

# The Influence of Risk Factors on Nosocomial Pneumonia Events in Hospital Al-Azis Intensive Care Unit Rantauprat

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**Keywords:** Nosocomial Pneumonia, Infection, Use of Antibiotics, ICU.

**Abstract:** Nosocomial pneumonia is a serious problem that can cause death directly or indirectly. The lightest thing that can be felt with the occurrence of nosocomial pneumonia is the length of hospitalization, so the patient have to pay great cost of care treatment. This study aims to determine the effect of risk factors on the incidence of nosocomial pneumonia. The method of this study is analytic observational case control with a retrospective approach. The analysis in this study was the analysis of multiple logistic regression at a real level  $\alpha = 0.05$ . The results showed that there was influence of age ( $p = 0.00$ ;  $p < 0.05$ ), length of treatment ( $p = 0.04$ ;  $p < 0.05$ ), duration of mechanical ventilator use ( $p = 0.01$ ;  $p < 0.05$ ), antibiotic use ( $p = 0.00$ ;  $p < 0.05$ ) against nosocomial pneumonia. There was no sex effect on nosocomial pneumonia ( $p = 0.12$ ;  $p > 0.05$ ). From multivariate analysis showed that the most dominant factor influencing was age ( $p = 0.00$ ). Prevention of nosocomial pneumonia is suggested to be carried out by applying aseptic and antiseptic principles during invasive procedures, implementing the patient safety principle, and using good personal protective equipment.

## 1 INTRODUCTION

Infectious diseases are still the main cause of high morbidity and mortality rates in the world. One type of infection is a nosocomial infection. Nosocomial infection is an infection that occurs in a hospital or health care facility after being treated 2x24 hours. Before being treated the patient did not have these symptoms and was not in the incubation period. Nosocomial infection is not a result of previous illnesses. Hospital as a place of treatment is also a health care facility that can be a source of infection where sick people are treated. Nosocomial infections can occur in patients, health workers and also everyone who comes to the hospital. Infections at this health center can be transmitted or obtained through health workers, sick people, career visitors or due to hospital conditions (Schwarzbold *et al.*, 2018)

The most common nosocomial infection is nosocomial pneumonia after urinary tract infection, which is as much as 13.18% or 5-10 episodes per 1000 hospitalizations. Nosocomial pneumonia (Hospital-acquired pneumonia) is a pulmonary infection that occurs more than 48 hours After being treated in hospital and getting rid of all infections

that occur before entering the hospital and not in the incubation period at hospital admission (Stenlund, Sjö Dahl and Yngman-Uhlin, 2017)

The incidence of nosocomial pneumonia in the ICU is more common than nosocomial pneumonia in public areas, which is found in nearly 20% of all infections in the ICU and 90% occur during mechanical ventilation. Hospital-acquired pneumonia is obtained in 9-27% of patients who are intubated, the risk of hospital-acquired pneumonia is highest at the time of initial admission to the ICU (Frantzeskaki and Orfanos, 2018)

The mortality rate in nosocomial pneumonia is 20 - 50%, this rate increases in pneumonia caused by *P. aeruginosa* or who has secondary bacteremia. The mortality rate of patients in ICU patients has increased 3-10 times compared to patients without Pneumonia. Some studies say that the duration of treatment increased 2-3 times compared to patients without pneumonia. This certainly will increase the cost of treatment in the hospital. In the United States, it was reported that the length of treatment increased by an average of 7 to 9 days (Xia, Gao and Tang, 2016)

Several risk factors are suspected to trigger nosocomial pneumonia including age over 60 years,

male sex, length of ICU treatment, use of invasive equipment > 48 hours (intubation, nasogastric tube, mechanical ventilator), use of antibiotics (Xia, Gao and Tang, 2016)

