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ORIGINAL ARTICLE

Incidence Rates of Healthcare-associated Infections in Hospitals: A Multicenter, Pooled Patient Data Analysis in India

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ABSTRACT

Aim: The aim of this study was to collect the multicenter data of healthcare-associated infections (HAIs) to assess the infection control scenario in India in context with CDC/NHSN and INICC database.

Materials and methods: Four National Accreditation Board for Hospitals and Health Care Providers (NABH) accredited hospitals were selected on random basis and raw data on healthcare-associated infections—number of days and number of infections in all intensive care patients was obtained as per the CDC-NHSN definitions and formula. Three major device related infections were considered for analysis based on the prevalence of HAIs and discussions with subject matter experts. All nodal champions from each hospital were trained and common data collection sheet for surveillance in accordance to CDC-NHSN was formed. The pooled means for HAI rates and average of the pooled means for all were calculated using data from four hospitals and were compared with CDC/NHSN and international nosocomial infection control consortium (INICC) percentiles of HAIs rates.

Results: The Indian pooled mean HAI rates for all infections were above CDC/NHSN percentile threshold but below INICC percentile. Ventilator-associated pneumonia (VAP) was considered as matter of prime concern, crossing P90 line of CDC/NHSN threshold. However, no HAI rate was in limit of P25.

Conclusion: Indian HAI rates were higher when mapped with CDC threshold. This promotes the need for more standardized and evidence-based protocols been adhered to so as to bring HAI within CDC/NHSN thresholds. However, the four hospitals have better HAI rates as compared to pooled INICC database.

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INTRODUCTION

Healthcare-associated infections (HAIs) are recognized as a major burden for patients, society and healthcare management. In 2008, European Center for Disease Prevention and Control (ECDC) estimated that more than 4 million people acquire a HAIs each year in European Union (EU) of which approximately 37,000 die as the direct consequence of the infection.[1] In the USA alone, the incidence of HAIs has been estimated to be approximately 2 million cases annually with approx 99,000 HAI attributable deaths, making it as fifth leading cause of death in acute care hospitals.[2] The prevalence of HAI in developing countries can become as high as 30 to 50%.[3] In developing countries, in spite of effectiveness of these infection control practices, studies have shown a very low compliance by healthcare professionals.[4]

There is an updated report of data on device associated HAIs within intensive care units (ICUs) collected by hospitals participating in the International Nosocomial Infection Control Consortium (INICC).[5,6] In US, Centre for Disease Control and Prevention (CDC) runs a multicentric, HAI control program with a surveillance system which is known as US National Healthcare Safety Network (NHSN)[7] formerly the National Nosocomial Infection Surveillance system (NNIS).[8]

Quality and patient safety are integral components for the effective healthcare delivery system. Healthcare-associated infections are a major issue jeopardizing patient safety with substantial impact on morbidity, mortality and use of additional resources. At hospitals with low- and middle-income countries (LMICs), it is important to understand the primary needs and obstacles for prevention and control of HAIs. The main issues in resource limited settings are lack of specific priorities, absence of data, healthcare safety both for the cared and the care-giver are low on priority and failure to implement the standardized practices. Collecting, collating and analysis of surveillance data in accordance to NHSN format and comparing them with benchmarked INICC or NHSN data will help us comprehend the gaps, thereby strategizing and operationalizing good prevention infection prevention and control (IPC) practices.

In this study, our aim was to prospectively analyze the patient data on HAI from four participating hospitals and comparing it with CDC/NHSN and INICC data. This helps to assess the Indian HAI scenario and explore need for evidence based HAI control policy at institutional and national level.

MATERIALS AND METHODS

Institutional Permission and Study Settings

This study was conducted with permission from institutional review board. As no direct patient data were utilized in the study, ethical clearance was waived.

Confidentiality Considerations

Being data of national importance, the participant institutions had requested to maintain anonymity for their names. Thus, in this study, the institutes were coded as 'Institute A', 'Institute B', 'Institute C' and so on throughout the project.

