SECTION 1
HEALTHCARE ASSOCIATED INFECTIONS

Contents

1.1 The risk of healthcare associated infections

'Along with medication errors, hospital acquired infections cause a great many deaths and illnesses within our hospitals'.

Peter Garling SC, Final Report of the Special Commission of Inquiry, Acute Care Services in NSW Public Hospitals, 2008

Healthcare associated infections (HAIs) are the most common complication affecting patients in healthcare settings. The literature suggests that at least 5.9% of hospital visits are affected by HAIs (31). Patients, visitors and health workers (HWs) are all at risk of acquiring a healthcare associated infection (HAI). HAIs are not limited to patients receiving care in a hospital - those receiving healthcare in community or home-based settings are also at risk.

Case study 1: Kevin's story - an all too common story

Kevin, a 58 year old builder, presented to the emergency department of a local hospital with a history of self-resolving episodes of confusion, dizziness and impaired memory over the course of a few weeks. Kevin's wife convinced him to go to the hospital after he had another, rather severe, episode of dizziness and limb weakness whilst at work on a building site.

Kevin was admitted to hospital and underwent numerous investigations with a subsequent diagnosis of transient ischaemic attack. Kevin was started on medication and having experienced no further neurological symptoms over the weekend, he was declared medically fit to return home. On the intended day of discharge (day 5), Kevin developed rigors and was found to be febrile, dyspnoeic and tachycardic. Methicillin-susceptible Staphylococcus aureus (MSSA) was cultured from his blood.

Kevin was referred to an infectious diseases physician for management of his MSSA bacteraemia, which required two weeks of IV antibiotics in hospital, followed by another four weeks via the hospital-in-the-home service. Kevin's recovery was complicated and, due to his infection and other stressors, Kevin was at an even higher risk of further ischaemic events (such as a stroke), which was very distressing for his wife. Although he did eventually recover, Kevin was unable to return to work until four months after his initial presentation to hospital.

Kevin's MSSA acquisition would be considered HAI as the date of positive culture was >48 hours from his admission. Investigations would need to determine most likely causative factor (e.g. possible association with peripheral intravascular cannula).

Potentially any microorganism may cause a HAI (32). A common misconception is that HAIs are caused only by multidrug-resistant microorganisms (MROs), such as methicillin-resistant *Staphylococcus aureus* (MRSA). HAIs can be caused by any bacteria, fungi, viruses, parasites and prions. Examples of microorganisms that cause HAIs include *Pseudomonas* spp.*, Enterobacterales* spp., *Clostridioides difficile, Acinetobacter* spp., *Candida spp.*, norovirus and influenza virus.

A HAI may occur in the presence or absence of an invasive procedure or device, and acquisition of a HAI is associated with greater morbidity and mortality risks. The literature reports:

- 3% of surgical procedures result in an infection (33);
- HAIs prolong the length of a patient's hospitalisation by an average of 10 days (34);
- The type of HAI and the microorganism involved influences the duration of additional hospitalisation required:
    - A post-operative Clostridioides difficile (*C. difficile)* infection (CDI) will prolong hospitalisation by an average of 9 days (35)
    - Surgical site infections prolong hospitalisation by an average of 10 days (36)
    - Bloodstream infections can prolong hospitalisation by up to 12 days (37)

- 30% of patients with a HAI are likely to be readmitted to hospital within 12 months (38);
- Intensive care unit (ICU) patients with a bloodstream infection are 2-3 times more likely to die than ICU patients without a bloodstream infection (37); and
- A patient's risk of mortality is at least three times greater if a HAI is acquired (33, 39).

In most instances HAIs are preventable. New South Wales (NSW) Public Health Organisations (HOs) and their HWs have an ethical and professional obligation to do no harm to the patients in their care. Registered HWs also have a legal requirement to adhere to infection prevention and control practices as required under the NSW Health Practitioner Regulation. This includes ensuring that patients do not acquire a HAI during their healthcare encounter. Implementing and adhering to infection prevention and control strategies to avoid the transmission of microorganisms is a crucial step in fulfilling this obligation.

