*Int.J.Curr.Microbiol.App.Sci* (2018) *7*(10): 2970-2975

*International Journal of Current Microbiology and Applied Sciences*
***ISSN: 2319-7706* Volume 7 Number 10 (2018)**
Journal homepage: http://www.ijcmas.com

**Original Research Article** https://doi.org/10.20546/ijcmas.2018.710.344

# Outbreak of MDR *Pseudomonas aeruginosa* on a Burn Intensive Care Unit Caused by Contaminated Saline Sprinkler

**Barnini Banerjee[1*], Muralidhar Varma[2], Chiranjay Mukhopadhyay[1] and K.E. Vandana[1]**

*[1]Department of Microbiology, [2]Department of Medicine, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, India*

**Corresponding author*

**Keywords**

Outbreak, Multidrug resistant, Pseudomonas, Burn ICU, Sprinkler

**Article Info**

***Accepted:***
20 September 2018
***Available Online:***
10 October 2018

**A B S T R A C T**

Burn wounds are associated with an increased risk of nosocomial infection by *Pseudomonas spp* and led to increased mortality among these infected patients. The reservoir of such an infection could be contaminated disinfectant bottles, water supplies, unsterilized surgical equipments etc. We report an outbreak in a burn intensive care unit (ICU) of a tertiary care hospital with multidrug-resistant *Pseudomonas aeruginosa* only sensitive to fluroquinolones. We established an outbreak investigation team, performed an exploratory analysis and initiated an intervention. Cases were identified as any patient infected with the outbreak strain of *Pseudomonas aeruginosa* after 48 hours of admission in the burn ICU from November 2017 to February 2018. We performed microbiological examinations of the clinical samples and environmental samples. All the isolates was identified by matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF VITEK®MS), and antimicrobial susceptibility testing for the isolates were done by VITEK®2 system. Outbreak strain isolated from 9 patients. During the source tracing the same multidrug resistant strain was found on the nozzle and pipe of the unsterilized saline sprinkler used for burn wound dressing since 5 months. After stoppage of this sprinkler in the ICU and implementing strict infection control practices, no more outbreak strain isolated further.

## Introduction

*Pseudomonas aeruginosa* is ubiquitous in the moist environment of the hospital. In the intensive care units (ICU), water is the source of this organism and frequent etiological agent for the outbreak (Anaissie *et al.,* 2002), especially in the burn ICU. This organism has the capability to form biofilm in tap, sink, toilet, showers and water containers. Patients are generally colonized or infected by them directly through contaminated water, water outlets, hands and equipment (Srinivasan *et al.,* 2003) (Trautmann *et al.,* 2005) (Reuter *et al.,* 2002). It is one of the virulent organisms in the burn ICU causing nosocomial burn wound infection. In the present era, multidrug resistant *Pseudomonas aeruginosa* is really

problematical for the clinician in the ICU. Presence of biofilm makes them resistant to multiple drugs and also delays the wound healing process. All these attribute to increase mortality and prolonged hospital stay. Outbreaks in the ICU by this multidrug resistant organism are not very uncommon.

The present study describes an outbreak of multidrug resistant *P. aeruginosa* infection in the burn ICU caused by contaminated saline sprinkler bottle and the control measures that were implemented in order to prevent further nosocomial infection.

## Materials and Methods

### Setting

Burn ICU of our hospital was involved in the outbreak. The hospital is a 2063-beded tertiary-care hospital.

### Epidemiological investigation

Clinical and microbiological data was reviewed for the patients admitted for more than 48 hours in the burn ICU from November 2017 to February 2018.

Cases were identified among them who were infected with *P. aeruginosa* with similar atypical antimicrobial susceptibility pattern during that period.

### Surveillance

Microbiological data from burn ICU in which the outbreak strain was detected were reviewed for 4 weeks before the outbreak, during the outbreak period itself when patients were positive for the outbreak strain, and during the 4 weeks following the outbreak. Cases of *P. aeruginosa* were counted on a weekly basis. Every patient was counted once only and included in the analysis.

### Microbiological workup

All the clinical specimen were processed in 5% Sheep blood agar and MacConkey agar. Environmental samples collected for source tracking were swabs from water outlets, wash basins suction apparatus, oxygen canisters, saline sprinkler bottle. Tap water and normal saline in the sprinkler bottle used for dressing of the wound were also collected for evaluation. All the swabs and saline were put in Brain heart infusion agar and also cultured on 5% Sheep blood agar and MacConkey agar.

Typical oxidase positive colonies growing on MacConkey agar and blood agar after incubating at $37^0$c for 24 hours were confirmed as *P. aeruginosa* using matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF VITEK®MS), and antimicrobial susceptibility testing for the isolates were done by VITEK®2 system (bioMérieux, Inc., Durham, NC). The bacterial isolates were considered to exhibit MDR when they showed resistance to three or more antibiotics (Rustini *et al.*, 2017).