Study Design

This was prospective, multicenter, observational analytical study. Our primary objectives included calculation of proportion rates for HAIs (device related) from January 2010 to December 2012 and conduct comparative analysis of HAIs with CDC-NHSN[7,8] and INICC[5,6] HAI database.

Sampling Method and Data Collection

On preliminary approval of study synopsis, random selection of accredited hospitals was done. Nodal Officers from each healthcare organization were called and trained in accordance with CDC-NHSN definitions and formula (numerator and denominator). The nodal officers in turn went back and trained their IC team on surveillance methodology. Each participating hospital submitted their Intensive Care Device associated healthcare-associated infections (DA-HAI) data. Three device related HAIs *viz* Ventilator-associated pneumonia (VAP),[9] Central line-associated blood stream infections (CLABSIs)[10] and catheter-associated urinary tract infections (CAUTIs)[11] were agreed upon, their data were collected and analyzed. It is to be noted that prior to information retrieval, Non-disclosure agreement (NDA) was signed so as to maintain confidentiality. Before analysis, the hospital names were coded as 'A', 'B', 'C' and 'D'.

DATA ANALYSIS

Calculation of Pooled Means

Calculation of pooled means for each of three types of HAI rates—VAP, CLABSI and CAUTI was performed using the following formulas as mentioned in NABH 3rd edition.

Percentile Calculation

To explore the threshold value for HAIs to understand and improve hospital infection control measures' quality, 25, 50, 75 and 90% percentile ranges were calculated for all three types of device related infections based on the hospital infections data using 'percentile' built-in function in MS-EXCEL software.

COMPARATIVE ANALYSIS IN CONTEXT WITH CDC/NHSN AND INICC THRESHOLD

Tabular Method

Similar table was prepared to that reflected in CDC/NHSN guidelines to investigate and understand the difference between pooled means and percentiles of Indian HAI rates and CDC/NHSN and INICC based HAI rates.

Graphical Method

Hospital-wise pooled means of HAI rates were plotted against CDC/NHSN and INICC thresholds based on percentiles for each type of HAI to investigate whether infection control rates in study hospitals are within CDC/NHSN and INICC recommended limits. For ease of interpretation, hospital-wise means were further averaged and plotted together.

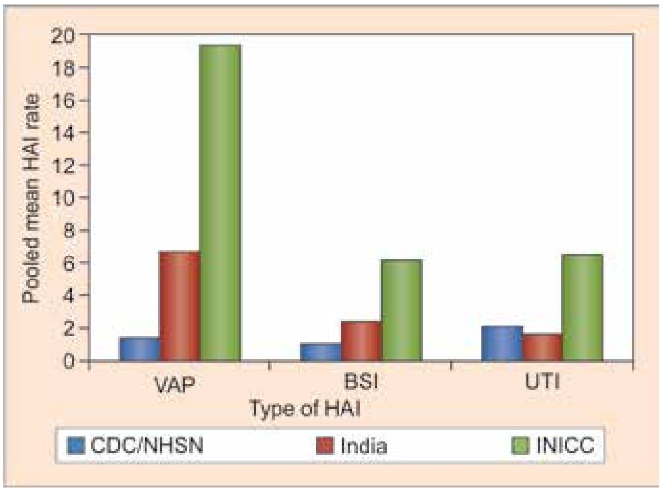
RESULTS

Four NABH-accredited hospitals pooled device associated HAIs data from their ICU measured 57807 ventilator days, 155614 central line days and 376585 urinary catheter days for the period of 2 years (Table 1). Pooled mean HAI rates emerged highest with VAP as 6.74/1000 ventilator days, next was 2.42/1000 central line days followed by 1.63/1000 urinary catheter days (Table 1 and Graph 1).

