TABLE 1. Factors Associated with Head-of-Bed Elevation Compliance: Association with Seniority of Nursing Staff and Location

Variables	No. of observations	Compliance, %	Univariate	Multivariate	
			P	*P*	95% CI
Age			.02	.24	−0.02 to 0.10
>30 years	238	23.9			
≤30 years	521	17.1			
Gender			.61		
Female	706	20.0			
Male	53	9.4			
Academic degree			.07		
University and master's	685	18.4			
College	74	27			
Experience of critical care			.78		
>2 years	455	19.6			
≤2 years	304	18.8			
Ranking of RN			.009	.004	0.01 to 0.21
RN3 + RN4	118	28.0			
RN + RN1 + RN2	641	17.6			
ICU licensed nurse			.28		
Yes	655	19.8			
No	104	15.4			
Location			<.001	<.001	-0.24 to −0.12
ICU	531	14.3			
Respiratory care center	228	30.7			
Received VAP education			.08		
Yes	652	20.2			
No	107	13.1			

NOTE. CI, confidence interval; ICU, intensive care unit; RN, registered nurse; VAP, ventilator-associated pneumonia.

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Nosocomial Transmission of Carbapenem-Resistant *Pseudomonas aeruginosa* among Burn Patients

To the Editor—We report a nosocomial transmission of a *Pseudomonas aeruginosa* strain producing VIM-2 type metallo-β-lactamase in association with oxacillinase OXA-10 among burn patients.

Patient A, a 32-year-old woman, suffered from a burn injury involving 15% of her body surface area after a suicide attempt by self-immolation in Tunisia in 2012. She was transferred to the burn unit at Grenoble University Hospital, France, on May 14, 2013. She received wound care and dressing changes in the balneotherapy room and the operating room. Contact precautions were used because cephalospor-

inase-producing *Proteus mirabilis* and *Providencia stuartii* and multidrug-resistant *Pseudomonas aeruginosa* susceptible only to polymyxin and fosfomycin were isolated from her wounds. Isolation was difficult because of psychiatric disorders. Skin grafting was performed on June 12. She received antibiotics, including trimethoprim-sulfamethoxazole until May 28 and clindamycine until June 26. On June 19, burn cultures yielded *P. aeruginosa* isolates susceptible only to polymixin. She was discharged from the unit on June 24 to the home care setting.

Patient B, a 25-year-old male, had a history of drug abuse and malnutrition. He was hospitalized for Lyell's syndrome involving 10% of his body surface area on June 11. He received wound care and dressing changes in the balneotherapy room until June 19, after which he was transferred to a subacute care and rehabilitation facility. He was readmitted to the hospital on June 21 for burn wound infection and bloodstream infection with *P. aeruginosa*. He improved with surgery and use of antibiotics. The resistance patterns of his strain and those of the index patient are illustrated in Table 1. Both the isolates were sent to the National Reference Centre. Both *P. aeruginosa* isolates showed a resistance mechanism with production of metallo-β-lactamase VIM-2 and oxacillinase OXA-10, confirming an identical strain.

The outbreak investigation highlighted the high risk of environmental contamination of wounds and dressings because of splashing and lack of cleaning in the balneotherapy room. Environmental disinfection was found to be insufficient, since surface sampling was found positive for noncarbapenem-resistant *P. aeruginosa*. The water from the department was filtered, and water samplings did not reveal any bacteria. The patients' rooms were distant from each other. Follow-up testing did not reveal further transmission of this strain for months thereafter.

Burn wounds are highly susceptible to colonization; it has been found that more than 90% of patients were colonized by the seventh day and that colonization flora of individual burn wounds changed over time.[1,2] *P. aeruginosa* is the third most frequently cultured organism from infected burn wounds in Europe; its susceptibility to ceftazidime and imipenem decreased markedly in the past 20 years.[3] These patients are more susceptible to infection because of their relative immunosuppression, deficiency in the protective skin barrier, invasive procedures, and prolonged hospital stays. Infection remains a leading cause of mortality of patients with burn injury.[4] An increased prevalence of resistant bacteria was observed in late bloodstream infections among burn patients.[2] It has also been shown that a single clone of multidrug-resistant *P. aeruginosa* can cause long-term persistence in different body sites of burn patients.[5] Colonization can subsequently promote various severe infections. Infection with drug-resistant *P. aeruginosa* in burn patients results in higher mortality rates, antibiotic costs, longer hospital stays, and surgical procedures.[6]

