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Study of Imipenem Resistant Metallo- Beta-Lactamase Positive *Pseudomonas aeruginosa* from Burns Wound Infections, Environmental Sources and Impact of Infection Control Measures in a Burns Care Center

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Imipenem resistant Metallo –Beta-lactamase producing *Pseudomonas aeruginosa* (IR-MBLP-PA) is an emerging threat causing burns wound infections with increased mortality and morbidity and with a potential to spread rapidly resulting in outbreaks and epidemics. Very limited data is available after review of literature on detection of IR-MBLP-PA from burns wound infections, environmental sources, their role as source and/or reservoir of nosocomial infections and impact of strict infection control measures on incidence of IR-MBLP-PA infections from burn care centers. Present study was conducted to detect IR-MBLP-PA from burns wound infections, different hospital environmental sources, their antibiogram typing, to assess the role of environmental source and /or reservoir on nosocomial infections and study the impact of Infection control measures on environmental sources of IR-MBLP-PA. During two years study period, 226 clinical and 62 environmental and 20 hand specimens of health care workers, collected and processed by standard laboratory procedures. IR-MBLP-PA detection was done by IMIPENEM+EDTA combined disc test. Antibiogram typing done. Association with clinical cases done by isolation of strain with identical antibiogram type of IR-MBLP-PA isolate from environmental source and clinical case. Impact of Infection control measures were assessed by percentage reduction in incidence of IR-MBLP-PA isolates from respective environmental sources. Study reported an overall incidence of 10.2%(23/226) for IR-MBLP-PA with 16.4% and 6.9% for IR-MBLP-PA before and after infection control measures respectively. Incidence of 34.78% from environmental sources and 10% (2/20) hands of HCWs was observed. Six of the eight IR-MBLP-PA antibiogram types from environmental sources and patients could be associated with 23 burns wound infections with two strains with no association. Strain 1 (Resistant to all antibiotics used) was most common strain (26.08%) associated with seven burns wound infections during the study period. Infection control measures reduced the incidence of *P. aeruginosa* among patients but was not successful in eradicating this organism from various environmental sources. With a high incidence of IR-MBLP-PA (10.2%), present study underscores the role of environmental source in burn care centre (sinks, suction apparatus , water of hydrotherapy tanks and mask of AMBU bags) as a source/or reservoir of infections by temporospatial association and by antibiogram typing. Although met with partial success, implementation of CDC recommended infection control measures resulted in decreased incidence of IR-MBLP-PA burns wound infections necessitating periodic environmental sampling for their detection. Aprons and gowns of health care workers, curtains, beddings and linen were not found to be important source/or reservoirs of IR-MBLP-PA. Resistance profile of predominant IR-MBLP-PA isolates helps in choosing initial empirical antibiotic therapy.

Key words : *Pseudomonas aeruginosa,* Burns wound infections, Environmental sources, Infection control measures.

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Emerging antimicrobial resistance trends in bacterial pathogens represent a serious therapeutic challenge for clinicians caring for burns patients[1]. *P.aeruginosa* encountered as noscomial pathogen causing outbreaks is a serious cause of morbidity and septic mortality in burns patients. Acquired resistance in *P. aeruginosa* is far reaching and highly adaptable, can emerge rapidly and progress through bacterial populations vertically and horizontally with relative ease[1,2].

Carbapenems have been used in clinical settings as a last resort antibiotics for their broad spectrum antibacterial activity against various betalactamase producing Gram negative bacteria including extended spectrum betalactamases and Amp-C producers[1]. Acquired Metallo-beta-lactamases (MBLs: IMP and VIM), a class B carbapenemases have recently emerged globally, since the first report from Japan in 1991[3]. These are the most worrisome resistance mechanisms owing to their capacity to hydrolyze with the exception Aztreonam, all betalactam antibiotics, including carbapenems[1,4]. Early detection of MBL producing Pseudomonas aeruginosa isolates is crucial to check the unnoticed spread within institutions. Situation is further complicated by nonavailability of standardized method proposed by CLSI for MBL detection[3]. Several nonmolecular screening tests viz., IMIPENEM+EDTA combined disc test, IMIPENEM-EDTA double disc synergy test, EDTA disc potentiation test and MBL-E test are being used for detection of MBL producing *P. aeruginosa*[4]. Thus, in addition to the specific measures required to identify and treat nosocomial *Pseudomonas* infections in burn patients, prevention of infection through modification of treatment protocols together with continuous infection control measures to afford early identification and eradication of nosocomial *Pseudomonas* infection are critical for cost-effective, successful burn care[1,2]. Most of the studies across the world highlight on incidence and prevalence of MBL positive *Pseudomonas aeruginosa* infections[3,6,7] with very few studies highlighting incidence among burns wound infection and environmental source/or reservoirs of IR-MBLP-PA[8,9]. Studies on influence of strict infection control measures on reduction of incidence of IR-MBLP-PA from environmental sources are scarce.

