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RESEARCH ARTICLE

## Implementation of Sepsis Prevention Guidelines for Nurses into a Clinical Practice

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**ABSTRACT:**

**Background:** Sepsis is one of the most serious complications in intensive care patients, which is associated with high mortality and morbidity of critically ill patients. Measures based on the effective prevention are one of the main strategies of treating patients. Aseptic procedures, barrier nursing techniques, selection of equipment used for the treatment as well as the replacement frequency of protective barriers are preferred nursing interventions of sepsis with regard to the prevention. The objective of this retrospective study was to assess the importance of nursing interventions and aspects of the incidence of sepsis and infectious complications in ICU patients, including analysis of erroneous nursing procedures that could affect the formation of sepsis.

**Methods:** A retrospective study was conducted by data collection from medical records and observation of patients hospitalized at the Clinic of Anesthesiology and Intensive-care during the period from January 2019 to December 2022. The overall sample consisted of 736 patients who were diagnosed with sepsis by a doctor according to confirmed infectious etiology. Data were processed by descriptive statistics, frequency tables and  $\chi^2$  (chi-square) test were used for evaluating and the Fisher's exact test was used for small frequency ( $n < 5$ ). Statistical tests were assessed at the significance level of 5. There were identified 231 patients with sepsis, 106 patients with confirmed infectious etiology, 31 patients with confirmed non-infectious causes (SIRS) and 7 cases of other infectious cause was confirmed during hospitalization. Another category of patients was represented by cases, in which the positive sputum was found in injection site infection, in positive punctate in wound, in purulent secretion from the wound or bacterial findings in urine without general symptoms of infection. Nursing interventions were analyzed with regard to the prevention of sepsis patients in intensive care.

**Results:** The largest number of sepsis was proved in 2019 (26.23%) and in 2020 (20.01%), while in 2021 (11.67%) and 202022 (14.02%) there was recognized a decrease in sepsis. According to the etiology there was significant share of VAP and catheter sepsis compared to uremic and early infection. Out of the nursing procedures that have proven to be important for the prevention of VAP there were identified a closed suction method, the selection of the endotracheal tube, the use of semi recumbent position. Selection of the catheter, puncture site selection, use of infusion filters or disinfection options were found as important examples in the prevention of catheter sepsis. Using a closed circuit system has proved to be the most effective in urinary tract infections. The results clearly show the effect of educational activities of working group on compliance with the rules of asepsis, compliance with barrier nursing activities and practices that are entirely in the hands of the nursing staff.

**Conclusions:** All preventive measures are in accordance with the recommendations of CDC (The Centers for Disease Control and Prevention) and SHEA (The Society for Healthcare Epidemiology of America) that recommend the education and training of the staff. The objective is to increase awareness of the necessity of preventive measures which help to reduce the incidence of infection with subsequent sepsis in patients in intensive care. Regular education and practical training can not only improve the quality of care, but we can also implement new procedures into the practice with regard to the nursing staff awareness of the importance of sepsis prevention at intensive care units.

