

# Prevalence and risk factors for sepsis in hospitals in Yogyakarta

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## Abstract

**Background:** Sepsis is a syndrome of physiological, pathological, and biochemical abnormalities caused by infection. This study aimed to analyze the prevalence and risk factors for sepsis at Pembinaan Kesejahteraan Umat (PKU) Muhammadiyah Gamping Hospital, Yogyakarta.

**Methods:** The research design was an analytic observational study using a cross-sectional design. The sample in this study were patients diagnosed with sepsis at the hospital from January 2019 to December 2022 and met the inclusion and exclusion criteria. The inclusion criteria were inpatients at the hospital from January 2019 to December 31, 2022, and patients diagnosed with sepsis according to the hospital protocol. Exclusion criteria were patients diagnosed with bacteremia but incomplete data. Sampling was conducted by consecutive sampling. Retrieval of data from patient data stored in medical records. The ethical permit was from PKU Muhammadiyah Gamping Hospital with the number 051/KEP-PKU/III/2023.

**Results:** The effect of length of stay, diabetes mellitus (DM), and age on the incidence of sepsis

was 22.5%. Length of stay had an effect on the incidence of sepsis with a p-value of 0.001. The odds ratio (OR) value was 3.177 (95% CI 2.033-4.965) meaning that a stay of more than 3 days had a risk of suffering from sepsis 3 times greater than a stay of less than 3 days. DM had an effect on the incidence of sepsis with a p-value of 0.009, OR 4.988 (95% CI 1.499-16.601) meaning that patients with DM were at risk of suffering from sepsis 5 times greater than patients who did not suffer from DM. Age had an effect on the incidence of sepsis with a p-value of 0.001, OR 4.162 (95% CI 2.660-6.512) meaning that over 60 years of age, the risk of suffering from sepsis was 4 times greater than patients under the age of 60 years.

**Conclusion:** The prevalence of sepsis for 4 years was 200 cases. The risk factors that were found to be significant were length of stay, DM, and age. The incidence of sepsis is very important to reduce by adhering to the management of this disease so that it is expected that the cost, length of stay, and high mortality from sepsis can be reduced.

**Key words:** Prevalence, risk factors, sepsis, hospital.

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## Introduction

Sepsis is a syndrome of physiological, pathological, and biochemical abnormalities caused by infection. It is a major public health problem, accounting for over \$20 billion (5.2%) of total United States hospital costs in 2011. The reported incidence of sepsis is increasing, likely reflecting an aging population with more comorbidities, greater recognition, and, in some countries, favorable coding to replacement. Although the incidence is unknown, conservative estimates suggest sepsis is a leading cause of death and critical illness worldwide. In addition, there is increasing awareness that patients who survive sepsis often have long-term physical, psychological,

and cognitive disabilities with significant health care and social implications. (1)

Late-onset sepsis (LOS), defined as the onset of sepsis after 72 hours of life, is one of the leading causes of death in the neonatal intensive care unit. The incidence rate of LOS in preterm infants varies from 20 to 38% in the first 120 days of life, and the mortality rate ranges from 13 to 19%. Survivors are at risk for prolonged hospitalization, development of necrotizing enterocolitis, bronchopulmonary dysplasia, and neurodevelopmental disorders. Diagnosing LOS in everyday clinical practice may be challenging, especially in preterm infants, because clinical symptoms have limited sensitivity and specificity. (2)

Recent statistics suggest that the true prevalence of sepsis is as high as 6% in hospitalized adults, while reliable predictions suggest that the incidence will nearly double in the next 30 years. The in-hospital death rate from sepsis is around 15%, whereas higher rates are observed in the intensive care unit, usually between 20% and 45%. Although Gram-positive and Gram-negative bacteria can trigger sepsis, *Staphylococcus aureus* (20.5% of cases) and *Pseudomonas* species (19.9%) are the most common. In addition, sepsis also often occurs in patients infected with *Candida* (17.0%) and other microorganisms. (3)

Many different infections can cause sepsis, a serious and often fatal clinical syndrome characterized by organ dysfunction and difficult to diagnose. Identifying specific sepsis prevention strategies is a public health priority. Epidemiological evaluation of sepsis usually uses death certificate data or health service utilization; these methods have well-described limitations. Most sepsis initiatives have focused on improving outcomes by promoting protocol-based approaches that facilitate early recognition and treatment. (4)