With the increasing Imipenem resistant *Pseudomonas aeruginosa* infections at burn care centre of our hospital, it was decided to investigate whether MBL production was directly related to this resistance mechanism. Epidemiology on these pathogens in burns wound infections, role of hands of health care workers and different environmental sources/or reservoirs of IR-MBLP-PA and impact of infection control measures was investigated.

MATERIAL AND METHODS

A prospective analytical study of consecutive patients with *P. aeruginosa* burns wound infections was performed at a tertiary care hospital for a period of two years. Specimens were collected by superficial sampling of the burns wound surface after removal of dressings and topical antibacterial agents and cleansing of the wound surface with sterile normal saline and quantitative culture done by standard laboratory procedures[10].

Data were collected from medical records, computer database and in most of the cases in consultation with treating doctors. Isolates from patients with *P. aeruginosa* as a colonizer of burns wound were excluded from the present study. Specimens from 20 health care workers were collected by sterile swab soaked in sterile normal saline. A total of 62 random specimens were collected for targeted surveillance of different hospital environmental sources namely, Nebulizers[2], Tubings of ventilator[2], Antisepetic and disinfectant solution[5], Mops used for cleaning floors[3], Curtains, beddings and other linen[10], Aprons and Gowns of Health care workers[20], Faucets of sinks[4] and suction apparatus[6] from different environmental sources of burns care unit as per Centre for Disease control recommendations[11].

Specimens from ceilings, floor, walls, furniture and other environmental sources unlikely to come in contact with the patients were not included in the study. Specimens like stethoscope and other apparatus unlikely to come in contact with non-intact skin or mucus membrane, vasculature or tissues of the patients were also excluded from the study. Infection control measures as recommended by CDC were followed[11-12]. Susceptibility to Amikacin, Ciprofloxacin, Gentamycin, Tobramycin, Piperacillin, Piperacillin-Tazobactam, Cefotaxime, Ceftazidime, Cefaperazone, Cefaperazone-Sulbactam, and Imipenem was determined by Kirby-Bauer's disc diffusion method according to CLSI guidelines[5]. Aztreonam, Polymyxin-B and Colistin were tested only against IR-MBLP-PA isolates.

P. aeruginosa isolates resistant to Imipenem were subjected to screening test for MBL production by IMIPENEM+EDTA combined disc test as described previously by Yong *et.al.*,[13]. Isolates with enhancement of zone size of more than or equal to 7mm between IMIPENEM+EDTA disc compared to IMIPENEM disc alone were considered as IR-MBLP-PA others were considered as Imipenem resistant MBL negative *P. aeruginosa* (IR-MBLN-PA). MBL negative ATCC (27853) standard strain of *P. aeruginosa* was used as negative control, which did not show any zone of enhancement around IMIPENEM+EDTA combined disc.

Typing of IR-MBLP-PA isolates was done by antibiogram typing

Association of IR-MBLP-PA environmental isolate with different nosocomial infections was done by circumstantial evidence (Tempororspatial association) and antibiogram typing. Repeat specimens were collected from the same burns care unit environmental sources, after strict infection control measures were implemented as per CDC guidelines[11]. Impact of infection control measures were assessed in terms of percentage reduction in incidence of IR-MBLP-PA isolates from different environmental sources of burns care centre.

