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Challenges in Detecting Sepsis and Responding to Patients with Sepsis in Critical Care Nursing

A Descriptive Literature Review

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Sepsis is a global health problem and a major cause of death worldwide. Severe sepsis can cause organ failure and death without timely detection and prompt treatment commenced in one hour, a challenge for nurses. The purpose of this study was to describe the challenges in detecting sepsis and responding to patients with sepsis in critical care nursing. The aim was to produce new knowledge that will help critical care nurses to improve care of sepsis patients and nursing practices in critical care. The study questions were: what are the challenges in detecting sepsis in critical care nursing and what are the challenges in responding to patients with sepsis in critical care nursing?

This descriptive literature review used data gathered from Cinahl and Medline databases and a total of ten primary research articles about sepsis in Emergency Departments (ED) and Intensive Care Units (ICU) in the United Kingdom, America, Australia, Malaysia and Europe were chosen for inductive content analysis, after carefully assessing the quality of each article with the Critical Appraisal Skill Program (CASP) criteria.

The major challenges identified from study results were lack of experience and knowledge in sepsis, knowledge deficit in monitoring and interpreting vitals, lack of nursing staff and other resources, excessive workload and less time for assessing patients, poor teamwork and leadership among staff, communication errors at handover and poor interdisciplinary communication during patient care, as the challenges in detecting sepsis and responding to patients with sepsis in critical care nursing.

This study found that critical care nurses face many challenges in detecting sepsis and responding to patients with sepsis. These findings are important challenges that provide key insights regarding care of septic patients, improvement of nursing practices to better care for these patients and empowering students who aspire to be future critical care nurses.

Key Words	Nosocomial infections, infection prevention, preventive practices, sepsis and critical care.

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Sepsis on maailmanlaajuinen terveysongelma ja merkittävä kuolinsyy maailmanlaajuisesti. Vaikea sepsis voi aiheuttaa elinten vajaatoiminnan ja kuoleman ilman oikea-aikaista havaitsemista ja nopeaa hoitoa tunnin kuluessa, mikä on haaste sairaanhoitajille. Tämän tutkimuksen tarkoituksena oli kuvata haasteita sepsiksen havaitsemisessa ja sepsispotilaille vastaamisessa tehohoidossa. Tavoitteena oli tuottaa uutta tietoa, joka auttaa tehohoidon sairaanhoitajia parantamaan sepsispotilaiden hoitoa ja hoitokäytäntöjä tehohoidossa. Tutkimuskysymykset olivat: mitä haasteita sepsiksen havaitsemisessa on tehohoidon hoitotyössä ja mitä haasteita on reagoida sepsispotilaisiin tehohoidon hoitotyössä?

Tässä kuvailevassa kirjallisuuskatsauksessa käytettiin Cinahlin ja Medlinen tietokannoista kerättyä tietoa ja valittiin yhteensä kymmenen primääristä tutkimusartikkelia, jotka koskivat sepsiksen ensiapuosastoilla ja tehohoitoyksiköillä Isossa-Britanniassa, Amerikassa, Australiassa, Malesiassa ja Euroopassa. Induktiivinen sisältöanalyysi tehtiin sen jälkeen, kun kunkin artikkelin laatu oli huolellisesti arvioitu Critical Appraisal Skill Program (CASP) -kriteereillä.

Tärkeimmät tutkimustuloksista tunnistetut haasteet olivat kokemuksen ja tiedon puute sepsisestä, tiedon puute elintärkeiden seurannassa ja tulkinnassa, hoitohenkilökunnan ja muiden resurssien puute, liiallinen työmäärä ja vähemmän aikaa potilaiden arviointiin, henkilöstön huono tiimityö ja johtajuus, viestintävirheet luovutuksessa ja huonossa tieteidenvälisessä viestinnässä potilaiden hoidon aikana. Nämä olivat tärkeimmät haasteet sepsiksen havaitsemisessa ja sepsispotilaille vastaamisessa tehohoidon hoitotyössä.

Tässä tutkimuksessa havaittiin, että tehohoidon sairaanhoitajilla on monia haasteita havaita sepsis ja reagoida sepsispotilaisiin. Nämä havainnot ovat tärkeitä haasteita, jotka tarjoavat keskeisiä näkemyksiä septisten potilaiden hoidosta ja hoitokäytäntöjen parantamisesta näiden potilaiden paremman hoidon parantamiseksi ja tulevaisuuden tehohoidon sairaanhoitajiksi pyrkivien opiskelijoiden voimaannuttamiseksi.

Avainsanat	Sairaalainfektiot, infektioiden ehkäisy, ennaltaehkäisevät käytännöt, sepsis ja tehohoito.

Contents

1 Introduction

Hospital Acquired Infection (HAI) is a major healthcare problem affecting many patients worldwide. World Health Organization (WHO) estimated in 2005 that five to ten percent of patients admitted to hospitals in developed countries acquired HAI, with the proportion exceeding 25% in developing countries, thus a global health problem. Critically ill patients are the most vulnerable during their stay in hospital due to the use of invasive devices, procedures and other underlying diseases that render them susceptible to infection. In addition, a very sick patient stays longer in hospital with increase illness incidence and increase hospitalization cost. (Burns 2014: 22-23.)

Infection prevention therefore is a collective work of healthcare professionals and patients, for patient and personnel safety. Nurses who interact with patients and spend more time assessing them, have a key role in recognizing and preventing infections. Also, nurses are in a unique position to recognize signs and symptoms of an infection and prevent patients from deteriorating. Sepsis for example is bacterial infection of the bloodstream that triggers inflammatory reaction and stimulates a wider systematic inflammatory response which leads to multiple organs dysfunction. (WHO 2020).

Sepsis is a medical emergency and requires prompt treatment to prevent its progression to severe sepsis, multiple organs failure and death. Success in sepsis care requires a nurse to quickly suspect and react promptly when faced with a deteriorating patient or patients whose vitals fail to improve. Early detection and timely management are however challenging. (Bleakley & Cole 2020.)

The purpose of this study is to describe the challenges in detecting sepsis and responding to patients with sepsis in critical care nursing. The aim is to produce new knowledge that will help critical care nurses and nursing students, to improve care of sepsis patients and improve nursing practices in critical care.

2 Background theory and key words

Sepsis is a critical healthcare problem and a major cause of morbidity and mortality. It is a clinical syndrome caused by severe infection and a severe systemic inflammatory reaction to the infection, resulting to acute injury to multiple organs. Sepsis can be acquired both in the community and in a healthcare facility and its occurrence and prevalence have increased worldwide in the past years. The burden of sepsis was estimated in 2017 at 48.9 million cases and 11 million deaths, amounting to 20% of all deaths worldwide (WHO 2020.)