Septic shock is common in the intensive care unit and often results in organ dysfunction and death. Over the past decades, the incidence of septic shock and disease severity has increased while case fatality rates and severity-adjusted death rates have decreased. As a result, more patients survive more severe illnesses. Many survivors experience impaired physical function and are allowed to return to health facilities rather than going home. Between 1979 and 2000, the percentage of patients with sepsis who were discharged to health facilities increased from 16.8% to 31.8%. (5)

Sepsis after an elective surgical procedure can be disastrous. For example, across all types of surgical procedures, sepsis is associated with an increased mortality of up to 32 times the normal incidence.

Perioperative sepsis causes not only a significant health burden for patients but also an economic burden for providers and payers. With the shift to packaged payment systems and public reporting of physician and hospital metrics, it is increasingly important to understand the causes and risk factors of adverse events that will sanction service providers.

(6)

This study aimed to analyze the prevalence and risk factors for sepsis at Pembinaan Kesejahteraan Umat (PKU) Muhammadiyah Gamping Hospital, Yogyakarta. It is hoped that knowing the prevalence and risk factors can be used as input to hospital management to formulate various efforts to suppress the emergence of sepsis, thereby reducing morbidity, cost of care, and death.

### Literature review

Our estimates of the prevalence of sepsis in in-hospital mortality are similar to previous analyses of large administrative and clinical databases. In contrast, studies based on death certificate data estimate that only 6% of deaths in the United States are related to sepsis. Part of this difference is due to death certificates recording deaths that occurred outside the hospital, as national data from 2014 shows that only 37% of deaths occurred in hospitals. (7)

Sepsis is the leading cause of death and critical illness worldwide. The global incidence rate of hospitalized sepsis is 437 cases per 100,000 person-years, with an in-hospital mortality rate of approximately 17% over the last decade. The increase in sepsis rates likely reflects an aging population with more comorbidities, greater recognition, and, in some countries, favorable coding for reimbursement. An earlier definition of sepsis ("Sepsis-1") was developed by the American College of Chest Physicians and Society of Critical-Care Medicine in 1992. According to this definition, sepsis is defined as the host's systemic inflammatory response to infection. (8)

This large-scale multicenter prospective cohort study demonstrated a high prevalence rate of sepsis in the intensive care unit of a third-level hospital in China. More than two-fifths of patients develop sepsis on admission to the intensive care unit (ICU) or within 48 hours of admission to the ICU, and more than half develop septic shock. *Acinetobacter* and *Pseudomonas* were the most isolated microorganisms, and prompt administration of antibiotics and adequate fluid resuscitation increased survival rates. (9)

The International Consensus Third Definition of Sepsis and Septic Shock (Sepsis-3) was published by the European Society of Intensive Care Medicine

and the Society of Critical Care Medicine and integrated into the International Surviving Sepsis Campaign guidelines in 2016. Terminology was simplified, and now only there are two recognized terms, namely sepsis and septic shock. Sepsis is now defined as life-threatening organ dysfunction caused by the body's irregular response to infection. Septic shock is defined as sepsis with circulatory, cellular, and metabolic dysfunction that is associated with a higher risk of death. (10)

Sepsis, defined as a condition arising when the host's response to infection causes organ dysfunction in the host, remains a major killer. Perhaps the most frequently cited article on the epidemiology of sepsis is a 2001 publication by Angus and colleagues, who used administration data to estimate that there are 751,000 cases (3.0 per 1,000 population) in the United States each year, resulting in more than 200,000 deaths. More recent studies have shown that sepsis causes or contributes to between one-third and one-half of all hospital deaths in the United States, with a greater proportion of patients presenting to the hospital with sepsis than with hospital sepsis. (11)

Immunologically, the spleen is designed as an immunoglobulin M memory B-cell factory and an environment in which blood flow can be easily monitored. Splenectomy during childhood or adolescence may become necessary because of hematological disease, trauma, or, rarely, malignancy. Children who have undergone splenectomy are considered to have impaired immune function and, as a result, may have a predisposition to develop severe post-splenectomy infections during high-risk periods. Robust estimation of the incidence of sepsis in children and adolescents without a spleen is limited, given the relatively rare incidence of splenectomy in children and sometimes difficult long-term monitoring. (12)

