

## BACTERIAL PATHOGENS AND ANTIBIOTIC SENSITIVITY PATTERN IN BURN UNIT OF HASAN SADIKIN HOSPITAL (RSHS) FROM JANUARY 2012 - DECEMBER 2015

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### ABSTRACT

**Background :** Infection is the common cause of death following burn injury. Antibiotic resistance is a major wide problem in burn unit. We evaluated the pattern of bacterial pathogens isolated from burn wound and sensitivity of antibiotics in burn unit of RSHS.

**Method :** A retrospective descriptive study has been done in Burn Unit RSHS by collecting data from burn unit patient's medical records over 4 years (2012-2015). Data of demography, characteristic of patients, wound isolates bacteria and sensitivity was collected.

**Result :** A total of 205 patients were admitted to burn unit of RSHS and 164 patients fulfilled the requirements to be analyzed. 114 (69.5%) patients were male and the most commonly affected age groups were young adults 15-40 years old. The mortality rate in burn unit was 71 patients (43.3%) and Acute Respiratory Distress Syndrome (ARDS) was commonly the primary cause of death (53.5%) and followed by sepsis (42.3%). Microorganism from burn wound isolates were *P. aeruginosa* (30.1%), *A. baumannii* (19.9%), *K. pneumonia* (19.3%), *E. cloacae* (9.1%), *E. coli* (4%), *P. stuartii* (2.8%). Meropenem was the most sensitive antibiotic against to *P. aeruginosa* and *K. pneumonia*. Amikasin was shown to be sensitive to *A. baumannii*, *E. cloacae* and *E. coli*. *P. stuartii* was 100% sensitive to meropenem, amikasin, piperacillin-tazobactam and cotrimoxazole. Cefoperazon, ceftriaxone and ceftazidime showed very low sensitivity (0-14.3%).

**Conclusion :** Dominant bacteria isolated was *P. aeruginosa* which was sensitive to meropenem and commonly resistant to the third generation of cephalosporin antibiotics, which becomes multi drug resistant bacteria.

**Keywords:** bacterial, antibiotic sensitivity, burn, burn unit

**Latar Belakang:** Infeksi adalah penyebab terbesar kematian pada pasien luka bakar. Resistensi antibiotik adalah masalah besar pada setiap unit luka bakar. Kami mengevaluasi pola pathogen bakteri yang disolasi dari luka bakar dan sensitivitas antibiotic pada pasien luka bakar RSHS.

**Metodologi:** Studi deskriptif retrospektif ini dilakukan di Unit Luka Bakar RSHS dengan cara mengumpulkan data dari rekam medis selama 4 tahun (2012-2015). Kami mengumpulkan data demografi, karakteristik pasien, isolat bakteri luka bakar dan sensitivitas antibiotik.

**Hasil:** Tercatat total 205 pasien yang terdaftar di Unit Luka Bakar RSHS dan 164 pasien memenuhi kriteria untuk dianalisa. Seratus empat belas pasien luka bakar (69.5%) adalah laki-laki dan paling banyak diderita oleh golongan usia dewasa muda 15-40 tahun. Angka kematian unit luka bakar tercatat sebanyak 71 pasien (43.3%) dengan penyebab terbesar (53.3%) Sindrom Distres Penapasan Akut (ARDS) diikuti oleh sepsis (42.3%). Mikroorganisme yang diisolasi dari luka bakar adalah *P. aeruginosa* (30.1%), *A. baumannii* (19.9%), *K. pneumonia* (19.3%), *E. cloacae* (9.1%), *E. coli* (4%), *P. stuartii* (2.8%). Meropenem merupakan antibiotik yang paling sensitive untuk melawan *P. aeruginosa* dan *K. pneumonia*. Amikasin merupakan antibiotic yang sensitive untuk melawan *A. baumannii*, *E. cloacae* dan *E. coli*. *P. stuartii* 100% sensitif terhadap meropenem, amikasin, piperacillin-tazobactam dan cotrimazol. Cefoperazon, ceftriaxone dan ceftazidime menunjukkan sensitivitas yang sangat rendah (0-14.3%).