2.1 Sepsis in critical care

Many admission and readmission cases in the ICUs are due to sepsis. Sepsis is also a common cause of death in ICUs. There has been prevalence in sepsis in the past years, with a simultaneous decrease in mortality. As many as 14 million adults and 2.5 million children survive sepsis worldwide every year and survivors often have long term complications such as immune dysfunction, other comorbidities, functional limitations, unplanned hospital admissions and impaired quality of life thereafter. This is because of the impaired immune functions caused by severe sepsis, its effect on inflammatory and anti-inflammatory systems and the possibility of future sepsis. (ICU Management & Practice 2022.)

2.2 Recognizing and managing sepsis in critical care

Early diagnosis and timely interventions are vital for patients with sepsis or septic shock, to reduce the risks of morbidity and mortality. However, timely detection and treatment continue to challenge critical care nurses despite new international guidelines on sepsis. (Genga & Russel 2017).

Current studies have found knowledge deficit of nurses in recognizing and responding to patients with sepsis. A study of 73 adult ward nurses and colleagues, investigating pediatric nurses' knowledge of systemic inflammatory response syndrome (SIRS) and sepsis recognition showed a knowledge deficit related to SIRS and sepsis, especially regarding the significance of hypothermia, neutropenia, and elevated lactate levels. (Jeffery, Mutsch & Knapp 2014). Similarly, another study of 544 intensive care nurses working in adult Intensive Care Units (ICUs) in Turkey was conducted to determine intensive care nurses' awareness of identification of early sepsis findings and the study

results showed that, many of the nurses who knew about the early warning signs of sepsis did not know its clinical indicators such as hypothermia, leucopenia and lactate levels. Also, there was knowledge deficit of the nurses in differentiating between early sepsis and late sepsis findings. (Birge, Aydin & Çamdeviren 2021).

Sepsis guidelines recommend assessment of temperature, heart rate, respiratory rate, blood pressure, oxygen saturation and level of consciousness in patients with suspected sepsis in acute hospital settings. The patient's skin is examined for mottled appearance, cyanosis of the skin, lips, tongue, skin rash, skin turgor and frequency of urination is equally checked. Critical Care Nurses use the Sequential Organ Failure Assessment (SOFA) score, to identify signs of organ dysfunction and mortality. SOFA is a bedside assessment tool that assigns one point to each of the following clinical manifestations: altered mental state indicated by a Glasgow Coma Scale (GCS) score less than 15, respiratory rate (RR) of 22 breaths per minute or more and a systolic blood pressure (SBP) of 100mmHg or less. A SOFA score of two or more is a high risk of a poor outcome meanwhile a score of less than two means the patient needs continuous monitoring for signs of deterioration. (Lat, Mashlan, Heffey & Jones 2018.)

Similarly, sepsis six care bundle is an evidence-based guideline for treatment of sepsis. It comprises of three diagnostic criteria and three therapeutic steps that all septic patients should receive within one hour of detecting sepsis. It includes administering high-flow oxygen to maintain target oxygen saturation, intravenous (IV) antibiotics administration to treat the infection, IV fluids resuscitation to optimize patient's blood pressure (BP), taking blood cultures to identify the type of pathogenic microbe, measuring lactate for tissue hypoxia and monitoring hourly urine output (UO). Effective delivery of the sepsis six care bundle in clinical practice reduces sepsis-related deaths significantly. (Lat et al 2018.)

Interventions are however still given to fewer patients in a timely manner. Studies have shown poor adherence to the care bundle by critical care nurses and obstacles in the treatment of sepsis cases. A survey of 40 nurse managers and 24 physicians of two teaching and two non-teaching busiest emergency departments in the USA conducted to identify barriers to implementation of a protocol process for early goal directed therapy in severe sepsis found that, more than half of the participants had difficulties in central venous catheter insertion, central venous pressure monitoring and difficulties in identifying patients with sepsis. (Carblom & Rubenfeld 2007). Similarly, another survey of 709 registered nurses (RN) of emergency departments in Singapore conducted to examine the RN's knowledge and confidence in recognizing and managing patients

with sepsis found that, only 369 of the nurses could confidently recognize and respond to patients with sepsis. (Chua, The, Basri, Ong, Phang & Goh 2022).

Furthermore, managing sepsis in critical care should involve early recognition and holistic nursing care protocol, to improve patient's prognosis and survival. (Genga & Russel 2017). Nurses who assess and interact with patients during care at their bedsides should recognize the patients with sepsis and the critical status change of the patients. However, sepsis is often under diagnosed and interventions are given to fewer patients in a timely manner. Therefore, this study is conducted to describe the challenges that critical care nurses face in detecting sepsis and responding to patients with sepsis. The aim is to produce new knowledge that will help critical care nurses and nursing students to improve care of sepsis patients and improve nursing practices in critical care.

2.3 Other nosocomial infections in critical care

The most common healthcare associated infections in critical care areas are catheter-associated urinary tract infections (CAUTI), ventilator associated pneumonia (VAP), surgical site infection (SSI), sepsis, skin and soft tissue infections. The infections spread to susceptible patients through direct contact of colonized hands of nurses and other workers, cross-transmission from contaminated surfaces, contaminated surgical equipment, long-term indwelling catheters, bed linens, air droplets, respirators, other hospital instruments and sometimes by patient's own skin microbiota, after surgery when the skin is open. Patients with compromised immune systems during their hospital stay are also more likely to contract an infection. (THL 2020.)

2.4 Defining key words

The key words in this study are *nosocomial infections, infection prevention, preventive practices, sepsis* and *critical care.*

Nosocomial infections: These are infections that patients acquired in hospital area during the process of receiving care, that was not present during the time of admission. Examples are pneumonia, surgical site infections, sepsis or bloodstream infections and urinary tract infections. (THL 2020).

Infection prevention: This is a practical, evidence-based approach to prevent patients and health workers from being harmed by avoidable infections. (WHO 2020). *Preventive practices* are measures or strategies employed by patients and health personnel in

preventing and controlling infection transmission. These include standard precautions designed for the care of all patients and transmission-based precautions which are designed for the care of patients with known or suspected infection. (Hinkle & Cheever 2018: 2129).

Sepsis: This is life-threatening clinical syndrome with organ dysfunction or acute injury to multiple organs, caused by severe infection of the blood stream and triggers a systemic inflammatory response. The host response then results in perfusion abnormalities with organ dysfunction. (WHO 2020).

