






POTENTIAL CONTRIBUTION OF CHATGPT® TO LEARNING ABOUT SEPTIC SHOCK IN INTENSIVE CARE

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ABSTRACT

Objective: to demonstrate the application of some prompts and to problematize the use of ChatGPT® to guide the best answers for nursing students and teachers on septic shock in intensive care learning.

Method: a methodological study where prompt technology was applied in ChatGPT® to support nursing learning in intensive care with an emphasis on septic shock. The study was organized in 3 stages, covering an understanding of ChatGPT® and models, as well as testing and exercising prompts.

Results: applications of prompts were presented, based on a structure of pre-defined stages that made it possible to exemplify the answers given and to organize an output generation diagram as a way of summarizing the process of decision support in intensive care.

Conclusion: ChatGPT® is a natural language processing model that uses deep learning approaches to generate human-like answers. However, the generation of prompts for the teaching-learning process in intensive care nursing requires in-depth association with the pillars of evidence-based practice.

DESCRIPTORS: Artificial Intelligence. Critical care. Intensive care units. Nursing. Information technology. Septic shock.

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CONTRIBUIÇÃO POTENCIAL DE APLICAÇÃO DO CHATGPT® NA APRENDIZAGEM DO CHOQUE SÉPTICO EM TERAPIA INTENSIVA

RESUMO

Objetivo: Demonstrar a aplicação de alguns *prompts* e problematizar o uso do ChatGPT® para guiar as melhores respostas aos estudantes e professores de enfermagem sobre choque séptico na aprendizagem em terapia intensiva.

Método: Estudo metodológico, com aplicação de tecnologia de *prompts* no ChatGPT® para apoiar a aprendizagem de enfermagem em terapia intensiva com ênfase no choque séptico. O estudo foi organizado em 3 etapas, contemplando o entendimento sobre o ChatGPT®, modelos, bem como teste e exercício de *prompts*.

Resultados: Foram apresentadas aplicações de *prompts* a partir de uma estrutura de etapas pré-definidas que permitiram exemplificar respostas dadas e organizar um diagrama de geração de saídas como uma forma de resumir o processo de apoio à tomada de decisão em terapia intensiva.

Conclusão: O ChatGPT® é um modelo de processamento de linguagem natural que usa abordagens de aprendizagem profunda para gerar respostas semelhantes às humanas. Contudo, a geração dos *prompts* para o processo de ensino-aprendizagem em enfermagem de terapia intensiva requer associação profunda com os pilares da prática baseada em evidência.

DESCRITORES: Inteligência artificial. Cuidados críticos. Unidades de terapia intensiva. Enfermagem. Tecnologia da informação. Choque Séptico.

POTENCIAL APORTE DE APLICAR CHATGPT® EN LA ENSEÑANZA DE SHOCK SÉPTICO EN CUIDADOS INTENSIVOS

RESUMEN

Objetivo: demostrar la aplicación de algunos *prompts* y debatir cómo se utiliza ChatGPT® para orientar las mejores respuestas a estudiantes y profesores de Enfermería sobre shock séptico en la enseñanza de cuidados intensivos.

Método: estudio metodológico en el que se aplicó la tecnología de *prompts* en ChatGPT® para respaldar la enseñanza de Enfermería en cuidados intensivos con énfasis en shock séptico. El estudio se organizó en 3 etapas, contemplando lo que se sabe sobre ChatGPT® y diversos modelos, al igual que pruebas y prácticas con *prompts*.

Resultados: Se presentaron aplicaciones de *prompts* a partir de una estructura de etapas predefinidas que permitieron ejemplificar respuestas dadas por el sistema y organizar un diagrama de generación de salidas como una manera de resumir el proceso de apoyo a las decisiones que se toman en cuidados intensivos.

Conclusión: ChatGPT® es un modelo de procesamiento del lenguaje natural que utiliza enfoques de aprendizaje profundo para generar respuestas semejantes a las humanas. Sin embargo, la generación de los *prompts* para el proceso de enseñanza-aprendizaje en Enfermería de cuidados intensivos requiere una profunda asociación con los pilares de la práctica basada en evidencias.

DESCRIPTORES: Inteligencia Artificial. Cuidados críticos. Unidades de cuidados intensivos. Enfermería. Tecnología de la información. Shock séptico.

INTRODUCTION

Artificial Intelligence (AI) is a multidisciplinary approach to computer science and linguistics that uses technology to simulate human cognitive and behavioral processes on computers. Computers are designed to show comprehension, reasoning and problem-solving skills similar to those of humans through specific coding. In addition, these systems can operate in areas that normally require intelligence (e.g. working on issues such as language perception, visual object recognition and decision making), using learning, adaptation, reasoning and understanding capabilities, parallel to cognition and complex human attributes such as attention, emotion, creativity, among others¹⁻².

AI-based models are progressively being used in health services and these applications will become even more widespread in the future. In this age of transformation in which technology is advancing rapidly, we hope that nurses will recognize AI models and be able to use this technology in nursing practices as well as increase their levels of knowledge and skills. As health services advance technologically, discussing potential advantages and disadvantages of AI-based technology, health care will be made possible by recognizing and participating in the development and use of these technologies.

In this AI universe, there are generative artificial intelligences, classified as generative adversarial neural networks (GANs), which have the capability of learning and generating new data, called generative and discriminative networks. These AIs learn from large databases so that they can acquire the construction pattern of this data. With this acquired understanding, they can generate new data³.

Generative AI thus describes algorithms (such as ChatGPT[®]) that can be used to create new content, including audio, code, images, text, simulations and videos. Recent advances in this field show the potential to change the way we approach content creation. It is important to note that ChatGPT[®] is not only an easy-to-use computer algorithm that produces short answers, but an intelligent system that can produce entire documents, essays or even computer codes⁴.