RESULTS

In the present analytical study of two years duration in the burns care in a rural tertiary care hospital, epidemiology of IR-MBLP-PA *Pseudomonas* is reported to increase the burn care provider's understanding of the behaviour of this very serious pathogen in the burn care setting. A total of 226 *P. aeruginosa* isolates from nosocomial burns wound infection were isolated and studied prospectively for determination of incidence IR-MBLP-PA nosocomial infections in burns wound center, before and after the implementation of CDC recommended infection measures. Present study reported an incidence of 63.3% and 38.2% for Gram negative bacilli and *P.aeruginosa* respectively in burns wound infections. 54.1% (60/111) of the burns wound infection by gram negative bacilli were due to *P. aeruginosa*. Incidence of Imipenem resistant *P. aeruginosa* was 16.4% with 13.6% and 2.7% for Imipenem resistant Metallo-Beta-Lactamase positive *P. aeruginosa* (IR-MBLP-PA)and Imipenem resistant Metallo-Beta-Lactamase negative *P. aeruginosa* (IR-MBLN-PA) respectively before intervention by CDC recommended infection control measures. High incidence of Imipenem resistance in *P. aeruginosa* was observed (42.8% Vs. 50%) before and after control measures respectively. Incidence of IR-MBLP-PA in the present study was 10.2% (23/226),in our burns unit with high incidence of Imipenem resistance 45% (27/60). Percentage reduction of 28.3%,22.7%, 8.6%, 6.7% and 1.8% was observed among Gram negative burns wound infections, Imipenem resistant *P. aeruginosa*, IR-MBLP-PA and IR-MBLN-PA respectively after the implementation of strict infection control measures.

Incidence of *P. aeruginosa* , Imipenem resistant *P. aeruginosa* and IR-MBLP-PA and IR-MBLN-PA was highest in 50-60% total body surface areas (TBSA) burns patients. 152(67%) were men and 74 (32.7%) were women with a mean age of 38.7 (age range, 2 years to 78 years). Mean duration of hospital stay from admission to first isolation of *P. aeruginosa* was 9.2 days (range of 5 days to 24 days). Incidence of polymicrobial *P. aeruginosa* infections was 28.6% (12/42) and 11.1% (2/18) before and after the implementation of strict infection control measures respectively.

Though a significant reduction in burns wound infections due to gram negative infections was achieved, same was not observed with *P. aeruginosa* (Imipenem resistant and Imipenem resistant MBL positive *P. aeruginosa*).

Present study reported a 38.3% (23/60) incidence of IR-MBLP-PA burns wound infections. Among the 27 IR-PA isolates, 23 were found to be IR-MBLP-PA. High incidence of *P. aeruginosa*, IR-PA and IR-MBLP-PA of 57.2% (24/42),55.6% (10/18) and 66.7% (10/15) respectively was observed in severe burns wound infections (50-60% of TBSA). Even though an appreciable reduction in the incidence of *P. aeruginosa* in severe burns

Table 1. Incidence of gram negative bacilli, *P.aeruginosa*, imipenem resistant *P. aeruginosa*, IR-MBLP-PA and IR-MBLN-PA before and after infection control measures among patients with burns wound infection

Incidence	Incidence of Gram negative Bacilli (number of isolates)	Incidence of *P. aeruginosa* (number of isolates)	Incidence of IR-PA (number of isolates)	Incidence of IR-MBLP-PA (number of isolates)	Incidence of IR-MBLN-PA (number of isolates)
Before intervention* (n=110)	63.3 (70/110)	38.2 (42/110)	16.4 (18/110)	13.6 (15/110)	2.7 (3/110)
After intervention (n=116)	35.4 (41/116)	15.5 (18/116)	7.8(9/116)	6.9 (8/116)	0.9 (1/116)
Percentage reduction	27.9	22.7	8.6	6.7	1.8

NOTE: * Intervention = CDE recommended infection control measures
P. aeruginosa = *Pseudomonas aeruginosa*, IR-PA = Imipenem resistant *P. aeruginosa*, IR-MBLP-PA = Imipenem resistant Metallo-Beta-Lactamase positive *P. aeruginosa*, IR-MBLN-PA = Imipenem resistant Metallo-Beta-Lactamase negative *P. aeruginosa*.