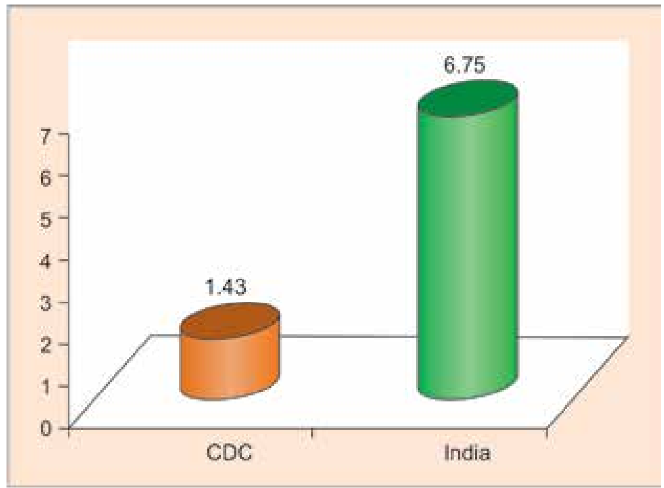
Pooled Indian ICUs data reveal VAP rate at 6.74/1000 ventilator days, which as compared to CDC-NHSN is 1.43 and INICC is 19.5. Pooled Indian CLABSI is at 2.40/1000 central line days which as compared to CDC-NHSN is at 1.02 and INICC is at 6.12, whereas pooled Indian CAUTI

Table 1: Pooled means of device-associated infections (pooled data from all four hospitals)

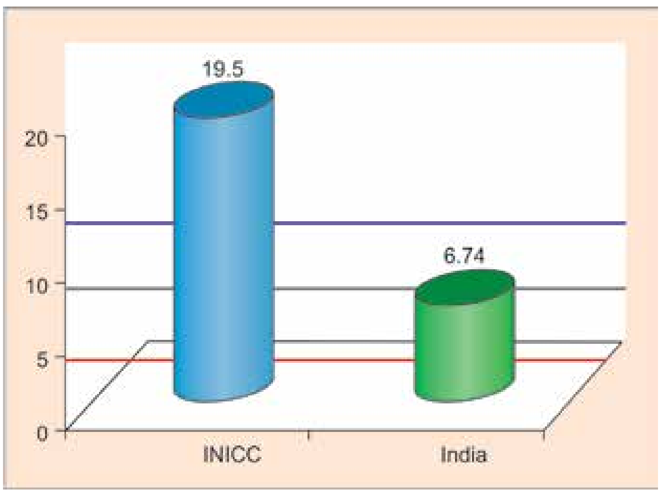
Type of infection	*Number of infections (N_I)*	*Number of infection days (N_{ID})*	*Pooled mean HAI rate [$R = (N_I / N_{ID}) \times 1000$]*
Ventilator-associated pneumonia (VAP)	390	57807	6.74
Central line-associated bloodstream infections (CLABSI)	378	155614	2.40
Catheter-associated urinary tract infections (CAUTI)	615	376585	1.63



Graph 1: Comparison of pooled means of HAI rates for India, CDC/NHSN and INICC

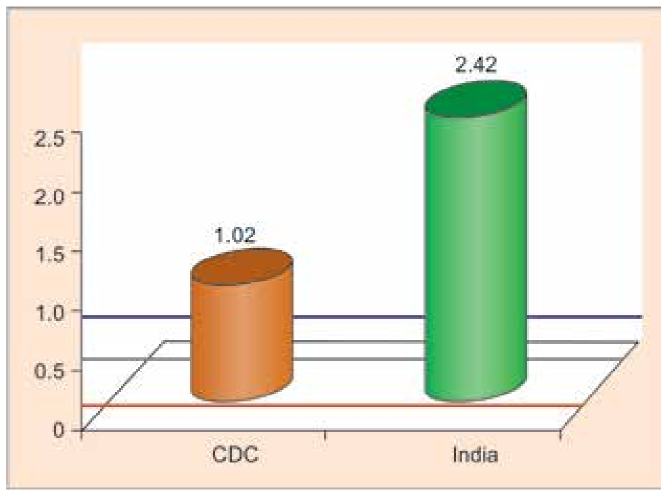


Graph 2: Mapping of pooled VAP incidence rates of study hospitals with CDC/NHSN thresholds