Thus, as an essential part of today's health care, nursing professionals need to adapt to the rapid advances in AI in order to provide efficient, person-centered care, with health accessible to all. An example of this is the Generative Chat Pre-Trained Transformer (ChatGPT[®]; launched on 11/30/2022), an open-access platform with possibilities, such as AI-supported chatbots, that will impact education in clinical practice and scientific documents in the health area⁵⁻⁷.

ChatGPT[®] is an AI-based broad language model (LLM-Master of Laws), trained on massive text datasets in multiple languages and capable of generating human-like answers from text input⁸. It was developed by OpenAI (OpenAI, L.L.C., San Francisco, CA, USA). The etymology of ChatGPT[®] is related to a chatbot (a program capable of understanding and generating answers using a text-based interface) that is based on the architecture of a pre-trained generative transformer (GPT)⁸⁻⁹.

The GPT architecture uses a neural network to process natural language, thus generating answers based on the text entered into the platform. When compared to its GPT-based predecessors, ChatGPT[®]'s superiority can be linked to its ability to answer in multiple languages, generating refined and highly sophisticated answers based on advanced modeling. It has been trained on a large amount of data, allowing it to generate coherent and contextually appropriate answers to a wide range of prompts. With its advanced natural language processing capabilities, ChatGPT[®] can perform tasks such as language translation, summarization and answering questions⁸⁻⁹.

In this sense, AI-powered chatbots can improve training by offering personalized learning opportunities to students and professionals (e.g. possibilities for clinical assessment of patients to

make a safer decision) and the experience of future intensive care nurses. However, the integration and adaptation of chatbots into intensive care nursing practice will require a careful and conscious approach to these issues by nurses.. Nurses must use technologies, such as chatbots, correctly and effectively, considering their potential benefits, limitations and risks in order to offer the best care to patients.

Therefore, for ChatGPT® to enhance intensive care nursing training and practice, taking into account the complex demands of intensive care patients, good questions need to be asked to promote better decision-making for increasingly safe care. Therefore, the aim of this study was to demonstrate the application of some prompts and to problematize the use of ChatGPT® to guide the best answers to nursing students and teachers about septic shock in intensive care learning.

METHOD

This methodological research study sought to develop a new instrument, method, procedure, product, program, research tool, theory or model. It was also used to validate and check the reliability of the instruments to measure constructs used as variables in the research¹⁰.

As the study aimed at new research opportunities based on artificial intelligence, we opted for methodological research with the application of technology involving the Graduate Program in Health Informatics (professional modality). Considering the complexity of the topic of septic shock in the context of nursing training, five professors (with nursing training and experience in intensive care) from the program mentioned above were the participants.

The methodological path was structured in three stages: understanding the structure and operation of ChatGPT®; writing model prompts and testing the prompts.

The first stage was aimed at understanding the structure and operation of ChatGPT®. From delving into the literature and understanding prompt engineering and generative AI, prompt was defined as a question, set of instructions or statement used to initiate or guide a task or conversation. When it comes to language processing, a prompt is an input that the model uses to give an answer or output. Thus, prompt engineering is the process of designing and optimizing questions for AI language models (as used in GPT-4).

The quality and effectiveness of the prompts used to train these models can significantly affect their performance and their ability to generate accurate and useful outputs.. In prompt engineering, the goal is to create prompts that effectively convey the model's inputs and outputs, minimizing ambiguity, noise and other factors that can reduce the model's accuracy or effectiveness. This involves selecting appropriate input formats and defining the expected output format, taking into account any restrictions or limitations that may affect the model's performance¹¹⁻¹².

GPT-3 is unimodal, i.e. it only accepts text entries. It can process and generate various forms of text (with formal and informal language), but it cannot handle images or other types of data. In contrast, GPT-4 is multimodal. It can accept and produce both text and image inputs and outputs, making it more diverse. According to OpenAI, the latest version of Chat GPT is more likely (40.0%) to produce accurate answers and less likely (82.0%) to respond to requests for prohibited content than GPT-3 Chat. Users can feel safer employing GPT-4 Chat because its AI is much less likely to respond to harmful or inappropriate queries¹¹⁻¹².

Some model prompts were written in the second stage. At their most basic level, both OpenAI's GPT-3 and GPT-4 predict text based on input (prompt). To get the best results, it was then necessary to write clear prompts with a broad context.. At this stage, we chose to address septic shock in

Intensive Care Nursing because of the authors' experience in the field and because it is a complex and challenging subject for nursing care. Thus, after a thorough grounding in the literature (and various discussions), it was possible to delimit the scope of the questions and carry out the tests to refine the questions in the ChatGPT® model. This process led to a consensus that the prompt structures performed best with clear, objective questions in English.

The prompts were tested and practiced in the third stage. As the prompts on orientation, care and septic shock were tested and practiced, it was possible to identify the specificity needed to construct each question to meet the proposed objective, thus broadening the learning process and filling in gaps. In this stage, teaching and professional experience were key to obtaining better output results. After practicing this technology for a few hours, it was possible to organize suggestions for students to write a GPT-3 or GPT-4 prompt.

In this sense, we emphasize that prompt engineering is the science and art of creating effective inputs to guide an AI model and generate the desired output. In this study, the prompts (inputs) were the clinical questions; the better the prompts, the better the results. We would emphasize that the process of generating prompts and verifying answers (outputs) was supported by consolidated scientific evidence, considering the time limitations of the tool itself.

RESULTS

Using ChatGPT® and similar tools implies risks, as answers can be generated from unreliable sources or provide incomplete sources and the consequences usually fall on the users. Therefore, all information needs to be verified with rigorous evidence, especially in the area of health. Despite the limitations of this technology, it is fast becoming an indispensable ally, which brings us to the heart of the following questions: How to ask the best questions in the intensive care unit? What are the results of the method used?

Prompt engineering is fundamental; its understanding is necessary for the training of nurses and should be added to the curriculum. Mastery of prompt engineering (as with any skill) comes as much from theoretical study of the subject matter as from practical experience. To maximize time and reduce trial and error, some examples are provided below for learning about septic shock in intensive care using ChatGPT®¹³.

