Prevention Of Infection In Health Care Settings

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INTRODUCTION

Historical Perspective

In the 1840's IgnazSemmelweis, an obstetrician from Hungary was working at the large Vienna maternity hospital which at that time had two obstetric clinics. Mortality rates at the First Clinic where medical students attended to patients was averagely over three times higher than in the Second Clinic where there were midwives. These women died of what was then called childbed fever (which we know today as puerperal sepsis); their newborns also died of a similar illness. Medical students, he noticed, came directly from autopsies to the labour ward without washing their hands. His intervention was the institution of handwashing using chlorine and this resulted in a dramatic drop in mortality at the hospital. [1]

In 1860's, British surgeon, Joseph Lister, introduced the use of carbolic acid (phenol) for cleaning wounds, [2,3] surgical instruments, hands of staff and spraying surrounding air.[2] This resulted in a reduction in mortality and morbidity and healing of injuries that previously would have required amputation.[3] He published his findings in his classic treatise on antisepsis that ushered in a new era in surgery[4] and has been reprinted in modern times.[5]

A great diversity of health care facilities and health care settings exist in which patients may receive health care. From the acute care setting, typical of hospital wards, to long term care settings which include nursing homes and hospices, healthcare may be offered on in-patient or out-patient basis (ambulatory care) or even at the patient's home (home care setting).

In these wide variety of settings, health care may be provided by different health professionals including doctors, nurses and physiotherapists amongst others. In the past terms such as 'nosocomial', 'hospital onset', 'hospital based' and 'hospital acquired' have been used to describe infections that occur during hospital admission. These terms have largely been dropped in favour of a more encompassing one, taking into consideration the broad range and diverse settings of healthcare as an infection could be acquired during, or related to healthcare in any of these settings. Such an infection is now referred to as a health- care associated infection (HAI).

Definitions

According to the US Centers for Disease Control and Prevention (CDC) a HAI can be defined as localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s) where the infection was neither present nor incubating at the time of admission[6] (in the case of an acute care setting such as a hospital). Infections that manifest after discharge but were acquired in health care facility (acute care setting) are also HAIs. Health-care associated infections (HAIs), when related to care in the home setting may be defined as those infections that were neither present nor incubating at the time the care was introduced in the patient's home.

The Department of Health of the UK defines HAIs as any infection by any infectious agent acquired as a result of a person's treatment by a health care provider or which is acquired by a health care worker in the course of their duties. Or as any infection to which an individual may be exposed or made susceptible to, or more susceptible to, where the risk of exposure or susceptibility is directly or indirectly attributable to the provision of the health care by a health care provider. The individual who may be at risk of infection does not have to be the individual receiving the health care, but could be a health care worker acting in the course of their duties.[7]

The Case for Prevention

Epidemiology

Over 1.3 million patients suffer the pains of HAIs worldwide, in both developed and developing economies at any given time,[8,9] but cumulatively those affected globally run to hundreds of millions.[10] HAIs occur as an adverse by- product of health care provided in many settings; they are a significant problem in both developing and developed nations[11] resulting in increased costs (for the patients and the health care system),increased hospital stay, increased morbidity and mortality, increased strain, stress, and serious disability, and promotes resistance to antibiotics.[12,13] Though HAIs occur or are related to care in all the different health care settings, it is those that occur in the acute care setting or hospitals that have been well documented and studied. Prevalence

of HAIs in other health care settings has not been as well studied.

HAIs occur in 5-10% of hospitalized patients in developed countries. In developing countries it is much higher and ranges from twice the risk in developed countries to 20 times more. In the worst affected developing nations it is over 25 times higher. More vulnerable patients such as neonates and intensive care unit (ICU) patients are more affected with 30- 50% of patients admitted to ICUs and neonatal wards having HAIs with higher rates in developing countries.[8,13,14]

Over 30 years ago, a study, Study on the Efficacy of Nosocomial Infection Control (SENIC Project) assessed infection control activities from 1970 – 1976. It was conducted to determine the effect of surveillance and infection prevention and control activities in US hospitals. The findings of the investigators were that components of effective infection prevention programs included: continuous well coordinated surveillance and control activities, having a trained, effectual infection control physician/epidemiologist, an infection control nurse per 250 beds, and a feedback mechanism for reporting infection rates to surgeons. Where such programs existed, with all four components, hospitals' infection rates were reduced by up to 32%. Hospitals without such programs, had an increase in the overall infection rate of up to 18% within the same period.[15,16]

As a result of the study, infection control programs were organized in other hospitals in the US[17] and since then national surveillance programs have been set up in other countries in Europe,[18-20] including Germany where there it has been effective in reducing HAIs.[21]

Infection control programs have also been established in some hospitals in Nigeria such as the Lagos University Teaching Hospital (LUTH) in 1974[22] and the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC) in 1995.[23] These programs have been limited by problems of inadequate staffing, poor infrastructure[22] and unavailability of modern investigative methods.[23]

HAIs could be systemic or localized and involve different anatomical locations and organ systems. Of the different kinds of HAIs, some are most frequent and are significantly important. They are: urinary tract infections (UTIs), lower respiratory tract infections (LRTIs), surgical site infections (SSIs), blood stream infections (BSIs),skin and soft tissue infections and gastrointestinal (GIT) infections.[9,13,24]

Different studies have found different percentages for each of these infections from location to location: in the OAUTHC study, wound infections are the most common (50.5%)[23], while in LUTH UTIs were most frequent (58%)[22].