Critical care: This is care for seriously ill patients who are at high risk of actual or potential life-threatening health problems. Critically ill patients require intensive and vigilant nursing care because they can rapidly deteriorate. (Urden, Stacy & Lough 2022:2).

3 Purpose, Aims and Research Questions

The purpose of this study is to describe the challenges in detecting sepsis and responding to patients with sepsis in critical care nursing. The aim is to produce new knowledge that will help critical care nurses and nursing students to improve care of sepsis patients and improve nursing practices in critical care. This study was conducted to answer the following questions:

1. What are the challenges in detecting sepsis in critical care nursing?

2. What are the challenges in responding to patients with sepsis in critical care nursing?

4 Methodology and Method

The methodological approach of this study is qualitative. The method used is descriptive literature review. A qualitative methodological research approach allows for systematic search and synthesis of texts and relevant literature to produce knowledge, generate ideas and build understanding of the phenomenon being studied. (Cronin, Ryan & Coughlan 2008).

A literature review is an objective in-depth summary and critical analysis of relevant primary studies with related literature on the topic being studied. It involves a collection of

individual research articles and show results of different studies. Examples of the different types of literature reviews are descriptive literature review, systematic review, meta-analysis, scoping review, and integrative review. A descriptive literature review summarizes available literature made up of relevant studies in a topic area and draws conclusions about the topic being investigated. The goal is to present the reader with a comprehensive and current knowledge of the research topic, to identify research gaps and inform future research avenues highlighting the significance of new research. (Cronin et al. 2008.)

Additionally, descriptive literature review tells what is known and not known about a topic. Descriptive literature review follows three phases and nine steps. The phases are planning, conducting and reporting meanwhile the steps are selecting the topic, defining objectives and formulating research questions, developing and validating a review protocol, searching the literature, selecting literature, analyzing, synthesizing, concluding and reporting. (Sehularo, Molato, Mokgaola & Gause 2021.)

4.1 Database search, data collection and selection

Different strategies were employed in the search, collection and selection of data. Keywords were carefully considered in forming search sentences to generate data from the different databases. The Population Interest Context (PICo) tool shown in **table 1** below was used for planning the search strategy. (Cronin, Ryan & Coughlan 2008.)

Table 1. PICo

P (population)	Nurses
I (interest)	Challenges in detecting sepsis, challenges in responding to patients with sepsis.
Co (context)	Critical care nursing

Current literature connected to sepsis were searched from CINAHL and MEDLINE electronic databases. Keywords were used together with Boolean and truncation tools to combine the keywords in the search of data. (Cronin, Ryan & Coughlan 2008). This is illustrated in **table 2** below.

Table 2. Boolean search strategy and search sentences.

BOOLEAN operators, truncation.	Search sentences
AND, OR, *	Challenges in detecting sepsis OR challenges in responding to patients with sepsis AND Critical care nurs*

A librarian at Metropolia University was also consulted to help with the choice of search strategy and in accessing couple of articles. Inclusion criteria were peer reviewed research articles, not more than ten years old, written in English language and in critical care nursing area. The inclusion and exclusion criteria were specific and are shown in **table 3** below.

Table 3. Inclusion and exclusion criteria.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Articles written in english	Written in other languages than English
Studies between 2012-2022	Studies conducted before 2012
Research articles, peer reviewed	Literature reviews, not peer reviewed
Critical care nursing	Other nursing areas
Challenges in detecting and responding to patients with sepsis in critical care	Challenges in detecting and responding to sepsis outside critical care

The same search terms were replicated in the different databases to be systematic in the search. (Cronin, Ryan & Coughlan 2008). The **table 4** below illustrates the results of the different database searches and screening of the searched data. The search results yielded a total of 525 articles, with 311 articles from CINAHL (n =311) and 214 articles from MEDLINE (n =214) as shown in the table.

Table 4. Database search results

Database	Search terms	Limiters	Hits	Chosen by title	Chosen by abstract	Chosen by full text
CINAHL	Challenges in detecting sepsis OR challenges in responding to patients with sepsis AND Critical care nurs*	2012-2022, English language, peer reviewed, research article, critical care.	311	42	10	8
MEDLINE	Challenges in detecting sepsis OR challenges in responding to patients with sepsis AND Critical care nurs*	2012-2022, English language, peer reviewed, research article, critical care.	214	20	4	2
TOTAL			525	62	14	10

Articles with titles not related to the topic challenges in detecting sepsis and responding to patients with sepsis (n =450) and duplicates (n =13) were removed from the total number of hits before further screening. The selected 62 articles based on title were quickly read through with focus on the abstract section and 14 articles out of the 62 were chosen. The articles with no abstract section (n=30) and unclear research aims and purpose (n =18) were excluded, as illustrated in the Prisma flow diagram **figure 1** below.

The 14 selected articles were further checked to ensure that they were answering to the research questions of this study and with clearly stated research results, of which,

ten articles were finally chosen for review (n=10). The selected articles for this descriptive literature review are shown in table 8 in appendix section. Each article was read several times to gain understanding of its content, data quality and relevance of the study results. (Cronin, Ryan & Coughlan 2008).

4.1.1 Quality check of journal and the articles

Publication channel check (JUFO) checks the journal quality. It uses a four-level classification system (0-3) to rate the quality of journals, one being basic level, two as leading level, three as highest level and zero is publication channels that do not meet the criteria for level one. (Publication Forum 2021). The journals of the selected articles were ranked as level one. Meanwhile, critical appraisal of a research article checks the quality of the research itself and helps to distinguish scientifically useful and well written articles from imprecise ones. (Gajbhiye, Tripathi, Parmar, Khatri & Potey 2021).

Similarly, Critical Appraisal Skill Program (CASP) was used to verify the quality of the articles by utilizing its checklist as follows: a clear statement of research aim(s), appropriate qualitative methodology, appropriate research design to address the research aims, recruitment strategy appropriate to research aims, data collected in a way to address research issues, the researcher and participants relationship considered, ethical issues consideration, meticulous data analysis, clear statement of findings and importance of the research (CASP 2018). The articles selected for this descriptive literature review met the criteria in CASP checklist.

4.1.2 PRISMA flow diagram for the data filtering process

Figure 1 below presents identification of studies through databases, as well as key-words, inclusion and exclusion criteria used and the data filtering process.