1. **Be as specific as possible:** The more specific your prompt, the more precise and focused the answer will be. In this study, prompts in English were used, but they can be written in any language (Figures 1 and 2).

In this example, a specific area of intensive care nursing is covered. However, a more general question can be asked (in any area of nursing), narrowing it down to the specific point to be addressed. For example: *What are the common challenges faced by nursing students in their training process and what types of support can be provided to overcome these difficulties?*

It is important to note that the information (general or specific) provided by ChatGPT® may vary depending on the individual characteristics of the patient and the protocols of the health institution. We emphasize that close collaboration between members of a multidisciplinary team of health professionals and the support of scientific evidence are crucial to optimizing results in critically ill patients.

Septic shock is a life-threatening condition that occurs as a complication of severe infection. When an infection spreads throughout the body, it can trigger a systemic inflammatory response, leading to widespread inflammation and organ dysfunction. In septic shock, this response is particularly severe, causing a significant drop in blood pressure and inadequate blood flow to vital organs.

When a patient with septic shock is admitted to the intensive care unit (ICU), the primary goal is to stabilize their condition and provide intensive medical support. Here are some key aspects of managing septic shock in the ICU:

1. Hemodynamic support: Patients with septic shock often experience low blood pressure due to vasodilation and fluid loss. To restore blood pressure and tissue perfusion, they require fluid resuscitation and may need vasopressor medications (e.g., norepinephrine) to constrict blood vessels and increase blood pressure.
2. Antibiotics: Prompt administration of appropriate antibiotics is crucial in septic shock to target the underlying infection. Broad-spectrum antibiotics are initially used, and they are often adjusted once the causative organism is identified through blood cultures or other diagnostic tests.
3. Source control: Identifying and eliminating the source of infection is important in managing septic shock. This may involve surgical intervention, such as draining an abscess or removing infected tissue, or other procedures to control the source of infection.
4. Ventilatory support: Patients with septic shock may develop respiratory failure and require mechanical ventilation in the ICU. Ventilatory support helps maintain oxygenation and correct any respiratory acidosis that may arise due to inadequate oxygen exchange.
5. Fluid management: Achieving an optimal fluid balance is crucial in septic shock. While fluid resuscitation is initially necessary, excessive fluid administration can lead to fluid overload and worsen organ function. Hemodynamic monitoring techniques, such

Figure 1 – Example of less specific prompts: “Tell me about septic shock in the ICU”, 2023.
Source: ChatOpenAI (2023)⁸

The main hemodynamic care for a patient facing septic shock involves restoring and maintaining adequate blood flow and oxygen delivery to the organs. Here are the key aspects of hemodynamic management in septic shock:

1. Fluid resuscitation: The initial treatment for septic shock involves fluid resuscitation to restore intravascular volume and improve cardiac output. This is typically done by administering intravenous fluids, such as crystalloids (e.g., normal saline or balanced solutions) or colloids (e.g., albumin). The goal is to optimize preload and improve tissue perfusion.
2. Vasopressor therapy: If fluid resuscitation alone is insufficient to restore blood pressure and organ perfusion, vasopressor medications are used. Norepinephrine is the first-line vasopressor in septic shock and acts by constricting blood vessels, increasing systemic vascular resistance, and elevating blood pressure. Other vasopressors like vasopressin or epinephrine may be added if needed.
3. Inotropic support: In cases where the cardiac output remains low despite adequate fluid resuscitation and vasopressor therapy, inotropic agents such as dobutamine may be used. These medications increase myocardial contractility, thereby improving cardiac output and tissue perfusion.
4. Hemodynamic monitoring: Continuous hemodynamic monitoring is crucial in septic shock to assess the patient's response to therapy and guide further interventions. This can be achieved through invasive methods, such as central venous pressure (CVP) monitoring, arterial blood pressure monitoring, and pulmonary artery catheterization, or non-invasive techniques like bedside echocardiography.
5. Oxygenation and ventilation: Ensuring adequate oxygenation and ventilation is essential in septic shock. Supplemental oxygen is provided to maintain oxygen saturation levels, and mechanical ventilation may be required if respiratory failure occurs. Lung-protective ventilation strategies are employed to minimize ventilator-induced lung injury.

Figure 2 – Example of more specific prompts: “What are the main hemodynamic care for a patient facing septic shock?”
Source: ChatOpenAI (2023)⁸

2. Describe your objective: Describe exactly what kind of output (answer) you are looking for (Figure 3). **Example of a prompt:** *I would like to have a short list of at least five ideas for a YouTube video about the future of septic shock treatment and prevention.*

1. "Advancements in Early Detection: The Future of Septic Shock Treatment and Prevention"
 - Explore emerging technologies and diagnostic tools that can help healthcare providers detect septic shock at its earliest stages, allowing for prompt intervention and improved patient outcomes.
2. "Precision Medicine: Personalized Approaches to Septic Shock Treatment"
 - Discuss how advancements in genomics and personalized medicine are shaping the future of septic shock treatment. Explore the potential for tailored therapies based on an individual's genetic profile, microbiome, and immune response.
3. "Innovations in Sepsis Management: Breaking the Barrier"
 - Highlight recent breakthroughs in septic shock treatment and prevention, such as novel therapies, targeted interventions, or innovative medical devices that are revolutionizing how we approach this life-threatening condition.
4. "The Role of Artificial Intelligence in Predicting and Managing Septic Shock"
 - Explore how artificial intelligence (AI) algorithms and machine learning can be utilized to analyze patient data, predict the development of septic shock, and guide clinicians in implementing early interventions and personalized treatment plans.
5. "From Lab to Bedside: Translational Research in Septic Shock"
 - Discuss the exciting field of translational research and its impact on septic shock treatment. Highlight promising preclinical studies or ongoing clinical trials that show potential for translating laboratory discoveries into effective therapies for patients with septic shock.

Remember to conduct thorough research and consult with medical professionals or experts in the field to ensure the accuracy and relevance of the information presented in your YouTube video.