All studies on nosocomial pneumonia found that most HAP subjects were male sex because this was because male sex was more susceptible to pneumonia. One of the causes of this vulnerability is because men are more exposed to cigarette smoke pollution which is a risk factor for pneumonia. Halim research results (2014) in RSCM 204 patients diagnosed with HAP, 109 people (53.4%) of whom were men. In Thailand, Werarak (2010) also found more male subjects affected by nosocomial pneumonia were 102 out of 140 subjects (70%). In North Sumatra, a study on the prevalence of nosocomial pneumonia in the ICU in Haji Hospital Medan by Ibrahim (2016) found the largest number of nosocomial pneumonia events in the male gender group of 20 people (86.95%). (Xiao *et al.*, 2016)

Nosocomial pneumonia can have an impact on increasing morbidity and mortality and increased the length of stay. This needs serious attention from hospital managers and medical personnel. Medical staff in hospitals, especially in the ICU room need to pay attention to any factors that cause nosocomial pneumonia, so they can take appropriate action to minimize or reduce the incidence of nosocomial pneumonia in the ICU room. The importance of doctors and nurses knowing what factors affect nosocomial pneumonia in the ICU so that it can minimize the impact caused by the background of this research needs to be done. (Xiao *et al.*, 2016)

## 2 RESEARCH METHOD

This type of research is an observational case-control analytic study with a retrospective approach, which is to see the effect of risk factors on the incidence of nosocomial pneumonia. This research was conducted on April 2019. The place of this research was conducted at Elpi Al-azisRantaupratat General Hospital. The population in this study were all patients diagnosed with nosocomial pneumonia based on CPIS scores in the ICU room at Elpi Al-AzisRantaupratat General Hospital. The sample in this study were 58 cases and 58 controls using *the sample size determination in health study software*.

Bivariate analysis and multivariate analysis used in this study are using *chi-square* and multiple logistic regression.

## 3 RESULTS AND DISCUSSION

### 3.1 Univariate Analysis

Univariate analysis in this study focused on variables of age, sex, duration of treatment, duration of use of mechanical ventilators, use of antibiotics. The description of univariate analysis in this study can be seen as in the following table:

Table 1: Description of Univariate Variable Risk Factors for Nosocomial Pneumonia in ICU Room of Elpi Al-Azis Hospital Rantaupratat 2018

No	Variabel	Pneumonia (Case)		No pneumonia (Control)		Amount	
		N	%	N	%		%
Age (Years)							
1.	>60 Years	39	75,0	13	25,0	52	100
2.	<60 Years	19	29,7	45	75,3	64	100
Gender							
1.	Female	17	39,5	26	60,5	43	100
2.	Male	41	56,2	32	43,8	73	100
Length of treatment							
1.	There is	38	64,4	21	35,6	59	100
2.	There is't	20	35,5	37	64,9	57	100

Based on the table 1 it was found that patients with age <60 years 64 people (55.2%) more than the sample of patients with age > 60 years totaling 52 people (44.8%). And samples with male sex more than women. The results obtained by the male type 73 people (62.9%), while the female gender 43 people (37.1%). Patients with > 5 days treatment 62 people (53.4%) more than <5 days treatment 54 (46.6%). Based on the table above, the results show that the use of mechanical ventilators > 5 days is 60 people (51.7%), while the use of mechanical ventilators <5 days is 56 people (48.3%). Based on the table, the results showed that patients with prior antibiotic use were 59 people (50.9%), while patients with more than two or more antibiotic use were 57 people (49.1%).

### 3.2 Bivariate Analysis

Bivariate analysis was used to determine the effect between the independent variables and the dependent variable using the *Chi-Square* test and the result data obtained as follows:

### 3.2.1 Effect of Age on the Occurrence of Nosocomial Pneumonia

Table 2: The Effect of Age on The Incidence of Nosocomial Pneumonia in The ICU Room of Elpi Al-Azis Hospital Rantauprapat in 2018

Incident of Pneumonia	Patient Status				Amount	
	Pneumonia		No Pneumonia		n	%
	n	%	n	%		
>60 years	39	75,0	13	25,0	52	100
≤60 years	19	29,7	45	75,3	64	100