Table 2. Impact of infection control measures on incidence of IR-MBLP-PA in burns wound infections

Type of burns inujury	Incidence of PA		Incidence of IR-PA		Incidence of IR-MBLP-PA	
	Before Intervention *	After intervention	Before intervention	After interventon	Before intervention	After interventon
50-60 % Burns	24	6	10	4	10	4
40-50% Burns	12	7	6	4	3	2
20-40 % Burns	6	5	2	1	2	2
TOTAL	42	18	18	9	15	8

NOTE: * intervention = CDC recommended infection control measures, *P. aeruginosa* = *Pseudomonas aeruginosa*, IR-PA = Imipenem resistant *P. aeruginosa*, IR-MBLP-PA = Imipenem resistant Metallo-Beta-Lactamase positive *P. aeruginosa*, IR-MBLN-PA = Imipenem resistant Metallo-Beta-Lactamase negative *P. aeruginosa*.

Table 3. Distribution of environmental isolates of IR-MBLP-PA in different areas of the hospital

Environmental Source (N=number)	Incidence before intervention	Incidence after intervention
Nebulizer (2)	3[1]ξ	1[0]
VentilatorTubings (2)	1[1]	1[1]
Disinfectant/Antiseptics (5)	2[2]	0[0]
Mops (3)	1[0]	0[0]
CurtainsBeddings Linen(10)	0[0]	0[0]
Aprons and Gowns(20)	2[0]	0[0]
Sinks (4)	2[1]	1[1]
Suction Apparatus (6)	3[1]	1[1]
Water Hydrotherapy tanks (4)	4[1]	2[1]
Mask of AMBU bag (6)	5(1)	2(1)
Total=62	23[8]	8[5]

NOTE: ξ A[B]; A= No of *Pseudomonas aeruginosa*, B= No of IR-MBLP-PA isolates, PA= *Pseudomonas aeruginosa*, IR-MBLP-PA = Imipenem resistant MBL positive *P. aeruginosa*

(50-60% of TBSA) [from 57.2% (24/42) to 33.3(6/18)] was observed, same was not the with IR-PA (55.6% to 44.4%) and IR-MBLP-PA (66.6% to 50%)

Mortality in IR-MBLP-PA infections was 52.2% (12/23)

Polymyxin B, Colisting and Aztreonam (tested only on IR-MBLP-PA) retained high susceptibility against IR-MBLP-*P*. Although, Cefotaxime, Cefaperazone, Cefaperazone + Sulbactam, Piperacillin and Piperacillin+ Tazobactam retained sensitivity against IR-MBLP-PA, therapeutic efficacy in vivo is doubtful. Ten and 6 of the IR-MBLP-PA (out of 23) isolates were found to be Multi-drug resistant (MDR) and PAN drug resistant respectively.

Incidence of IR-MBLP-PA from different environmental sources of burns unit was 34.8% (8/23). Although, *P.aeruginosa* was reduced from 23 to 8 following strict infection control measures recommended by CDC, reduction in the incidence of IR-MBLP-PA was only from 8 to 5.

Although, IR-MBLP-PA from many of the environmental sources was eradicated, Infection control measures could not eradicate IR-MBLP-

Table 4. Resistance rates of *Pseudomonas aeruginosa* isolates to different antibiotics

Antibiotic	No of resistant *P. aeruginosa* Isolates	Percentage of resistant *P. aeruginosa*
Gentamycin	226	100
Ciprofloxacin	161	71.24
Piperacillin	161	71.24
Piperacillin + tazobactam	150	66.34
Cefotaxime	167	73.9
Ceftazidime	162	71.7
Cefaperazone	210	92.9
Cefaperzone + sulbactam	161	71.24
Tobramycin	193	85.4
Amikacin	161	71.24
Colistin	65	28.8
Aztreonam	30	13.27
Polymyxin b	0	0
Imipenem	27	11.94