**Kesimpulan:** Bakteri isolat yang paling sering ditemukan adalah *P. aeruginosa* yang sensitive terhadap meropenem dan secara umum resisten terhadap antibiotik cephalosporin generasi tiga, sehingga menjadi bakteri dengan *multi drug resistant*.

**Kata Kunci :** bacterial, antibiotic sensitivity, burn, burn unit

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## INTRODUCTION

Burn is one of the most common and devastating forms of trauma. Patients with serious thermal injury require immediate specialized care in order to minimize morbidity and mortality. Burn injury causes mechanical disruption at the skin, which allows environmental microbes to invade the deeper tissue, so burn patients are at a high risk of infection. Wound infection mostly originating from nosocomial infection. As a result of the nature of the burn injury itself, the immune compromise effects of burns, prolong hospital stays, invasive diagnostic and therapeutic procedure.<sup>1,2</sup>

Infection is the common cause of death following burn injury. The risk of burn wound infection is directly correlated to the extent of the burn. Although area of burn injury relatively sterile in 24 hours then started colonization of gram negative bacteria. *Pseudomonas aeruginosa* is common bacteria in burn injury and it can be found in 70% of burn injury in the third weeks. At burn unit of Cipto Mangunkusumo Hospital (RSCM), infection commonly caused by *Klebsiella pneumonia* and *Pseudomonas aeruginosa*.<sup>3</sup> At Soetomo Hospital, *Pseudomonas aeruginosa* and *Acinetobacter* are dominant in burn patients.<sup>4</sup> The pattern of bacterial pathogens are different in every centers. Eradication of infection in burn patients is impossible, but a well surveillance, infection control and preventing program can help reduce the incidence.<sup>1,2</sup>

Antibiotic resistance is a major wide problem in the world including in Indonesia. It has been realized that the spread of drug resistance organisms is related to the wide spread use of antibiotics. Data from RSCM burn unit in 2010 showed that the bacteria were resistant to levofloxacin, followed by imipenem and cefotaxime.<sup>3</sup> In Soetomo Hospital, amikacin, ceftazidime, meropenem, cefoperazone-sulbactam and cefepime were among the non-sensitive antibiotics in their burn unit.<sup>4</sup>

There was still no data reported from Hasan Sadikin Hospital (RSHS) burn unit about the pattern of microorganisms and antibiotics sensitivity. The purpose of this study was to identify the dominant wound isolated bacteria pathogens and the sensitivity of antimicrobial pattern of bacteria isolated. This study will be capable to give recommendation for empirical antimicrobial therapy management of burn unit infection

## METHOD

A retrospective descriptive study has been done in Burn Unit RSHS. Total admitted patients during January 2012 to December 2015 were 205 patients. We collected patient's medical records including data of demography, characteristic of patients, wound swab isolated bacteria and antimicrobial sensitivity.

## RESULTS

Between January 2012 and December 2015, there were 205 patients admitted to burn unit of RSHS and only 164 patients can be analyzed from their medical record. A total of 114 (69.5%) patients were male and the most commonly affected age groups were young adults 15-40 years old. The primary source of burn injuries identified was flame and the percentage was predominantly 31-50% TBSA. Most patients (53.7%) have domicile in Bandung area. Patient's characteristics are described below (Table 1).

As many as 71 patients (43.3%) died and the primary cause of death (53.5%) was Acute Respiratory Distress Syndrome (ARDS), followed by sepsis (42.3%). The extent of burn injury area was related to outcome of the patient. Mortality rate has a positive correlation with percentage of body surface injured (table 2). All of the patient have nutrition problems and electrolyte imbalances (figure 1).

Microorganism identified from isolated burn wound showed *Pseudomonas aeruginosa* (*P. aeruginosa*) as the most frequent bacteria, followed by *Acinetobacter baumannii* (*A. baumannii*), *Klebsiella pneumonia* (*K. pneumonia*), *Enterobacter cloacae* (*E. cloacae*), *Escherichia coli* (*E. coli*) and *Providentia stuartii* (*P. stuartii*), respectively shown in figure 2. In this study, almost all of bacteria isolated from burn wound isolates are sensitive to meropenem, amikasin (table 3). *P. aeruginosa* is the most common multidrug resistant bacteria and the frequency raised in 2015 (figure 3).