$\chi^2=21,7$ ;  $p=0,00$ ( $p<0,05$ ) OR=7, 95%CI(3,11-16,2)

Based on the table 2 it can be seen that the incidence of nosocomial pneumonia in the ICU is highest at age > 60 years 39 patients out of 52 people (75.0%) compared to those aged ≤ 60 years 19 patients out of 64 people (29.7%). Statistical analysis showed that there was an influence of age on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p = 0.00$ ;  $p < 0.05$ ). and odd ratio; 7.10 95% CI (3.11-16.2). This means that the risk of pneumonia is 7.10 times greater for people aged > 60 years than for those aged ≤ 60 years.

### 3.2.2 Effects of Gender on the Occurrence of Nosocomial Pneumonia

Table 3: The Influence of Sex on the Occurrence of Nosocomial Pneumonia in the ICU Room of Elpi Al-Azis Hospital Rantauprapat in 2018

The incidence of pneumonia	Status Pasien				Amount	
	Pneumonia		No Pneumonia		n	%
	n	%	n	%		
>60 years	17	39,5	26	60,5	43	100
<60 years	41	56,2	32	43,8	73	100

$X^2=2,36$ ;  $p=0,12$  ( $p>0,05$ ) OR=0,5 95%CI(0,23-1,09)

Based on the table 3, it can be seen that the incidence of nosocomial pneumonia in the ICU is highest in male sex 41 out of 73 patients (56.2%). compared with female sex 17 of 43 patients (39.5%) The results of statistical analysis showed that there was no gender-related to the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p = 0.12$ ;  $p > 0.05$ ).

### 3.2.3 Effect of Length of Treatment on the Incidence of Nosocomial Pneumonia

Table 4: Effect of Duration of Care on the Occurrence of Nosocomial Pneumonia in the ICU Room of Elpi Al-Azis Hospital Rantauprapat in 2018

The incidence of pneumonia	Status Pasien				Amount	
	Pneumonia		NonPneumonia		n	%
	n	%	n	%		
Length of treatment >5 days	37	59,7	25	40,3	62	100
<5 days	21	38,9	31	61,1	54	100

$X^2=4,19$ ;  $p=0,04$  ( $p>0,05$ ) OR =2,32 95%CI(1,10-4,90)

Based on the table 4, it can be seen that the incidence of nosocomial pneumonia in the ICU is highest in the duration of treatment > 5 days 37 of 62 patients (59.7%) compared to the duration of treatment < 5 days 21 of 54 patients (38.9%). The results of the statistical analysis showed that there was an effect of the length of treatment on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p = 0.04$ ;  $p < 0.05$ ). and odd ratio; 2.32 95% CI (1.10-4.90). This means that the risk of pneumonia is 2.32 times greater for the duration of treatment than for the duration of treatment < 5 days.

### 3.2.4 The Effect of Long Use of Mechanical Ventilators on the Occurrence of Nosocomial Pneumonia

Table 5: The Effect of Antibiotic Use on The Incidence of Nosocomial Pneumonia in The ICU Room of Elpi Al-Azis Hospital Rantauprapat in 2018

Incident of Pneumonia	Patient Status				Amount	
	Pneumonia		No Pneumonia		n	%
	n	%	N	%		
Use of Antibiotics	38	64,3	21	35,6	59	100
There is't	20	35,7	33	64,3	57	100

$\chi^2=8,83$ ;  $p=0,00$ ( $p<0,05$ ) OR =3,34 95%CI(1,56-7,16)

Based on the table 5 it can be seen that the incidence of nosocomial pneumonia in the ICU room was highest in the previous antibiotic use of 38 patients out of 59 people (64.4%) compared to without the use of antibiotics before 21 patients out of 57 people (35.6%). Statistical analysis showed that there was an effect of antibiotic use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p = 0.00$ ;  $p < 0.05$ ). and odd ratio; 3.34 95% CI (1.56 to 7.16). This means that the risk of pneumonia is 3.34 times greater for previous antibiotic use than for not using previous antibiotics.