The use of antimicrobial therapy has been repeatedly associated with the development of drug resistance. In the context of the rapid emergence of antibiotic-resistant organisms, resistant bacteria have become a significant challenge in the treatment of severe burns. Nevertheless, molecular typing performed on isolates of *P. aeruginosa* among colonized burned patients suggested that resistance was not due to the acquisition of resistance mechanisms by a previously susceptible strain but instead probably due to the spread of resistant strains from patient to patient.[7] Limiting the use of antimicrobials may have a positive impact on controlling the spread of resistant microorganisms, since colonization by resistant patterns may be facilitated by the use of antibiotics and the eradication of susceptible flora from patients. The environment is also very important for nosocomial infection, in particular for burn patients. It has been proved that amenities involving the use of water may be a potential source of *P. aeruginosa* for susceptible patient groups, including patients with burns.[8]

Nosocomial infections and cross-contamination of multidrug-resistant organisms are a critical challenge in burns units. Transmission of highly resistant bacteria is facilitated in burn departments because of wound colonization, sharing of medical facilities for bandages, use of antimicrobials, and susceptibility of burned patients. Contaminated hands of health-care professionals and colonized or infected patients are sources of infection as well as environment. In our case, cross-transmission was particularly noticeable because of the severity of the infection and the multidrug resistance. Indirect

TABLE 1. Antimicrobial Susceptibility Patterns of Metallo-β-Lactamase-Producing *Pseudomonas aeruginosa* Isolates from Disk Diffusion Tests

Sample	TIC	TCC	ATM	CAZ	IMP	FEP	GEN	TOB	AMK	CIP	SXT	PMB	FOS
Patient A													
Burn wounds, May 14	R	R	I	R	R	R	R	R	R	R	R	S	S
Burn wounds, June 19	R	R	I	R	R	R	R	R	R	R	R	S	R
Patient B													
Blood cultures, June 21	R	R	I	R	R	R	R	R	R	R	R	S	R
MIC (mg/L)			32	12	>256				>256			1.5	256

NOTE. AMK, amikacin; ATM, aztreonam; CAZ, ceftazidime; CIP, ciprofloxacin; FEP, cefepime; FOS, fosfomycin; GEN, gentamicin; I, intermediate; IMP, imipenem; MIC, minimum inhibitory concentration; PMB, polymyxin; R, resistant; S, susceptible; SXT, sulfamethoxazole-trimethoprim; TCC, ticarcillin plus clavulanic acid; TIC, ticarcillin; TOB, tobramycin.

transmission via the balneotherapy room was the most likely route of this transmission. Wound infection by antibiotic-resistant organisms should be considered a potential risk, and their presence must be identified by microbiological surveillance, systematic screenings, and periodic cultures from various parts of the wound. Water sampling strategies could be planned on a regular basis in order to maintain healthcare workers' vigilance. Moreover, knowing microbial colonization, antimicrobial susceptibility, and trends in nosocomial infections in burn units can help healthcare workers choose the optimal empirical antibiotic treatment. Raising healthcare workers' knowledge about this subject is essential to control the risk of transmission in these departments, in association with strict infection control procedures in burn units.

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Carbapenemase-Producing Enterobacteriaceae (CPE) in the Pediatric Setting: Results from an 18-Month Survey

To the Editor—The emergence of carbapenemase-producing Enterobacteriaceae (CPE) in children is a serious matter of concern, because it severely limits treatment options. Rapid identification is crucial, both for appropriate antimicrobial therapy and for implementation of infection control measures.[1] Few epidemiological data on CPE infections in children are available.[2]

Our study aimed to evaluate the occurrence of CPE in an Italian tertiary pediatric center, the Regina Margherita Children's Hospital of Turin. Between May 1, 2012, and October 31, 2013, patients from whom CPE strains had been isolated from any clinical specimens were included and prospectively investigated. Only the first isolate from each patient was considered. Identification and antimicrobial susceptibility testing were performed using the Vitek-2 automated system (bioMérieux), and results were interpreted according to European Committee on Antimicrobial Susceptibility Testing breakpoints.[3] Colistin and tigecycline minimum inhibitory concentrations (MICs) were additionally determined by Etest (bioMérieux). Enterobacteriaceae isolates with imipenem and/or meropenem MICs of 2 mg/L or greater were tested for carbapenemase production using a combined disk assay (KPC/MBL and OXA-48 Confirm Kit, Rosco Diagnostica).[4-7]

During the study period, 15 patients (9 males) were identified as infected or colonized with CPE. The mean age (± standard deviation [SD]) was 10.6 ± 5.84 years. Eleven cases (73%) were found in the hemato-oncology unit, 2 (13.5%) were found in the intensive care unit, and 2 (13.5%) were found in the infectious diseases ward. One patient had been transferred from a pediatric hospital in Maracaibo, Venezuela, 2 months before; 1 patient had been admitted after a 3-month stay in the Italian hospital of Cairo, and 1 patient had just been discharged from an adult ward. Eleven patients had malignancies (10 had acute leukemia or lymphoma, and 1 had medulloblastoma); of these 11 patients, 8 had refractory or relapsed neoplasms, whereas 3 were not receiving therapy, and 2 had undergone allogeneic hematopoietic stem cell