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Impact of a multidimensional approach on ventilator-associated pneumonia rates in a hospital of Shanghai: Findings of the International Nosocomial Infection Control Consortium☆,☆☆,★

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Abstract

Purpose: The aim of this study was to analyze the impact of a multidimensional infection control approach on the reduction of ventilator-associated pneumonia (VAP) in intensive care units (ICUs) patients of one hospital in China.

Materials and Methods: We conducted a before-after study from January 2005 to July 2009, which was divided into baseline (phase 1) and intervention (phase 2) periods. During phase 1, active prospective outcome surveillance of VAP was performed by applying the definitions of the Centers for Disease Control and Prevention/National Health Safety Network, and the methodology of the International Nosocomial Infection Control Consortium. During phase 2, the multidimensional approach was implemented. Ventilator-associated pneumonia rates obtained in phases 1 and 2 were compared in yearly periods.

Results: We recorded data from 16 429 patients hospitalized in 3 ICUs, for a total of 74 116 ICU bed days. The VAP baseline rate was 24.1 per 1000 ventilator-days. During phase 2, the VAP rate significantly decreased to 5.7 per 1000 ventilator-days in 2009 (2009 vs 2005: relative risk, 0.31; 95% confidence interval, 0.16-0.36; $P = .0001$), amounting to a 79% cumulative VAP rate reduction.

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★ Every hospital's institutional review board agreed to the study protocol, and patient confidentiality was protected by codifying the recorded information, making it only identifiable to the infection control team.

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Conclusions: Implementing a multidimensional infection control intervention for VAP was associated with a significant cumulative reduction in the VAP rate in our ICUs.

1. Introduction

Ventilator-associated pneumonia (VAP) has been reported to be the most serious health care–associated infection (HAI), as the leading cause of morbidity and mortality for device-associated infections (DAIs), particularly in the intensive care unit (ICU) setting [1-4]. The mortality attributable to VAP has been shown to exceed 10% [5].

Furthermore, VAPs have long been considered among the commonest type of HAI, resulting in a substantial increase in hospital costs and length of stay (LOS) [2,5]. Patients with VAP require prolonged periods of mechanical ventilation, excess use of antimicrobial medications, and increased direct medical costs [5].

Ventilator-associated pneumonia occurs when there is bacterial invasion of the pulmonary parenchyma in a patient receiving mechanical ventilation. Risk factors for VAP include prolonged intubation, enteral feeding, witnessed aspiration, paralytic agents, underlying illness, and extremes of age [6]. In early studies, it was reported that between 10% and 20% of patients undergoing ventilation developed VAP [7]. More recently, publications report rates of VAP that range from 1 to 4 cases per 1000 ventilator-days in industrialized countries [8] and around 13 cases per 1000 ventilator-days in the developing world, as reported by the International Nosocomial Infection Control Consortium (INICC) [9].

Surveillance has proven an effective tool for the reduction of DA-HAI in the developed world, and leading US agencies and professional societies have endorsed the recommendations of the Institute of Healthcare Improvement that a ventilator bundle be implemented at every ICU to reduce the incidence of VAP to zero [10]. However, in limited-resource countries, the importance of measuring the ICU patient infection risks, outcomes, and processes remains underrecognized many times [2,11], and very few analyses have been performed to show the impact of interventions on the VAP rate, which would serve as guidance for tackling this problem [2]. Likewise, study heterogeneity in developing countries may hinder the underlying causes of excessive variation in the reported rates [2,4].

As a countervailing strategy, in 2002, the INICC developed an outcome and process surveillance program specifically designed for ICUs in developing countries [12]. Through the implementation of the INICC program, it was demonstrated that there was a notable difference in the DA-HAI rates between the ICUs of hospitals from the industrialized world and those from limited-resource health care settings, with rates ranging from 3 to 5 times higher [3,4,13,14].

Within the context of developing countries, outcome and process surveillance, integrated in an intervention bundle with performance feedback of infection control practices, has been shown to successfully reduce and control DA-HAIs in different studies conducted in INICC member hospitals [15]. The multidimensional infection control approach for VAP reduction implemented in this study was based on the guidelines published by the Society for Health Care and Epidemiology of America and the Infectious Diseases Society of America, which describe evidence-based interventions and recommendations for VAP prevention in the ICU [6]. Their core recommendations are designed to interrupt the 3 most common mechanisms by which VAP develops: aspiration of secretions, colonization of the aerodigestive tract, and use of contaminated equipment. Our approach included those interventions that are associated with the reduction of the aspiration of secretions, such as maintaining patients in a semirecumbent position (30°-45° elevation of the head of the bed) unless there are contraindications and the reduction of the colonization of aerodigestive tract, such as oral care with chlorhexidine and hand-hygiene procedures.

This study analyzed the impact of a multidimensional approach on VAP rates adopted in 3 ICUs of a university hospital in Shanghai, which included the following measures for VAP reduction: (1) bundle of infection control interventions, (2) education, (3) outcome surveillance, (4) process surveillance, (5) feedback of VAP rates, and (6) performance feedback of infection control practices.

2. Methods

2.1. Setting and study design

The study was performed in 3 ICUs (surgical ICU, cardiothoracic ICU, and medical ICU) of Zhongshan Hospital, a university hospital located in Shanghai, China. It was divided into 2 phases: phase 1 (baseline period, consisting in the first 12 months of participation in the INICC program, from January to December 2005), and phase 2 (intervention period, from January 2006 to July 2009). During phase 1, we performed active, prospective DAI surveillance, and during phase 2, we implemented a multidimensional approach.

The hospital participates actively in the INICC surveillance program with an infection control team that comprised a medical and infection control professionals and has a microbiology laboratory where pathogens isolated from