Water samples were inoculated in culture bottle containing $HIH_2S^{TM}$ Test strip (Himedia). After 48 hours of incubation sub cultured into MacConkey agar.

## Results and Discussion

Surveillance: During the four months period total from 62 patients *Pseudomonas aeruginosa* isolated from different clinical samples in the burn ICU. During the 4-week period before the outbreak, the number of patients with *P. aeruginosa* isolated from clinical specimens was 0.5 cases per week. During the outbreak period, December-January the occurrence of new P. aeruginosa-positive patients was 1.3 cases per week. After the outbreak period it became 0.3 cases per week.

Outcome: During outbreak, from 12 patients it

isolated from various clinical samples (Figure 1). 9 of 12 had infection with the outbreak strain. All of them developed the wound infection and 3 of 9 (33.3%) developed bacteremia. 3 (33.3%) of them expired due to septic shock (Table 1). The outbreak strain of *Pseudomonas aeruginosa* was multidrug resistant. It was resistant to amikacin, gentamycin, ceftazidime, cefepime, cefoperazone-sulbactum, piperacillin, piperacillin-tazobactum and cabapenems. They were only sensitive to fluoroquinolones like ciprofloxacin and levofloxacin.

Environmental sample: Swabs collected from water outlets, wash basins, suction apparatus and oxygen canisters were sterile after 72 hours of incubation. Water collected from the burn ICU tap was also sterile. The outbreak strain isolated from saline sprinkler bottle (Figure 2). It was used for burn wound dressing. We had also isolated the same strain from the nozzle and the pipe of the bottle. From the nozzle of the bottle swab was taken and cultured on MacConkey agar and pipe was cultured by flush method.

Termination of the outbreak: It was found that saline sprinkler bottle had been frequently used for dressing of the burn wound without autoclaving the same. All these bottles were removed and stopped using for the dressing purpose. After the removal, the outbreak strain isolated from two patients within 10 days. Because they were admitted to the ICU before removal of the bottle. Thereafter no such outbreak strain isolated from the burn ICU.

**Table.1** Characteristics of the cases infected with the outbreak strain of *P. aeruginosa*

| Case NO. | Age | Gender | Diagnosis | Duration of Hospital stay | Specimen | Infection | Bacteremia | Outcome |
|---|---|---|---|---|---|---|---|---|
| **1** | 4yrs | Male | 45% thermal burn | 35 days | Wound swab | Post op wound infection | No | Survived |
| **2** | 58 Yrs | Female | 22% thermal burn | 42 days | Wound swab | Post op wound infection | No | Survived |
| **3** | 3 yrs | Male | 13% thermal burn | 18 days | Wound swab | Post op wound infection | No | Survived |
| **4** | 7yrs | Female | 24%thermal burn | 46 days | Wound swab | Post op wound infection | No | Survived |
| **5** | 32 yrs | Male | 55% thermal burn | 53 days | Wound swab, Blood | Post op wound infection | Yes | Survived |
| **6** | 61 yrs | Female | 42% thermal burn | 22 days | Wound Swab, Blood | Post op wound infection | Yes | Expired due to sepsis |
| **7** | 25 yrs | Female | 45% thermal burn | 35 days | Wound swab | Post op wound infection | No | Survived |
| **8** | 45 yrs | Male | 33% electrical burn | 14 days | Wound swab | Post op wound infection | No | Expired due to sepsis |
| **9** | 72 yrs | Female | 43.5% thermal burn | 15 days | Wound Swab, Blood | Post op wound infection | Yes | Expired due sepsis |