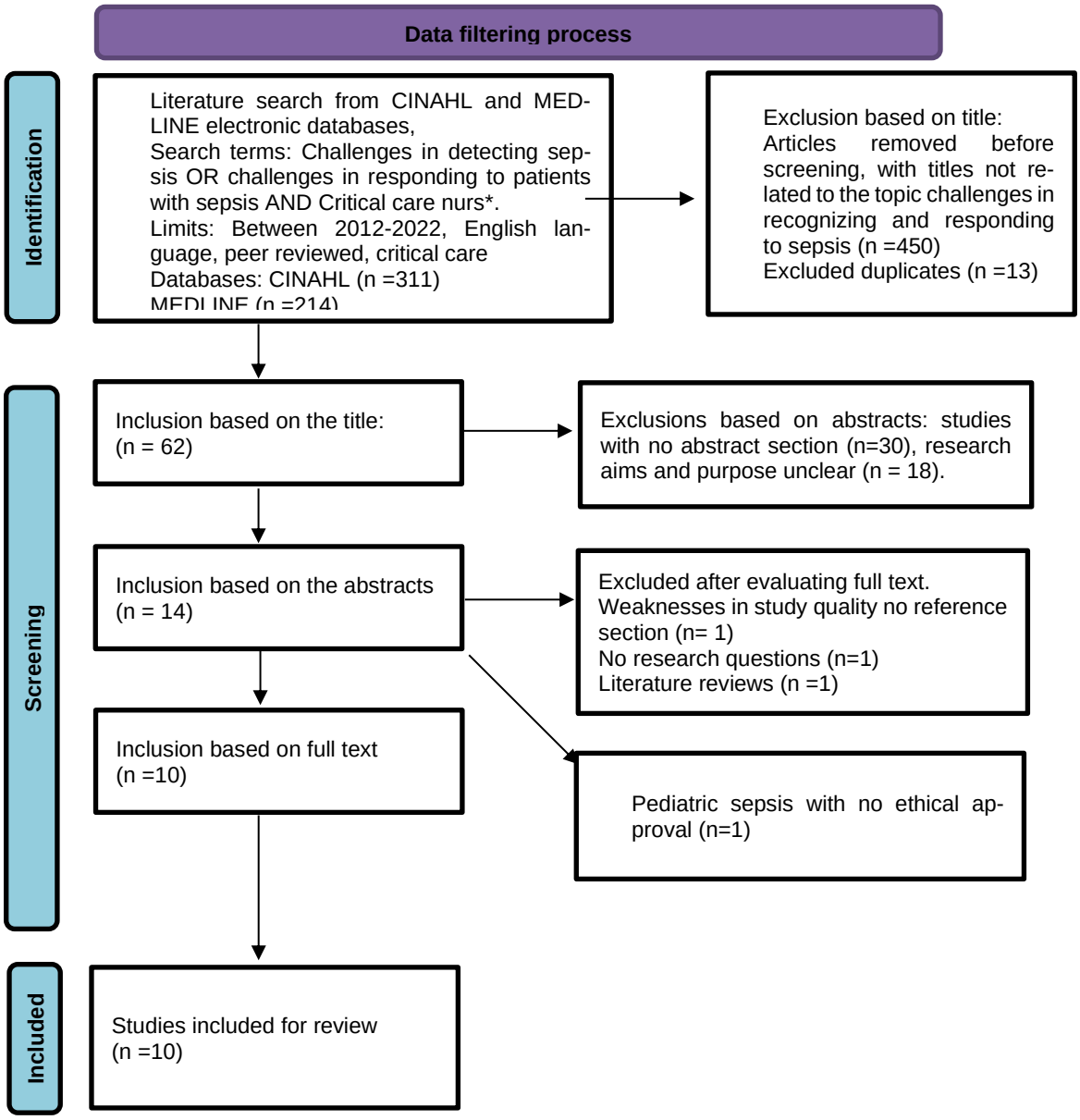

Figure 1. Data search and filtering process. Prisma 2020.

4.2 Data analysis method

Content analysis and thematic analysis are two analysis methods frequently used in qualitative descriptive studies. (Vaismoradi, Turunen & Bondas 2013). In this descriptive literature review, inductive content analysis was used in analyzing the available literature.

In inductive content analysis, the concepts are all derived from the data. A specific unit of analysis is first selected comprising of individual words, combinations of words, sentences, paragraphs, whole interviews or observations. The words, sentences or paragraphs with the same central meaning or that contain aspects related to each other through their contents form a meaning unit. The meaning units are then condensed or shortened while still preserving their core meaning. Labeling of the meaning units and grouping together under higher order headings is coding and creation of categories and themes, which are the tools to think with and prepare for data interpretation, since labelling a condensed meaning unit with a code allows the data to be thought about in new and different ways. Therefore, a category is a group of content that share a commonality and creating categories is the core feature of qualitative content analysis. (Graneheim & Lundman 2004:106-107.)
The list of categories can be further grouped into broader categories to reduce the number of categories. This approach moves from specific to general and the categories are derived from the data. The goal is to understand the data that has been collected and to provide a conceptual description of the phenomenon under study. (Elo & Kyngäs 2002).

In this descriptive literature review, ten primary research articles in nursing science were selected for analysis, see **table 8** in the appendix section for the articles included for review. The selected articles were analyzed using inductive content analysis method, which is exemplified in **table 5** below. Meaning units were obtained from sentences, paragraphs and interview responses that had contents connected to challenges in detecting sepsis and responding to patients with sepsis through their contents. The meaning units were then shortened while still preserving the core meaning. Meaning units from all ten articles were then labelled and grouped together in the coding process, grouping with related contents. The categories were then created including subcategory, which were also grouped under generic category and then main category. The **table 5** below illustrates the data analysis process, with meaning units, condensed meaning units, subcategories, generic and main categories.