Figure 3 – Example of the type of output (answer) obtained after applying the above prompt with emphasis on the objective, 2023.
Source: ChatOpenAI 2023⁸

3. Describe your objective and give the context: Consider your conversation with ChatGPT® as the one you would have with a professional you have just met who can answer your questions and help you face the challenges of intensive care nursing. The better the description of the purpose and context you would like to use, the more appropriate the result will be (Figure 4). **Example of a prompt:** *I am writing a manuscript about the main nursing care for patients with septic shock in the ICU based on the use of artificial intelligence. You can list some precautions with specific results. Nurses and nursing students, who are outside the area and are still learning, is my audience. Please, use a friendly and approachable tone.*

Title: "Enhancing Nursing Care in the ICU: Harnessing Artificial Intelligence for Patients with Septic Shock"

Introduction:

Welcome, nurses and nursing students, to an exploration of how artificial intelligence (AI) is transforming the care of patients with septic shock in the intensive care unit (ICU). In this article, we will discuss the essential nursing care practices empowered by AI, along with specific outcomes they can achieve. Let's delve into this exciting development that can improve patient outcomes and enhance your nursing practice.

1. Early Detection with AI-Driven Monitoring Systems:

Artificial intelligence-based monitoring systems are revolutionizing patient care. They continuously analyze vital signs, laboratory data, and other parameters to identify subtle changes that may indicate the onset of septic shock. By alerting nurses to early warning signs, AI can facilitate prompt interventions, potentially reducing mortality rates and complications associated with septic shock.

Result: Timely identification of septic shock symptoms, leading to early interventions and improved patient outcomes.

1. AI-Powered Decision Support Tools:

Artificial intelligence can assist nurses by providing real-time decision support. AI algorithms analyze vast amounts of patient data, such as medical history, lab results, and treatment protocols, to offer evidence-based recommendations for septic shock management. This empowers nurses with valuable insights and aids in making informed clinical decisions.

Result: Enhanced nursing decision-making, ensuring adherence to best practices in septic shock treatment and prevention.

1. Predictive Analytics for Individualized Patient Care:

AI algorithms can analyze patient data to predict the risk of septic shock development or deterioration. By considering factors such as vital signs, laboratory results, and patient history, nurses can proactively implement preventive measures tailored to each patient's needs. This individualized approach helps identify high-risk patients, enabling earlier interventions and personalized care plans.

Result: Proactive interventions to prevent septic shock, leading to improved patient outcomes and reduced healthcare costs.

1. Intelligent Alerts and Alarms:

AI-enabled systems can generate intelligent alerts and alarms, helping nurses prioritize care for patients with septic shock. These systems can notify nurses when a patient's condition worsens, when vital signs deviate from the expected range, or when specific interventions are due. By reducing the risk of oversight, nurses can provide timely interventions and closely monitor critical patients.

Result: Improved patient safety, reduced errors, and enhanced monitoring of septic shock patients in the ICU.

1. AI-Driven Education and Training:

Artificial intelligence also has the potential to support nursing education and training. AI-based platforms can offer interactive simulations, virtual patient scenarios, and educational resources to enhance nurses' understanding of septic shock management. These tools provide a safe environment for skill development, critical thinking, and decision-making, ultimately improving the quality of care delivered to patients.

Result: Enhanced nursing competency in septic shock management, fostering a culture of continuous learning and professional growth.

Conclusion:

As nursing professionals, embracing the power of artificial intelligence in septic shock care can revolutionize patient outcomes in the ICU. From early detection to individualized care plans and decision support, AI empowers nurses to provide safer, more effective care. By utilizing these AI-driven tools, nurses can be at the forefront of advancing patient care in septic shock management, ensuring better outcomes for their patients.

Figure 4 – Example of the type of output (answer) obtained after applying the prompt with emphasis on configuration and context, 2023.

Source: ChatOpenAI (2023)⁸

4. Experiment with different prompt styles: The style of your prompt can significantly affect the answer given. Try out different formats, such as generating a list, providing a summary, main ideas or giving the characteristics of your audience, desired roles, among others. (Figures 5, 6, 7, 8 and 9):

What are the nursing care based in ICNP for patients in Septic shock?

The International Classification for Nursing Practice (ICNP) is a standardized nursing language that helps facilitate communication and documentation of nursing care. When providing nursing care for patients in septic shock, nurses can use the ICNP to guide their practice. Here are some nursing care interventions based on the ICNP framework:

- 1. Assessment:**
 - Perform a comprehensive assessment of the patient, including vital signs, level of consciousness, skin appearance, urine output, and laboratory values.
 - Document the patient's medical history, including any *known* infections, recent surgeries, or chronic conditions.
 - Evaluate the patient's response to interventions and monitor for changes in condition.
- 2. Fluid Management:**
 - Administer intravenous fluids as prescribed to restore and maintain adequate fluid balance.
 - Monitor fluid intake and output closely, documenting measurements and assessing for signs of fluid overload or dehydration.
 - Adjust fluid administration based on the patient's hemodynamic status, such as blood pressure, central venous pressure, or cardiac output.
- 3. Infection Control:**
 - Implement strict infection control measures to prevent the spread of infection within the ICU.
 - Follow proper hand hygiene protocols and ensure adherence to isolation precautions as needed.
 - Collaborate with the interdisciplinary team to identify and address the source of infection and implement appropriate treatment plans.
- 4. Hemodynamic Support:**
 - Monitor the patient's blood pressure, heart rate, and oxygen saturation continuously.
 - Administer vasopressor medications as prescribed to maintain adequate perfusion and blood pressure.
 - Assess the patient's response to vasopressor therapy, titrating the medication dose as needed to achieve hemodynamic stability.
- 5. Oxygenation and Ventilation:**
 - Monitor the patient's respiratory status closely, including respiratory rate, oxygen saturation, and lung sounds.
 - Administer supplemental oxygen as prescribed to maintain adequate oxygenation.
 - Collaborate with respiratory therapists to assess the need for mechanical ventilation and provide appropriate ventilatory support.
- 6. Medication Administration:**
 - Administer prescribed antibiotics promptly, ensuring timely administration to target the infection effectively.
 - Administer medications for pain relief, sedation, or other symptoms as ordered by the healthcare provider.
 - Monitor the patient for adverse reactions or complications related to medication administration.
- 7. Psychosocial Support:**
 - Provide emotional support and reassurance to the patient and their family members during this challenging time.
 - Communicate effectively and involve the patient and their family in care planning and decision-making processes.
 - Collaborate with the healthcare team to ensure holistic care addressing the patient's psychological, emotional, and spiritual needs.
- 8. Education and Discharge Planning:**
 - Educate the patient and their family about septic shock, its causes, and preventive measures.
 - Provide information about prescribed medications, potential side effects, and the importance of adherence to treatment plans.
 - Collaborate with the interdisciplinary team to develop a comprehensive discharge plan that includes follow-up care, medication management, and necessary support services.