### 3.2.5 The Effect of Antibiotic Use on the Occurrence of Nosocomial Pneumonia

Table 6: The Effect of Antibiotic Use on the Occurrence of Nosocomial Pneumonia in the ICU Room of Elpi Al-Azis Hospital Rantauprapat in 2018

The incidence of pneumonia	Status Pasien				Amount	
	Pneumonia		No Pneumonia			
	n	%	n	%	n	%
Use of Antibiotics						
There is	38	64,4	21	35,6	59	100
There is't	20	35,5	37	64,9	97	100
$X^2=8,83$ ; $p=0,00$ ( $p>0,05$ )	OR =3,34	95%CI (1,56-7,16)				

Based on the table 6 it can be seen that the incidence of nosocomial pneumonia in the ICU room was highest in the previous antibiotic use of 38 patients out of 59 people (64.4%) compared to without the use of antibiotics before 21 patients out of 57 people (35.6%). Statistical analysis showed that there was an effect of antibiotic use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p = 0.00$ ;  $p < 0.05$ ). and odd ratio; 3.34 95% CI (1.56 to 7.16). This means that the risk of pneumonia is 3.34 times greater for previous antibiotic use than for not using previous antibiotics.

### 3.3 Multivariate Analysis

Multivariate analysis in this study is intended to look at the effect of independent variables on the dependent variable together for the sake of estimation. Based on the results of the bivariate analysis, candidate variables included in the *logistic regression* analysis can be seen as in the following table.

Table 7: The final table of regression test results

Variabel	p	Odds	95% CI	
			Lower	Upper
Age	0,00	8,29	3,24	21,1
Prolonged Use of Mechanical Ventilators	0,00	3,55	1,39	9,07
Use of Antibiotics	0,01	3,01	1,22	7,41
Konstanta	0,00			

Based on the table 7 it can be seen that together the regression model is feasible to be used to determine the effect of risk factors on the incidence of nosocomial pneumonia ( $p < 0.00$ ). Individually, the results of the analysis found that there was an influence of age on the incidence of nosocomial pneumonia ( $p < 0.00$ ) with an odds ratio (OR) of 8.29; 95% CI (3.24-21.1). This means that the incidence of nosocomial pneumonia in the ICU room is 8.29 times greater in patients aged > 60 years compared to patients aged < 60 years. The analysis also found the effect of the duration of mechanical ventilator use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p < 0.00$ ) with an odds ratio (OR) of 3.55; 95% CI (1.39-9.07). This means that the risk of pneumonia incidence is 3.55 times greater for use of mechanical ventilators > 5 days than with the use of mechanical ventilators < 5 days. Statistical analysis showed that there was an effect of antibiotic use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p < 0.01$ ). and odd ratio; 3.01 95% CI (1.22-7.41). This means that the risk of pneumonia is 3.01 times greater for previous antibiotic use than for not using previous antibiotics. From the results of this study, it was also found that the sex and duration of treatment variables did not affect the incidence of nosocomial pneumonia in the ICU ( $p > 0.05$ ). From the results of this study, it was also found that the age variable was the most dominant variable affecting the incidence of nosocomial pneumonia in the ICU Room of Elpi Al-Azis Hospital Rantauprapat.

## 4 DISCUSSION

### 4.1 Univariate Analysis

Based on the table above it was found that patients with age < 60 years 64 people (55.2%) more than the sample of patients with age > 60 years totaling 52 people (44.8%). And samples with male sex more

than women. The results obtained by the male type 73 people (62.9%), while the female gender 43 people (37.1%). Patients with > 5 days treatment 62 people (53.4%) more than <5 days treatment 54 (46.6%). Based on the table above, the results show that the use of mechanical ventilators > 5 days is 60 people (51.7%), while the use of mechanical ventilators <5 days is 56 people (48.3%). Based on the table, the results showed that patients with prior antibiotic use were 59 people (50.9%), while patients with more than two or more antibiotic use were 57 people (49.1%).