UTIs

This is the most frequent HAI worldwide[9,25,26] but is the second most common HAI in England.[24] 80% of UTIs that are HAIs are catheter related[9] hence the term catheter associated UTI (CAUTI). Other risk factors are invasive procedures on the urinary tract, pregnancy, and advanced age.

LRTIs

Most important risk factor is the use of a mechanical ventilator that canlead to pneumonia which may be fatal. The term used for such is ventilator associated pneumonia (VAP). Other predisposing factors include nasogastric intubation, seizures, unconscious state and prolonged hospital stay.

SSIs

These are infections that are directly related to an operative procedure. Many times surgeries are a life saving intervention with no alternatives but are associated with a risk of infection which becomes higher with failure of aseptic techniques, inadequate wound care, insufficient antibiotic prophylactic cover and underlying diseases such as diabetes mellitus (DM).

BSIs

The most important risk factor is the presence of intravenous catheters, central and peripheral. Central venous catheters are associated with about 70% of BSIs that are HAIs. They are called central line associated BSIs (CLABSI). Other important causes include invasive procedures as they create a breach in the normal skin barriers.

GIT Infections

These are the most common HAIs in England accounting for 22% of HAIs. 70% of these infections are due to *Clostridium difficile.* They usually occur following the use of broad spectrum antibiotics. Noroviruses also are involved.[24]

TRANSMISSION OF HAIs

For infection to occur in any setting, including the health care setting, certain factors must be present, which interact with each other. They are: an infectious agent, a susceptible host, and a mode of transmission; the relationship between the three is called the chain of infection.[27]

Infectious Agent

Such agents usually are microorganisms and possess the ability to be transmitted through the environment and cause infection in a susceptible host. They could be viruses, bacteria, fungi, or parasites. With relation

to the host the agent could be from an endogenous source or an exogenous source.
If endogenous, they form part of the microbial flora colonizing the host, present on the skin and mucous membranes of the nose, mouth, gastrointestinal tract, and vagina. In the normal state they do not cause an infection but under certain conditions they are able to initiate infection.
If exogenous they could be from numerous sources including health care workers (HCW), HCW uniforms, other patients, visitors, inanimate objects such as medical devices, health care equipment and furniture, and the environment.[6]

A susceptible host
The infective agent is able to evade the normal immunity of the host or in some cases the line of defenses is breached, or is already deficient. In this situation the host is even more susceptible. Patients' illnesses may have the effect of lowering their immunity, so may certain medical procedures or treatments they may undergo.

Route of transmission
Transmission of infectious agents is defined as any mechanism by which an infectious agent is spread through the environment or to another person.[27] Possible modes or routes of transmission include:

Contact Transmission
It is divided into direct and indirect contact. It is the most common mode of transmission. Direct contact as the name implies involves direct physical interaction between the susceptible host and an infected human source of the infectious agent with no intermediate contaminated object or person. In indirect contact there is an intermediate inanimate object or a person. Examples of indirect transmission include hands of HCW carrying microbes from one patient to another and devices or instruments used for different patients without proper cleaning or sterilization in between.

Droplet Transmission
It involves carriage of infectious agents in respiratory droplets from the respiratory tract of infected individuals to mucosal surfaces of susceptible hosts. This droplets classically are described as being > 5µm in size, covers only a short distance ⩽ 3feet, and do not remain suspended in the air over long periods. *Neisseria meningitides* and influenza virus are transmitted by this route. Some authors consider droplet transmission to be a kind of contact transmission.[27]

Airborne Transmission
In this kind of transmission infectious particles are carried around in airborne droplet nuclei. They are usually ⩽ 5µm in size.They are carried over long distances and remain suspended in the air for a long time. An example of an organism spread by this route is *Mycobacterium tuberculosis.* [38]

Vector borne Transmission
Here infectious agents or microbes are transmitted by vectors such as rats and mosquitoes.

Common Vehicle Transmission
Infectious agents are transmitted by common environmental items such as contaminated food, water, medications, devices, and equipment.

HAI PREVENTION AND CONTROL

Goals of Infection Prevention and Control
The primary goals and objectives of infection prevention and control should be clear and understood by all at all levels. And they are universally the same. They are: to protect all patients from infection while receiving healthcare; to protect from infection all health care workers and other staff necessary for the delivery of health care, students or trainees in health care professions, visitors to and all others in or who may come to the health care environment, and to achieve all these in an effective manner using resources as judiciously as possible. To do this there is a need to establish an infection control program.[29]

Organisation of an Infection Control Program
For an infection control program to be effective it must include among its components: organized surveillance and infection control activities, a trained infection control physician, an adequate number of infection control nurses and a mechanism for informing physicians, surgeons or those directly involved in patient care of the rates of HAIs, especially those occurring in the departments or wards where they work, or under their supervision. This is necessary as infection prevention and control is the collective responsibility of all individuals, organizations and authorities involved in or responsible for the provision of health care at different levels.

