Vol 25 No. 1 November 2018

p-ISSN 0854-4263
e-ISSN 4277-4685

INDONESIAN JOURNAL OF
# CLINICAL PATHOLOGY AND MEDICAL LABORATORY
Majalah Patologi Klinik Indonesia dan Laboratorium Medik

## CONTENTS

### RESEARCH

Proportion of Isomorphic Erythrocyte Urine in Diabetic Kidney Disease with Flow cytometry Methods
**Erica Catarina, Coriejati Rita, Basti Andriyoko, Ida Parwati** ..... 1 - 6

Analysis of Ret-He in Chronic Kidney Disease Patients at Dr.Wahidin Sudirohusodo Hospital, Makassar
**Febrina Rovani, Asvin Nurulita, Mansyur Arif** ..... 7 - 10

Analysis of Red Blood Cell Distribution Width Coefficient of Variation on Stroke Patient
**Kartika Paramita, Agus Alim Abdullah, Mansyur Arif** ..... 11 - 15

IgA Anti-Dengue Profile in Samples with Positive Dengue PCR or NS1
**M Thohirin Ramadhani, Aryati, M Vitanata Arfijanto** ..... 16 -20

The Association of Insulin Resistance and Lipid Profile Ratio in Metabolic Syndrome
**Rini Rahmayani, Adi Koesoema Aman, Santi Safril** ..... 21 - 25

Correlation of Free Hemoglobin Level and Plasma Nitric Oxide in Packed Red Cell during Blood Bank Storage Period
**Ricca Fitria, Rismawati Yaswir, Zelly Dia Rofinda, Desywar** ..... 26 - 30

Correlation of Lipid Profile with Interleukin-12 in Type 2 Diabetes Mellitus
**Meri Ponda Sari, Hanifah Maani, Ellyza Nasrul, Zelly Dia Rofinda** ..... 31 - 34

Platelet Indices for Predicting Liver Fibrosis in Patients with Chronic Hepatitis B Infection
**Shendy Sherly Soeliauwan, Darwati Muhadi, Mutmainnah** ..... 35 - 37

The Relationship Between the Level of Interleukin-6 and Procalcitonin in Severe Sepsis Patients at the Adam Malik Hospital
**Sesily C Nainggolan, Adi Koesoema Aman, Achsanudin Hanafi** ..... 38 - 41

Spontaneous Platelet Aggregation in Third-Trimester Pregnancy at Adam Malik Hospital, Medan
**Rezqi Maulani Jusuf, Hotma Partogi Pasaribu, Herman Hariman** ..... 42 - 46

Correlation between Presepsin and Sequential [Sepsis-Related] Organ Failure Assessment (SOFA) Score as an Organ Dysfunction Marker in Sepsis
**Stevi Dwiyani, Agnes Rengga Indrati, Leni Lismayanti, Adhi Kristianto S** ..... 47 - 52

Correlation of Atherogenic Index of Plasma with Stenosis Level of Coronary Artery in Acute Coronary Syndrome
**Ilhamifithri, Rismawati Yaswir, Eugeny Alia, Efrida** ..... 53 - 57

The Compatibility of Neutrophil to Lymphocyte Count Ratio with Serum Procalcitonin as Bacterial Infection Markers in Sepsis Patients
**Elvinawaty, Hanifah Maani, Zelly Dia Rofinda, Husni** ..... 58 - 63

The Diagnostic Value of Troponin I Testing to Coronary Angiography with a Point of Care Testing Instrument in Patients with Acute Myocardial Infarction
**Riska Anton, Sheila Febriana, Asvin Nurulita, Uleng Bahrun** ..... 64 - 67

Comparisons of Fibro Q Index and FIB-4 in Various Stages of Chronic B Hepatitis
**Evy Adrianti, Liong Boy Kurniawan, Ibrahim Abdul Samad** ..... 68 - 72

Microorganism Pattern on Nasal Cavity of End Stage Renal Disease Patients with Regular Hemodialysis and Staffs in Hemodialysis Installation Adam Malik Hospital Medan
**Imelda Damayanti, Ricke Loesnihari, Syafrizal Nasution** ..... 73 - 78

