Knowledge of infection control practices among intensive care nurses in a tertiary care hospital

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Received 17 September 2012; received in revised form 9 January 2013; accepted 11 February 2013

KEYWORDS
Infection control; Hand hygiene; Standard and transmission-based precautions; Care bundles

Summary
Background: The threat of hospital-acquired infections persists despite advances in the health care system. A lack of knowledge regarding infection control practices among health care workers decreases compliance with these practices. We conducted a study to assess the knowledge of infection control practices among nursing professionals at our hospital.
Methods: In total, 100 nurses in the intensive care units at our hospital were given a questionnaire with 40 multiple choice questions, including 10 questions each regarding hand hygiene, standard and transmission-based precautions, care bundles and general infection control practices. The responses were scored as percentages.
Results: The overall knowledge and awareness regarding different infection control practices were excellent (>90% positive responses) in 5% of the nursing professionals, good (80–90% positive responses) in 37%, average (70–80% positive responses) in 40% and below average (<70% positive responses) in 18%.
Conclusion: The infection control knowledge among the nurses was fairly good; however, there is still a wide scope of improvement with regular educational programs and in-house training.

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Introduction

Even with advances in the health care system, the threat of hospital-acquired infections (HAIs) remains. The Centers for Disease Control and Prevention (CDC) reported that an estimated 1.7 million infections occur annually in hospitals in the United States (US), with 99,000 associated deaths [1]. The Study on the Efficacy of Nosocomial Infection Control (SENIC) estimated that the cost of HAIs was $4.5 billion in 1992, and after adjusting for inflation, this cost increased to approximately $6.65 billion in 2007 [2]. Infection prevention and control efforts have historically focused on monitoring and preventing HAIs locally; however, HAI prevention has recently become a global priority, which has resulted in an evolution of infection prevention and control [2]. Infection control policies have been established, but HAIs still cannot be prevented because of a lack of control over the implementation of such policies [3]. More than a century and a half ago, Semmelweis demonstrated that hand washing was sufficient to reduce the incidence of nosocomial infections; however, the compliance of health care workers (HCWs) with recommended hand washing practices remains low [4—7]. A major contributing factor to poor compliance is lack of awareness [4,8]. Strategies have been adopted at various institutional levels; however, compliance failure is a root cause for the increased incidence of nosocomial infections [4,9].

Aims and objectives

The aim of this study was to examine the knowledge of nursing professionals regarding infection control practices in clinical settings.

Study design

Hospital setting

The study was conducted at a 350-bed Joint Commission International (JCI)-accredited tertiary care hospital in India with established infection control policies and practices. The hospital has an infection control officer and infection control nurses (ICNs) who are actively involved in infection control training and surveillance. The nursing staff are instructed on hospital infection control policies during their induction into the hospital and regularly thereafter. The hospital has extensive infection control awareness programs, including an infection control manual for all the wards, a hospital-wide hand hygiene campaign, regular surveillance of hand hygiene by ICNs, a monthly best hand washing compliance trophy, infection control trainer programs, and the celebration of infection control month with activities to increase awareness among hospital employees, such as a quiz, poster-making and T-shirt painting competitions.

Material and methods

The subjects in the study were nursing staff from various intensive care units at the hospital. In total, 100 nurses were enrolled in the study. The nurses were divided into three categories based on their nursing experience: junior nurses (0—5 years), nurses-in-charge (5—8 years) and nursing supervisors (>8 years).

A questionnaire with 40 multiple choice questions, including 10 questions each regarding hand hygiene, standard and transmission-based precautions, care bundles and general infection control practices, was designed. Ethical clearance was obtained from the hospital ethics committee. The questionnaire was given to each of the study subjects. The responses were analyzed, and the scores were tabulated as percentages.

Results

In total, 100 staff nurses completed the questionnaire. The distribution of staff according to years of experience was 82 nurses with 0—5 years of experience (junior nurses), 13 nurses-in-charge with 5—8 years of experience and 5 senior nursing supervisors with more than 8 years of experience.