The rate of new atrial fibrillation events in patients with sepsis admitted to the ICU that we found in our systematic review was higher than the 4 to 9% event rate reported for the general ICU population but lower than the estimated 30 to 50% rate in post-cardiac surgery patients. In addition, the event rates reported in our review varied widely between studies, which may be explained by random variations due to the sample size of most included studies but also by differences in patient populations and misclassification. (13)

## Methods

The research design is an analytic observational study using a cross-sectional design. The sample in this study were patients diagnosed with sepsis at the

hospital from January 2019 to December 2022 and met the inclusion and exclusion criteria. The inclusion criteria were inpatients at the hospital from January 2019 to December 31, 2022 and patients diagnosed with sepsis according to the hospital protocol. Exclusion criteria were patients diagnosed with sepsis but incomplete data. The method of sample selection, sampling, was conducted by consecutive sampling. Retrieval of data from patient data stored in medical records. The ethical permit from PKU Muhammadiyah Gamping Hospital with number 051/KEP-PKU/III/2023.

## Results

**Tables 1 and 2** show the characteristics of the respondents and the results of statistical tests regarding the length of stay, age, and gender on the incidence of sepsis. The statistical test was carried out using a multivariate test. This multivariate test used logistic regression because the data was nominal. Based on the data in **Tables 1 and 2**, it can be explained as follows:

- a. The effect of length of stay, diabetes mellitus (DM), and age on the incidence of sepsis was 22.5%.
- b. Length of stay had an effect on the incidence of sepsis with a p-value of 0.001. OR value of 3.177 means that the length of stay of more than 3 days had a risk of suffering from sepsis 3 times greater than the length of stay of less than 3 days.
- c. DM had an effect on the incidence of sepsis with a p-value of 0.009. OR value of 4.988 means that patients with DM had a risk of suffering from sepsis 5 times greater than patients without DM.
- d. Age had an effect on the incidence of sepsis with a p-value of 0.001. OR value of 4.162 means that over 60 years of age the risk of suffering from sepsis was 4 times greater than patients under the age of 60 years.

## Discussion

In this study, the prevalence of sepsis during 2 years of data collection was 200, consisting of 112 males and 9 females. There was a correlation between the incidence of DM and the incidence of sepsis, with a p-value of 0.016 and OR=4.988. There was a correlation between the length of stay and the incidence of sepsis with p=0.001 and OR=3.177. There was a correlation between age and the incidence of sepsis with p=0.001 and OR=4.162. These results need to be compared with other countries.

Among healthcare-associated risk factors, hospitalization within the previous 90 days was the strong-

est independent variable associated with sepsis caused by a multi-drug resistant organism (MDRO). In addition, septic shock is a risk factor for MDRO-induced sepsis, although some have argued that septic shock is a marker of disease severity and should not be considered a risk factor in itself. (14)

One of the main reasons we studied sepsis survivor populations was to reveal the important risk factors associated with long-term mortality, often masked by risk factors associated with short-term mortality, such as acute illness severity. The gradual increase in harm seen with increasing APACHE II acute physiology component scores was continued in the sensitivity analysis, excluding patients with severe chronic comorbidities. When considered in the context of clinical and biological differences within the sepsis group, these findings reinforced the value of clinical information routinely available during initial critical care admission for sepsis for use in the follow-up care of sepsis survivors. (15)

Sepsis syndrome is a major cause of death and arises from the systemic inflammatory response to infection. Severe sepsis increases the risk of a new diagnosis of atrial fibrillation (AF). Patients who develop new AF during severe sepsis are at increased risk for stroke and death in the hospital. The incidence and risk factors for novel AF occurring along the sepsis syndrome spectrum have not been well characterized. Understanding the epidemiology of newly diagnosed AF that occurs during sepsis can provide insight into poorly understood mechanisms. (16)

Sepsis is a life-threatening organ dysfunction caused by a disorganized host response to infection. Sepsis and septic shock are major health problems, affecting millions of people worldwide each year and causing the death of between one in three and one in six people affected. Early identification and appropriate treatment in the early hours after developing sepsis can improve outcomes. This document's recommendations are intended to guide clinicians caring for adult patients with sepsis or septic shock in hospital settings. (17)