Table 5. Distribution of antibiogram types of IR-MBLP-PA

Strain of IR-MBLP-PA	Antibiogram	Number (n)	No of nosocomial Infections Caused by Particular Strain
1	R- Resistant to all	6	7
2	R- G, Pip,Pip+Tz, Ce, Cs, Cs+Sul, ToS- Cip, Cz, Ak	2	2
3	R- G, Cip, Ce, Cz, Cs, Cs+Sul,ToS- Pip, Pip+Tz,Ak	2	3
4	R- G, Cip, Ce, Cs, Cs+Sul, To, Ak S- Cz,Pip, Pip+Tz,	3	3
5	R- G, Pip, Pip+Tz, Ce, Cz, AkS- Cip, Cs, Cs+Sul, To	5	5
6	R- G, Pip, Ce, Cz, Cs, Ak, Pip+Tz, Cs+Sul S-To,Cip,Cs+Sul	2	3
7	R- Pip, Pip+Tz, Cs, Cs+Sul, G, Ce, Cz, To, CipS- Ak	2	0
8	R –Ak, Pip, Pip+Tz, Cs, Cs+Sul, Ce, Cz, Cip, GS-To	1	0

NOTE : Ak= Amikacin, Cip=Ciprofloxacin,G=Gentamycin,To=Tobramycin,Pip=Piperacillin,Pip+Tz =Piperacillin-Tazobactam, Ce=Cefotaxime, Cz= Ceftazidime,Cs= Cefaperazone, Cs+Sul =Cefaperazone- Sulbactam, R= Resistant , S= Susceptible

PA from sinks, ventilator tubings, suction apparatus and water of hydrotherapy tanks. Even though, *P. aeruginosa* was isolated from Mops, Curtains, beddings, linen , gowns and aprons of helath care workers, these sources did not act as source and/reservoir of IR-MBLP-PA.

Out of the 20 healthy health care workers screened for IR-MBLP-PA from hands, one doctor and one staff nurse were found to be colonized with IR-MBLP-PA (strain 1) .

A total of 8 strains of IR-MBLP-PA were isolated from patients, hospital environmental soruces and hands of health care workers. Strain 1 (resistant to all drugs tested) was most common 26.1% (6/23) followed by strain 5 constituting 21.7% (5/23) of the IR-MBLP-PA isolates. Strain 7 and 8 were not observed in burns wound infections during study period.

DISCUSSION

The present study highlights the epidemiology of IR-MBLP-PA burns wound infection to increase the burn care provider's understanding of the behavior of this serious pathogen. The study reported very high incidence of Imipenem resistance among *P. aeruginosa* (42.85% Vs 50%) before and after institution of strict infection control measures. Overall incidence of Imipenem resistance was (21.82%) in nosocomial infections due to *P. aeruginosa*, with an increasing trend (14% in 2004, 15.6% in 2005, 17.2% in 2006 and 18% in 2007)[data not shown in tables]. This clearly indicates emergence and persistence of Imipenem resistant *Pseudomonas aeruginosa* isolates in the hospital and especially in burns care unit (BCW). This tertiary care hospital mainly catering patients from surrounding rural areas, unlikely being treated with broad spectrum antibiotics like Imipenem rules out community acquired infections . Variable Imipenem resistance among *P. aeruginosa* (8-63.74%) has been reported in different studies[2, 3,4,6,7].

High incidence of IR-MBLP-PA infections 38.3% (23/60), constituting 85.2% (23/27) of Imipenem resistant isolates was observed. Carbapenems are considered as indicator drugs for the detection of resistance mechanisms in *Pseudomonas aeruginosa*. [2,3] Resistance to Imipenem is due to decreased outer membrane permeability, increased efflux systems, alteration of penicillin binding proteins and Carbapenem hydrolyzing enzymes – Metallo- beta –lactamases. Although most Imipenem resistance in *P. aeruginosa* remains as a result of porin loss, a great concern is exercised about the growing number of outbreaks, some of them large and protracted by IR-MBLP-PA caused by strains with IMP, VIM and SPM metallo-beta-lactamases[2,3].