**Keywords:** sepsis, preventive measures, ventilator-associated pneumonia, urinary tract infection, catheter sepsis.

## Introduction

Sepsis is a complex syndrome that is difficult to define, diagnose, treat and care for. It is a series of events and changes in the body caused by the overall body's response to infection. Its annual incidence is according to available literature of approximately 3 cases per 1,000 inhabitants - Worldwide over 18 million cases. It is also expected annual increase of 1.5%. The overall number of deaths increases every year. Literary sources (Kula, 2004) reported 350,000 deaths per year (USA and Europe), the medical costs of almost € 26 billion, and limited effective diagnostic and therapeutic interventions. At present greatest emphasis is placed on the use of methods which are able to reduce the risk of sepsis development. Nursing procedures preventing infection transition are among the practices that significantly contribute to reducing the incidence of sepsis. Given the high mortality rate for severe sepsis, the center of attention of professional associations became procedures that could be used to influence the negative numbers of dying of sepsis and septic shock. An international group of experts engaged in intensive care and infectious diseases has therefore established a standard of care for patients with severe sepsis, which are summarized in the Barcelona Declaration. In accordance with the activities of medical society there was established Forum for Sepsis in April 2005. The main objective of Working Group for the Prevention of Sepsis in intensive and resuscitation departments in the University Hospital Ostrava is the education of the nursing staff about the need to respect all the principles concerning implementation of nursing interventions with regard to the risk of infection development. It was created educational program (<http://sepsis.fnspo.cz>), which was also implemented in the curricula of students in higher vocational school of health and Faculty of Health and Social Sciences. There were conducted studies that showed the need for continued educational and preventive activities in terms of sepsis prevention. Nursing procedures that prevent infections are among the procedures which significantly contribute to reduction of incidence of sepsis. It is problematic staff awareness of the importance of hand washing, lack of compliance with the rules of sterility in introducing intravenous catheters or for example the predominance of the supine position in mechanically ventilated patients or the use of the incorrect technique of secret suctioning. The problem is ignorance in compliance with the rules for the proper use of protective equipment, compliance with barrier nursing techniques, proper wound care and other preventive measures that relate to the prevention of hospital infections. A number of studies indicate that unused space for introducing

these simple and cost-efficient procedures into everyday clinical practice actually exists. Infections mean a huge risk to patients and medical staff, so that every step in the process of infection prevention is important. The objective of this retrospective study was to evaluate the level of importance of specific nursing interventions on the incidence of sepsis in patients hospitalized in KARIM FHO. The aim was to detect erroneous nursing procedures that could influence the formation of sepsis. It was also necessary to assess whether the impact of these practices and using specific tools, its proper use, selection of materials and compliance with recommended replacement could affect the occurrence of certain types of infections, including sepsis. The assessment of procedures implemented in the treatment of patients with sepsis has been taken on the basis of educational activities on the prevention of sepsis in intensive care in FHO. Activities of The working groups on the prevention of sepsis in intensive care FHO started in April 2005.

The main task of the working group was to establish educational activities of medical staff in intensive care and develop materials for the preparation of standard operating procedures for the various practices related to the prevention of sepsis at intensive care units.

### Determining hypotheses

H<sub>01</sub> I assume that the educational activities of the working groups for the prevention of sepsis are related with a lower incidence of sepsis in patients admitted to the ARC FHO.

H<sub>02</sub> I suppose that the most common cause of sepsis in patients admitted to the ARC FHO is ventilator-associated pneumonia (VAP).

H<sub>03</sub> I assume that the introduction of optimal preventive measures within the context of nursing procedures and interventions may influence the frequency of sepsis in patients admitted to the ARC FHO.

### Methods:

During the 12 months (January-December 2023), we collected data from medical records of patients hospitalized at KARIM FN Ostrava during the four-year period from January 2019 to December 2022. The overall sample consisted of 736 patients, of whom 231 (31.39%) patients were diagnosed with sepsis. In 106 cases sepsis originated and infectious etiology was confirmed during hospitalization. Criteria for inclusion in the study was abnormal body temperature > 38 ° C or <36 ° C, abnormal heart rate > 90/min (otherwise unexplained), abnormal respiratory rate > 20/min. or pCO<sub>2</sub> <4.3 kPa (otherwise unexplained),

abnormal leukocyte count  $> 12 \times 10^9 / l$  or present leukopenia  $< 4 \times 10^9 / l$ , the presence or the premise of infection, positive blood culture findings and a final diagnosis of doctor. Data were obtained by questionnaire survey. It was created the form for data collection containing 122 items. The first part focuses on the characteristics of the sample, length of stay, type of sepsis, the emergence of sepsis during hospitalization, infectious agents and the final confirmation of the diagnosis of sepsis by doctor. The remaining four sections of the questionnaire evaluate the resulting types of sepsis (VAP, catheter, uremic and early sepsis), the use of specific equipment and nursing procedures that were applied in selected patients. Data obtained by questionnaire survey was first processed by descriptive statistics. For the evaluation of the data were used frequency tables and  $\chi^2$  (chi-square) test, in case of small frequency ( $n < 5$ ) Fisher's exact test. Statistical tests were assessed at the significance level of 5%.

