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Infection control education: Impact on ventilator-associated pneumonia rates in a public sector intensive care unit in Pakistan

M.S. Khan[a], S.Z. Siddiqui[b], S. Haider[b], A. Zafar[a,*], F. Zafar[a], R.N. Khan[b], K. Afshan[b], A. Jabeen[b], M.S. Khan[b], R. Hasan[a]

[a] *Department of Microbiology and Pathology, Aga Khan University, Stadium Road, P.O. Box 3500, Karachi 74800, Pakistan*
[b] *Department of Anaesthesia, Dow University of Health Sciences, Karachi, Pakistan*

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Summary We describe efforts towards introducing infection control (IC) practices and establishment of antimicrobial resistance (AMR) surveillance in a public sector hospital in Pakistan. The study was conducted in an eight-bed intensive care unit. IC principles, introduced through interactive sessions, were used as an intervention and their impact was observed by conducting surveillance for ventilator-associated pneumonia (VAP) before and after the intervention. Respiratory isolates of VAP patients in the period after intervention were screened for AMR, and empiric antibiotic at the time of admission was compared with the antimicrobial sensitivity pattern reported. VAP rates were high in general and declined in the period after intervention, although the difference was not significant. Of 37 VAP patients in the period after intervention, 68% had more than one clinically significant organism isolated from the respiratory specimen. *Acinetobacter* spp. were isolated from 76% of patients and *Pseudomonas aeruginosa* from 43%. All *Acinetobacter* spp. and 72% *P. aeruginosa* were multidrug resistant. The mean stay of the nosocomially infected patients was significantly higher than for the uninfected group (6.5 vs. 2.1 days, $P < 0.001$). Our study suggests IC education needs to be supplemented by a hospital system that facilitates IC practices and development of surveillance programmes.

1. Introduction

Nosocomial infections (NI), associated with significant risks of morbidity and mortality, are classified as healthcare associated injuries.[1] NI affects nearly two million patients each year in the USA resulting in some 80 000 deaths.[2] This figure goes up to three million NI per year and 50 000 deaths for

* Corresponding author. Tel.: +92 21 4861601; fax: +92 21 4934294/4932095.
E-mail address: afia.zafar@aku.edu (A. Zafar).

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the European countries.[3] There is limited surveillance data available from developing countries on NI rates. However, the few reported studies show that NI rates in these countries are high and variable. In India, a study by Mehta et al.[4] carried out in intensive care units (ICU) of seven Indian cities showed overall NI rate of >4%. Studies from Iran and Saudi Arabia show a similar picture.[5,6] The risk of acquiring NI in ICUs is five to ten times greater then in other areas of the hospital.[7,8]

Nosocomial pneumonia is currently the second most common NI and the leading cause of death from hospital-acquired infections.[9] Most episodes of nosocomial pneumonia occur in patients undergoing mechanical ventilation.[10] Ventilator-associated pneumonia (VAP) significantly prolongs hospital stays[11,12] and this has a direct impact on the cost of healthcare and more importantly significantly increases attributable mortality.[11,12] Multidrug-resistant (MDR) organisms including *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Acinetobacter* spp., *Klebsiella pneumoniae*, *Enterobacter* spp. and *Stenotrophomonas maltophilia* are often associated with inadequate antimicrobial therapy in patients with culture-proven VAP.[13,14] In the absence of surveillance, very little is known about the rates of various NI, the organisms causing these infections and their antimicrobial resistance (AMR) patterns from general hospital wards or ICUs in Pakistan. Furthermore, due to inadequate infection control (IC), it is assumed that NI rates, particularly in ICUs are quite high.

With extremely limited funding available for healthcare in public sector hospitals of developing countries, emphasis needs to be placed on prevention of infection rather than on its treatment. Although there is no clear consensus on strategies for prevention of NI including VAP, a number of studies have proven the efficacy of education in lowering VAP rates.[15,16]

The objectives of our study included surveillance for VAP to calculate the rates of infection, organisms involved and their AMR patterns in a surgical intensive care unit (SICU) of a public sector hospital of Pakistan. The impact of educational sessions as an intervention for reducing NI rates was also assessed.

2. Materials and methods

2.1. Study setting and population

The study was conducted in an eight-bed SICU of a tertiary care public sector hospital in Pakistan. This unit receives post-operative patients from operating rooms, surgical wards and referred cases from other hospitals in Karachi. As all the patients were critically ill and ventilated, they were unable to give consent and therefore the next of kin gave informed consent.

2.2. Data collection

Patients acquiring VAP (acquiring pneumonia after 48 h of admission in the SICU) were identified during a 6-month period (June to November 2007) following IC training sessions and compared to similar retrospective data (July to December 2006) prior to the sessions. The AMR patterns of VAP patients during the post-training sessions were also studied.

2.3. Surveillance

All patients diagnosed with VAP by their attending physicians were identified and a dedicated research assistant was assigned to collect data. A standard questionnaire was designed to record demographic information, co-morbidity, clinical manifestations, duration of stay and antibiotic usage prior to admission as well as during the ICU stay. Tracheal aspirates and blood were collected and submitted to the clinical microbiology laboratory for culture for all patients suspected of VAP. Repeat isolates from same patient were not included in the analysis. Clinically significant isolates were identified by conventional methods and antimicrobial susceptibilities were checked by using Clinical and Laboratory Standards Institute guidelines.[17]

2.4. Definitions

Multidrug resistance was defined as resistance to two or more of the antimicrobial drugs or drug classes to which a particular organism is not intrinsically resistant. The drug classes included *beta*-lactam antibiotics and carbepenems (including penicillin, cephalosporin and imipenem), macrolides, trimethoprim-sulfamethoxazole, tetracycline, ofloxacin, aminoglycoside and chloramphenicol. Respiratory isolates were considered clinically significant if there were $\geq$100 000 organisms isolated on quantitative culture in the presence of clinical signs.[17]

VAP was defined as nosocomial pneumonia in patients who had been on mechanical ventilation for $\geq$48 h. Nosocomial pneumonia was identified using the National Health-care Safety Network of the Centers for Disease Control and Prevention (CDC) definition.[18]

2.5. Intervention

All the unit staff including doctors, nurses and ancillary staff were trained for 6 h on average through the intervention training sessions. The sessions provided information on basic IC guidelines including hand hygiene, prevention of VAP and other nosocomially acquired infections, and proper waste disposal. No feedback was provided to the unit regarding the VAP rates during the study period. No attempts were made to record change in practices of the unit staff regarding VAP prevention after the intervention.

2.6. Statistical analysis

VAP rates were calculated by dividing the identified number of VAP patients with the total number of patients who received mechanical ventilation during each study period. All data were entered into SPSS version 16.0 (SPSS Inc., Chicago, IL, USA). The mean and SD were calculated for continuous variables and frequencies for categorical variables. Cross-tabulation was done to determine relationship between different variables and *P*-values were calculated