IMIPENEM+EDTA combined disc test, a non-molecular screening test used in the present study is a sensitive and specific test clearly discriminating positive and negative results for MBL detection.[5] Though PCR is highly sensitive and specific test, is limited by high cost and nonavailability at all hospitals[4]. Significant proportions of Imipenem resistant *P. aeruginosa* isolates were found to be MBL producers by different Indian workers, Varaiya et.al,83.33% (50/60) and Hemalatha et.al,87.5% (7/8**).**[7] Most of the studies were limited by small sample size and not burns wound infection specific incidences.

Distribution of IR-MBLP-PA infections was not uniform in the burns care centre of our hospital. Most of the IR-MBLP-PA infections were among 50-60% TBSA burns with (66.7%=10/15) and 50% (4/8) before and after infection control measures respectively. Rajput A et.al report an incidence of 16% of IR-MBLP-PA among burns wound infection[15].

IR-MBLP-PA isolate from burns of less than 20% was frequently a colonizer of the wound or as part of the polymicrobial infections in which role played by the isolate could not be assessed with certainty. Decrease in the incidence of IR-MBLP-PA in other categories of burns wound infection was moderate (Table 2). Burden of IR-MBLP-PA infections was found to be endemic in our centre. The occurrence of an MBL-positive isolate in a localized hospital environment poses not only a therapeutic problem but also a serious concern for infection control management. The microbiology laboratory should promptly inform infection control management. The patient should be regarded as high risk, and appropriate isolation measures should be enforced. If necessary, patient's medical forms should indicate the high-risk nature of the infection, informing clinicians and other health care workers who may come in contact with the patient[2,3,14]. Routine detection of

MBLs ensuring optimal patient care and careful in vitro testing before antibiotic use may help in the prevention and treatment of burn patients infected with metallo-beta- lactamase-producing *P. aeruginosa*[15].

Significant finding was the higher mortality in IR-MBLP-PA infections (52.2% i.e. 12/23) compared with Imipenem sensitive *P. aeruginosa* infections (21,2% i.e. 7/33). Mortality among IR-MBLP-PA was 60% (9/15) and 37.5% (3/8) before and after infection control measures demonstrating a 22.5% reduction in the mortality rate. Mortality among Imipenem sensitive *P. aeruginosa* was 25% (6/24) and 11.1% (1/9) before and after infection control measures respectively, demonstrating a 13.9% reduction in the mortality rate. A great reduction in the incidence and mortality were observed in general among gram negative burns wound infections.

Among eight discrete strains of IR-MBLP-PA from different sources (By antibiogram typing) strain 1 (26.1%) and strain 5 (21.7%) were predominant associated with seven and five burns wound infection during the study period. Strain 1 isolated from 26.1% of IR-MBLP-PA burns wound infections,sink,suction apparatus, hydrotherapy tank water and hands of health care workers, resulted in 6 deaths due to burns wound infectioin. Strain 1 was PAN drug resistant (resistant to all drugs except polymyxin B, Colistin and Aztreonam). Ten of the 23 isolates were multi drug resistant (resistant to more than 5 drugs). Paterson report that all of the IR-MBLP-PA isolates and 52% of IR-MBLN-PA isolates were multidrug resistant, while 11% of IR-MBLP-PA isolates and 8% of IR-MBLN-PA isolates were PAN DRUG resistant.[16] Clinicians were practically left with no option for treating patients with PAN DRUG resistant IR-MBLP-PA infections.

Twenty of the 23 IR-MBLP-PA environmental isolates (86.9%) belonging to 5 discrete strains (strain 1 and strain 3to 6) by phenotypic characterization (ANTIBIOGRAM TYPING) were found to be source and/or reservoirs of burns wound infections caused by IR-MBLP-PA. This association was established by circumstantial evidence, temporospatial association and identical strains from environmental sources and clinical cases by antibiogram typing. Though the routes of transmission of the IR-MBLP-PA remained unclear, IR-MBLP-PA recovered from these areas of hospital environment were found to be the possible source of increasing nosocomial infections due to existence of ample of opportunities in ICU s for transmission.

Coexistence of IR-MBLP-PA isolates with non MBL producing *P. aeruginosa* was a worrisome finding as MBL resistance allele on a transferable conjugative plasmid could be readily mobilized to these isolates, further increasing the burden of IR-MBLP-PA environmental isolates in the hospital[3].