The Correlation between the Mean Platelet Volume Values with Thrombocyte Aggregation in Nephropathy Diabetic Patients
**Agus Sunardi, Nadjwa Zamalek Dalimoenthe, Coriejati Rita, Adhi Kristianto Sugianli** ..... 79 - 85

The Role of Platelet Concentration Transfusion on The Correlation between Platelet Number and Maximum Amplitude with Bleeding Volume Post Cardiopulmonary Bypass
**Ryan Bayusantika Ristandi, Nida Suraya, Leni Lismayanti, Sylvia Rachmayati** ..... 86 - 90

The Relationship between Nitric Oxide and Glycemic Control in Controlled and Uncontrolled Type 2 Diabetes Mellitus Patients in the Adam Malik Hospital Medan
**Yessy Suziarty, Ratna Akbari Ganie, Santi Syafril** ..... 91 - 94

Analysis of Red Blood Cell Distribution Width Value Towards Fibrotic Stage in Chronic Hepatitis B
**Fatma Idris, Darwati Muhadi, Mutmainnah** ..... 95 - 98

Correlation of Serum High-Density Lipoprotein Cholesterol and Homocysteine Level in Patient with Acute Myocardial Infarction
**Yayie Dwina Putri, Rismawati Yaswir, Lillah, Tuty Prihandani** ..... 99 - 103

Correlation between Galectin 3, Creatinine and Uric Acid on Stage V Chronic Renal Failure
**Indranila KS, Guruh AI, Meita H** ..... 104 - 110

## LITERATURE REVIEW

Role of Delta Check in Clinical Laboratory Services
**Osman Sianipar** ..... 111 - 114

## CASE REPORT

Primary Myelofibrosis
**Muhammad Irhamsyah, Darwati Muhadi, Mansyur Arif** ..... 115 - 120

Malignant Lymphoma with Leukemic Phase in Children
**Sahriany S, Agus Alim Abdulah, Mansyur Arif** ..... 121 - 128

INDONESIAN JOURNAL OF
CLINICAL PATHOLOGY AND MEDICAL LABORATORY
Majalah Patologi Klinik Indonesia dan Laboratorium Medik



2018 Nov; 25(1): 1-
p-ISSN 0854-4263 e-ISSN 2477-4685
Available at www.indonesianjournalofclinicalpathology.org

# MICROORGANISM PATTERN ON NASAL CAVITY OF END STAGE RENAL DISEASE PATIENTS WITH REGULAR HEMODIALYSIS AND STAFFS IN HEMODIALYSIS INSTALLATION ADAM MALIK GENERAL HOSPITAL MEDAN

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**ABSTRACT**

Colonization is the presence and growth of microorganism on the skin or mucous membrane of the body without any sign of infection. Commonly colonized microorganisms are normal flora within a person's body, but can also be microorganism in the hospital that colonizes within the body a few days after they enter the hospital. The longer a person is hospitalized the more likely to be colonized with the microorganism in the hospital. The objective is to determine microorganism pattern and antimicrobial sensitivity in the nasal cavity of regular hemodialysis patients and staff in Hemodialysis Installation of Adam Malik Hospital Medan. The study was analytic observational with a cross-sectional method, conducted in the Department of Clinical Pathology of Adam Malik Hospital Medan together with Hemodialysis Installation of Adam Malik Hospital Medan from August 2016 - October 2016. The sample was anterior nasal cavity swab which went through identification and sensitivity test. A total number of participants following the study were 46 people where patients and staffs were equal to 23 people. Most bacterial colonization of the nasal cavity of patients and staffs: *Staphylococcus epidermidis* 9 (39.13%) and 12 (52.17%); *Staphylococcus aureus* 4 (17.39%) and 3 (13.04%); *Staphylococcus saprophyticus* 2 (8.70%) and 2 (8.70%). There were 3 MRSA from a total of 23 bacteria (13.04%) in regular hemodialysis patients. MRSA colonization was found in regular hemodialysis patients with 50% sensitivity level of Vancomycin.