## Results:

In 2019, originated 26.23% of septic states and in 2020 the number was 20.01%. In 2021 it dropped to 11.67% and in 2022 the data were nearly the same - 14.02%. In accordance with the activities of Working Group on the Prevention of Sepsis, which started its activity in 2005, prepare education materials, manage conference. Since 2019 in FHO we organized regular seminars with selected issues concerning prevention of sepsis from the perspective of the nursing staff on a month bases. Based on that information there were created standard operating procedures that were evaluated by audit. All the preventive measures that have been established thanks to the working group are in compliance with the recommendations of CDC (The Centers for Disease Control and Prevention) and SHEA - The Society for Healthcare Epidemiology of America). Based on these data, we can observe the loss of sepsis among the group of respondents. According to infectious etiology there was recorded ventilator-associated pneumonia in 39 (36.80%) and in an additional 20 (5.34%) patients were recorded infections of the upper and lower airways in the results of the reference group of respondents. These were mainly community-acquired pneumonia, which did not occur in connection with artificial ventilation. Catheter sepsis was also confirmed in 39 (36.80%) cases, early infection in 23 (21.70%) and uremic sepsis in 5 (4.7%) cases.

## Discussion:

The preventive measures generally play a pivotal role in the incidence of nosocomial infections. These

measures have been incorporated into an anti-epidemic plan; however, also other specific procedures must be followed in the course of the nursing process (Kalil et al., 2016). The factors, which may be influenced, include mainly the clinical staff that is responsible for complying with the preventive measures, especially respecting the barrier approach in patient treatment, management of nursing care and treatment strategy (Oliveira et al., 2014). The learning contents were reported to be in accordance with the Surviving Sepsis Campaign guidelines. Attention should also be paid to re-examining and closing the gap on sepsis education in the nursing. The educational program needs to focus on the prevention of VAP, catheter infection, urinary tract infection and wound infection.

It turns out that the number of VAP (39) and catheter sepsis (39) is represented in the same number as compared with the occurrence of uremic and early infections, which are significantly higher. The influence of these infections depends on the number of ventilated patients (375) and especially the number of patients with established vascular catheter (617). Catheter infections and ventilator-associated pneumonia are very frequent complications in ICU units. Prevalence Study (ŠRÁMOVÁ et al., 2009) shows that the largest proportion of infections are pneumonia and lower respiratory tract infections (47.5%), bloodstream infection was diagnosed in 14.2%, 18.3% urinary infections and surgical wound in 6.9% of total number of infections (493). Our sample file therefore contains 59 (42.14%) pneumonia cases, which is almost comparable with the study of ŠRÁMOVÁ (2009). It is one of the most common infections according to The European Prevalence of Infection in Intensive Care study (EPIC) and it represents 45% of all infections in the ICU VAP. Authors Chytra et al. (2003) suggest that the incidence of VAP ranges from 8-28%, which is in contradiction with the findings in the study of ŠRÁMOVÁ (33.9%) and the reference group of respondents (36.80%). In the case of catheter infections, most studies agree on the incidence of 3-12%. The study of ŠRÁMOVÁ (2009) confirmed the number 14.2%. Ševčík in his lecture notes from a source of CDC (2002), the incidence of 15-25%. Hugonnet et al. (2004) reported incidence of 19.8%. In a retrospective study there is the result of 39 bacteriologically confirmed catheter sepsis for a period of 4 years, the equivalent of one year is about 5.31%. This result corresponds to the above studies.

In case of early infection the incidence in clean wound ranges usually between 2-5% of all

infections. The same number is listed by SHEA (The Society for Healthcare Epidemiology of America). The study confirmed the results for four years at 21.70%. Converted into one year it is 3.1%, which confirms the above data. In uremic infections the incidence is around 17%. It is the second most common cause of secondary bacteremia, following catheter infections. ŠRÁMOVÁ study (2009) showed that the incidence varied between 18.3%. In the study of the Regional Office of Public Health (RÚVZ) in Trnava (2007), the number ranged in 26.0%. In monitored set of respondents resulting data showed the incidence of urinary tract infections in the number of 4.7%.