The departmental distribution of the nurses is shown in Table 1. Overall, 45 nurses were from medical intensive care units, 28 nurses were from a step-down ICU and a high-dependency unit (HDU), 10 nurses were from a coronary care unit, 8 nurses were from cardiac surgery recovery, and 9 nurses were from surgical recovery.

Table 2 shows the overall awareness of infection control practices among the nursing professionals according to their years of experience, which was interpreted as excellent when the positive responses to the questionnaire were >90%, good with 80—90% positive responses, average with 70—80% positive responses and below average with <70% positive responses. The overall awareness was good in 37% of the nurses, average in 40% and below average in 18%. Only 5% of the nurses had excellent knowledge. More experienced nurses had good
knowledge of various infection control practices, whereas nurses with less experience had average knowledge. Overall, 60% of nurses with >8 years of experience had good knowledge of infection control practices, and 40% had average overall knowledge. Of the nurses-in-charge with 5–8 years of experience, 69% had good knowledge, and 31% had average knowledge. Junior nurses with <5 years of experience had variable levels of knowledge of infection control practices: 6% had excellent knowledge, 30.5% had good knowledge, 41.5% had average knowledge, and 22% had below-average knowledge.

Table 3 shows the awareness of the nursing staff regarding different infection control practices, including hand hygiene, standard and transmission-based precautions, care bundles and general infection control practices. The responses to the hand hygiene-related questions were adequate: 23% of the nurses had excellent knowledge, 32% had good knowledge, 34% had average knowledge, and only 11% had below-average knowledge. For questions related to standard and transmission-based precautions, 9% of the staff nurses had excellent knowledge, 22% had good knowledge, 47% had average knowledge, and 22% had below-average knowledge. The responses to care bundle questions indicated that 8% of the nurses had excellent knowledge, 18% had good knowledge, 43% had average knowledge, and 31% had below-average knowledge. Regarding general infection control practices, only 2% of the nurses had excellent knowledge, 24% had good knowledge, 63% had average knowledge, and 11% had below-average knowledge.

The nurses had good knowledge regarding hand hygiene: 55% of the nurses provided good or excellent responses (>80% positive responses). For other infection control practices, such as standard and transmission-based precautions, care bundles and general infection control practices, most of the nurses had average knowledge (>70% positive responses).

Discussion

In the present study, more than 40% of the HCWs correctly answered over 80% of the questions concerning important aspects of infection control. Knowledge of hand hygiene was adequate, but a significant deficiency in the knowledge of other infection control practices was observed, as approximately 70% of the nurses provided average or below-average responses. This finding is important because it contradicts the effectiveness of extensive in-house infection control programs and training.

Studies have reported varying levels of knowledge regarding infection control in HCWs, and the proportion of HCWs who were aware of these practices ranged from 16—75%. A study of HCWs in Nepal reported that 16% of HCWs had knowledge of infection control [10]. A study in Jordan reported that 49.6% of HCWs had knowledge of infection control, whereas a study in India by Taneja et al. reported that 75.5% of staff nurses at a tertiary care hospital had knowledge of infection control [11,12]. Most previous studies recommended training to improve the infection control knowledge of HCWs.

<table>
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<th>Table 1 Area wise distribution of the nurses.</th>
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<tr>
<td>Staff →</td>
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<tr>
<td>Area ↓</td>
</tr>
<tr>
<td>Medical intensive care units</td>
</tr>
<tr>
<td>Coronary care unit</td>
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<tr>
<td>Cardiac recovery</td>
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<tr>
<td>Surgical recovery</td>
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<tr>
<td>Step-down ICU and HDU</td>
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<td>Total (n)</td>
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<th>Table 2 Overall awareness of infection control practices according to experience.</th>
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<tbody>
<tr>
<td>Staff</td>
</tr>
<tr>
<td>Nursing supervisors</td>
</tr>
<tr>
<td>Nurses-in-charge</td>
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<tr>
<td>Junior Nurses</td>
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<tr>
<td>Total</td>
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In addition, a study by Angelillo et al. demonstrated that continuing education courses on hospital infections positively impacted infection control procedures and compliance with barrier techniques [13].