Percentile (VAP)	*CDC*	*INICC*
25%	0.36	4.88
50%	0.71	9.75
75%	1.07	14.62

Graph 3: Mapping of pooled VAP incidence rates of study hospitals with INICC thresholds



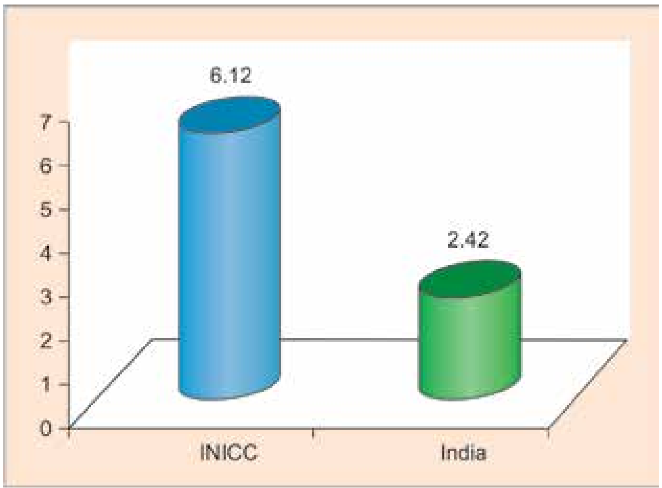
Graph 4: Mapping of pooled CLABSI incidence rates of study hospitals with CDC/NHSN thresholds

data is significantly better than the benchmark figure of CDC-NHSN at 2.09 and INICC at 6.5 (Graph 1).

Ventilator-associated pneumonia rate appears to be close to P75 (75th percentile) for CDC-NHSN data and close to P50 (50th percentile) for INICC (Graphs 2 and 3). Central line associated blood stream infections rates at 2.40 appears to be close to P90 (90th percentile) for CDC-NHSN and P25 (25th percentile) for INICC database (Graphs 4 and 5). Pooled Indian CAUTI rates at 1.63 appears to be close to between P50 and P25 (25th percentile) for CDC-NHSN and P75 (75th percentile) for INICC database (Graphs 6 and 7).

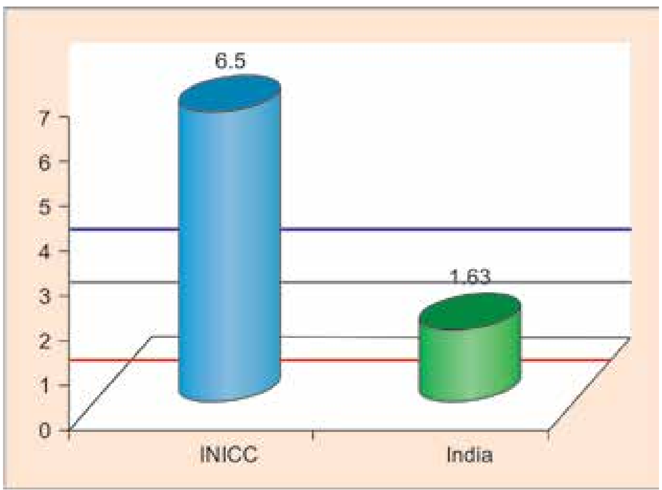
DISCUSSION

Centre for disease control/NHSN[8] HAI rates are considered to be a bench mark in hospital infection control. Evidence of which is utilized in developing HAI prevention policies for effective implementation across the world. Therefore, this was considered as baseline for comparative analysis in the study. International nosocomial infection control consortium[5] data for HAI rates were also used for comparison, as the data represents the developing countries across the world, and helps in determining the current status of HAI in