**Key words:** Microorganism pattern, colonization, nasal cavity, end-stage renal disease, hemodialysis, MRSA

## INTRODUCTION

Colonization is the presence and growth of a microorganism in the skin or mucous membrane of the human body without any sign of infection. The colonizing microbes generally are normal flora in the human body. However, it can also be obtained from the hospital. The microbes can colonize in patient's body within a few days of their arrival at the hospital.[1] The longer the patient is hospitalized the more likely the bacteria in ahospital environment can colonize in their body. Health workers may also get microorganism colonization from the hospital environment and being a carrier of that pathogen. Microorganism colonization can act as a potential source of the pathogen in spreading nosocomial infection.[1]

The immune system changes in end-stage renal failure patients are causing the patients to be easily infected.[2,3] The decrease in immune responses in these patients can be caused by the uremic conditions, vitamin D deficiency, and the hemodialysis procedure it self.[4-8]

Regular hemodialysis patients are prone to getting nosocomial infection both endogenously and exogenously. The endogen nosocomial infection can be caused by both normal florae that previously exists in the patient's body and hospital microorganism that colonize inside the patient's body.[1] Primary bacteremia incidence in end-stage renal failure patients that received regular hemodialysis was reported about 2%-4.5% in every 1000 catheters in a day or about 1-2 episodes in every patient in a year. Hemodialysis catheter usage in end-stage renal failure patients is the main mortality predictor in end-stage renal failure patients receiving regular hemodialysis.[9] Primary bacteremia is the leading cause of morbidity and the second most common cause of mortality in end-stage renal failure patients receiving regular hemodialysis.[10]

Several studies have been conducted to know

nasal cavity bacterial colonization profiles in end-stage renal failure patients who undergo regular hemodialysis and also in hemodialysis unit staff.

A study conducted by Olivas *et al.*, in 70 patients and 10 nurses in a hemodialysis unit in Mexico were found bacterial colonization in the nasal cavity of patients, 9% were basil Gram-negative bacteria. However, they found no colonization in the nurses. MRSA colonization inpatients' nasal cavity was 19%, while in the nurse's nasal cavity and nurse's hands were 50% and 10%, respectively. Based on this research, it is also known that primary bacteremia is mainly caused by *Staphylococcus aureus*, e.g. about 67%, in which the 25% was MRSA type. [11]

Ghasemian *et al.* conducted a study in the nasal cavity of regular hemodialysis patients and found *Staphylococcus aureus* colonization as much as 36.9%, in which 74.2% was MRSA.[12]

Based on several previous studies above, it is known that Staphylococcus aureusis the most common cause of nasal colonization in end-stage renal disease patient who undergoes regular hemodialysis. Patients with nasal *Staphylococcus aureus* colonization have a higher risk to progress into staphylococcal wound infection after operation procedure compared to without colonization patients. It is also clear that patients in bacteremia condition caused by *Staphylococcus aureus* usually get the bacteria colonizing in their nasal cavity and the strain of the nasal colonizing bacteria has the same strain with bacteria found in the blood.[13]

Several health workers also have *Staphylococcus aureus* colonization in their nose. The frequency depends on how close the health worker is exposed to the patients. This health worker always brings the germs in their hands and it is believed to be the cause of nasal colonization in their nose. It also contaminates patients' hands and other objects in environment.[13]

Exogenous nosocomial infections are mainly caused by human contact (from another patient, health worker also visitors) and less commonly caused by hospital environment. Health workers can experience bacterial colonization by hospital pathogen bacteria or normal flora that turn into a pathogen in an immune compromised person.[1] Healthy health workers may carry resistant bacteria strain in their nose and skin, that in turn can spread those bacteria into the community and trigger it to be wide spread.[14] Health workers that continuously and directly contact patients, and contaminated objects can spread the microorganism to other patients and most of them become carriers for a long time.[15]

Based on the explanations above, this study aims to know the bacterial colonization in the nasal cavity of regular hemodialysisend-stage renal failure patients and hemodialysis unit staff in the Adam Malik General Hospital Medan. This study also aims to know the resistance pattern of the bacteria into antimicrobial agent so the data can be used as a reference to prevent nosocomial infection among end-stage renal failure patient that undergo hemodialysis regularly, by infection prevention and control unit. This pattern includes the differences of microorganism and its sensitivity towards antimicrobial in the nasal cavity of end-stage renal failure patients and hemodialysis unit staff in the Adam Malik General Hospital Medan.