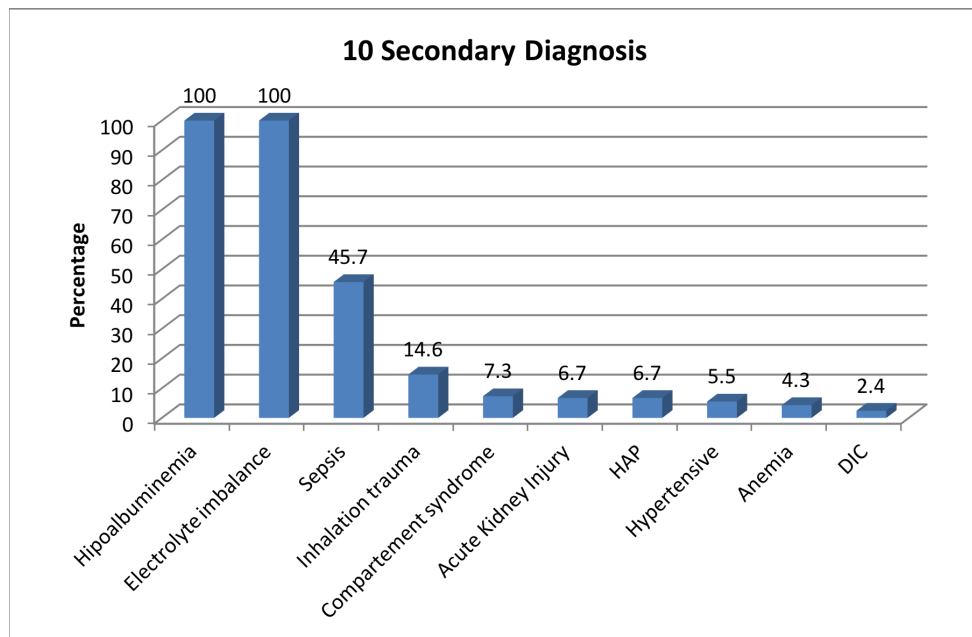
**Disclosure:** The authors have no financial interest to disclose.

**Table 1.** Patient Demographic and Type of Injury

Demographic / Type	No. of Patient	Percentage
Sex		
Male	114	69.5%
Female	50	30.5%
Age		
0 - 5	25	15.2%
6 - 14	12	7.3%
15 - 40	67	40.9%
41 - 65	50	30.5%
> 65	10	6.1%
Cause of Burn		
Flame	83	50.7%
Electric	51	31.1%
Scald	25	15.2%
Chemical	4	2.4%
Blast	1	0.6%
Location		
Bandung	88	53.7%
Outer Bandung	76	46.3%
% TBSA burned		
< 15	5	3%
15 - 30	59	36%
31 - 50	68	41.5%
51 - 60	19	11.6%
> 60	13	7.9%

**Table 2.** Outcome of the Patient

Outcome	No. of Patient	Percentage
Admission Outcome		
Recovery	61	37.2%
Death	71	43.3%
Discharged against medical advice	32	19.5%
Cause of Death		
ARDS	38	53.5%
Sepsis	30	42.3%
Lungs oedema	1	1.4%
DIC	1	1.4%
Heart decompensation	1	1.4%
Mortality by % TBSA burned		
< 15	0	0
15-30	10	17%
31-50	34	50%
51-60	15	79%
>60	12	92.3%