Infection control involves hand hygiene, standard and transmission-based precautions and care bundles for urinary tract infections, central line infections and ventilator-associated pneumonia. Hand hygiene practices have been recommended by the CDC and the Association for Professionals in Infection Control and Epidemiology (APICE) [14,15]. The earliest guidelines encouraged the use of plain soap and promoted the use of waterless agents, but many other studies have demonstrated superior activity of alcohol-based products for reducing bacterial counts [14,16–18]. Despite the documented guidelines, the rates of hand hygiene practices by health care workers remain low. The rate of adherence is 40%, as determined from the average adherence rates reported in 34 studies from 1981 to 2000 [16]. Three methods are commonly used to evaluate HCW adherence to hand hygiene practices: direct observation of hand hygiene, self-reporting of adherence and indirect measures to assess hand hygiene product usage. Assessment of hand hygiene by self-reporting, usually by administering questionnaires to HCWs, is among the least costly methods. However, self-reporting can overestimate the prevalence of hand hygiene [16,19]. In our study, we found that 55% of the nurses had correctly answered 8 out of 10 questions on hand hygiene, and only 11% of the nurses answered more than 3 questions incorrectly. This finding might be an over-estimation of hand hygiene practices or may be attributed to the extensive hospital-wide campaign and the posters on hand hygiene that are on display at various locations in the hospital. Larson et al. found that the involvement of top-level management to improve the organizational culture regarding hand hygiene resulted in a significant response from the staff [20].

Strict adherence to universal precautions is paramount to the prevention of infectious diseases [21]. The World Health Organization (WHO) estimates that approximately 3 million HCWs are susceptible to occupational exposure to blood-borne viruses each year [22]. Studies have extensively reported suboptimal and non-uniform adherence to standard and transmission-based precautions by HCWs in both developed and developing countries [23,24]. Knight reported that only 58% of nurses in Australia used gloves when handling blood or blood collection equipment, whereas a study from North India found that 40% of HCWs recapped needles and only 32% wore eye protection when indicated [25,26]. In our study, approximately 70% of the nursing professionals had average or below-average knowledge of standard and transmission-based precautions. A survey of general medical practices by Sneddon indicated that only 57% of HCWs employed universal precautions [27].

Recent articles have suggested that care bundles are beneficial as part of a comprehensive infection control program in adults and in the pediatric population [28]. In their study of ICUs in the US, Furuyu et al. suggested that hospitals must improve care bundle implementation and compliance rather than only instituting policies [29]. Robb et al. analyzed eight care bundles of treatments that were known to be effective at reducing in-hospital mortality. Cumulative sum charts showed significant reductions in the standardized mortality ratios in the targeted year of the care bundle improvements compared with the previous year [30]. In our study, we found that 47% of the nurses had average knowledge of care bundles. However, 31% of the nurses had below-average knowledge, which emphasizes the need for vigorous training programs for different care bundles.

In our hospital setting, there is a tremendous focus on training. Therefore, we had high expectations from our nursing professionals and, as a result, our scoring system and the interpretation of the

<table>
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<tr>
<th>Different practices</th>
<th>Excellent (&gt;90% score)</th>
<th>Good (80–90% score)</th>
<th>Average (70–80% score)</th>
<th>Below average (&lt;70% score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand hygiene</td>
<td>23</td>
<td>32</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>Standard and transmission based precautions</td>
<td>9</td>
<td>22</td>
<td>47</td>
<td>22</td>
</tr>
<tr>
<td>Bundles of care</td>
<td>8</td>
<td>18</td>
<td>43</td>
<td>31</td>
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<tr>
<td>General infection control practices</td>
<td>2</td>
<td>24</td>
<td>63</td>
<td>11</td>
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scores as excellent, good, average or below average were strict. The below-average cut-off was <70%, i.e., nurses with more than 12 incorrect responses were considered to have poor knowledge.