## METHODS

This study was an analytic observational study with cross-sectional design.The research conducted in the Department of Clinical Pathology in the Adam Malik General Hospital collaborating with Hemodialysis Department of the Adam Malik General Hospital. Study period was from August 2016 to October 2016. Based on the minimal sample size calculation, it was determined that 46 samples were included in this study. The samples comprised of 23 regular hemodialysis patients and 23 hemodialysis staff that fulfill inclusion and exclusion criteria.

The inclusion criteria were male and female more than 18 years old diagnosed with end-stage renal failure who underwent regular hemodialysis for more than three months. The inclusion criteria for hemodialysis staff were staff in hemodialysis department who had worked for more than three months and agree to join this study. The exclusion criteria were having either respiratory infection nor urinary tract infection at the time of the study, taking antibiotics within last one week, end-stage renal failure patient who underwent acute hemodialysis.

The data was analyzed using Chi-Square with a significance value of 5%. Ethical clearance was approved by the Medical Research Committee, Faculty of Medicine, University of North Sumatra, Medan with a letter approval number of 565/TGL/KEPK FK USU-RSUP HAM/2016. Written informed consents were obtained from research subjects who agreed to join this research. Written consents were requested after the explanation of this study objectives.

The sample was nasal swab from the anterior part of the nasal cavity. The samples were then directly stained as anticipation towards sample

representation. After ward, the sample was cultured in blood agar and Mac Conkey media.

Colony growth in blood agar media was then immediately Gram stained. Gram-positive bacteria should be continued with the catalase test. If the colony mixture produced bubbles (positive catalase test), then the bacteria was *Staphylococcus sp*. and the test was continued using API Staph. If the colony mixture didn't produce any bubbles (negative catalase test) then the bacteria was *Streptococcus sp*., and the hemolysis zone should be observed: If there was wide and clear hemolysis it was *Streptococcus β hemolyticus*, then the test was continued with Bacitracin test. If the bacitracin test was sensitive then it was *Streptococcus pyogenes,* while if it was resistant then it was *Streptococcus agalactiae;* If a greenish partial hemolysis was seen then it was said to be *Streptococcus α hemolyticus*, then the test was continued with Optochin test. If the test was sensitive, it was *Streptococcus pneumoniae*. If the test was resistant it was *Streptococcus viridans*; If there was no hemolysis in erythrocytes (no change was seen in the colony surface) then it was said to be *Streptococcus γ hemolyticus*.

The Gram-negative colonies growth in Mac Conkey media would be Gram stained and further be tested using API 20E. After the bacterial identification was finished and antimicrobial susceptibility test using Kirby Bauer disk diffusion method. The interpretation of inhibition zone diameter toward antimicrobial agents of bacteria commonly found in nasal cavity can be seen in Table 1.

## RESULT AND DISCUSSION

The grouping of staff work in hemodialysis unit and end-stage renal failure patients receiving regular hemodialysis based on age and sex can be seen in Table 2 and 3. While the pattern of microorganism found in nasal cavity of staff working at hemodialysis unit and end-stage renal failure patients receiving regular hemodialysis can be seen in Table 4. The differences of antimicrobial sensitivity pattern between hemodialysis unit staff and regular hemodialysis patient can seen in Table 5.

In this study, there were found 3 cases with Methicillin-Resistant *Staphylococcus aureus* (MRSA) from four *Staphylococcus aureus* cases found in regular hemodialysis patients. The similar result was shown in a previous study conducted by Ghasemian *et al*., that found *Staphylococcus aureus* colonization as many as 26.9%, from which 74.2% was MRSA, in the nasal cavity of patients who underwent regular hemodialysis.[12] The different result was found in hemodialysis staff did not find any MRSA in three *Staphylococcus aureus* cases found in the nasal cavity of hemodialysis staff.