Table 5. An example of data analysis of the research articles

Meaning units	Coding	Subcategory	Generic category	Main category
"Nurses' lack of authorization to take blood cultures or administer the first dosage of antimicrobials". (Article 2)	Nurses lack authorization with blood culture procedures and limited rights to give medications	Lack authorization Lack power Limited rights	Lack of nursing authorization in procedures and medications	The challenges in responding to patients with sepsis
"I don't know, as a trust I don't think the nurses usually take blood cultures, it seems to be a doctor role". (Article 4)	Restrictions with blood culture procedures	Defined duties Lack power		
"I'm a doctor, you're a nurse. You can do this within this parameter, but we can do this, we have powers above that". (Article 9	Nurses have defined responsibilities and limited scope of practice	Defined scope of practice Lack power		
"We can give morphine and fentanyl; I don't see why we can't give fluids" and "If it states that nurse can initiate fluids . . . if that gave us that power, that standing order to initiate fluids without the doctor sighting it, yes, I think that's what's holding us up". (Article 9)	Nurses have limited rights to give IV fluid therapy	Limited rights Lack of power		
"If you have it on a care pathway, that gives them allowance, permission almost to phone the consultant and escalate it, so they're allowed to do that". Article 4.	Nurses have limited rights and power to escalate	Limited rights Lack of power		

5 Results

The results of this descriptive literature review show major challenges which critical care nurses face in detecting sepsis and responding to patients with sepsis, including lack of experience and knowledge in sepsis, knowledge deficit in monitoring and interpreting vitals, lack of nursing staff and other resources, excessive workload for nurses and less time for patient assessment and care delivery, institutional policies on fluids, medications and care protocols, poor teamwork and leadership among staff, communication errors at handover and poor interdisciplinary communication during patient care. These challenges are classified into eight generic categories including lack of experience, institutional culture and protocol, insufficient resources, lack of knowledge and competence, poor communication and handover errors, lack of nursing authorization, excessive workload and individual health status. These results elaborated below and summarized in **tables 6 and 7** of the appendix section.

5.1 Challenges in detecting sepsis in critical care nursing

The generic categories and the different challenges include the following:

5.1.1 Lack of experience

Detecting sepsis particularly in its early stage was mentioned as challenging. Poor patient assessment and physical examination of the patient was observed in less experienced nurses who only looked at diagnostic tools and not the actual picture of the patient to recognize subtle signs and symptoms, change in skin colour, skin rashes, lips and tongue. Junior doctor's inexperience equally impacted nurses' ability to act to septic patients. (Harley et al. 2019.) Meanwhile, experienced nurses were more likely to practice intuitive decision making when faced with clinical challenges and will step out of their scope of practice when there was need for initiating for example IV fluids in sepsis patients that could improve the patient's prognosis. (Kabil et al. 2020). One of the studies also found that nurses' knowledge of systemic inflammatory response syndrome (SIRS) and sepsis without recent education increased with the level of ICU in hospitals. (Van den Hengel et al. 2016). Thus, the more experience nurses had with septic patients, the more their knowledge about sepsis and SIRS.

5.1.2 Institutional culture

Institutional culture was one of those important aspects that was often mentioned in all the articles. This category included challenges such as lack of collegial support and team spirit, inexperienced nurses not supported with assessment and identification, fear of pointing errors and lack of confidence to consult more experienced nurses. Some critical care nurses expressed concerns about nurses who go to triage too early and not supported by more experienced colleagues with patient assessment (Harley et al. 2019). Other nurses stated that lack of collegial supported created an underlying fear of making mistakes. (Olander et al. 2021). Moreso, poor team spirit made nurses to lack confidence to point out errors or communicate to team leaders with intimidating personalities. Thus, delaying and impacting care negatively. (Harley et al. 2019).

5.1.3 Insufficient resources

Shortage of nursing staff, short contact time with patients and limited ICU bed capacities were major challenges under the category of insufficient resources. Compressed time frames and busy schedule with huge workload prevented nurses from fully and thoroughly assessing their patients. (Harley et al. 2019). Similarly, when there were not enough nursing staff and limited intensive care unit (ICU) bed capacities, delay in patient admission and transfers were observed. (Matthaeus-Kraemer et al. 2016).

5.1.4 Lack of knowledge and competence

This category included challenges such as nurses' knowledge deficit of sepsis and poor interpretation of clinical signs and symptoms, insufficient knowledge and training on screening and prognostic tools, less qualified nurses with limited knowledge admitting and attending to patients and knowledge deficit of early warning signs of sepsis when guidelines do not confirm assessment. There was also a significant lack of knowledge among nurses when patients presented with low body temperatures and had low concentration of neutrophils as signs of sepsis (Rahman et al. 2019). Registered nurses mentioned of 8.3mmol/L in an interview, as the value of venous lactate that will raise concern for severe sepsis, portraying knowledge deficit of signs of severe sepsis and patient deterioration. (Burney et al. 2012). Similarly, lactate test was not taken from one third of patients that presented with signs and symptoms, possibly delaying sepsis detection and indicating poor understanding of need for lactate measurements in sepsis

(Crilly et al. 2019). Critical care nurses in emergency department talked of delayed detection and poor recognition of sepsis in triage for patients who presented with no fever. (Burney et al. 2012). Other nurses equally mentioned that patient assessment was difficult when signs and symptoms were vague and not confirmed by guidelines. (Olander et al. 2021).

5.1.5 Individual health status

Challenges observed under this category were patient's age and pre-existing medical condition, other comorbidities or underlying diseases masking signs and symptoms of sepsis, change in individual patient's status causing IV access issues for example and treatment restrictions with certain patients. Detecting sepsis in vulnerable patients such as the elderly and those with pre-existing organ dysfunction seemed even more difficult, as they can be afebrile, have limited stress response with relatively normal vitals. Nurses equally expressed the difficulty of detecting sepsis particularly in its early stage, as the early signs and symptoms could be attributed to other common medical conditions. (Crilly et al. 2019.) The assessment was particularly difficult when signs and symptoms were vague and not confirmed by guidelines. (Olander et al. 2021). The sepsis pathway was also seen as complex and overloaded with information.

5.2 Challenges in responding to patients with sepsis in critical care

The identified generic categories and different challenges include the following:

5.2.1 Lack of nursing authorization

Nurses limited rights with medications and procedures like taking blood cultures and administering the first dose of antimicrobials or initiating IV fluids therapy, defined scope of practice and limited access to protocol medications were challenges under this category of lack of nursing authorization. Due to the limitation in scope of practice, some nurses preferred not to cannulate or initiate the recommended IV fluids in sepsis even when the patients needed their fluids, because they would not want to step out of their scope of practice. It was equally mentioned that other nurses stepped out of their scope of practice when there was need for initiating IV fluids for sepsis patients. (Kabil et al. 2020).

5.2.2 Institutional culture and protocol

Institutional policies with fluids, antibiotics, and vasopressors therapies in the care of septic patients, laboratory delay with samples, physician delay in diagnosing and prescribing medications and pharmacy delays in preparing protocol medicines were the major challenges under this category of institutional culture and protocol. Some nurses mentioned that when septic shock was first detected by them, there was delay on the physician's part in evaluating the patient and prescribing antibiotics. Lack of leadership in improving sepsis six bundle performance and a culture of not measuring urine output and doing fluid charts were other important challenges that were largely expressed. (Roberts et al. 2017.) Similarly, nurses stated that care of septic patients was challenging with no written care protocol put in place in the department and thus they were unaware of what the institution's severe sepsis care protocol recommends. (Burney et al. 2012).