Remember, nursing care in septic shock should be individualized based on the patient's specific needs and the healthcare facility's protocols. The ICNP framework can serve as a helpful guide for documentation and communication, ensuring consistent and high-quality nursing care for patients in the ICU.

Figure 5 – Example of prompts applied according to the use of a direct question: *What is the nursing care based on the ICNP (International Classification Nursing Practice) for patients in Septic shock?*, 2023. Source: ChatOpenAI (2023)⁸

When caring for patients with suspected septic shock, it is important to monitor for potential signs and symptoms that may indicate a deteriorating condition. While it's crucial to consult local protocols and guidelines specific to your healthcare setting, here is a list of potential alerts to be aware of:

1. Abnormal Vital Signs:
 - Persistent fever (above 38°C or 100.4°F) or hypothermia (below 36°C or 96.8°F)
 - Tachycardia (heart rate >90 beats per minute)
 - Hypotension (systolic blood pressure <90 mmHg or mean arterial pressure <65 mmHg)
 - Rapid respiratory rate (tachypnea)
2. Altered Mental Status:
 - Confusion, disorientation, or agitation
 - Decreased level of consciousness or responsiveness
 - Difficulty arousing the patient
3. Poor Perfusion Signs:
 - Cool and clammy skin
 - Delayed capillary refill (>2 seconds)
 - Decreased urine output or oliguria
 - Poor peripheral pulses or weak peripheral perfusion
4. Respiratory Distress:
 - Labored or rapid breathing
 - Increasing oxygen requirements
 - Oxygen saturation below the target range
5. Signs of Organ Dysfunction:
 - Worsening renal function (elevated creatinine, decreased urine output)
 - Liver dysfunction (abnormal liver function tests)
 - Coagulation abnormalities (prolonged clotting times, decreased platelet count)
 - Cardiovascular compromise (signs of myocardial dysfunction or cardiac output impairment)
6. Elevated Inflammatory Markers:
 - Increased levels of inflammatory markers, such as C-reactive protein (CRP) or procalcitonin
7. Suspected or Confirmed Infection:
 - New or worsening signs of infection, such as localized pain, redness, or purulent discharge from a wound or catheter site
 - Positive blood culture or other culture results indicating the presence of pathogens

Remember, these potential alerts should be interpreted in the context of the patient's overall clinical presentation. It is essential to collaborate with the healthcare team, adhere to local protocols, and promptly escalate care when necessary. Early recognition of septic shock and prompt intervention can significantly impact patient outcomes.

Figure 6 – Example of prompts applied according to list usage: *List all potential alerts for patients with suspected Septic shock, 2023.*

Source: ChatOpenAI (2023)⁹

Septic shock is a life-threatening condition characterized by a severe infection that triggers a systemic inflammatory response and leads to organ dysfunction. The key symptoms and progression of septic shock can be summarized as follows:

1. Infection: Septic shock typically arises from a severe infection, often caused by bacteria, but can also be caused by fungi or viruses. Common sources of infection include pneumonia, urinary tract infections, abdominal infections, or bloodstream infections.
2. Initial symptoms: Patients with septic shock initially present with symptoms of infection, such as high fever, chills, rapid heart rate, and rapid breathing. Other signs may include altered mental status, decreased urine output, and skin changes (pale, cool, and clammy).
3. Systemic inflammation: The immune response to the infection triggers a widespread inflammatory reaction throughout the body. Inflammatory mediators are released, leading to increased permeability of blood vessels, fluid leakage, and activation of clotting factors.
4. Organ dysfunction: The inflammatory response and compromised circulation can impair organ function. Commonly affected organs include the kidneys, liver, lungs, and heart. Symptoms of organ dysfunction may include decreased urine output, elevated liver enzymes, respiratory distress, and altered mental status.
5. Hypotension and poor tissue perfusion: As septic shock progresses, there is a significant drop in blood pressure due to widespread vasodilation and loss of fluid from blood vessels. This results in poor tissue perfusion, inadequate oxygen delivery, and cellular damage.
6. Multiple organ failure: Without timely intervention, septic shock can progress to multiple organ failure, where multiple organs become severely compromised. This can lead to respiratory failure, acute kidney injury, liver dysfunction, cardiovascular collapse, and ultimately, death.

The progression of septic shock is rapid and can be life-threatening. Early recognition of symptoms, prompt administration of antibiotics, fluid resuscitation, and support of organ function are crucial in managing septic shock and improving patient outcomes. Timely escalation of care to the intensive care unit (ICU) and close monitoring are necessary to address the complex needs of patients with septic shock.

Figure 7 – Example of prompts applied according to summary usage: Summarize the key symptoms and progression of Septic shock, 2023.

