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Review article

Disease burden of nosocomial infections and knowledge of nurses regarding the nosocomial infections: A Review

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Abstract

Nosocomial infection it can be explain as infection that is contracted from hospital mediated environment or staff of a healthcare facility. Further, it can be spread in the hospital environment, nursing home, rehabilitation facility, clinic, or other clinical settings. Hospital-acquired infection or nosocomial infections are those acquired during course of patient care hospitalization. It has been observed that healthcare personnel are major source of the infections. Hand hygiene is considered is a major cause of the infections. WHO have release guidelines on hand hygiene. There are evidences which support that if healthcare staff, most importantly nurses are given proper education, the infections are prevented. In this review, we will discuss burden of the infections in developed and developing countries and knowledge of nurses regarding the infection.

Keywords: Nosocomial infection, nursing, nursing home, knowledge of nurses.

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1. Introduction

Health care professionals are constantly exposed to microorganisms. Many of which can cause serious or even lethal infections [1]. Nurses in particular are often exposed to various infections during the course of carrying out their nursing activities [2]. Nosocomial infection (NI), or hospital-acquired infection or Health-care-associated infection (HCAI) refers to infection that is acquired during the process of care and not manifested at the time of admission to a hospital or other health-care facility [3,4].

HCAI is a major problem for patient well-being and its surveillance and prevention must be a first priority for settings and institutions committed to making health care safer globally. The impact of HCAI results in prolonged hospital stay, long-term disability, increased resistance to antimicrobials, high costs for patients and their families, and excess mortality. Although the risk of acquiring HCAI is universal and pervades every health-care facility and system around the world, the global burden is unknown because of the difficulty of gathering reliable diagnostic data. Overall estimates indicate that more than 1.4 million patients worldwide in developed and developing countries are affected at any time [5]. Although data on the burden of diseases worldwide that are published in WHO's World Health Reports inform HCWs, policy-makers, and the public of the most important diseases in terms of morbidity and mortality, HCAI does not appear on the list of the 136 diseases evaluated [6]. The most likely reason is that the diagnosis of HCAI is complex, relying on multiple criteria and not on a single laboratory test. In addition, although national

surveillance systems exist in many industrialized countries, [7] e.g. the National Nosocomial Infection Surveillance (NNIS) system in the United States of America (USA), they often use different diagnostic criteria and methods, which render international comparisons difficult due to benchmarking obstacles. In developing countries, such systems are seldom in place. Therefore, in many settings, from hospitals to ambulatory and long-term care, HCAI appears to be a hidden, cross-cutting concern that no institution or country can claim to have solved as yet.

Health care-associated infection in developed countries

In developed countries, HCAI concerns 5–15% of hospitalized patients and can affect 9–37% of those admitted to intensive care units (ICUs) [5,8]. Recent studies conducted in Europe reported hospital-wide prevalence rates of patients affected by HCAI ranging from 4.6% to 9.3% [9]. According to data provided by the Hospital in Europe Link for Infection Control through Surveillance (HELICS), approximately 5 million HCAIs are estimated to occur in acute care hospitals in Europe annually, representing around 25 million extra days of hospital stay and a corresponding economic burden of 13–24 billion Euro. In general, attributable mortality due to HCAI in Europe is estimated to be 1% (50 000 deaths per year), but HCAI contributes to death in at least 2.7% of cases (135 000 deaths per year). The estimated HCAI incidence rate in the USA was 4.5% in 2002, corresponding to 9.3 infections per 1000 patient-days and 1.7 million affected patients; approximately 99 000 deaths were attributed to HCAI 7[10] The annual economic impact of HCAI in the USA was approximately US$ 6.5 billion in 2004 [11].

In the USA, similar to the position in other industrialized countries, the most frequent type of infection hospital wide is urinary tract infection (UTI) (36%), followed by surgical site infection (SSI) (20%), bloodstream infection (BSI), and pneumonia (both 11%) [10]. It is noteworthy, however, that some infection types such as BSI and ventilator-associated pneumonia have a more severe impact than others in terms of mortality and extra-costs. For instance, the mortality rate directly attributable to BSIs in ICU patients has been estimated to be 16–40% and prolongation of the length of stay 7.5–25 days [12]. Furthermore, nosocomial BSI, estimated to account for 250 000 episodes every year in the USA, has shown a trend towards increasing frequency over the last decades, particularly in cases due to antibiotic-resistant organisms [13].

