing the therapy and resorting to those simpler therapies that do exist, further compromising patient outcomes. Such circumstances lead to moral distress for many clinicians which in turn may lead to burnout and turnover [20].

Whilst broad spectrum antibiotics were available in almost all hospitals, lactate tests and culture testing were often not available. Transportation, lack of finance, technology and infrastructure, disease burden and poor governance may be contributing factors to limited supplies [21]. Such limitations may reduce the clinician's capacity to make early and definitive diagnosis and treatment and can contribute to early deterioration and death in patients suffering sepsis [22]. In qualitative comments from respondents, it was noted that even when diagnostic and therapeutic options are available in the hospital, families are required to pay up front before the test or treatment is provided. This can further compromise treatment times, patient outcomes and family economy. In addition, it was also shared that when the hospital does not have an item available, families are asked to purchase the item themselves and bring it to the hospital for the patient. Unfortunately, the economic aspect of sepsis has received limited attention in L&LMIC [23].

Of interest, 38 % of respondents identified that their hospitals have implemented early warning systems of varying levels of sophistication to support clinicians with clinical judgments and standardised treatment protocols. However, such tools are predominantly developed, tested, and validated in HIC and are awaiting validation studies in L&LMIC [24,25].

We acknowledge hope through the World Health Organization [26] and their resolution to focus on and improve emergency, critical and operative care for universal health coverage and prevention of health emergencies. These efforts build on previous resolutions to improve the prevention, diagnosis and clinical management of sepsis [9] and improve emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured [27].

Our study highlights how disadvantaged populations from L&LMIC are continuing to be challenged to provide adequate health care provision, especially in the context of sepsis. Our emphasis must be to support L&LMIC to identify specific measures to improve the areas of need identified in this study, namely, timely respiratory support, lactate measures, timely provision of all type of cultures, results and therapeutics. In addition, the continued need to improve trained human resources as well as provision of appropriate escalation protocols validated by research to these settings and pathways to ensure timely recognition and management of sepsis and the deteriorating patient.

Limitations.

In this cross-sectional study, we have not been able to study all L&LMIC, nor to assure proportional representation of each country. Some countries had more than one hospital represented, hence, we have kept the analysis high level across the L&LMIC group. Due to budget and time constraints, we could only survey in English and Spanish languages. Also, the forward translations (English into Spanish translation of the survey items and Spanish into English translation of qualitative comments) might have prevented us to capture the diversity of sepsis management practices. It is assumed that many participants come from racially and ethnically diverse backgrounds which can skew question interpretation and meaning despite our best efforts to test the tool and language with colleagues from the target populations during the pilot phase. It is acknowledged that differences exist between major teaching hospitals, private hospitals, regional and rural hospitals. We did not attempt to gain an equally distributed cross-section of these various types of hospitals in this study. Finally, it is noted that the data was collected through 2022 while COVID was still present in many countries and may have limited the time and attention participants could have allocated to this task, however we remain satisfied with the response rate and diversity of countries represented.

Conclusion

Our study provides a baseline analysis of the capability of L&LMIC hospitals to respond to and treat sepsis according to international guidelines. This capability is not consistent or sustained. We identify substantial delays for patients with sepsis receiving fundamental tests and treatments in L&LMIC and recognise the ongoing need to bridge the sepsis management gap between L&LMIC and HIC settings. Further, multi-national and multi-language, studies are needed to conduct in-country analysis to validate the findings purported by staff on the ground, and in addition share strategies that can be utilised in low resourced settings to complement HIC processes not readily accessible in L&LMIC.

CRediT authorship contribution statement

Ged Williams: Writing – original draft, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Laura Alberto:** Writing – review & editing, Methodology, Formal analysis. **Maysa Taha:** Writing – review & editing, Project administration, Methodology, Investigation, Data curation. **Elizabeth Papathanassoglou:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical statement

The study received ethics approval from the University of Alberta Research Ethics Board, Canada. Ethics ID: Pro00105078.

To protect the privacy of participants, all collected data were anonymous and identifying information of respondents and institutions remain confidential. Participants were informed that they can cease participation at any time without fear of consequence; hence, incomplete surveys were excluded from data analysis. No patient data were collected.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.iccn.2025.104032.

References

[1] Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2016;315(8):801–10. https://doi.org/10.1001/jama.2016.0287.

[2] Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, et al. Global, regional, and national sepsis incidence and mortality, 1990-2017: analysis for the Global Burden of Disease Study. Lancet 2020;395(10219):200–11. https://doi.org/10.1016/S0140-6736(19)32989-7.

[3] Schultz MJ, Dünser MW, Dondorp AM, Adhikari NKJ, Iyer S, Kwizera A, et. al. Current Challenges in the Management of Sepsis in ICUs in Resource-Poor Settings and Suggestions for the Future, in Dondorp AM, Dünser MW, Schultz MJ (Eds.) Sepsis Management in Resource-limited Settings. Springer. 2019. Open Access (eBook). https://doi.org/10.1007/978-3-030-03143-5.

[4] Vukoja M, Riviello E, Gavrilovic S, Adhikari NK, Kashyap R, Bhagwanjee S, et al. A survey on critical care resources and practices in low- and middle-income countries. Glob. Heart 2014;9(3).

[5] Organization for Economic Cooperation and Development (OECD). Intensive care beds capacity (20 April 2020) https://www.oecd.org/coronavirus/en/data-insights/intensive-care-beds-capacity. Accessed: 6 January 2024.