Source: ChatOpenAI (2023)⁶

Septic shock can have significant consequences for both the patient and their family members. The impact on the patient's family can be emotional, psychological, and practical. Here are some common consequences of septic shock for the patient's family:

1. **Emotional Distress:** Family members often experience intense emotional distress when a loved one is in septic shock. They may feel fear, worry, anxiety, helplessness, and uncertainty about the outcome. Witnessing a family member in a critical condition can be emotionally overwhelming and take a toll on their well-being.
2. **Uncertainty and Fear:** Septic shock is a life-threatening condition, and the uncertainty surrounding the patient's prognosis can create significant fear and distress for the family. They may fear the potential loss of their loved one, causing emotional turmoil and a sense of powerlessness.
3. **Financial Burden:** The financial impact of septic shock can be substantial for the patient's family. ICU care, hospitalization, and ongoing medical interventions can lead to high medical bills and potential loss of income if family members need to take time off work to support their loved one. This financial burden can add stress and anxiety to an already challenging situation.
4. **Caregiver Role Strain:** Family members often take on the role of caregivers for the patient during and after septic shock. This responsibility can be physically and emotionally demanding, requiring significant time, energy, and expertise. Balancing caregiving duties with other responsibilities, such as work and family commitments, can be overwhelming and result in caregiver burnout.
5. **Disruption of Daily Life:** The occurrence of septic shock often leads to a disruption of the family's daily routines and responsibilities. Family members may need to rearrange their schedules, find childcare, or make other logistical arrangements to provide support for the patient. This disruption can cause additional stress and strain on the family dynamics.
6. **Psychological Impact:** Witnessing the severe illness of a loved one in septic shock can have long-lasting psychological effects on family members. They may experience symptoms of anxiety, depression, post-traumatic stress disorder (PTSD), or other mental health challenges due to the traumatic nature of the situation.
7. **Decision-Making Burden:** Families may be faced with difficult decisions regarding the patient's care, especially if the patient's wishes are not clearly communicated. Making complex medical decisions, such as end-of-life choices or treatment options, can be emotionally and morally challenging for family members.

It is important for healthcare providers to recognize and support the needs of the patient's family during this difficult time. Offering emotional support, facilitating clear communication, providing resources for counseling or support groups, and involving them in care discussions can help mitigate the consequences of septic shock and promote a supportive environment for the family.

Figure 8 – Example of prompts applied according to the use of Target audience (characteristics):
Explain the consequences of a patient's septic shock to his/her family, 2023.
Source: ChatOpenAI (2023)⁸

As a scientist, I can explain to you, as a nurse, the importance of controlling C-reactive protein (CRP) levels in patients with septic shock. CRP is an acute-phase protein that is produced by the liver in response to inflammation, particularly in the presence of infection. Here's why monitoring and controlling CRP levels are crucial in septic shock

1. **Diagnostic Marker:** CRP serves as a valuable diagnostic marker for assessing the presence and severity of inflammation. Elevated CRP levels in septic shock indicate an ongoing systemic inflammatory response, which helps clinicians confirm the diagnosis and assess the patient's condition.
2. **Prognostic Indicator:** CRP levels can provide important prognostic information in septic shock. Higher CRP levels are associated with increased disease severity, organ dysfunction, and poor outcomes. Monitoring CRP trends can aid in predicting patient response to treatment and identifying those at higher risk of complications or mortality.
3. **Treatment Response:** CRP levels can be used to monitor the response to treatment in septic shock. As therapy is initiated and the infection is controlled, CRP levels typically decrease. Serial measurements of CRP can help evaluate the effectiveness of interventions and guide treatment decisions.
4. **Infection Control:** CRP levels can assist in monitoring the effectiveness of antibiotic therapy. A decline in CRP levels over time indicates a favorable response to treatment and control of the underlying infection. Persistently elevated or rising CRP levels may suggest ongoing infection or the need for adjustment in antimicrobial therapy.
5. **Early Detection of Complications:** Monitoring CRP levels can help in early detection of complications related to septic shock. Sudden or significant increases in CRP levels may indicate the development of secondary infections, superinfections, or complications such as abscess formation. Prompt identification of these complications enables timely intervention and management.
6. **Trend Monitoring:** Serial monitoring of CRP levels provides a dynamic assessment of the patient's inflammatory response. An upward trend in CRP levels may indicate worsening infection or inadequate response to treatment, warranting further investigation and adjustment of therapeutic strategies.

In summary, controlling C-reactive protein levels is important in septic shock as it aids in diagnosis, provides prognostic information, monitors treatment response, assists in infection control, facilitates early detection of complications, and helps track the patient's inflammatory status. By closely monitoring CRP levels, healthcare providers can make informed decisions regarding patient management, optimize treatment strategies, and improve patient outcomes.

Figure 9 – Example of prompts applied according to role suggestions: *Act like a scientist and explain to the nurses why controlling C-reactive protein in septic shock is important*, 2023.

Source: ChatOpenAI (2023)⁸

5. Repeat and refine your questions to dig deeper and/or get better answers: It should be noted that the best results are rarely obtained immediately after the first prompt. Therefore, refine your questions, just like when you organize a content test or teach a class in which you look for the best answers indicating that the content has been understood. If you still fail to get the output you want, try guiding the model with continuation prompts. This can be more productive than hoping to get the answer you want with a single prompt. It is also possible to start a conversation like this: ask the AI to consider each step or present the pros and cons before you decide on an answer. The examples shown above can help you better understand this topic of repeating and refining questions.

In addition, if you are searching in unfamiliar territory and looking for information in a field where you are unfamiliar, feedback loops can be used to go into detail. Although ChatGPT® initially gives generic answers, it is always possible to use the output as input for subsequent prompts, generating a cycle of problems and answers.

6. Use your previous topics: In ChatGPT® you can return to a specific discussion by clicking on the topic in the left-hand column where the prompts are stored. Thus, you do not need to start again and can simply continue the discussion with ChatGPT®.

7. Ask open and closed questions: open questions generally produce broader answers, while closed questions produce more specific answers.

8. Request examples: if the answer is unsatisfactory or incomprehensible, say that you didn't understand it; then ask for an example or ask to improve or regenerate the answer.