## 4.2 Bivariate Analysis

### 4.2.1 Effect of Age on the Occurrence of Nosocomial Pneumonia

Age variable is the most dominant factor in this study, this is because according to the observations of researchers in the field that in the ICU room of Elpi Al-Azis Hospital Rantauprapat the average patient using a mechanical ventilator is a patient aged > 60 years. In addition, patients aged > 60 years are patients who have an average length of stay > 5 days which is another risk factor that influences the prevalence of nosocomial pneumonia.

### 4.2.2 Effects of Gender on the Occurrence of Nosocomial Pneumonia

The gender variable is not meaningfully caused by the following things. In healthy conditions and young age, there are differences in endurance between men and women where female endurance is better than men. The hormone estrogen in women can activate *nitric oxide synthase* (NOS3) which can increase phagocytosis so that it can fight microorganisms well. In general, men are often exposed to nosocomial pneumonia because it is thought to be influenced by sex-specific hormones such as steroid hormones, such as androgens, estrogens, and progesterone as a modifying factor in the immune response and can inhibit the inflammatory process. Then the male gender is more susceptible to certain diseases including HAP (Sweeney and Khatri, 2016)

### 4.2.3 Effect of Length of Treatment on the Incidence of Nosocomial Pneumonia

Length of stay can be caused by the patient's medical condition or the presence of nosocomial infection that extends the length of the stay can reach 5-20 days (MOH, 2005). Richard Johnson and Jennifer

Simpson (2009) stated that the length of stay could increase due to nosocomial infection to 13.3 days, 2 times longer than normal. Apart from medical conditions, length of stay can also be caused by non-medical conditions, such as administrative delays in hospitals, lack of planning in providing services to patients (patient scheduling) or policies in the medical field. (I Wayan Journalist, 2012).

### 4.2.4 The Effect of Long Use of Mechanical Ventilators on the Occurrence of Nosocomial Pneumonia

The use of mechanical ventilators increases the risk of nosocomial pneumonia by transferring oropharyngeal microorganisms to the trachea through the endotracheal tube during intubation and decreased endurance of the patient due to severe underlying disease. Tracheal colonization is the presence of microorganisms from cultures obtained from tracheal samples that initially had no signs of the process of airway infection. In Elpi Al-Azis General Hospital, Rantauprapat, according to the researchers' observations, most patients who use mechanical ventilators are > 60 years old and with a duration of > 5 days. Another thing that researchers found was the procedure of installing a mechanical ventilator in patients who were under-attention because the anesthesiologist had more than one place of duty.

### 4.2.5 The Effect of Antibiotic Use on the Occurrence of Nosocomial Pneumonia

Irrational use of antibiotics can cause resistance to the patient's body which allows the patient's immune system to become weak which is susceptible to microorganisms that cause HAP. The choice of empirical antibiotics for critical patients in the ICU requires several considerations, including the specific pattern of germs in the ICU, and the possibility of infecting germs that have become resistant to empiric antibiotics given previously. Because of the critical condition of the patient, the bactericidal effect of antibiotics becomes less efficient and has the potential to cause germ resistance.

## 4.3 Multivariate Analysis

To determine the effect of risk factors on the incidence of nosocomial pneumonia ( $p < 0.00$ ). Individually, the results of the analysis found that there was an influence of age on the incidence of nosocomial pneumonia ( $p < 0.00$ ) with an odds ratio (OR) of 8.29; 95% CI (3.24-21.1). This means that

