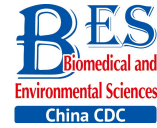


## Letter to the Editor



## Nosocomial Infection Surveillance in a Tuberculosis Specialized Hospital in China

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**Nosocomial infections (NIs) are a critical issue affecting the quality of healthcare. In this study, we performed a retrospective study to explore the incidence rates, mortality rates, and microbial spectrum of NIs in Beijing Chest Hospital, a tuberculosis (TB) specialized hospital in China. Our data demonstrate that the overall incidence rate of inpatients with NIs slightly decreased from 2012 to 2016, which may be associated with the implementation of hand hygiene measures, while the mortality rates associated with NI did not significantly change. In addition, the species distribution of NIs was quite different from that presented in previous reports, and *Klebsiella pneumoniae* was the most frequently isolated microorganism.**

Nosocomial infections (NIs) are a critical issue affecting the quality of healthcare, which is associated with the emergence of adverse healthcare outcomes<sup>[1-2]</sup>. It has been estimated that more than 5% of in-patients have an NI in developed countries, while the situations are more serious in developing countries, despite limited data<sup>[3]</sup>. Due to these infections under medical care, inpatients suffer not only from extended hospitalization with the use of antibiotics, but also from elevated morbidity and mortality rates<sup>[4]</sup>. Over the past few years, the emergence of multidrug-resistant bacteria (MDRB) has aggravated the difficulties faced by clinicians, which diminishes available treatment options for these patients<sup>[5]</sup>.

Antibiotic use in hospitals has been considered as a risk factor contributing to the increasing prevalence of NIs, especially the infections due to drug-resistant organisms<sup>[4]</sup>. Due to the intrinsic resistance of the infectious agent *Mycobacterium tuberculosis* (MTB), tuberculosis patients must be treated with multiple antibiotics for 6-12 months<sup>[6]</sup>. As a consequence, their exposure to high-dose and long-term antibiotics increases the risk of NIs in

tuberculosis (TB) specialized hospitals<sup>[3]</sup>. Unfortunately, there are limited data regarding the incidence and causative organisms of NIs from TB specialized hospitals in settings with high TB burdens. The objective of this study was to determine the incidence rates, mortality rates, and microbial spectrum of NIs in Beijing Chest Hospital, a TB specialized hospital in China.

Beijing Chest Hospital is a public tertiary hospital with 612 beds, and there are two major units regarding thorax diseases, including tuberculosis and thoracic tumors. Each year, more than 9,000 inpatients seek healthcare in this hospital. We conducted a 5-year retrospective descriptive study of NIs from January 2012 to December 2016. Data were collected from daily reports of infection control surveillance systems in our hospital through reviews of the medical records, infection control committee records, and laboratory records. The definition of NI followed the criteria endorsed by the Chinese Centers for Disease Control and Prevention. Samples (blood, urine, cerebrospinal fluid, endotracheal tuber aspirates, etc.) were collected and processed using standard microbiological methods described previously<sup>[2]</sup>.

Categorical variables were compared using the Chi-square test or Fisher's exact test. In addition, the Chi-square test for trends was used to test for trends of NIs over the years. Statistical analysis was performed with SPSS version 14.0 (SPSS Inc., Chicago, IL, USA). The difference was considered statistically significant if the *P* value was lower than 0.05.

The total number of inpatients treated in Beijing Chest Hospital increased from 2012 to 2016, while the overall incidence rate of patients with NI decreased from 1.9% (176/9,068) in 2012 to 1.2% (123/11,443) in 2016. Statistical analysis revealed that the NI incidence rate in 2012 was significantly higher than those in other years (*P* < 0.01). The difference in the incidence rate of NI between 2013

(1.3%, 137/10,950) and 2014 (0.9%, 102/11,360) was statistically significant ( $P = 0.01$ ), whereas there were no significant differences among other years ( $P > 0.05$ ). Despite slight decreases in the NI incidence rate, the mortality rate associated with NI was not significantly different, ranging from 14.6% to 17.8%. No statistical difference was identified in the NI mortality rate between different years ( $P > 0.05$ ) (Table 1).

In total, 774 episodes of NIs were identified in 667 patients. Table 2 shows the most frequent microorganisms isolated in patients with NI from 2012 to 2016. The infecting microorganisms were as follows: *Klebsiella pneumoniae* ( $n = 134$ , 17.3%), *Pseudomonas aeruginosa* ( $n = 100$ , 12.9%), *Enterobacter cloacae* ( $n = 76$ , 9.8%), *Acinetobacter baumannii* ( $n = 120$ , 15.5%), *Escherichia coli* ( $n = 53$ , 6.8%), *Staphylococcus aureus* ( $n = 39$ , 5.0%), *Staphylococcus epidermidis* ( $n = 35$ , 4.5%), and others ( $n = 217$ , 28.0%). Further analysis showed that the prevalence rate of *Klebsiella pneumoniae* significantly increased from 14.2% in 2012 to 24.0% in 2016 (Chi-square trend 7.11,  $P = 0.01$ ), while this trend was not significantly different

in the rates of other NI microorganisms, respectively ( $P > 0.05$ ).