Practical measures, which aim to highlight practical preparedness of staff working in intensive beds to reduce infections and sepsis, are part of the measures recommended by companies like SHEA - Society for Healthcare Epidemiology of America. In the context of first recommendation it is all about compliance with semi recumbent position, use of intubation cannula with suction of sub glottal space and pressure maintenance in the cuff, preventing unplanned extubation and reintubation. The second recommendation is especially important to ensure the decolonization of the oropharynx and perfect, regular oral hygiene. The third strategy is to care for the ventilation equipment such as circuits, nebulizers, etc. The use of the supine position in mechanically ventilated patients represents independent risk factor for the development of pneumonia associated with artificial ventilation. The probability of its occurrence in supine position is almost three times higher and it is probably a consequence of the higher risk of gastro esophageal reflux, microbially contaminated content and subsequent aspiration. Semi-recumbent position, when the axis of the chest forms with the axis of pad an angle  $> 30^\circ$  is considered to be effective prevention of gastro esophageal reflux and subsequent aspiration. Torres et al. more than ten years ago found that the supine position is connected with bacterial findings in the stomach and endobronchial findings up to 70% of cases with positive endobronchial cultivation. In a prospective randomized clinical study, which objective was to analyze the relationship between the supine and semi recumbent position and occurrence of VAP, Drakulovic et al. discovered 80% lower incidence of microbiologically confirmed VAP in patients in semi recumbent position. On the contrary to the above findings there is surprisingly low use of this method in clinical practice. At random monitoring in the group of 170 patients Grap et al. found 70% incidence of supine position and the average value of the elevation of the torso only  $19^\circ$ . Cook DJ., Et al. dealt with the analysis of the causes of this

situation, concluding that the main problem is the low level of nursing staff awareness of the importance of semi recumbent position. In the study group of respondents there was compared the influence of positioning the patient into a semi recumbent position and the incidence of VAP. Statistical difference in investigated samples was  $p < 0.001$ , which undoubtedly confirms the importance of the elevated position of patients. Additional monitored intervention from the nursing perspective was the method of suction. Chytra (2009) in his work quotes Siempos Br. J. Anaesth (2008), who state that the difference between open and closed method has not been proved and there is only difference in economic profitability. In the investigated group of respondents, we evaluated 329 cases of suctioning, where we found a total of 71 positive cultures of sputum collected and 258 negative cultures and we found a statistical difference  $p < 0.001$ . In the open method of suction, there were 64.78% of positive findings and in closed method with only 35.21% positive cultures. Authors (Ibrahim EH, et al., 2008) published information about the importance of use of cannulas with the possibility of suction sub glottal space. In 337 patients, we evaluated the bacteriological sputum culture. In cases where we used cannula with the suction, we found positive rate in 16.30%. In contrast, when using conventional cannula we discovered positive rate in 25.71% cases. Furthermore, we evaluated the length of the endotracheal or tracheostomy cannula and its impact on the incidence of positive sputum. The biggest positivity was found in the case of dwelling cannula longer than 14 days (41.18%). The problem of introducing is related to attachment of the biofilm, which is itself a risk factor for VAP. Ideal cannula could possibly be coated with the silver ions, which are mentioned in his lecture Chytra (2009). He cites here multicenter prospective study of Kollef, JAMA (2008), which states that the use of these cannulas reduces the number of VAP by 35%. A very important recommendation is to decolonize oropharynx. There are studies that evaluated the effects of the use of chlorhexidine, which was used for the decolonization of the oral cavity. In a study SCANNAPIECO (2009) when using 0.12% chlorhexidine they failed to reduce potential pathogens in dental plaque and the occurrence of VAP. These were patients at traumatological or mixed ICU. Conversely, a reduction in incidence has been demonstrated with the use of less concentrated 0.12% chlorhexidine in patients on Cardiology ICU. Another randomized study Panchabhai (2009) notes the importance in the use of 2% chlorhexidine in 12 - hour treatment of the oral cavity. The authors consider that the more concentrated solution has a lasting impact on

reducing the formation of plaque (biofilm). Studies suggest that further research surveys should be implemented when using a more concentrated solution of chlorhexidine (2%).