Infection control is the responsibility of every individual in the healthcare facility however the primary responsibility rests with the highest level of management; the head, manager or medical director is ultimately responsible for safety and quality of health care and so must ensure appropriate arrangements for effective infection prevention and control practices (IPCP) are made.[30,31]

It is recommended that an Infection Control Committee (ICC) and an Infection Control Team or Unit (ICT) be set up, especially in large institutions. The ICC should be a multidisciplinary committee with the institution's head or a representative as member. Other members should include an infection control physician, infection control nurse and representatives from all clinical specialties, administration, laboratories, pharmacy, cleaning and sterilization, engineering, environmental and waste departments and all other departments. They should be involved in the review and approval of policies, plans, and guidelines for IPCP recommended by the ICT and in enforcing their implementation. They should ensure also the provision of adequate resources for materials for IPCP and staff training.[9,30,31]

The ICT should draw up policies, plans, and guidelines for IPCP. They are responsible for the execution and day-to-day running of programs for infection prevention and control (IPC). The ICT should have in it trained infection control physicians from clinical/medical microbiology or infectious diseases or some related specialty and trained infection control nurses. They should ensure and organize training of all staff in relevant IPC measures, activities and attitudes. They should coordinate all IPC activities and monitor staff compliance, with policies and best practices, carry out continuous HAI surveillance and report to the ICC and management as well as give relevant health care professionals feedback on HAI rates associated with their health care activities. They should develop an antibiotic policy and monitor and ensure compliance with it. They should give advice in design of health care structures to ensure they are suitable or meet IPC standards

Surveillance.

Surveillance is a vital component of effective ICP programs designed to reduce the incidence of HAI. Surveillance is defined as "the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health". Infection control professionals apply this definition to both reduce and prevent health care–associated infections. Surveillance is a comprehensive method of measuring outcomes and related processes of care, analyzing data, and providing information to members of the health care team to assist in improving the outcomes.[32]

Other Basic Infection Prevention and Control Practices

For all forms of patient care certain basic, minimum precautions are required. They are: "Standard precautions" – for all patients and then, Additional (Transmission-based precautions) – for selected patients.

Standard precautions are a set of guidelines that protect HCW and patients by attempting to eliminate contact with all secretions or biological fluids, skin lesions, mucous membranes, and blood or body fluids. It stipulates the use of gloves for each contact which may lead to contamination, and gowns, mask and eye protection where contamination of clothes or the face is anticipated and respiratory hygiene and cough etiquette for patients with respiratory infections

Briefly they involve: hand hygiene, use of no touch technique wherever possible, wearing of gloves when in contact with blood, body fluids, secretions, excretions, mucous membranes and contaminated items, hand hygiene immediately after glove removal, extreme care in sharps handling, prompt clean up of infective material spills, discarding single use materials, disinfecting or sterilizing reusable materials between each patient use, appropriate waste handling, prior segregation of hospital linen before sending to laundry and use of personal protective equipment (PPE).[9,38,30]

Transmission-based precautions are used with selected patients with suspected infection based on the mode of transmission of such infections (i.e. airborne, contact, or droplet) to limit or prevent transmission.[28]

Hand Hygiene

It has been shown that the hands of HCW are a common vehicle for the transmission of pathogens causing HAIs. Hand hygiene is a general term that applies to either hand washing with plain or antiseptic soap and water, antiseptic hand rubbing or surgical hand antisepsis. Hand hygiene is considered the most important measure for reducing the spread of pathogens and transmission of multi-resistant organisms in health-care settings.[13] When appropriately performed, it reduces the transmission of microbial pathogens and the burden of infectious diseases, both in the community and in the healthcare setting [1,13,33-35] as Ignaz Semmelweis proved in the 1840's.[1] Hand hygiene with alcohol based rubs is most effective followed by use of antiseptic soaps the least effective being use of plain soap and water.[33,34]

The main hurdle in its implementation is compliance as studies have shown that it is less than 50% in most settings. It is believed that acceptable levels of

compliance with appropriate hand hygiene practice can be attained by administrative support (locally, nationally and internationally) for programs promoting hand hygiene, leadership and clinical governance, continuous education and motivation of caregivers, patient participation, and systemic change to ensure that hand-hygiene agents are available at the point of care.[13,35]

Conclusion

HAIs are a huge problem globally. Its effect is heavier in developing countries. Application of the basic principles of infection prevention and control such as hand hygiene, standard precautions, transmission precautions and other low cost infection prevention and control measures would go a long way to reduce this burden.[36]

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