5.2.3 Excessive workload

Excessive workload for nurses had contributing factors such as the Care of critically ill patients with multiple and complex comorbidities, time consuming nursing activities and multiple orders to complete. Busy workload was identified as the primary factor causing delays in initiating treatment. (Kabil et al. 2020.) Nurses equally talked of the huge caseload and burden of caring for critically ill patients with multiple intravenous (IV) lines that require constant checking (Burney et al. 2012). The multiple administration of IV medications and fluids sometimes created an IV access issue that impacted on timely care delivery. (Harley et al. 2019).

5.2.4 Insufficient resources

Insufficient nursing staff, limited ICU beds, malfunctioning equipment and limited time to adequately deliver the sepsis six care bundle within one hour were all challenges in this category of insufficient resources. Nurses mentioned that it was time consuming and complex to go through all the steps of the sepsis care pathway as it is overloaded with information. Moreso, shortage of nursing staff and busy workload were challenges that were widely addressed as causing delays in initiating treatments and successfully completing resuscitation protocol. Patients then became even more sick when treatment was delayed and ended up in resuscitation areas with inotropes and arterial lines.

(Kabil et al. 2020.) Delays in patient transfer between general ward (GW) and the intensive care unit (ICU) was caused by shortage of nurses and lack of available ICU beds, which was observed as risky for the septic patients. (Matthaeus-Kraemer et al. 2016).

5.2.5 Lack of knowledge and competence

Nurses' knowledge deficit in monitoring and interpreting vitals, insufficient knowledge of cannulation and IV medication administration and knowledge deficit in performing the sepsis six care bundle were challenges within the category of lack of knowledge and competence. There were instances when blood cultures were not taken prior to antibiotics administration. (Crilly et al. 2019). There were also cases when nurses did not understand the significance of giving IV fluids concomitantly with IV antibiotics to a septic patient to optimize patient's blood pressure and drive the medicine into the blood stream. It was also reported that less experienced nurses without cannulation competency faced difficulty cannulating sick patients, which led to delay in initiating IV fluids and antibiotics. (Kabil et al. 2020.) Other challenges such as insufficient training in sepsis care protocol and skills assessment, the lack of written care guidelines and didactic materials in departments were contributing factors. It was reiterated that the sepsis pathway is complex and overloaded with information and hard to remember especially for junior and inexperienced nurses and thus, persistent training and education regarding the sepsis pathway could be helpful. (Kabil et al. 2020).

5.2.6 Poor communication and handover errors

Poor communication and poorly coordinated handovers were also discussed as major challenges under delay in detection and delay treatment of severe sepsis. The different challenges addressed under this category were limited patient information and inadequate medical history at admission and handover, ineffective communication between staff at handover, poor interdisciplinary communication, poor communication of treatment urgency and lack of direct ICU instructions. Inadequate patient medical history at admission were frequently mentioned especially in emergency department (ED). (Matthaeus-Kraemer et al. 2016). Similarly, when patients were given the wrong triage category, the urgency of their condition was not conveyed. (Kabil et al. 2020). Handovers between hospital's general ward (GW) and the ICU were described as poorly coordinated because of the absence of responsible physician and loss of vital information. (Matthaeus-Kraemer et al. 2016). Communication between nurses and doctors were also described as inhibiting at times and the contributing factors were the experience level of nurses and their clinical skill set. (Kabil et al. 2020).

6 Discussion

Sepsis is a critical healthcare problem, a major cause of admission to the ICU and a major cause of death worldwide, with a huge global burden that was estimated by WHO in 2017 to be 48.9 million sepsis cases and 11 million sepsis-related deaths worldwide. Prompt detection of sepsis and timely interventions are no doubt vital for patients and saves lives. (Bleakley & Cole 2020). However, timely detection of sepsis and appropriate interventions are not without challenges as shown by the results of this study. The study results showed eight generic categories after a careful review of ten primary research articles, whose subcategories describe the challenges critical care nurses face in detecting sepsis and responding to patients with sepsis in critical care.

Challenges such as nurses' knowledge deficit of sepsis and its clinical signs and symptoms, knowledge deficit regarding monitoring and interpreting vitals and shortage of nursing staff in implementing care protocol for early sepsis resuscitation were among the challenges that were reiterated as obstacles for early detection of sepsis and for responding to septic patients amongst critical care nurses. These finding are consistent with the results of a survey of ED nurses and physicians conducted in the United States to investigate the barriers to implementing protocol-based sepsis resuscitation in the emergency department, which stated that, a critical shortage of nursing staff, the inability to monitor central venous pressure and difficulty in identifying septic patients were some of the largest impediments to implementing a resuscitation clinical pathway. (Carblom & Rubenfeld 2007).

The major findings of this descriptive literature review are important challenges for nurses and student nurses, as they provide key insights regarding the difficulties with care of septic patients. An understanding of the different challenges can be beneficial for nurses who are in constant interaction with these patients and who spend more time with them at bed side, on how to improve their nursing practices and better care for the septic patients. The findings of this study are equally important in empowering students who aspire to be future critical care nurses and in enriching educational materials for critical care nursing.

Furthermore, this study has shown that detecting sepsis and managing septic patients involves challenges. Nurses' knowledge deficit of sepsis, knowledge deficit in monitoring and interpreting vitals were some of the challenges mentioned by both ED nurses and ICU nurses. However, factors that support nurses's understanding and knowledge of sepsis and its treatment were rarely addressed and hence a knowledge

gap. This can be a point of further research that could produce new knowledge about nursing understanding of the care of septic patients.

6.1 Validity

Validity in qualitative research assesses how well the research tools measure the phenomenon being studied. The validity of a qualitative research results for example is determined by clear and concrete research questions and correct interpretation of questions, valid data collection process to ensure there are no defects in data collection, a valid data analysis method, correct data reporting and unbiased interpretation of results. (Roberts et al. 2006.)

To ensure the validity and trustworthiness of the data and results of this qualitative study, a systematic database search was done via CINAHL and MEDLINE electronic databases using clear search sentences and being specific with inclusion criteria. Articles not older than ten years were included in the search and clear and concrete research questions were formulated with the use of PICo tool and Boolean operators, to guide the search of data. The same search terms were replicated in the different databases. To further ensure validity and reliability of this study, publication channel check (JUFO) was performed for each article to check the quality of its journal and the critical appraisal skill program (CASP) checklist was utilized to assess the quality of each article. Data was analyzed using inductive content analysis with the categories generated from the data. Interpretation of the results of data analysis was fair and unbiased.