The HCAI burden is greatly increased in high-risk patients such as those admitted to ICUs. Prevalence rates of infection acquired in ICUs vary from 9.7–31.8% in Europe [14] and 9–37% in the USA, with crude mortality rates ranging from 12% to 80% [8]. In the USA, the national infection rate in ICUs was estimated to be 13 per 1000 patient-days in 2002 [10]. In ICU settings particularly, the use of various invasive devices (e.g. central venous catheter, mechanical ventilation or urinary catheter) is one of the most important risk factors for acquiring HCAI.

Burden of health care-associated infection in developing countries

While HCAI surveillance is already a challenging task in highly resourced settings, it may often appear an unrealistic goal in everyday care in developing countries. In addition to the usual difficulties to define the diagnosis of HCAI must be added the paucity and unreliability of laboratory data, lack of standardized information from medical records, and scarce access to radiological facilities. Limited data on HCAI from these settings are available from the literature. This is well demonstrated by an electronic search of the period 1995–2008, which allowed the retrieval of around 200 scientific papers published in English and approximately 100 in other languages [15] Overall, no more than 80 of these papers featured rigorous, high quality, methodological characteristics.

The magnitude of the problem is particularly relevant in settings where basic infection control measures are virtually nonexistent. This is the result of the combination of numerous unfavorable factors such as

understaffing, poor hygiene and sanitation, lack or shortage of basic equipment, and inadequate structures and overcrowding, almost all of which can be attributed to limited financial resources. In addition to these specific factors, an unfavorable social background and a population largely affected by malnutrition and other types of infection and/or diseases contribute to increase the risk of HCAI in developing countries [16]. Under these conditions, thousands of infections – in particular due to hepatitis B and C viruses and human immunodeficiency virus (HIV) transmission – are still acquired from patients, but also from HCWs through unsafe use of injections, medical devices and blood products, inadequate surgical procedures, and deficiencies in biomedical waste management [16].

When referring to endemic HCAI, many studies conducted in developing countries report hospitalwide rates higher than in developed countries. Nevertheless, it is important to note that most of these studies concern single hospitals and therefore may not be representative of the problem across the whole country [17]. Given the difficulties to comply with the USA Centers for Disease Control and Prevention (CDC) definitions of nosocomial infection, the most frequently surveyed type of infection is SSI, which is the easiest to define according to clinical criteria. The risk for patients to develop SSI in developing countries is significantly higher than in developed countries.

The burden of HCAI is also much more severe in high-risk populations such as adults housed in ICUs and neonates, with general infection rates, particularly device-associated infection rates, several-fold higher than in developed countries. In a systematic review of the literature, neonatal infections were reported to be 3–20 times higher among hospital-born babies in developing than in developed countries [18].

A very limited number of studies from developing countries assessed HCAI risk factors by multivariate analysis. The most frequently identified were prolonged length of stay, surgery, intravascular and urinary catheters, and sedative medication.

The magnitude and scope of the HCAI burden worldwide appears to be very important and greatly underestimated. Methods to assess the size and nature of the problem exist and can contribute to correct monitoring and to finding solutions. Nevertheless, these tools need to be simplified and adapted so as to be affordable in settings where resources and data sources are limited. Similarly, preventive measures have been identified and proven effective; they are often simple to implement, such as hand hygiene. However, based on an improved awareness of the problem, infection control must reach a higher position among the first priorities in national health programmes, especially in developing countries.

Role of Hand Hygiene in Control of the Infection

Hand hygiene is now regarded as one of the most important element of infection control activities. In the wake of the growing burden of HCAIs, the increasing severity of illness and complexity of treatment, superimposed by multi-drug resistant (MDR) pathogen infections, health care practitioners (HCPs) are reversing back to the basics of infection preventions by simple measures like hand hygiene. This is because enough scientific evidence supports the observation that if properly implemented, hand hygiene alone can significantly reduce the risk of cross-transmission of infection in healthcare facilities (HCFs).