[6] Vincent JL, Marshall JC, Namendys-Silva SA, François B, Martin-Loeches I, Lipman J, et al. ICON investigators. Assessment of the worldwide burden of critical illness: the intensive care over nations (ICON) audit. Lancet. Respir Med 2014;2(5):380–6. https://doi.org/10.1016/S2213-2600(14)70061-X.

[7] Azevedo LCP, Machado FR. Sepsis in Low- and Middle-Income Countries. In: Wiersinga W, Seymour C (eds) Handbook of Sepsis. 2018. Springer, Cham. doi.org/10.1007/978-3-319-73506-1_15.

[8] Estenssoro E, Loudet CI, Edul VSK, Osatnik J, Ríos FG, Vásquez DN, et al. Health inequities in the diagnosis and outcome of sepsis in Argentina: a prospective cohort study. Crit Care 2019;23(1):250. https://doi.org/10.1186/s13054-019-2522-6.

[9] World Health Organization. Improving the prevention, diagnosis and clinical management of sepsis (WHA70.7). 2017. Geneva: http://apps.who.int/gb/ebwha/pdf_files/WHA70/A70_R7-en.pdf?ua=1. Accessed 1 April 2024.

[10] Williams G, Fulbrook P, Alberto L, Kleinpell R, Christensen M, Sitoula K, et al. Critical care nursing policy, practice, and research priorities: An international cross-sectional study. J Nurs Scholarsh 2023;55(5):1044–57. https://doi.org/10.1111/jnu.12884.

[11] Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. Intensive Care Med 2021;47(11):1181–247. https://doi.org/10.1007/s00134-021-06506-y.

[12] Williams G. The true worth of a nurse … time to act! J Adv Nurs 2020;76(10):2469-2470. doi: 10.1111/jan.14418.

[13] World Health Organization. State of the world's nursing 2020: investing in education, jobs and leadership. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.

[14] Campbell S, Greenwood M, Prior S, Shearer T, Walkem K, Young S, et al. Purposive sampling: complex or simple? Research Case Examples J Res Nurs 2020 Dec;25(8):652–61. https://doi.org/10.1177/1744987120927206.

[15] Fantom NJ, Serajuddin U. The World Bank's classification of countries by income. Policy Research working paper, no. WPS 7528 Washington, D.C. 2016: World Bank Group. http://documents.worldbank.org/curated/en/408581467988942234/The-World-Banks-classification-of-countries-by-income. Accessed 1 April 2024.

[16] Hamadeh N, Van Rompaey C, Metreau E. New World Bank country classifications by income level: 2021-2022. World Bank Blogs. 1 July 2021. https://blogs.worldbank.org/en/opendata/new-world-bank-country-classifications-income-level-2021-2022. Accessed 1 April 2024.

[17] Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42(2):377-81. doi: 10.1016/j.jbi.2008.08.010.

[18] McNeish D. Thanks coefficient alpha, we'll take it from here. Psychol Methods 2018;23(3):412–33. https://doi.org/10.1037/met0000144.

[19] Hsieh H-F, Shannon SE. Three Approaches to Qualitative Content Analysis. Qual Health Res 2005;15(9):1277–88. https://doi.org/10.1177/1049732305276687.

[20] Beheshtaeen F, Torabizadeh C, Khaki S, Abshorshori N, Vizeshfar F. Moral distress among critical care nurses before and during the COVID-19 pandemic: A systematic review. Nurs Ethics 2024;31(4):613–34. https://doi.org/10.1177/09697330231221196.

[21] Yenet A, Nibret G, Tegegne BA. Challenges to the Availability and Affordability of Essential Medicines in African Countries: A Scoping Review. Clinicoecon Outcomes Res 2023;13(15):443–58. https://doi.org/10.2147/CEOR.S413546.

[22] van den Berg M, van Beuningen FE, Ter Maaten JC, Bouma HR. Hospital-related costs of sepsis around the world: A systematic review exploring the economic burden of sepsis. J Crit Care 2022;71:154096. https://doi.org/10.1016/j.jcrc.2022.154096.

[23] Thwaites L, Nasa P, Abbenbroek B. Dat VQ, Finfer S, Kwezera A, *et al.* Management of adult sepsis in resource-limited settings: global expert consensus statements using a Delphi method. Intensive Care Med, 2025;51:21–38. doi: 10.1007/s00134-024-07735-7.

[24] Adegbite BR, Edoa JR, Ndzebe Ndoumba WF, Dimessa Mbadinga LB, Mombo-Ngoma G, Jacob ST, et al. A comparison of different scores for diagnosis and mortality prediction of adults with sepsis in Low-and-Middle-Income Countries: a systematic review and meta-analysis. EClinicalMedicine 2021;42:101184. https://doi.org/10.1016/j.eclinm.2021.101184.

[25] Chua WL, Rusli KDB, Aitken LM. Early warning scores for sepsis identification and prediction of in-hospital mortality in adults with sepsis: A systematic review and meta-analysis. J Clin Nurs 2024;33(6):2005–18. https://doi.org/10.1111/jocn.17061.

[26] World Health Organization. Integrated emergency, critical and operative care for universal health coverage and protection from health emergencies. (WHA 76.2). 30 May 2023. https://apps.who.int/gb/ebwha/pdf_files/WHA76/A76_R2-en.pdf. Accessed 1 April 2024.

[27] World Health Organization. Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured (WHA72.16). 28 May 2019. Geneva. https://iris.who.int/bitstream/handle/10665/329363/A72_R16-en.pdf?sequence=1. Accessed 1 April 2024.