Sepsis has complex and dangerous origins and conditions. It can be caused by various factors and affects the function of several organs. Lung infection is one of the main causes of sepsis, and more than 40% of septic patients have a lung infection. Studies have shown that patients with sepsis and lung infections are more severe and have higher death rates. If patients with sepsis and lung infections can be assessed early and appropriate treatment strategies can be applied in time, the mortality rate can be effectively reduced. (18)

Over the last two decades, sepsis has been defined

as “systemic inflammatory response syndrome (SIRS) caused by infection” for adults and children. However, this definition has long been criticized for its too broad inclusion of milder conditions, such as influenza virus infection in the absence of organ dysfunction. Nearly half of the adult patients admitted to the hospital met two or more SIRS criteria at least once during their stay in the ward, whereas Kaukonen et al. demonstrated that approximately 12% of adult ICU patients with infection and at least one organ dysfunction did not meet criteria for SIRS, but their mortality rate remained significant. (19)

The Sepsis Campaign was developed to reduce severe sepsis and septic shock mortality. Campaign activities on sepsis aimed at this goal include the development of evidence-based guidelines, educational packages to increase awareness and understanding of the condition, and quality improvement initiatives to help healthcare professionals adopt identified best practices. A recent analysis covering a period of 7 years and 6 months showed that active participation was associated with increased adherence to guidelines, as evidenced by increased adherence to established performance metrics. In addition, this increase itself was associated with a decrease in mortality from sepsis. (20)

In China, a multi-center prospective study of sepsis in hospitalized children was performed and reported that the prevalence of sepsis was 5.5%. Of the 1530 children who met the criteria for sepsis, 121 (7.9%) had severe sepsis and 32 (2.1%) had septic shock. Based on these data, the estimated incidence of sepsis in children in China was 181 cases per 100,000 children. In China, the overall case fatality rate was 3.5% for all sepsis cases, the mortality rate from severe sepsis and septic shock was 34.6%, and more than 70% of these deaths occurred within the first 72 hours after hospital admission. (21)

One of the key factors in surviving sepsis is the rapid identification of the disease and the timely initiation of treatment. In an effort to improve outcomes and lower mortality rates, guidelines and step packages have been widely implemented in hospitals in recent years. Although there have been some reports of success using these strategies, pregnant women may not experience results from these attempts. Because of the physiological changes in pregnancy, diagnosing sepsis is difficult, and the parameters used in the general population are less specific for pregnant women. (22)

To improve outcomes, it is critical to provide optimal management in every aspect of care, including initial screening, optimization of hemodynamics, antibiotic treatment, and control of the source of in-

fection. This requires a rapid but coordinated approach from multiple disciplines, including the general public, emergency medical services, and hospitals with the support of proactive government policies. Detailed national epidemiological information on sepsis can play a critical role in this process. (23)

### **Conclusion**

The prevalence of sepsis for 4 years was 200 cases. The risk factors that were found to be significant were length of stay, DM, and age. The incidence of sepsis is very important to be reduced by adhering to the management of this disease so that it is expect-

ed that the cost, length of stay, and high mortality from sepsis can be reduced.

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### **Conflict of interest**

There was no conflict of interest in this study.

**Table 1.** Characteristics of respondents

Variable	Sepsis			
	Yes		No	
	n	%	n	%
Length of treatment				
- >3 days	139	69.5%	91	45.5%
- ≤3 days	61	30.5%	109	54.5%
Diabetes mellitus				
- Yes	14	7.0%	4	2.0%
- No	186	93.0%	196	98.0%
Age				
- >60 years	113	56.5%	51	25.5%
- ≤60 years	87	43.5%	149	74.5%

**Table 2.** Results of statistical test on the factors that influenced the incidence of sepsis

Variable	R <sup>2</sup>	B	p	OR	95% CI for EXP (B)	
					Lower	Upper
Length of treatment	0.225	1.156	0.001	3.177	2.033	4.965
Diabetes mellitus		1.607	0.009	4.988	1.499	16.601
Age		1.426	0.001	4.162	2.660	6.512

Legend: R<sup>2</sup>=the influence of length of stay, diabetes mellitus, and age on the incidence of sepsis; B=the influence of each variable; OR=odds ratio; CI=confidence interval.

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