**Figure 1.** Ten most common secondary diagnosis

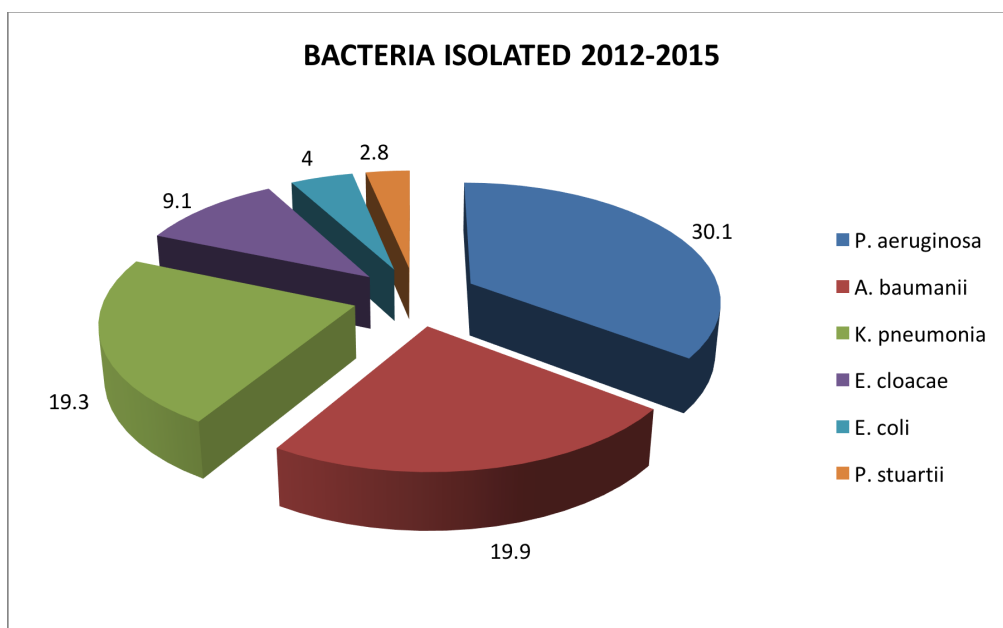


Figure 2. Identified wound isolated bacteria [n(%)]

Table 3. Antibiotic sensitivity pattern of predominant bacteria isolated from burn wound isolates

Antibiotic	<i>P. aeruginosa</i> N = 53	<i>A. baumani</i> N = 35	<i>K.pneumonia</i> N = 34	<i>E. cloacae</i> N = 16	<i>P. stuartii</i> N = 5	<i>E. coli</i> N= 7
Amikasin	14 (26.4%)	21(60%)	26 (76.5%)	12 (75%)	5 (100%)	6 (85.7%)
Cefepime	9 (17%)	1 (2.9%)	1 (2.9%)	5 (31.3%)	4 (80%)	1 (14.3%)
Cefoperazon	1 (1.9%)	1 (2.9%)	4 (7.5%)	1 (6.3%)	2 (40%)	0
Ceftriaxon	1 (1.9%)	1 (2.9%)	2 (5.9%)	0	1 (20%)	1 (14.3%)
Ceftazidime	8 (15.1%)	1 (2.9%)	1 (2.9%)	0	2 (40%)	0
Ciprofloxacin	11 (20.6%)	3 (8.6%)	10 (29.4%)	6 (37.5%)	1 (20%)	1 (14.3%)
Cotrimoxazole	1 (1.9%)	12 (34.3%)	9 (26.5%)	1 (6.3%)	5 (100%)	4 (57.1%)
Gentamicin	5 (9.4%)	4 (11.4%)	4 (7.5%)	2 (12.5%)	0	5 (71.4%)
Imipenem	6 (11.3%)	7 (20%)	9 (26.5%)	5 (31.3%)	1 (20%)	0
Levofloxacin	8 (15.1%)	1 (2.9%)	18 (52.9%)	5 (31.3%)	1 (20%)	1 (14.3%)
Meropenem	25 (47.2%)	15 (42.9%)	27 (79.4%)	10 (62.5%)	5 (100%)	6 (85.7%)
Piperacillin-Tazobactam	13 (24.5%)	2 (5.7%)	11 (32.4%)	3 (18.8%)	5 (100 %)	4 (57.1%)
Tigecyclin	0	20 (57.1%)	24 (70.6%)	9 (56.3%)	1 (20%)	3 (42.9%)