Failure to perform appropriate hand hygiene is considered to be the leading cause of HCAI and the spread of multi-resistant organisms, and has been recognized as a significant contributor to outbreaks. There is convincing evidence that improved hand hygiene through multimodal implementation strategies can reduce HCAI rates. In addition, although not reporting infection rates several studies showed a sustained decrease of the incidence of multidrug-resistant bacteria isolates and patient colonization following the implementation of hand hygiene improvement strategies [19].

Literature regarding knowledge of nurses

A survey of doctors' and nurses' knowledge, attitude and compliance with infection control guidelines in Birmingham teaching hospitals was conducted by Stein et al. This study investigated knowledge about infection control amongst doctors and nurses through a cross-sectional survey conducted between March and May 2001 in three Birmingham, UK teaching hospitals. Seventy-five doctors and 143 nurses, representing 7% and 4%, respectively, of potential respondents, participated in the study measuring knowledge of, attitudes towards, and compliance with universal precautions. Overall knowledge of risks of blood-borne virus (BBV) transmission from an infected patient after needle-stick injury was low [44.0% for hepatitis B virus (HBV), 38.1% for hepatitis C virus (HCV), 54.6% for human immunodeficiency virus (HIV)]. There were significant differences between doctors and nurses concerning the estimations of HBV (e-antigen +) (P=0.006) and HIV (P<0.001) transmission risks. Eighty-six percent of nurses stated that they treat each patient as if they are carrying a BBV compared with 41% of doctors. Doctors and nurses differed significantly in their attitudes about and reported compliance with washing hands before and after patient contact and with wearing gloves when taking blood (P<0.001 for all). Doctors consistently de-emphasized the importance of, and reported poor compliance with, these procedures. Doctors were also more likely to state that they re-sheath used needles manually than were nurses (P<0.001). Thirty-seven percent of respondents reported that they had suffered a needle-stick injury with a used needle, with doctors more likely to be injured than nurses (P=0.005). Twenty-eight percent of these doctors and 2% of the nurses did not report their needle-stick injuries (P=0.004). Education, monitoring, improved availability of resources, and disciplinary measures for poor compliance are necessary to improve infection control in hospitals, especially amongst doctors [20].

A study was conducted on role of hand hygiene in health care-associated infection prevention. The study revealed that factors influencing hand hygiene compliance, the impact of hand hygiene promotion on healthcare-associated pathogen cross-transmission and infection rates, and challenging issues related to the universal adoption of alcohol-based hand rub as a critical system change for successful promotion [21].

A cross-sectional study was conducted among nurses and physicians providing direct patient care in four hospitals in Hong Kong on perceptions of the importance and impact of health care associated infections and hand hygiene. Among respondents a total of 60% of the nurses and 46% of the physicians acknowledged that over 75% of healthcare-associated infections can be prevented by hand hygiene [22].

A descriptive study was conducted on the level of knowledge and practice of prevention of hospital acquired infections among trained nurses in surgical wards and the factors that hinder this practice. The findings revealed that 98% of the respondents have heard about nosocomial infections while 2% have not. About 78% of the respondents practice prevention of hospital acquired infections while 22% do not. About 94% of the respondents expressed that they have hindrances to the practice of prevention of nosocomial infections. The hindrances include poor working environment among 26%, poor knowledge about prevention of nosocomial infection was 10%, and lack of water for hand washing and other material resources 58%. The Study reveals that majority of the trained nurses in surgical wards have knowledge about the prevention of nosocomial infections but not all practice it due to lack of equipments and poor working environment [23].

A study was conducted to assess the knowledge of health team in relation to infection control measures as well as their level of practice in the application of infection control measures at the endoscopy units in El-Kasr El-Ani Hospital, The New Kasr El-Ani Teaching Hospital (French), and the Internal Medicine Hospital, all hospitals are affiliated to Cairo University. The selected sample consisted of 40 doctors, 50 nurses, and 30 workers. The result revealed that 5% of physicians, 10% of nurses had satisfactory

knowledge and 30% of physicians and just 4% of nurses had adequate level of performance, while none of the workers had satisfactory level of knowledge or practice. The study recommended an educational program for the endoscopy staff about infection and infection control measures application for the protection of staff and patients [24].