MRSA is not invasive in healthy people. Patients that have a risk to be infected by this bacteria are the patients suffering from cancer, children treated in intensive care unit, a patient with the immune disorder, a patient with a prosthetic heart valve, IV line or catheter, and also end-stage renal failure receiving regular hemodialysis.[1]

Based on several previous studies, Mupirocin cream application into the nasal cavity of patients and health workers that are detected as MRSA carriers may be done as prevention of MRSA infection and evaluated after three months. Several studies showed that intra nasal Mupirocin cream usage can be useful to decrease auto infection risk when patients are treated in ICU.[16-18]

**Table 1.** The interpretation of inhibition zone diametertoward antimicrobial agents of bacteria commonly found in thenasal cavity

| Antibiotic types | Disk content | Resistant diameter (mm ) | Intermediate Diameter (mm) | Sensitive diameter (mm) |
|---|---|---|---|---|
| Amoxicillin | 10 µg | 0 - 13 | 14 - 17 | ≥ 18 |
| Ampicillin | 10 µg | 0 - 13 | 14 - 16 | ≥ 17 |
| Amikacin | 30 µg | 0 - 14 | 15 - 16 | ≥ 17 |
| Clindamycin | 2 µg | 0 - 14 | 15 - 20 | ≥ 21 |
| Ciprofloxacin | 5 µg | 0 - 15 | 16 - 20 | ≥ 21 |
| Linezolid | 30 µg | 0 - 20 | 21 - 22 | ≥ 23 |
| Cefoxitin | 30 µg | ≥ 21 | - | ≥ 22 |
| Ceftriaxone | 30 µg | 0 - 13 | 14 - 20 | ≥ 21 |
| Cefoperazone | 75 µg | 0 - 15 | 16 - 20 | ≥ 21 |
| Cefotaxime | 30 µg | 0 - 14 | 15 - 22 | ≥ 23 |
| Meropenem | 10 µg | 0 - 13 | 14 - 15 | ≥ 16 |
| Vancomycin | 30 µg | 0 - 9 | 9 - 12 | ≥ 13 |

**Table 2.** The grouping of staff work in the hemodialysis unit based on age and sex

| Age | n (%) | Female n (%) | Male n (%) |
|---|---|---|---|
| 21 – 30 | 12 (52.17%) | 8 (34.78%) | 4 (17.39%) |
| 31 – 40 | 6 (26.09%) | 6 (26.09%) | 0 |
| 41 – 50 | 3 (13.04%) | 3 (13.04%) | 0 |
| 51 – 60 | 2 (8.70%) | 2 (8.70%) | 0 |
| Total | 23 (100%) | 19 (82.61%) | 4 (17.39%) |

**Table 3.** The grouping of end-stage renal failure patients receiving regular hemodialysis based on age and sex

| Age | N (%) | Female n (%) | Male n (%) |
|---|---|---|---|
| 21 – 30 | 4 (17.39%) | 2 (8.70%) | 2 (8.70%) |
| 31 – 40 | 5 (21.74%) | 1 (4.35%) | 4 (17.39%) |
| 41 – 50 | 3 (13.04%) | 1 (4.35%) | 2 (8.70%) |
| 51 – 60 | 7 (30.44%) | 4 (17.39%) | 3 (13.04%) |
| 61 – 70 | 4 (17.39%) | 2 (8.70%) | 2 (8.70%) |
| Total | 23 (100%) | 10 (43.48%) | 13 (56.52%) |

**Table 4.** The pattern of microorganism found in thenasal cavity of staff working at hemodialysis unit and end-stage renal failure patients receiving regular hemodialysis

| Microorganism type | Hemodialysis staff | Regular HD patients | Total | P-value Fisher test |
|---|---|---|---|---|
| *Staphylococcus epidermidis* | 12 (52.17%) | 9 (39.13%) | 21 | |
| *Staphylococcus aureus* | 3 (13.04%) | 4 (17.39%) | 7 | |
| *Staphylococcus saprophyticus* | 2 (8.70%) | 2 (8.70%) | 4 | |
| *Staphylococcus hemolyticus* | 1 (4.35%%) | 2 (8.70%) | 3 | |
| *Staphylococcus hominis* | 1 (4.35%%) | 1 (4.35%%) | 2 | |
| *Staphylococcus capitis* | 1 (4.35%%) | 0 | 1 | |
| *Streptococcus agalactie* | 0 | 1 (4.35%%) | 1 | 0.977 |
| *Streptococcus viridans* | 0 | 1 (4.35%%) | 1 | |
| *Klebsiella pneumoniae* | 1 (4.35%%) | 2 (8.70%) | 3 | |
| *Klebsiella oxytoca* | 1 (4.35%%) | 1 (4.35%%) | 2 | |
| *Pseudomonas aeruginosa* | 1 (4.35%%) | 0 | 1 | |
| Total | 23 (100%) | 23 (100%) | 46 | |