NI is a significant predictor of mortality in inpatients. In this study, we firstly explored the incidence of NI in patients in a TB-specialized hospital in China. On the basis of our data, the overall NI incidence rate was 1.2%, which is much lower than stated in previous reports from intensive care units, ranging from 5% in Europe to 40% in Sub-Saharan Africa and Latin America<sup>[2,7]</sup>. In addition, a significantly decreased occurrence of NI has been observed in this study. Since 2013, hand hygiene measures were implemented in Beijing Chest Hospital, which may be associated with the decreased trend of NI in this hospital. Consistent with our observations, a recent meta-analysis has revealed that the implementation of hand hygiene measures contribute to a 47% decrease in the *Enterococci* infection, while single-room isolation, contact precautions, and other measures are not as effective as hand hygiene measures<sup>[8]</sup>. Considering their promising cost-effectiveness, hand hygiene measures should be preferred in clinical practice for preventing NIs during hospitalization.

**Table 1.** Nosocomial Infection and Infection-related Mortality in Beijing Chest Hospital from 2012-2016

Year	No. of Inpatients	No. of NIs: (%)	No. of Deaths Associated with NI*	NI Mortality (%)
2012	9,068	176 (1.9)	26	14.8
2013	10,950	137 (1.3)	24	17.5
2014	11,360	102 (0.9)	16	15.7
2015	11,595	129 (1.1)	23	17.8
2016	11,443	123 (1.1)	18	14.6
Total	54,416	667 (1.2)	107	16.0

**Note.** \* NI, nosocomial infection.

**Table 2.** Most Frequent Microorganisms Isolated in Patients with Nosocomial Infection from 2012 to 2016

Year	No. of Isolates (%)								
	Total	<i>Klebsiella pneumoniae</i>	<i>Pseudomonas aeruginosa</i>	<i>Enterobacter cloacae</i>	<i>Acinetobacter baumannii</i>	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>	<i>Staphylococcus epidermidis</i>	Others
2012	232 (100.0)	33 (14.2)	30 (12.9)	22 (9.5)	41 (17.7)	18 (7.8)	9 (3.9)	9 (3.9)	70 (30.1)
2013	158 (100.0)	22 (13.9)	20 (12.7)	17 (10.8)	24 (15.2)	10 (6.3)	8 (5.1)	8 (5.1)	49 (31.0)
2014	131 (100.0)	22 (16.8)	22 (16.8)	16 (12.2)	21 (16.0)	9 (6.9)	8 (6.1)	6 (4.6)	27 (20.6)
2015	149 (100.0)	32 (21.5)	18 (12.1)	12 (8.0)	20 (13.4)	9 (6.0)	8 (5.4)	8 (5.4)	42 (28.2)
2016	104 (100.0)	25 (24.0)	10 (9.6)	9 (8.6)	14 (13.5)	7 (6.7)	6 (5.8)	4 (3.8)	29 (27.9)
Total	774 (100.0)	134 (17.3)	100 (12.9)	76 (9.8)	120 (15.5)	53 (6.8)	39 (5.0)	35 (4.5)	217 (28.0)

Another interesting finding observed in this study was that the mortality rate associated with NI was not significantly different despite being slight decreases in the NI incidence rate. Numerous reports have revealed that infections with drug-resistant pathogens are difficult to treat and are contributing to higher mortality and costs<sup>[9]</sup>. In China, the abuse of antibiotics has become a major clinical and public health concern<sup>[10]</sup>. There is no doubt that the abuse of antibiotics is the main cause of drug resistance, and increasing rates of drug resistance have been noted in several clinical pathogenic microorganisms, reflecting the consequences of the abuse of antibiotics<sup>[10-11]</sup>. Despite implementing new antibiotics with high efficacy, the potential increasing drug resistance may be associated with unchanged treatment outcomes of patients with NI. Hence, a detailed analysis on the drug resistant profiles of bacteria causing NIs would extend our knowledge in this field. Unfortunately, *in vitro* drug susceptibility testing data of bacteria causing NIs were not available in our hospital before 2015, which is an obvious limitation of this study. Further analysis will be carried out to investigate the prevalence of drug-resistant bacteria, especially multidrug-resistant bacteria, among the NIs, which will provide new evidence for our hypothesis.

We found that *K. pneumoniae* was the most frequently isolated microorganism, which is consistent with the data from Egypt<sup>[2]</sup>. In contrast, the predominant causes of NI reported from Western countries were Gram-positive bacteria, including staphylococci and enterococci<sup>[12-13]</sup>. In the United States, *Enterococci* accounted for 20%-30% of NIs<sup>[13]</sup>. Similarly, *Staphylococci* were the leading causes of NIs in Australia (70%)<sup>[12]</sup>. The significant difference in the species distribution from our study compared with others may be associated with the intrinsic character of Beijing Chest Hospital. As a TB specialized hospital, a high proportion of inpatients are patients with TB, a kind of respiratory infectious disease. *K. pneumoniae* is always a cause of pneumonia, cystic fibrosis, and bacteremia, and the transmission of *K. pneumoniae* is majorly through person-to-person contact and respiratory machines. Hence, the potential high exposure of *K. pneumoniae* in the TB hospital may contribute to its high prevalence in this study.

In conclusion, our data demonstrate that the overall rate of inpatients with NI slightly decreased from 2012 to 2016, which may be associated with the implementation of hand hygiene measures,

while the mortality associated with NI was not significantly different. In addition, the species distribution of NIs is quite different from that in previous reports, and *K. pneumoniae* is the most frequently isolated microorganism in the present study. Further analysis will be carried out to investigate the prevalence of drug-resistant bacteria, especially multidrug-resistant bacteria, among the NIs.

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