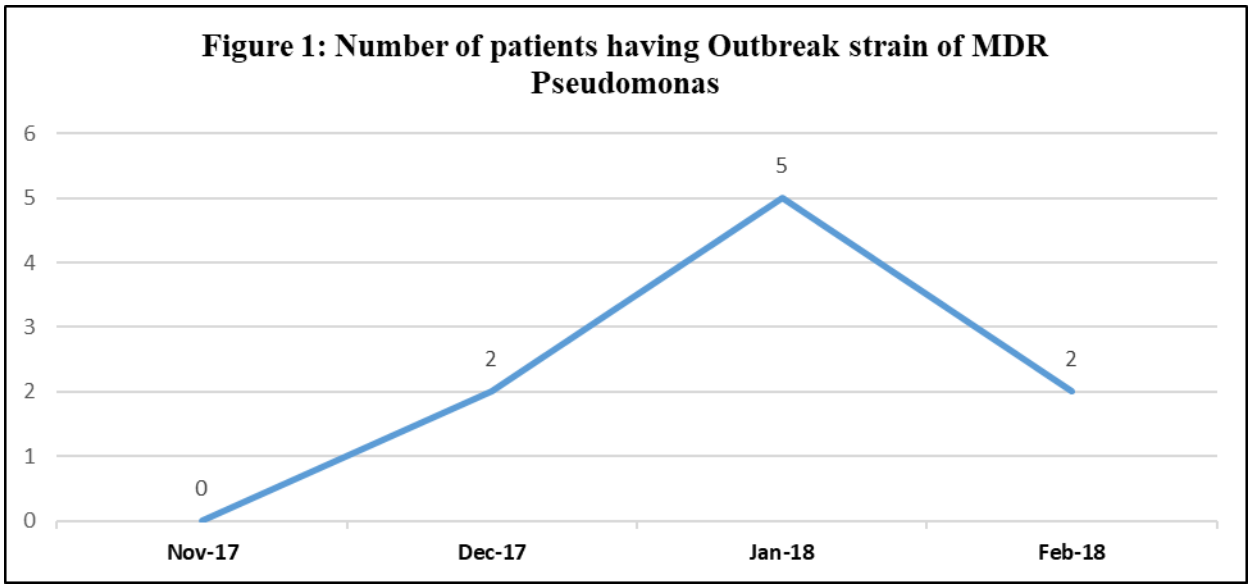
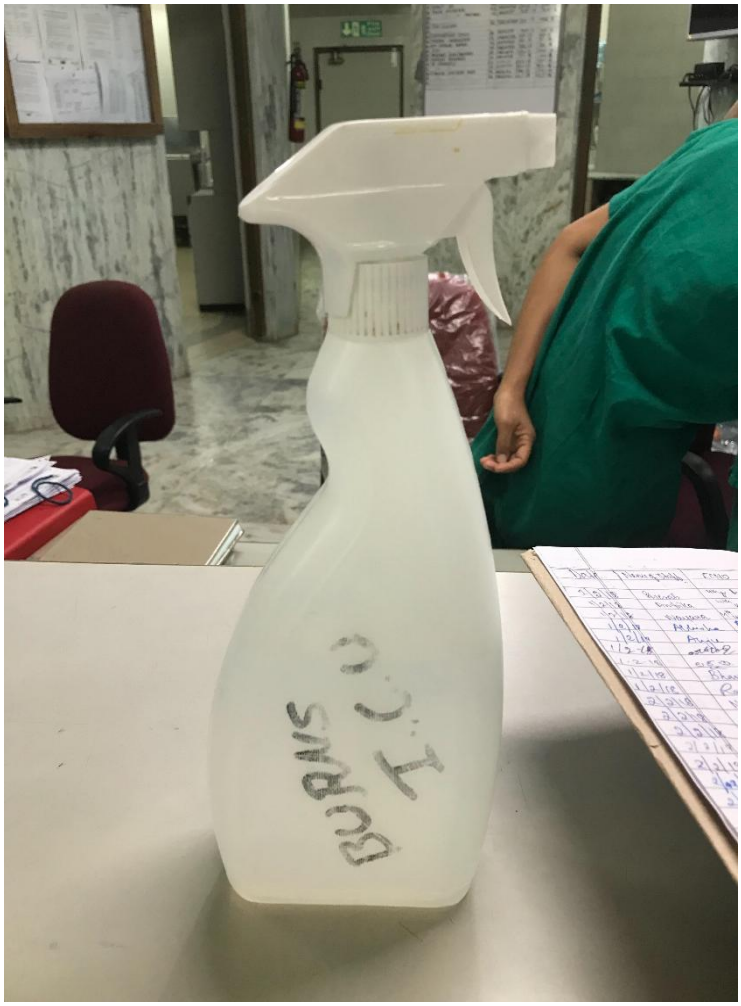



**Fig.2** Saline Sprinkler bottle-Source of the outbreak



Infection or colonization of the burn wound with *Pseudomonas aeruginosa* is a common phenomenon (Maechler *et al.,* 2015). As hospital acquired infections are common in the ICUs so it is necessary to prevent the transmission of this organism in this area (Salm *et al.,* 2016). Transmission occurs specifically due to ICU specific working procedures or through the hand of health care workers (Ali *et al.,* 2017)