Strain 7 and 8 from mask of AMBU bag, sinks and disinfectant/antiseptics were not encountered as pathogens from burns wound infections. These probably represent contamination rather than colonization. This underlines the importance of strict infection control measures preventing the transmission of IR-MBLP-PA isolate from environmental source to susceptible patients. However, it is not possible to state that strains isolated only from the hospital environment during relatively short period of the investigation have never caused infection or would never do so if given the opportunity. This does not rule out the possibility of transmission of these strains to susceptible patients in future if strict infection control measures are not practiced.

IR-MBLP-PA was observed to be endemic in environmental sources of burns care centre. Strain 2 from two of the burns patients with 30-40% was not identified from any of the environmental sources in the burn care centre. This necessitates further workup to identify any other environmental source of IR-MBLP-PA isolates in the hospital. Though there is little evidence to suggest healthy carriers among health care workers as source of IR-MBLP-PA isolates, the possibility cannot be ruled out since two of the health care workers were colonized by strain 1 at hands. Crespo et.al reported a patient shifted from another hospital as a source IR-MBLP-PA for clinical infections. Overnight cleaning of sinks and their drains with hypochlorite, restricted use and decommissioning of sinks resulted in eradication of MBL strain from these sites. [8] Tsakris *et al.* reported community acquired IR-MBLP-PA isolates from feces from healthy adults in community as a reservoir, resulting in the community acquired IR-MBLP-PA infections. Some as yet unknown environmental species also could be the sources of the mobile metallo-beta-lactamase determinants that recently appeared among gram negative pathogens[17].

Though incidence of *P. aeruginosa* and IR-MBLP-PA reduced following strict infection control measures, could not be eradicated totally from the environmental sources of burns care centre. Successful clones will be widespread in nature and therefore predominate in the patient population, in whom variants accumulate drug resistance mechanism like Imipenem resistant metallo-beta-lactamases, that allow their transmission and persistence in the burns care centre[1].

Persistence of IR-MBLP-PA in sinks, suction apparatus and AMBU bag was probably due to intermittent contamination from other sources and hands of health care workers. Use of proper in use concentration of disinfectants and avoiding immersion of thermometers, and other equipments eradicated IR-MBLP-PA from these sources. Mops, curtains, beddings and aprons were not observed as source/reservoir of IR-MBLP-PA. Although with an appreciable reduction, strict infection control measures were not found to be very effective in eradication of IR-MBLP-PA (which is already endemic in the burns ward). Very limited data on review of literature is available for comparison regarding effect of infection control measures on reduction in incidence of this pathogen with a potential to rapidly spread within the hospital. [3]

Timely detection of IR-MBLP-PA isolates from different environmental sources of burn care centre, achieved by active surveillance and hospital infection control measures, appears to be crucial in decreasing the incidence of IR-MBLP-PA burns wound infections and the spread of these strains in the hospital.

Conclusions of the study

1) With a high incidence in general 10.2%, IR-MBLP-PA is the most common pathogen in severe burns wound infection (50-60% TBSA)
2) This study underscores, the role of hospital environment as potential source and/reservoir of IR-MBLP-PA isolates necessitating periodic environmental sampling in burn care centers of the hospital for detection of Imipenem Resistant Metallo-Beta-lactamase positive *Pseudomonas aeruginosa* (IR-MBLP-PA)
3) Suction apparatus, sinks and water of hydrotherapy tanks were found to be most important sources of IR-MBLP-PA necessitating strict infection control measures to prevent their spread to other areas of the hospital
4) Curtains, beddings, linen, Aprons and Gowns of health care workers were not found to be important sources of IR-MBLP-PA isolates
5) Strict hand hygiene can prevent the spread of IR-MBLP-PA burns wound infections, especially during outbreaks
6) Antibiotic resistance pattern of environmental IR-MBLP-PA isolates (ANTIBIOGRAM TYPING) help in choosing initial antibiotic for empirical antibiotic treatment
7) Center for disease control recommended infection control measures were met with partial success in reducing incidence of IR-MBLP-PA infections among burn wound infection, necessitating further studies to search for endogenous source of this pathogen (from patients)

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