the incidence of nosocomial pneumonia in the ICU room is 8.29 times greater in patients aged >60 years compared to patients aged <60 years. The analysis also found the effect of the duration of mechanical ventilator use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p < 0.00$ ) with an odds ratio (OR) of 3.55; 95% CI (1.39-9.07). This means that the risk of pneumonia incidence is 3.55 times greater for use of mechanical ventilators >5 days than with the use of mechanical ventilators <5 days. Statistical analysis showed that there was an effect of antibiotic use on the incidence of nosocomial pneumonia in the ICU room at Elpi Al-Azis Hospital Rantauprapat ( $p < 0.01$ ). and odd ratio; 3.01 95% CI (1.22-7.41). This means that the risk of pneumonia is 3.01 times greater for previous antibiotic use than for not using previous antibiotics. From the results of this study, it was also found that the sex and duration of treatment variables did not affect the incidence of nosocomial pneumonia in the ICU ( $p > 0.05$ ). From the results of this study, it was also found that the age variable was the most dominant variable affecting the incidence of nosocomial pneumonia in the ICU Room of Elpi Al-Azis Hospital Rantauprapat.

## 5 CONCLUSION

There was an influence of age on the incidence of nosocomial pneumonia ( $p < 0.00$ ) with an odds ratio (OR) of 8.29; 95% CI (3.24-21.1). This means that the incidence of nosocomial pneumonia in the ICU room is 8.29 times greater in patients aged > 60 years compared to patients aged <60 years. There was a long-term effect of the use of mechanical ventilators on the incidence of nosocomial pneumonia in the ICU room of Elpi Al-Azis Hospital Rantauprapat ( $p < 0.00$ ) with an odds ratio (OR) of 3.55; 95% CI (1.39-9.07). This means that the risk of pneumonia incidence is 3.55 times greater in the use of old mechanical ventilators compared with the use of short mechanical ventilators. There is an influence of the use of antibiotics on the incidence of nosocomial pneumonia in the ICU room of Elpi Al-Azis Hospital Rantauprapat ( $p < 0.01$ ). and odd ratio; 3.01 95% CI (1.22-7.41). This means that the risk of pneumonia is 3.01 times greater for the use of antibiotics  $\geq 2$  types of antibiotics compared to 1 type of antibiotics. Sex and duration of treatment had no effect on the incidence of nosocomial pneumonia in the ICU ( $p > 0.05$ ). From the results of this study, it was also found that the most dominant age variable influenced the incidence of Nosocomial

Pneumonia in the ICU of Elpi Al-Azis Hospital Rantauprapat in 2018.

## 6 SUGGESTION

For doctors and medical staff especially those who served in the ICU room at Elpi Al-Azis Rantauprapat Hospital to provide higher service and attention to patients aged >60 years, especially regarding hygiene in efforts to prevent early nosocomial infections, apply aseptic and antiseptic principles during the procedure invasive, the implementation of the principle of *patient safety*, and the use of good personal protective equipment. Remind doctors to use antibiotics if more than one week needs to be evaluated whether they need to be continued, stopped or replaced according to culture results. In the treatment of patients need to be guided by *clinical pathway* diagnosis of the disease so that patients are not too long in the hospital and not too long the patient uses a mechanical ventilator. For doctors and other medical personnel so that the results of this study can be used as epidemiological data for Elpi Al-Azis General Hospital Rantauprapat, specifically the ICU section, to take steps to prevent and reduce the incidence of nosocomial pneumonia such as education, early detection or providing adequate management. To the Elpi Al-Azis General Hospital Rantauprapat especially those responsible for completing medical record data, such as doctors and paramedics to complete medical record data and write neatly and clearly so that readers can understand correctly and correctly. Further research needs to be done with more samples and a longer period. If possible can use a *prospective research design* by taking into account various limitations in this study. Research into other factors that have to do with the risk of nosocomial pneumonia is needed.

## ACKNOWLEDGEMENTS

My deep thanks to DELI HUSADA Deli Tua Health Institute for providing the opportunity for all lecturers on this beloved campus to gain Knowledge in Writing the Scientific Journal and provide new Experiences in holding the International Conferences. Hopefully with the implementation of this activity in the future I can contribute to the progress of DELI HUSADA Deli Tua Health Institute.

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