9. Use your time wisely: If you are asking about a process or schedule, specify this in your prompt (Figures 10 and 11).

The healing process following septic shock can vary from patient to patient and depends on several factors, including the severity of the infection, the extent of organ damage, and the overall health and resilience of the individual. Here is a general overview of the healing process after septic shock:

1. **Stabilization and Resolution of Infection:** The first step in the healing process is controlling and resolving the underlying infection that caused septic shock. This involves appropriate antibiotic therapy, source control (such as draining abscesses or removing infected devices), and supportive measures to restore the body's immune response.
2. **Organ Function Recovery:** During septic shock, multiple organ systems can be affected, including the kidneys, liver, lungs, and heart. As the infection is controlled and inflammation subsides, the affected organs have the potential to recover and regain normal function. However, the extent and speed of recovery can vary among individuals.
3. **Rehabilitation and Physical Recovery:** Survivors of septic shock may experience physical weakness, fatigue, and deconditioning due to the significant stress their bodies have undergone. Rehabilitation plays a crucial role in the healing process, focusing on physical therapy, respiratory exercises, and gradual reconditioning to restore strength, mobility, and functional independence.
4. **Emotional and Psychological Healing:** The psychological impact of septic shock can be substantial, both for patients and their families. Survivors may experience post-traumatic stress disorder (PTSD), anxiety, depression, or other psychological challenges. Supportive care, counseling, and access to mental health resources are essential to address these emotional aspects of healing.
5. **Long-Term Follow-up and Management:** Even after surviving septic shock, patients may require ongoing medical management and follow-up care. Regular check-ups, monitoring of organ function, and addressing any long-term complications or sequelae are crucial to ensure optimal recovery and prevent future complications.

It's important to note that the healing process following septic shock can be complex and may require time and individualized care. The involvement of a multidisciplinary healthcare team, including critical care specialists, infectious disease specialists, physical therapists, mental health professionals, and primary care providers, is vital in providing comprehensive support and facilitating the healing journey for survivors of septic shock.

Figure 10 – Example of prompts applied any without time reference:
Describe the healing process after a septic shock, 2023.
Source: ChatOpenAI (2023)⁶

As a scientist, I can explain to you, as a nurse, the importance of controlling C-reactive protein (CRP) levels in patients with septic shock. CRP is an acute-phase protein that is produced by the liver in response to inflammation, particularly in the presence of infection. Here's why monitoring and controlling CRP levels are crucial in septic shock:

1. **Diagnostic Marker:** CRP serves as a valuable diagnostic marker for assessing the presence and severity of inflammation. Elevated CRP levels in septic shock indicate an ongoing systemic inflammatory response, which helps clinicians confirm the diagnosis and assess the patient's condition.
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In summary, controlling C-reactive protein levels is important in septic shock as it aids in diagnosis, provides prognostic information, monitors treatment response, assists in infection control, facilitates early detection of complications, and helps track the patient's inflammatory status. By closely monitoring CRP levels, healthcare providers can make informed decisions regarding patient management, optimize treatment strategies, and improve patient outcomes.

Figure 11 – Example of prompts applied with a time reference: *What can a patient typically expect during the first six weeks of healing after suffering a septic shock?*, 2023.

Source: ChatOpenAI (2023)⁸

10. Define realistic expectations: Although GPT-4 is a powerful tool, it does have its limitations. For example: it doesn't allow access to real-time data (although you can adjust this with plugins); there's an end date (2021) which may not be a problem soon⁸; references are not made explicit (answers then need to be checked) and it doesn't give personal advice or replace the judgment of a health professional.

Based on the examples above, a diagram of output generation from prompts has been structured. The diagram was designed to summarize the method or process of generating prompts and outputs to support decision-making in the practice of intensive care for the teaching-learning process of septic shock (Figure 12).

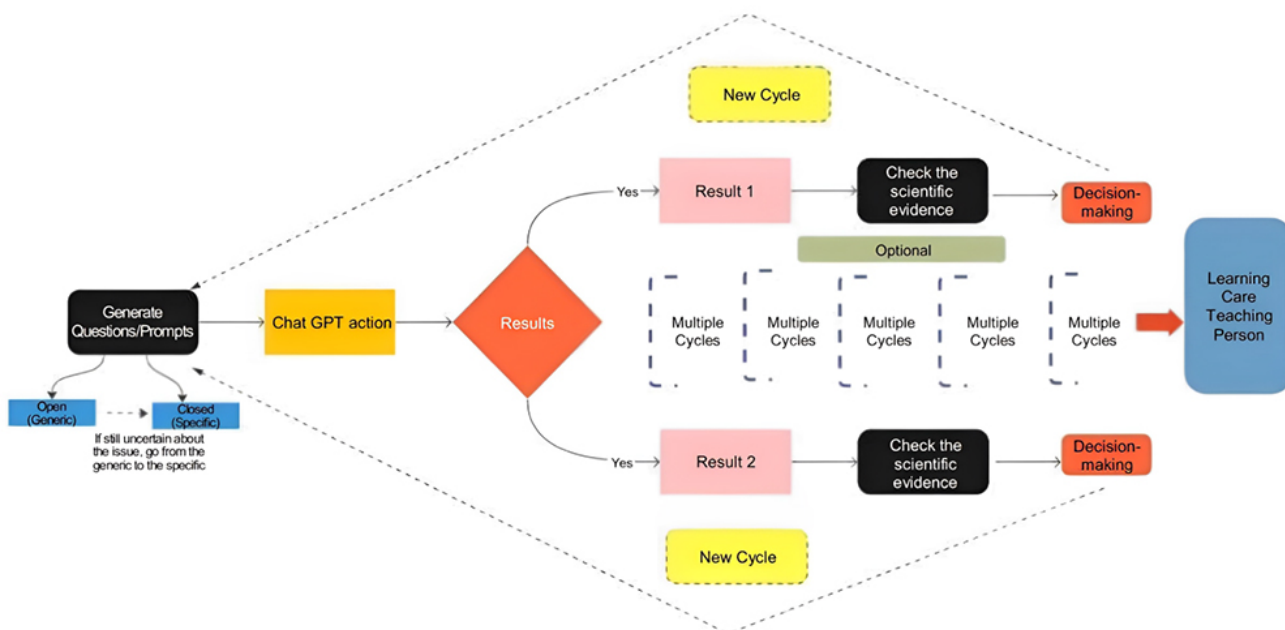


Figure 12 – Diagram corresponding to the process for generating prompts and outputs to support decision-making in intensive care.