**Table 5.** The differences of antimicrobial sensitivity pattern between hemodialysis unit staff and regular hemodialysis patient

| Antimicrobial agent | Staff n (%) | | | Patient n (%) | | | P-value |
|---|---|---|---|---|---|---|---|
| | Sensitive | Intermediate | Resistant | Sensitive | Intermediate | Resistant | |
| Amoxicillin | 15 (65.22%) | 6 (26.09%) | 2 (8.69%) | 7 (30.43%) | 4 ( 17.39%) | 12 (52.18%) | 0.005 |
| Ampicillin | 13 (56.52%) | 6 (26.09%) | 4 (17.39%) | 6 (26.09%) | 3 (13.04%) | 14 (60.87%) | 0.010 |
| Amikacin | 22 (95.65%) | 1 (4.35%) | 0% | 21 (91.30%) | 1 (4.35%) | 1 (4.35%) | 1.000 |
| Clindamycin | 10 (43.48%) | 3 (13.04%) | 10 (43.48%) | 6 (26.09%) | 1 (4.35%) | 16 (69.56%) | 0.254 |
| Ciprofloxacin | 22 (95.65%) | 0% | 1 (4.35%) | 13 (56.52%) | 5 (21.74%) | 5 (21.74%) | 0.005 |
| Ceftriaxone | 21 (91.30%) | 2 (8.70%) | 0% | 14 (60.87%) | 3 (13.04%) | 6 (26.09%) | 0.016 |
| Cefoperazon | 23 (100%) | 0% | 0% | 22 (95.65%) | 1 (4,35)% | 0% | 1.000 |
| Cefotaxim | 21 (91.30%) | 2 (8.70%) | 0% | 13 (56.52%) | 0% | 10 (43.48%) | 0.000 |
| Linezolid | 17 (73.92%) | 3 (13.04%) | 3 (13.04%) | 9 (39.12%) | 2 (8.70%) | 12 (52.18%) | 0.022 |
| Vancomycin | 21 (91.30%) | 2 (8.70%) | 0% | 14 (60.87%) | 1 (4.35%) | 8 (34.78%) | 0.004 |
| Meropenam | 20 (86.96%) | 3 (13.04%) | 0% | 10 (43.48%) | 4 (17.39%) | 9 (39.13%) | 0.001 |

This study showed the Vancomycin sensitivity as the drug of choice of MRSA infection in regular hemodialysis patients was high. The sensitivity was 50%. Based on that Vancomycin sensitivity level against MRSA bacteria, it can be considered as a guideline for clinicians in charge in the Adam Malik general hospital so that they become wiser in using this antibiotic.

This study also found 67.39% Coagulase Negative *Staphylococcal* (CoNS) colonization in regular hemodialysis patients and also hemodialysis staff in which the most common type was *Staphylococcus epidermidis* (45.65%). Moreover, we also found *Staphylococcus saprophyticus* (8.69%), *Staphylococcus hemolyticus* (6.52%), *Staphylococcus hominis* (4.35%), and *Staphylococcus capitis* (2.17%). This result is similar to the study conducted by Akhtar towards 468 workers in Rawalpindi Hospital in India that they found CoNS colonizationas much as 73.3%.[19]

*Staphylococcus epidermidis* is the most commonly found normal flora in the nose and skin. It was said to be pathogen but is recently known this bacteria was responsible in several nosocomial infection cases, e.g. post heart valve insertion, urinary tract infection, surgical wound infection, cerebrospinal fluid shunt infection, ophthalmic infection and also infection from prosthetic insertion.[1,20]

Based on this study, there were found Gram-negative bacteria in hemodialysis staff, i.e. *Klebsiella pneumoniae* (4.35%), *Klebsiella oxytoca* (4.35%), and *Pseudomonas aeruginosa* (4.35%). Meanwhile, *Klebsiella pneumoniae* (8.69%), and *Klebsiella oxytoca* (4.35%) were found in regular hemodialysis patients.