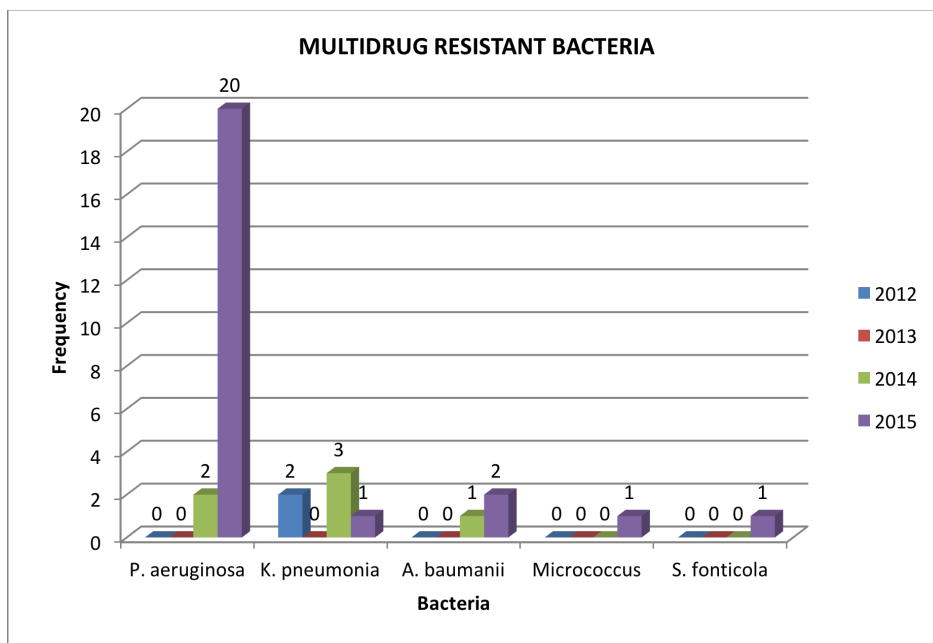


Figure 3. Profile of multidrug resistant bacteria 2012-2015

**DISCUSSION**

Majority of the patients are aged between 15-40 years old (40.9%) and 41-65 years old (30.5%). Adult people commonly severed from burn injuries because they are high risk population.<sup>5</sup> These populations have lots of activities and contact with materials that risk to make burn injuries. Mortality rate in burn unit of RSHS for 4 years is 43.3 % with the leading cause of death is ARDS (53.5%). Many factors might affect this condition. Our burn unit doesn't have an Intensive Care Unit (ICU) and ventilator, so burn patients with ARDS have to be sent to general ICU which is commonly full of other patients.

The burn wound surface is sterile immediately following injury, however, it is repopulated quickly with gram positive organism from hair follicles, skin appendages, and the environment during the first 48 hours.<sup>5,6</sup> More virulent gram negative organism replaces the gram positive organism after 5-7 days. The burned patient is at high risk for nosocomial infection as a result of the nature of the burn injury itself, the immune compromising effects of burns, prolong hospital stays and intensive diagnostic and therapeutic procedure. There are conflicting results from different burn centers regarding the most commonly seen infection in acute burn care. Some reports suggest that burn wound infection is the most common type infection, whereas some others reports show predominance of pneumonia and primary blood stream infection.

The same authors concluded that these differences might be related to the variation in the rates of usage of invasive devices such as ventilators, catheters etc.<sup>1,2,5,6</sup>

In secondary diagnosis, all of the patients had electrolyte imbalance problem and hypoalbuminemia. Burn tissue damage will lead to albumin leakage. Protein will be used as a source of energy because of hypermetabolism and hypercatabolism of the body. This increased metabolic rate begins immediately following injury and persists until wound coverage is achieved. The damage of the tissue will alter cell membrane potential and cause the change of electrolyte in intravascular.<sup>1,5</sup>

The extent of burn injury has positive correlation to the mortality rate. The mortality rate for patients with burn area >31% TBSA is as high as 50% while that for patients with burn area > 61% TBSA could be up to 92,3%. The percentage area of burn injury (TBSA) is a significant risk factor to burn wound infections, but not to the device associated infection. Usage duration of urinary catheters and ventilators are identified as risk factors for the corresponding hospital-acquired infection. As an effective infection control policy, minimal usage of invasive devices, better control infection procedures and improved aseptic technique while inserting devices could decrease the rate of nosocomial infection in burn unit.<sup>6,7,8</sup>