6.2 Ethics

Ethics refers to the moral principles that guide decision-making and behavior. Moral principles are guidelines of what is considered right or wrong. Research ethics thus ensures that healthcare professionals and all researchers work and research ethically, adhering to national and international ethical standards to do good for the public from which all humans can benefit. (Ingham-Broomfield 2011).

The main ethical principles that support planning and conducting research include respect for persons and the right of self-determination, maintaining privacy and confidentiality of participants' information. Beneficence, that is, potential benefits of the study for participants or the public. Non-malfeasance, that is, free from harm and risk of exploitation. Justice and fairness, including truth talking about any benefit or risks that may be

involved. It is therefore necessary to ensure that nurse researchers understand and apply the ethical principles within any healthcare research. (Glasper & Rees 2016.)

This study is a descriptive literature review of past primary studies conducted around the topic of sepsis, thus, questionnaires for informants, informed consents of participants and the permission of an ethics committee was not deemed necessary. However, articles used for this study follow the ethical principles of qualitative research and are approved by appropriate ethics committees. The topic of this study is an ethically right topic in healthcare and globally. The study is conducted for educational reasons, to produce knowledge that will benefit both students and critical care nurses. Data for this study was obtained from Metropolia's databases for students and permission obtained to access data of limited access. All sources included in this study were duly referenced and no plagiarism of previous works. The ethics and reference lists of all included articles were equally checked to qualify for use and the Turnitin service used to check for plagiarism.

7 Conclusion and Recommendations

Overall, this study described the challenges faced by critical care nurses in detecting sepsis and responding to patients with sepsis, with available literature mainly in ED and ICU settings. Challenges such as lack of experience and knowledge in sepsis, lack of nursing staff and other resources to successfully complete a resuscitation protocol, excessive workload and less time for patient assessment and care delivery, lack of leadership and teamwork among staff, communication errors at handover and poor interdisciplinary communication during patient care were often mentioned by both ED nurses and ICU nurses. However, there were also experienced nurses with good knowledge base relating to detecting sepsis and care of septic patients. It is equally important to note that sepsis is a complex clinical syndrome and caring for patients with sepsis is complex and involves many challenges according to this study. The findings of this study are therefore beneficial for both critical care nurses and students, empowering them to articulate their perceptions and increase their knowledge of sepsis care and its challenges, which will help improve the care of septic patients and positive patient prognosis with reduced morbidity and mortality.

8 Limitations

This study was limited to critical care setting, precisely ICU and ED areas. Sepsis in care homes and hospital wards were excluded and therefore the concept of patient deterioration and the challenges in responding to the patients in these settings may vary. However, treatment of majority of septic patients commences in the emergency department and continues in ICU. Thus, findings from this study are trustworthy.

Additionally, only ten research articles were reviewed in this study, one article with authors from the United Kingdom, two articles from America, one article from Malaysia, three articles from Australia and three articles from Europe, as shown in **table 8** in appendix section. Thus, limited scope and no information about sepsis situation and its challenges with ICUs in Africa for example.

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The results of data analysis based on inductive content analysis method are shown on the table below.

Table 6. The challenges in detecting sepsis in critical care

Main category	Generic category	Subcategory
The challenges in detecting sepsis in critical care nursing	Lack of experience	Inexperienced nurses' difficulty recognizing subtle signs of sepsis.
		Poor patient assessment, physical examination and observations.
		Junior doctor's inexperience impacting nurses' ability to act to sepsis patients.
	Institutional culture	Lack of collegial support and team spirit.
		Intimidating team leaders and lack of confidence to speak up.
		Fear of pointing errors, lack of confidence to consult more experienced nurses.
	Lack of knowledge and competence	Nurses' knowledge deficit of sepsis
		Insufficient knowledge and training on screening and prognostic tools.
		Poor recognition and interpretation of signs and symptoms.
		Knowledge deficit of hypothermia and neutropenia as signs of sepsis.
		Knowledge deficit of early warning signs of sepsis when guidelines do not confirm assessment.
		Less qualified nurses admitting and attending to patients.
	Insufficient resources	Insufficient nursing staff,
		Limited ICU beds,
		Short contact time with patients,
		Compressed time frames with less time for patient assessment
	Poor communication and handover errors	Limited patient information at admission
		Ineffective communication at handover,
		Urgency of patient's condition not conveyed or recognized and

		Poor interdisciplinary communication
	Individual health status	Patient's age and preexisting medical conditions
		Underlying diseases masking signs and symptoms of sepsis.
		Early signs and symptoms indicating other medical conditions,
		Unclear signs and symptoms not confirmed by guidelines

Table 7. Challenges in responding to patients with sepsis in critical care nursing

Main category	Generic category	Subcategory
Challenges in responding to patients with sepsis in critical care nursing	Lack of nursing authorization	Nurses limited rights with procedures and medicines,
		Defined scope of practice and
		Limited access to protocol medicines.
	Institutional culture and protocol	Laboratory delays with samples,
		Physician delays with assessment and prescriptions,
		Pharmacy delays with protocol medications,
		Institutional policies on fluids, antibiotics, and vasopressor therapies,
		Poor teamwork, leadership, and interdisciplinary collaboration
	Excessive workload	Care of critically ill patients with multiple comorbidities,
		Case complexity with multiple tasks,
		Time consuming nursing activities and
		Delays in completing orders
	Poor communication and handover errors	Limited patient information at handover,
		Ineffective communication between staff,
		Lack of direct ICU instructions,
		Poor communication of treatment urgency and
		Poor interdisciplinary communication.
	Insufficient resources	Insufficient nursing staff,
		Limited ICU beds,
		Equipment malfunction

		Limited time to adequately deliver sepsis six.
	Lack of knowledge and competence	Nurses' knowledge deficit in monitoring and interpreting vitals,
		Insufficient knowledge of cannulation and medication administration,
		Knowledge deficit in performing sepsis six steps,
		Insufficient training in sepsis care protocol and skills assessment,
		Lack of written care guidelines and didactic materials in departments
	Individual health status	Change in patient's status and IV access issues,
		Age of patient and other comorbidities and
		Treatment restrictions.

The table below contains articles included for this review.