In our study, the experienced nurses scored better than the nurses with less experience. Overall, 60% of nurses with >8 years of experience and up to 70% of nurses with 5–8 years of experience had good knowledge regarding infection control practices, whereas only 30% of nurses with <5 years of experience scored higher than 80% (a good response). None of the nursing supervisors or nurses-in-charge were classified into the below-average category. This finding is in agreement with the study by Suchitra, which demonstrated that increased experience in a hospital was significantly correlated with increased knowledge, improved attitudes and the implementation of infection control practices among various categories of staff [4]. However, none of our experienced staff (>8 years or 5–8 years) received excellent scores, which may have resulted from higher participation in administrative activities than bedside patient care. Only five nurses were categorized as having excellent knowledge, and all of these were junior nurses. In our experience, we have observed that such nurses later become an asset to the organization, as they learn quickly and should be instructed to become trainers.

Many guidelines are available for ensuring adequate infection control in various settings, and many professional journals provide recommendations [31–33]. However, more continuing education in this area is needed [34,35]. A lack of education and training decreases compliance with the fundamental aspects of infection control practices [36]. Other studies have found that the training of HCWs on infection control policies is inadequate; therefore, hospitals should review their policies on the provision of education and training regarding infection prevention and control procedures [4,13,37]. These reviews will help to ensure that all staff are targeted for induction training and that key staff who are in daily contact with patients are educated on the most recent infection prevention and control practices. Suchitra et al. recommended yearly educational modules for the retention of knowledge and translation of behavioral changes in HCWs into infection control practices [4].

Even with advances in the health care system, the threat of hospital-acquired infections remains. Not all HAIs can be prevented; however, evidence suggests that one-third to one-half of HAIs can be prevented [38]. Hospital administrators should strive to create an organizational atmosphere in which adherence to recommended infection control practices is considered to be an integral part of providing high-quality care. For this approach to be successful, hospitals must provide visible support and sufficient resources, such as continuous education programs [4,13,37]. These programs should be designed according to the specific needs of each category of HCW [4,13,39]. Effective strategies to prevent the transmission of organisms that cause HAIs should include the implementation of programs with policies and procedures that are designed to protect patients and HCWs from infection. These programs should be designed by a hospital-wide committee that includes an infection control team composed of a physician and infection control practitioners. This infection control team should be responsible for the implementation of infection control guidelines, policies and procedures by all healthcare personnel in the healthcare setting.

Limitations
A limitation of this study was that we did not supervise the practices of the nurses and relied solely on their subjective self-assessment in the questionnaires. Therefore, the responses may have been only knowledge-based and may not have accurately reflected the true attitudes and behaviors toward infection control practices. Therefore, the reported level of knowledge regarding these practices may not be accurate. These data may not be absolute; however, they offer insight into infection control practices that may encourage other hospitals to review their practices and training policies. Another limitation of the study was that our questionnaire was not validated for content or difficulty level analysis, which may have led to erroneous results.

Conclusion
This study was conducted on nursing professionals at a tertiary care hospital to assess their knowledge and perception regarding infection control practices. This study confirms findings from the literature that infection control knowledge among nurses is fairly good, but a wide range of improvements is needed. Regular educational programs on infection control, standard and transmission-based precautions and ward-based teaching programs on various care bundles must be included in in-house training. Such training includes the execution of educational and induction programs that are designed to overcome any shortcomings in
the knowledge, attitude and practice of infection control by HCWs. An institutional culture that focuses on infection control practices will reduce the incidence of HAlS.

Conflicts of interest

None.

Financial disclosures

No funding was received from any source.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jiph.2013.02.004.

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