The diagram above can serve as a reference to support teachers and professionals in developing new prompts in various areas of practice and learning for nurses. From the perspective of caring for patients with septic shock, we would like to highlight the important contribution of ChatGPT®, which enables both students and professionals to exercise clinical reasoning based on a structure of logically well-formulated questions and supported by the four pillars of evidence-based practice (research evidence, practice, patient and context).

DISCUSSION

In the scientific and academic community, ChatGPT® received mixed responses, reflecting the controversies over the benefits *versus* risks of advanced AI technologies. On the one hand, ChatGPT® (among other Large Language Models, LLMs) can be beneficial in dialog and writing tasks, helping to increase the efficiency and accuracy of the required output. On the other hand, concerns have been raised that require more supervision and investment in AI exit detectors. This is necessary to deal with possible errors and biases in its output (which can limit its capabilities and result in inaccuracies) based on the data set used to train ChatGPT®. In addition, security concerns and potential cyber-attacks spreading disinformation via LLMs should also be considered¹⁴.

In the literature, ChatGPT® has been approached as an evolved form of search engine, in the sense that it can suggest themes, questions and research objectives by relating them to the initial question¹. The experience gained during the preparation of the manuscript showed that ChatGPT® can be a component of the teaching and learning system as a tutor as well as in self-learning in nursing.

By practicing the prompts for learning about septic shock, teachers and students manage their time better by obtaining quick and accurate information. By incorporating the information obtained and seeking confirmation and further study in the scientific literature, there was a stimulus to research, study and clinical reasoning. This process must be incorporated into teaching so that artificial intelligence can contribute more and more to teaching and learning¹⁵.

ChatGPT® can therefore be used as a tool to support decision-making in the learning process. It has the potential to help research and accelerate the technological transformation of clinical and translational nursing, as well as discovering new care for different drugs in development, predicting diseases and complications, diagnosing and assessing before health problems set in¹⁶.

Generative AI such as ChatGPT® can stimulate the development of digital literacy, a core competence in nursing informatics, encouraging critical thinking about the integration of AI into health care. In addition, it can offer valuable support to students and teachers, improving the quality of writing, assisting in research and teaching tasks (organizing, summarizing and simplifying ideas) and helping to interpret data¹⁷.

It is fundamental to ensure the privacy and security of confidential patient information, as is the case with any digital health technology when applied directly to care. Sending confidential information to ChatGPT® can have serious consequences. Health organizations that intend to implement models such as ChatGPT® must have comprehensive guidelines for using such tools to handle patient data and implement measures to protect data privacy, such as anonymizing identifiable data, encryption, compliance with national health regulations, among others¹⁸.

Users of some recently developed AI-based software claim to take advantage of ChatGPT®'s cutting-edge features to meet data security and privacy requirements, although the effectiveness of these tools in a clinical environment requires a rigorous validation and quality control process^{1,16}. Interdisciplinary collaboration is needed between AI developers, health professionals, policymakers and data security experts. This reflection should also be observed in the professional training process, according to the possibilities presented here.

Integrating ChatGPT® with effective prompt generation techniques can simplify health documentation, but must be approached with care to manage ethical challenges and prevent harms. The adoption of this technology can generate benefits in health documentation, the teaching process and decision-making by health professionals, improving their productivity and patient care. Guidelines for the use of AI tools in the documentation of patient data will be an important step. However, research efforts will be needed to investigate the effectiveness of these tools compared to existing methods¹⁹.

Among other aspects, we highlight the importance of learning for a robust, dynamic and progressive nursing experience based on evidence. This requires curricula that are flexible and attentive to the global AI movement in teaching and care processes, ensuring nurses' place in care environments and improving patient outcomes²⁰.

Empathetic communication is the basis of the nurse-patient relationship and over-reliance on chatbots can lead to a reduction in empathy among nurses. For example, providing pre-prepared answers to nurse-patient dialogues can make these interactions more impersonal and less therapeutic. Additionally, chatbot answers may not be reliable or evidence-based²⁰. The OpenAI website itself admits that ChatGPT® can generate false or misleading information and produce offensive or biased content, and recommends caution in its use. However, technologically competent nurses can assess

the risk of using this tool considering its limitations. Nurses will continue to be responsible for their clinical decisions, including those made on the basis of the chatbot's answers.

In relation to the incorporation of confidential or personally identifiable data, the ChatGPT® platform warns users and organizations that the information processed in it is stored provisionally on OpenAI servers and does not guarantee its security. Therefore, nursing professionals must take precautions to protect sensitive or confidential data of patients and people in general, as well as those of the health organization. Security measures can include the use of encryption or the non-disclosure of information online.

Any app programmed to implement ChatGPT® must also adhere to data protection in accordance with national legislation¹. The study limitations include the fact that it is still in a theoretical stage and needs to be applied to students, teachers and nurses in the context of intensive care.

CONCLUSION

The ChatGPT® discussions and examples were initiated in intensive care applied to septic shock learning, as it is important to understand how this type of artificial intelligence technology works in a specific nursing focus.

In a logical and increasingly complex sequence, ChatGPT® make learning friendly and dynamic in the care of patients with septic shock and other problems, although it is a recent topic in nursing.

Health decisions are ethical actions and the use of this tool in teaching and care requires constant consultation of safe and up-to-date evidence without forgetting its limitations.

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