Table 8. Articles included for review

Authors, year, country.	Research topic purpose, aim.	Methodology & methods	Participants	Main outcomes
1. Burney et al. 2012. USA.	Early detection and treatment of severe sepsis in the emergency department: Identifying barriers to implementation of a protocol-based approach. Aim: To identify and address specific barriers for resuscitation of patients with severe sepsis and septic shock in the emergency department and maximize benefits of a planned sepsis treatment initiative.	Quantitative study with online questionnaires.	101 emergency department nurses and physicians of a medical center. n=101	Study results identified barriers to quantitative resuscitation protocol for sepsis. These barriers included the inability to perform central venous pressure/central venous oxygen saturation monitoring, limited physical space in the emergency department, and lack of sufficient nursing staff. Among nurses, the greatest perceived contributor to delays in treatment was a delay in diagnosis by physicians; among physicians, nursing delays and in

				availability of ICU beds were the greatest barriers.
2. Matthaeus-Kraemer et al. 2016. Germany.	Crossing the handover chasm: Clinicians' perceptions of barriers to the early detection and timely management of severe sepsis and septic shock. Purpose: to identify barriers to the early detection and timely management of severe sepsis throughout the emergency department (ED), general ward (GW), intermediate care unit (IMC), and the intensive care unit (ICU).	Qualitative Focus group discussion	29 clinicians (11 physicians and 18 nurses) n=29	Major causes of delayed detection and treatment were communication errors and handover difficulties throughout patients' course of treatment, which are further divided into inadequate histories before hospital admission, poorly coordinated handovers between the ambulance service and the ED; delayed patient transfer between the ED and the GW as well as delays in patient transfers between the GW and the ICU by, for example, a lack of bed capacity and a shortage of staff.

3. Van den Hengel et al. 2016. Nether lands	Knowledge about systemic inflammatory response syn-drome (SIRS) and sepsis: a sur-vey among Dutch emergency department nurses. Aim is to ex-amine the fac-tors that influence the knowledge and recognition of systemic inflammatory response syn-drome (SIRS) criteria and sepsis by emergency de-partment (ED) nurses.	Observa-tional sur-vey, with question-naires.	216 emer-gency depart-ment nurses n=216	Knowledge of ED nurses concern-ing SIRS and sepsis increased proportionally with the level of ICU in hospitals. Re-cent education in sepsis raised knowledge level as well. ED nurses over the age of 50 scored significantly lower than their younger colleagues.
4. Roberts et al. 2017 UK.	Barriers and facilitators to-wards implementing the Sepsis Six care bundle at a case study hospital. Aim is to understand and address such implementa-tion issues.	A mixed method investiga-tion, with semi-structured inter-views.	113 partici-pants: nurses from E D, Medical and Surgical, doc-tors and con-sultants.	Different facilita-tors and barriers towards Sepsis Six performance across different staff groups were identified. Facili-tators included confidence in knowledge and skills, beliefs in overall benefits of the bundle, be-liefs that identifi-cation and man-agement of sep-tic patients fell within everyone's role, and that

				regular use of the bundle made it easier to remember. Some beliefs were applicable for the entire group, others were specific to particular staff groups.
5. Roberts et al. 2017 USA.	A survey of critical care nurses' practices and perceptions sur-rounding early intravenous antibiotic initiation during septic shock. Aim is to evaluate the knowledge, practices and perceptions of critical care nurses regarding antibiotic initiation in patients with newly recognized septic shock.	A descriptive survey, with questionnaires	100 critical care nurse n=100	Almost all the nurses knew of the existence of sepsis protocol. However, delay in antibiotics initiation and lack of awareness of IV antibiotics were observed. Most of the nurses stated they would optimize blood pressure with either fluid or both fluid and a vasopressor before antibiotic initiation.
6. Harley et al. 2019 Australia.	Emergency nurses' knowledge and understanding of their role in recognizing	Qualitative, with semi structured interviews	14 emergency department nurses n=14	Deficit in the nurses' capacity to recognize and respond to patients with sepsis.

	and responding to patients with sepsis. Aim: to enrich nursing educational packages used to improve quality of patient care and patient outcomes.			Participants' perspectives were aligned with six main interrelated themes: contribution of the organization, appreciation of knowledge, appreciation of clinical urgency, appreciation of importance of staff supervision, aware-ness of the importance of staff experience and awareness of the need to seek advice.
7. Crilly et al. 2019 Australia.	Recognition, response, and outcomes of sepsis. An observational study. Objective: to describe clinical recognition, response, and outcomes of patients with sepsis.	Observational study.	96 adult patients admitted under general medicine followed by intensive care n=96	Sepsis was recognized for most patients with a history of fever or rigors, indicating signs of infection. Regarding response and outcomes, less than half of the patients were seen within the recommended triage timeframe, most patients were not given antibiotics with-in

				60minutes of triage or diagnosis as recommended, each of the 'Sepsis Six' strategies were provided in more than 65% of patients, 17% were re-admitted within 28 days and the in-hospital mortality 18%.
8. Rahman et al. 2019 Malaysia.	Knowledge and attitude towards identification of systemic inflammatory response syndrome (SIRS) and sepsis among emergency personnel in tertiary teaching hospital. Aim: To evaluate emergency personnel's knowledge and attitude toward identification and management of SIRS and sepsis.	Cross-sectional study, with questionnaires	118 emergency nurses and personnel n=118	Study results showed that emergency nurses and other personnel have a moderate knowledge and neutral attitude toward identification and management of SIRS and sepsis. Awareness and knowledge of SIRS and sepsis should be enhanced among emergency personnel to improve outcome.
9. Kabil et al. 2020 Australia.	Emergency nurses' experiences of the implementation of early goal directed fluid resuscitation therapy in the management	Qualitative, with semi structured interviews	10 registered nurses n=10	Timely initiation of early goal directed fluid resuscitation was

	of sepsis: a qualitative study. Aim, to explore experiences of emergency nurses initiating early goal directed fluid resuscitation in patients with sepsis.			inhibited by several factors including nurses' perceptions, experiences, and clinical practice challenges. Busy workloads were identified as primary factor causing delays in initiating treatment
10. Olander et al. 2021 Sweden.	Assessment of patients with suspected sepsis in ambulance ser-vices: a qualitative interview study. Aim: to explore ambulance clinicians' (AC) lived experiences in assessing patients suspected of having sepsis.	Qualitative, with semi-structured interviews	19 ambulance clinicians including nurses n=19	Results showed that ACs need to be observant of information and warning signs in the patient's environment during assessment to suspect sepsis. Sepsis was considered difficult to suspect solely based on guidelines or specific symptoms and signs.