*Klebsiella* is an opportunistic bacterium that can colonize in skin, oropharynx and gastrointestinal tract. *Klebsiella* carriers are related to endotracheal intubation, changing immune response and antibiotic use. *Klebsiella* is known as pathogen causes nosocomial infection in children and adult. It is estimated that 8% of nosocomial infections are caused by *Klebsiella. Klebsiella pneumoniae* and *Klebsiella oxytoca* that can cause infections of the lower respiratory tract, urinary tract and operation wound.[21]

In a hospital environment, *Pseudomonas aeruginosa* can spread through the touch of health worker and contamination or improper sterilized medical devices. Hospitalized patients especially patients using breathing aid machine, catheter or patients with immune response changes caused by other conditions or disease, and also patients with a post-operation wound or burn with wound infection risk, are at risk for being infected by *Pseudomonas aeruginosa.* It is estimated that 51.000 cases of nosocomial infections caused by *Pseudomonas aeruginosa* are happened every year in the United States, in which more than 13% is caused by Multidrug-Resistant *Pseudomonas aeruginosa*.[22]

Olivas *et al.* study conducted in 70 patients and 10 nurses in a hemodialysis unit in Mexico showed bacterial colonization in the patient's nasal cavity, in which 9% was Gram-negative bacteria. However, no bacterial colonization was found in the nurse's nasal cavity. The Gram-negative bacteria found in a patient's nasal cavity were *Klebsiella pneumonia, Escherichia coli, Acinetobacter baumanii,* and *Morganella morganii*.[11]

Based on this study, we can see the Meropenem activity against Gram-negative rod bacteria in hemodialysis unit staff and regular hemodialysis patients. The bacterial sensitivity towards Meropenem was 66.7% sensitive and 33.33% intermediate. This study results can also beconsidered by clinician work in the Adam Malik Hospital so making them wiser in using Meropenem.

## CONCLUSION AND SUGGESTION

Based on this study, the microorganism pattern found in nasal cavity of regular hemodialysis patients consists of *Staphylococcus epidermidis* 9 (39.13%), *Staphylococcus aureus* 4 (17.39%), *Staphylococcus saprophyticus 2* (8.69%), *Staphylococcus haemolyticus 2* (8.69%), *Staphylococcus hominis 1* (4.35%), *Streptococcus agalactiae* 1 (4.35%), Streptococcus viridans 1 (4.35%), *Klebsiella pneumonia* 2 (8.69%), and *Klebsiella oxytoca* 1 (4.35%). Meanwhile, the microorganism pattern found in nasal cavity of hemodialysis unit staff consists of *Staphylococcus epidermidis* 12 (52.17%), *Staphylococcus aureus* 3 (13.04%), *Staphylococcus saprophyticus* 2 (8.70%), *Staphylococcus hominis* 1 (4.35%), *Staphylococcus capitis* 1 (4.35%), *Staphylococcus haemolyticus* 1 (4.35%), *Klebsiella pneumoniae* 1 (4.35%), *Klebsiella oxytoca* 1 (4.35%), and *Pseudomonas aeruginosa* 1 (4.35%). Generally, the sensitivity levels of all antimicrobial agents in hemodialysis unit staffs were adequately controlled, except Clindamycin which resistance level was 43.48%. In regular hemodialysis patients, the resistance levels of Amoxicillin, Ampicillin, and Clindamycin were high enough i.e. 52.18%, 60.87% and 69.56%, respectively. In Ciprofloxacin, Ceftriaxone and Cefotaxime, the sensitivity level were good enough, i.e. 56.52%, 60.87%, and 56.52%,

respectively. The sensitivity of Vancomycin was also good enough, 60.87%. However, the sensitivity of bacteria towards Meropenem and Linezolid was quite low i.e., 43.48% and 39.12%, respectively. Among the four *Staphylococcus aureus* found in regular hemodialysis patients, we found 3 *Staphylococcus aureus* cases that were MRSA in which the sensitivity level towards Vancomycin was 50%. The abilities of Meropenem as an antimicrobial agent against Gram-negative bacteria in patients and staff were similar, i.e. 66.67% was sensitive, and 33.33% was intermediate.

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