The effect of compliance with the complex set of strategic procedures with a demonstrated effect upon a significant decrease of VAP incidence has a great impact upon decreasing the incidence of this disease, as has been confirmed with numerous studies performed at departments of intensive care (Oliveira et al., 2014). As an example, it is possible to mention the study performed by Hungarian authors, which showed a decreased incidence of VAP and decreased relative risk following introduction of the preventive bundle of measures by 44% (Mogyoródi et al., 2016).

On the issue of catheter sepsis prevention are defined specific recommendations. This is essentially the method of selecting the insertion site, choosing the type of catheters, skin disinfection, method of treatment of inputs, protection of the infusion lines, etc. The greatest recommendation by SHEA is education and training of the staff involved in the introduction and treatment of catheters. In addition, at strict hand hygiene, sterile barrier, injection site disinfection with chlorhexidine and selection of the insertion site. In reference file we studied the influence of line filters to infection. Patients who had the infusion line protected by line-filter had a positive culture at 13.40%, while those, who had no filter at 30.15%.

In recommendations there is often a reference to the choice of catheters, which are protected by coating of mixture of antibiotics, silver ions, chlorhexidine or positive membrane. The principle of all is the elimination of biofilm inside a catheter and subsequent colonization of the lumen. In set of observed respondents, we compared the effect of catheters coated with the chlorhexidine / silver sulfadiazine effect with the conventional catheter. The catheter was coated only inside lumen. The result showed that the use of antimicrobial coated catheter was positive in cultures at 6.58%, and when using a conventional catheter that was at 37.25%. Statistically significant difference was ( $p < 0.001$ ). The same experience published authors Maki et. al (1997) who state that the use of antibacterial catheter colonization decreased from 24.1% to 13.5% and there was a decrease of catheter infection of 7.6 / 1,000 days to 1.6 /

1,000 days. In another study Jager et al. (2002) states that catheters with a mixture of chlorhexidine / silver sulfadiazine were used in cancer patients receiving chemotherapy. An important and recommended element of prevention is thorough preparation of the insertion site and especially its disinfection. The study recommends disinfection with 2% aqueous solution of chlorhexidine gluconate. In the study group of respondents there was used magistralite chlorhexidine solution. We found positive rate in 12.70% when using an alcoholic solution in 17.63% and an iodine solution in 31.67%. A statistically significant difference ( $p > 0.001$ ).

With regard to the urinal infection prevention, it is recommended in accordance with the methodology of Evidence Based Medicine Group and the maintenance of a closed urinary drainage. In the study group of respondents, there was used a closed system in 496 patients and a positive rate of bacteriological examination of urine was found in 16.13%. In 15 patients a closed circuit was not used and the positive cultures occurred in 46.67% of cases. Statistically significant difference  $p > 0.002$  confirmed the influence of the closed drainage to reduce urinary tract infections. Furthermore, there was evaluated the length of the introduction of urinary catheter in connection with the occurrence of urinary tract infection. From the file of 518 drained patients, there was found that when replacing the catheter to 7 days there was 0.51% Urinal infections. In the category of catheter introduced to 14 days, there were confirmed positive cultures in urine at 2.61% for urinary catheters introduced more than 14 days positivity was found in 21.43%. Statistically significant difference  $p < 0.001$  confirmed a significant correlation between the observed factors.

### Conclusion:

Intensive education and participation of nursing staff in implementing preventive measures affecting the incidence of sepsis and infectious complications in the workplace of intensive care, focusing particularly at treatment of critically ill, can reduce the incidence of infectious complications and sepsis cases in intensive care. It is necessary to include preventive measures affecting incidence of septic complications in intensive care nursing and therapeutic protocols.

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