A quasi-experimental study was conducted among nursing personnel to identify the impact of a promotion programme on hand hygiene practices and its effect on hospital acquired infection rates in a neonatal intensive care unit of a university hospital in Thailand. The study samples were 26 nursing personnel. The study reveals that after implementing a hand hygiene promotion program, compliance with hand hygiene among nursing personnel improved significantly from 6.3% before the program to 81.2%, 7 months after the program . All participants agreed that promotion program implemented in this project motivated them to practice better hand hygiene [25].

A prospective study conducted across three hospitals showed a significant drop in the rates of surgical site infections (SSI) and hospital-acquired urinary tract infection (UTI) by increasing the awareness of hospitalacquired infections among healthcare workers. An education program for the healthcare workers in the three different hospitals was included in the study. This showed a significant reduction rate of 8.1% for SSI ($P < 0.001$) and 3.9% for hospital-acquired UTI ($P < 0.001$). This reveals that linking of prevention efforts and continuous monitored infection rates are thus necessitated [26].

An observational study was conducted among health care worker's including nurses to determine the hand hygiene practices. The intervention consisted of problem-based and task orientated hand hygiene education, enhancement of minimal handling protocol and clustering of nursing care, liberal provision of alcohol-based hand antiseptic, improvement in hand hygiene facilities, ongoing regular hand hygiene audit, and implementation of health care– associated infection surveillance. The observational study was repeated 6 months after the completion of the intervention program, which extended over 1-year period. The study reveals that there was improvement in most aspects of hand-washing technique in the post intervention stage and the health care–associated infection rate decreased from 11.3 to 6.2 per 1000 patient-days and it emphasize the need for a problem-based and task-orientated education program that can improve hand hygiene compliance [27].

A Study regarding nosocomial respiratory infections and nurses' performance related to infection control measures was conducted in artificially ventilated patients in Egypt to assess nurses' practices regarding daily care activities, ventilator decontamination, use of universal infection control measures and the maintenance of the patients' care environment. The study revealed a high incidence of nosocomial respiratory infections. Also, it was revealed that pseudomonas was the causative agents in more than one fourth of the cases. Moreover, nurses' infection control practices were inadequate [28].

A recent descriptive study conducted to assess critical nurses' knowledge and evaluate their practice regarding infection control standard precautions. The study revealed that, approximately two thirds (63.6%) of the studied sample had unsatisfactory knowledge level, more than half (57.1%) of the studied sample had satisfactory performance level. Negative significant correlations were found between mean knowledge scores, and age; mean knowledge scores and years of experience ($r = -.323$ & $r = -.325$ at $P < 0.004$ respectively); between mean practice scores and age; and mean practice scores and years of experience ($r = -.235$ & $r = -.291$ at $P < 0.39$, 0.010 respectively). However, positive correlations were found between mean knowledge scores and mean practice scores; age and years of experience ($r = 0.318$ & 0.794 at $P < 0.005$ & 0.000 respectively) [29].

A descriptive study was conducted on nurses who worked at surgical wards in Azady Teaching Hospital in Kirkuk city to assess the

practices of nurses towards standard precautions. The study revealed that the majority (91.9%) of the nurses did not get training sessions regarding infection control and (83.4%) of them had not participated continuous learning about infection control. According to the level of practices towards standard precautions, it has revealed that poor practices of standard precautions by surgical wards nurses had shown in surgical wards [30]

Jain *et al* conducted a study to assess the knowledge and attitude of health care providers regarding the indications for catheterization and methods of preventing Catheter-associated urinary tract infection (CAUTI). A prospective questionnaire-based survey was done from March 2011 to August 2011. A structured questionnaire comprising of 41 items related to demographic details of the respondents, their knowledge regarding indications for catheterization and methods of preventing CAUTI was given to 54 doctors and 105 nurses. The response was evaluated for statistical correlation using a computer software. The mean years of experience of the respondents in the health care setup were 6.8 years. Only 57% of the respondents could identify all the measures for prevention of CAUTI. The knowledge regarding the indication for catheterization though suboptimal was significantly better amongst the doctors as compared to nurses. The knowledge regarding indication and preventive measures was suboptimal in our study group. There is a tremendous scope of improvement in catheterization practices in our hospital and education induced intervention would be the most appropriate effort toward reducing the incidence of CAUTI [31].