Percentile (BSI)	*CDC*	*INICC*
25%	0.25	1.53
50%	0.51	3.06
75%	0.76	4.59

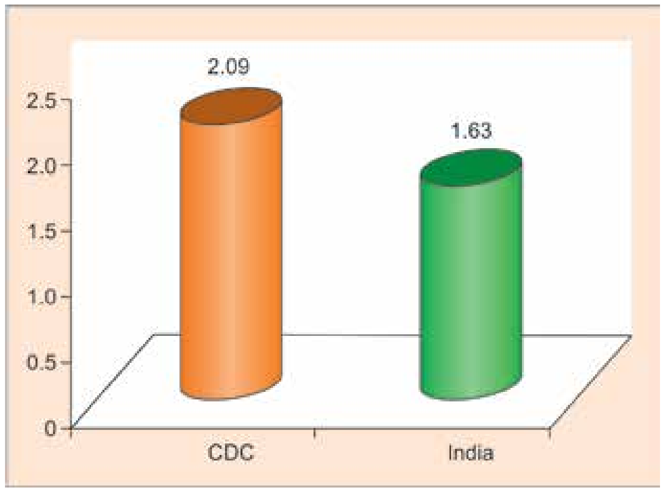
Graph 5: Mapping of pooled CLABSI incidence rates of study hospitals with INICC thresholds



Percentile (UTI)	*CDC*	*INICC*
25%	0.52	1.62
50%	1.04	3.25
75%	1.57	4.65

Graph 7: Mapping of pooled CAUTI incidence rates of study hospitals with INICC thresholds

India in relation to other developing nations. In current era of evidence-based guidelines, it is also necessary to incorporate real world evidence to explore solutions which are implementable in the Indian context of healthcare. Primary data were collected using vetted data extraction proforma from the hospitals which were NABH accredited. There is no standard guidelines/ policy on HAI prevention and control available in India. Although it is fact that INICC guidelines are evidence-based and could be utilized by developing countries for better care delivery, the contextualized implementation remains the biggest challenge.



Graph 6: Mapping of pooled CAUTI incidence rates of study hospitals with CDC/NHSN thresholds

As evident from the study findings, pooled incidence rates for VAP in India are beyond 90th percentile (P90) threshold as compared to CDC/NHSN VAP rates and were clearly identified as matter of prime concern. The lower threshold limit for CAUTI was because of lower rates compared to CLABSI and VAP. Nevertheless, holistically, there is an urgent need for evidence based HAI control policy similar to CDC/NHSN and strategies to effectively implement them. However, when the threshold values were replaced with INICC thresholds values, study hospitals showed remarkably better performance with pooled means of HAI rates lying below threshold lines of 25th percentile (P25). Surprisingly, VAP control was significantly evident in our study findings in context with INICC[6] thresholds with even 25th percentile limit (P25) unlike the CDC threshold with pooled rate crossing set limit. There could be an assumption that demography and prevalent hospital care delivery system in developed countries are different than those of developing countries, which results in better infection control policies and implementation measures in US as compared to the developing countries. Therefore, it is recommended to cautiously interpret the evidence, especially when mapping national quality indicators with established threshold of developed nations likewise in the present study, before any priority-setting and policy decisions.

The main limitation of our study was small number of study hospitals, though adequate regional representation across the country was fulfilled with hospital selection. Therefore, the average data could not be considered robust enough for informed decision-making. The causative factors tend to change according to regions in the country. As our study sites does not represent a comprehensive data taking into account of all the variability, this could be foreseen as a future scope of such projects with larger sample size and more realistic population representation. The data represented in CDC/NHSN guidelines is categorized by speciality care area and their infection rates.

Being an exploratory research design, the Indian percentile values at this point of time cannot be considered as national threshold, for formulating guidelines of HAI prevention and control policies. However, the findings of this study does prove that existence of evidence-based guidelines results in better infection control. Thus, they could be essentially utilized to effectively inform the decision makers for structuring a stronger environment for HAI control in India. The study can be considered as a pilot project for designing larger epidemiologic studies including more quality indicators, and participation of wider range of healthcare setups from across the country. This will not only be more representative but also help in enhancing regional HAI trends leading to development of stronger and up-to-date database, which in turn would become a guide to formulate public health policies for effective prevention and containment of HAIs and rising antimicrobial resistance.

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