In the burn ICU of our hospital in the month of December 2017-January 2018 an increase in the total number of *Pseudomonas* post op wound infections occurred, in comparison to the previous months and characteristically all the strain were multidrug resistant. They were only sensitive to quinolones like ciprofloxacin or levofloxacin. During investigation, it was observed that since 5 months sprinkle bottle filled with normal saline has been used to spraying saline for removing and applying dressing of the wounds. The culture from the nozzle of sprinkler bottle isolated same strain of *Pseudomonas aeruginosa*, which infected all the patients. *Pseudomonas* could not have survived in sprinkler if it had been regularly sterilized. It has been observed that there was no documentation for regular sterilization and cleaning of sprinkler. In the past also, the environment as an exogenous source of *Pseudomonas* infection has been confirmed. Tap water, sinks, faucets, showers and hands of healthcare workers were found to be the source of this organism (Petignat *et al.,* 2006) (Blanc *et al.,* 2004). A prolonged hospital stay with exposure to a hospital environment had been also contributed to infection by MDR *Pseudomonas* (Das *et al.,* 2018). In our case also most of the patient stayed for longer time in the ICU. So easily could had colonized and then developed post op wound infection with the same outbreak strain. Even 33.3% had bacteremia due to same MDR strain and 3 of 9 expired. Their immunocompromised status and damaged skin integrity due to extensive burn could have played important role in the mortality. As an outbreak control measure, we stopped using sprinkler for dressing of burns wounds. Doctors and nurses have been trained about sterile dressing methods of wound as burns wound dressing is complex and started strict hand hygiene audit in the ICU. The number of isolates was significantly decreased only after implementation of all these measures.

Contaminated sprinkler bottle used for burn wound dressing can be potential drivers of MD*R P. aeruginosa* outbreaks in the burn ICU. This outbreak strain contributed 33.3% of mortality. We were able to achieve the complete elimination of the same strain after total stoppage of using this unsterilized equipment in the ICU and implementing strict infection control practices.

## References

Ali, U., Abbasi, S.A., Kaleem, F., Aftab, I., Butt, T. 2017. Outbreak of Extensively Drug Resistant *Stenotrophomonas maltophilia* in Burn Unit. *J Ayub Med Coll Abbottabad*., 29(4):686-688.

Anaissie, E.J., Penzak, S.R., Dignani, M.C. 2002. The hospital water supply as a source of nosocomial infections: a plea for action. *Arch Intern Med*., 162: 1483–1492.

Blanc, D.S., Nahimana, I., Petignat, C., Wenger, A., Bille, J., Francioli, P. 2004. Faucets as a reservoir of endemic *Pseudomonas aeruginosa* colonization/ infections in intensive care units. *Intensive Care Med*., 30:1964–8.

Das, P.B., Mishra, M.P., Rath, S.N. 2018. Surveillance of bacteria methicillin-resistant *Staphylococcus aureus* and *Pseudomonas aeruginosa* in patients admitted to orthopedic department in a

tertiary referral hospital. *Asian J Pharm Clin Res*., 11(6):381-385.

Maechler, F., Pena Diaz, L.A., Schroder, C., Geffers, C., Behnke, M., Gastmeier, P. 2015. Prevalence of carbapenem-resistant organisms and other Gram-negative MDRO in German ICUs: first results from the national nosocomial infection surveillance system (KISS). *Infection*, 43:163–8.

Petignat, C., Francioli, P., Nahimana, I., Wenger, A., Bille, J., Schaller, M.D., *et al.,* 2006. Exogenous sources of *Pseudomonas aeruginosa* in intensive care unit patients: implementation of infection control measures and follow-up with molecular typing. *Infect Control Hosp Epidemiol*., 27(9): 953-7.

Reuter, S., Sigge, A., Wiedeck, H., Trautmann, M. 2002. Analysis of transmission pathways of *Pseudomonas aeruginosa* between patients and tap water outlets. *Crit Care Med*., 30: 2222–2228.

Rustini, R., Jamsari, J., Marlina, M., Nasrul, Z.N., Yuliandra, Y. 2017. Antibacterial resistance pattern of *Pseudomonas aeruginosa* isolated from clinical samples at a general hospital in Padang, West Sumatra, Indonesia. *Asian J Pharm Clin Res*., 10(8):158-160.

Salm, F., Deja, M., Gastmeier, P., Kola, A., and Hansen, S., Behnke, M., Gruhl, D., Leistner, R. 2016. Prolonged outbreak of clonal MDR *Pseudomonas aeruginosa* on an intensive care unit: contaminated sinks and contamination of ultra-filtrate bags as possible route of transmission? *Antimicrob Resist Infect Control*, 5:53.

Srinivasan, A., Wolfenden, L.L., Song, X, *et al.,* 2003. An outbreak of *Pseudomonas aeruginosa* infections associated with flexible bronchoscopes. *N Engl J Med*., 348: 221–227.

Trautmann, M., Lepper, P.M., Haller, M. 2005. Ecology of *Pseudomonas aeruginosa* in the intensive care unit and the evolving role of water outlets as a reservoir of the organism. *Am J Infect Control*., 33 (suppl. 1): 41–49.

**How to cite this article:**

Barnini Banerjee, Muralidhar Varma, Chiranjay Mukhopadhyay and Vandana, K.E. 2018. Outbreak of MDR *Pseudomonas aeruginosa* on a Burn Intensive Care Unit Caused by Contaminated Saline Sprinkler. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 2970-2975.
doi: https://doi.org/10.20546/ijcmas.2018.710.344