A study was conducted to assess the knowledge and practice of 400 healthcare personnel regarding hospital infection control practices was performed. A structured questionnaire was distributed to the study group and collected the same day. Knowledge and practices of 329 nurses and 71 doctors regarding hand hygiene, SPs, hospital environmental cleaning and needle stick injury were collected and analyzed. The study group had suboptimal knowledge regarding the SPs (55.3%) and risks associated with NSI (31.8%). The implementation of SPs was biased towards the HIV positive status of the patient. Only 57% of the doctors and nurses followed the maximal barrier precautions before a CVC insertion. The lack of knowledge and practices regarding basic infection control protocols should be improved by way of educational intervention, in the form of formal training of the doctors and nurses and reinforcement of the same. The study reiterated the finding that educational intervention does affect knowledge and implementation of infection control practices at any healthcare setup. Though no direct evidence is available to support this finding, we have many indirect evidences to prove so. The protection of HCP in many developing countries is often ignored by the authorities and more importantly by the HCP themselves. Our study points out that there is always a scope for improvement in the infection control practices being followed. It would be beneficial for all HCP to receive formal training regarding the same. Educational training programmes or still better would be a multidisciplinary intervention in the aura of a quality control circle to help these HCP realize the importance of basic infection control practices such as hand hygiene, SPs, risk of NSI, post-exposure prophylaxis and cleaning of hospital environment. It is obvious that routine use of these infection control practices by HCP would help reduce the rate of HCAI in any healthcare setup [32].

Vij *et al* conducted a study to assess the knowledge and practice of staff nurses on infection control measures and the relationship between knowledge and practice was carried out in a super speciality teaching institute. Data revealed the mean knowledge and mean practice of staff nurses regarding infection control measures to be 73.1% and 62.7% respectively. The studies showed there exists a positive relationship between knowledge and practice. Both are directly proportional to each other. This indicates that with improved knowledge, we can also improve the practice, which should be of major concern in the present day health care scenario. In service education, refresher

courses and training programmes on infection control measures should be systematically planned and regularly conducted for staff nurses so as to keep staff nurses up to date on the topic. Continuous surveillance of HAI in vulnerable areas and notification to the concerned authorities is essential and the formulation of regulations should be effectively performed, so as to be able to take appropriate measures in time. Continuous vigilance, assessment and supervision of clinical performance of various levels of workers will help to start a multidimensional attack on the problem of HAI [33].

Suchitra *et al* assessed the knowledge, attitudes and practices among the different health care workers (HCWs) on nosocomial infections. A total of 150 HCWs, doctors (n=50), nurses (n=50) and ward aides (n=50) were included. A questionnaire was administered to the HCWs to assess their knowledge, attitudes and practices on nosocomial infections. A scoring system was devised to grade those (KAP score). They were further subjected to a series of similar questionnaires at intervals of 6, 12 and 24 months after an education module. Subjects in each category of staff (n=10) were observed for compliance to hand washing practices in the ward in the post-education period. Statistical analysis was done using statistical software. The study showed an increase in the number of subjects in each category scoring good and excellent in the post-education questionnaire; however this declined with the progress of time. It was observed that the compliance level to hand washing practices differed among the different HCWs. Total compliance was 63.3% and ward aides were most compliant 76.7% (adjusted Wald 95% CI= 58.80-88.48). The present study concluded that education has a positive impact on retention of knowledge, attitudes and practices in all the categories of staff. There is a need to develop a system of continuous education for all the categories of staff. In order to reduce the incidence of nosocomial infections, compliance with interventions are mandatory [34].

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