This result revealed that *P. aeruginosa* (30,1%), *A. baumannii* (19,9%), *K. pneumonia* (19,3%), *E. cloacae* (9,1%), *E. coli* (4%), and *P. stuartii* (2,8%) were predominant isolates identified in RSHS burn unit. Other study showed that the most frequent bacteria isolated in Cipto Mangunkusumo Hospital were *K. pneumonia* (23%), *P. aeruginosa* (20%) and *S. aureus* (14%).<sup>8</sup> In Soetomo Hospital, bacteria isolated from burn wound were *P. aeruginosa*, *Acinetobacter* and *K. pneumonia*. All of them are known to cause hospital-acquired infection.<sup>4</sup>

Another serious problem usually found in burn unit is bacterial resistance to antibiotic therapy. The number of cases is increasing from time to time, lead to increased mortality rate and also costs. Antibiotics in burn therapy can play a double role, as prophylaxis as well as for treatment. In Indonesia, all patients in burn unit received antibiotics, while in Sweden antibiotics were given to only half of burn patients, including 96% of patients with infection and 26% of those without infection. The overuse of antibiotics in Indonesia indicates the over anxiety doctors, since the quality of water and air in the hospital, as well as the hygiene of the medical personnel, is not controllable by their hospital management.<sup>8,9</sup>

Empirical antimicrobial therapy to treat fever should be strongly discouraged because burn patients often have fever secondary to the systemic inflammatory response to burn injury. Prophylactic antimicrobial therapy is recommended only for coverage of the immediate perioperative period around excision or grafting of burn wound. In patients with burn wound, infection control program need to be documented and reported according to recent classification system. To reduce rates of infection, surveillance for surgical site infections are needed to be reported to surgeons and other clinical workers.<sup>6,7,8,9</sup>

Almost all isolates found to be drug resistant, at least to two or more of the drugs tested. Meropenem and amikasin were found to be more sensitive than the other drugs. Meropenem was the most sensitive antibiotic against *P. aeruginosa* and *K. pneumonia* followed by amikasin. *A. baumannii*, *E. cloacae* and *E. coli* were very sensitive to amikasin. *P. stuartii* was 100% sensitive to meropenem, amikasin, piracillin-tazobactam and cotrimoxazole.

Cefoperazon, ceftriaxone and ceftazidime showed a very low sensitivity(0-14,3%) to *P. aeruginosa*, *A. baumannii*, *K. pneumonia* *E. cloacae* and *E. coli*. Multi resistant drug increased significantly in 2015 and *P. aeruginosa* is the dominant bacteria that found to be multidrug resistant. In burn unit of Soetomo Hospital, antibiotics that found to be still sensitive to *P. aeruginosa* for the last 5 years are amikacin (18.1-21.9%), ceftazidim (17.6-21.3%), meropenem (20.1-21.4%), cefoperazon-sulbactam (18.3-20.1%) and cefepim (20.3-20.8%).<sup>4</sup> A study from Iraq and Afghanistan showed that *P. aeruginosa*, *K. pneumonia*, *A. baumannii* complex and *S. aureus* are all multidrug resistant bacteria.<sup>10</sup>

The increasing incidence of multidrug bacteria might be the effect of the inappropriate use of antibiotics. There is no standardized prescription and management scheme in using antibiotics in burn unit. Despite the fact that common bacterial agents are similar at different burn center, the antimicrobial sensitivity pattern cannot be compared between these centers. Culture and sensitivity tests need to perform routinely in burn patients, to provide early identification of organism colonizing the wound and to guide in antibiotic therapy.

## CONCLUSION

Most bacteria isolated from burn wound at RSHS burn unit were resistant to almost all third generation of cephalosporin antibiotics. *P. aeruginosa* was the dominant isolated bacteria commonly sensitive to meropenem but found to be resistant to tygecycline, ceftriaxone, and cefoperazone. Recently, *P. aeruginosa* has become multidrug resistance bacteria. Eradication of infection in burn patients is impossible, but a well-conducted surveillance infection control program may help to reduce infection and mortality rates in burn unit. This database can be used to evaluate antimicrobial sensitivity development in relation to antibiotic usage.

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