Infection prevention and control programs are a core element in healthcare patient safety and quality programs. HOs require a comprehensive program to make sure that current and future risks, challenges and threats of HAIs, transmissible multidrug-resistant organisms and communicable diseases are identified and managed. The core components of a comprehensive infection prevention and control program comprises (1):

- A governance structure that incorporates risk escalation, reporting and feedback
- A description of what the program includes, goals, risks and assigned responsibility for each core component
- Clear objectives that have scalability to manage endemic multidrug-resistant organisms/outbreaks
- Trained professional(s) to lead and manage the program
- Executive engagement, clearly defined infection prevention and control (IPC) leadership and strong relationships between IPC, executive teams and clinical governance
- Linkages between national, state, Local health district (LHD) and facility policies/guidelines
- Microbiological/infectious diseases support
- Education and training programs for all HWs that are evaluated for effectiveness and applicability to each of the health professional groups
- A HAI surveillance program that includes national, state and facility clinical and process indicators
- Multimodal strategies based on risk assessment to drive improvements in HAI rates, infection prevention practices, and patient infection risks
- Monitoring/audit/evaluation of infection prevention and control practices and feedback mechanisms
- A program for the maintenance of standards and practices for reducing or eliminating contamination of environmental and equipment risks
- Built environment, materials and equipment at both the facility, clinical level and point of care to reduce the risk of HAI and transmission of multidrug-resistant organisms

1.2 Modes and routes of transmission

A mode of transmission describes how a microorganism moves from one host to another. Transmission can either occur vertically, from mother to child, or horizontally, between individuals who are not necessarily related. In horizontal transmission, microorganisms will use either a direct or indirect mode of transmission to leave the current host and colonise the next host. Routes of transmission may involve direct contact, indirect contact, droplet, airborne and/or vector-borne. Common source transmission is the spread of microorganisms from a single source. This is often facilitated by the contamination of food or water and is best illustrated by institutional foodborne outbreaks. There are certain microorganisms that simultaneously employ multiple transmission routes. For example, norovirus can be spread by direct contact, indirect contact, droplet transmission and common-source transmission through contaminated food.

- **Person to person-** A common way for infectious diseases to spread is through the direct transfer of bacteria, viruses or other pathogens from one person to another
- **Animal to person-** Being bitten or scratched by an infected animal or handling animal waste can be hazardous.
- **Mother to unborn child-** A pregnant woman may pass pathogens that cause infectious diseases to her unborn baby
- **Food Contamination- C**ausing pathogens can infect is through contaminated food and water.

1.2.1 Contact transmission routes

Contact transmission routes refer to the movement of microorganisms from a colonised or contaminated source to a susceptible host, via either direct or indirect physical contact.

Direct contact transmission involves skin-to-skin contact and the physical transfer of microorganisms directly from an infected person to a susceptible host.

Patients may infect themselves when touching wound sites or mucosal membranes with hands colonised with commensal microorganisms or contaminated by body substances that contain microorganisms (e.g. blood, respiratory secretions).

Indirect contact transmission involves the initial transfer of microorganisms from a host individual to an intermediary object and then subsequent transfer to another individual. The unwashed hands of HWs are common mediators of indirect contact transmission (40-42), due to contact with fomites and the environment.

Reusable medical devices that are inadequately reprocessed between patients are also implicated in the indirect contact transmission of microorganisms to patients (43, 44).

AS/NZS 4187:2014
Reprocessing of reusable medical devices in health service organizations

AS/NZS 4815:2006
Office-based health care facilities - Reprocessing of reusable medical and surgical instruments and equipment, and maintenance of the associated environment

Refer to Section 8, *Reprocessing* for further advice

1.2.2 Droplet transmission route

Droplet transmission involves large droplets carrying microorganisms from a colonised or infected individual, often produced by coughing, talking and breathing (45, 46).
Due to their size, large droplets can only travel very short distances (≤ 1 metre) before either settling and contaminating surfaces (2) or making contact with and potentially infecting the mucosal surfaces of susceptible individuals. Therefore droplet transmission requires close contact between the colonised or infected host and other susceptible individuals.

1.2.3 Airborne transmission route

Airborne transmission is a form of indirect transmission that occurs by the dissemination of small expelled aerosols that can carry microorganisms. Aerosols are much smaller than droplets and are often produced by coughing, talking and breathing (46) as well as during clinical aerosol generating procedures (AGP) such as suctioning, intubation and chest physiotherapy (47). Such aerosols can travel long distances and can remain suspended in the air for prolonged periods of time.

Case study 2: Reece's story - a tale of transmission

A nine year old boy, Reece, presented to the hospital's emergency department with abdominal cramping, continuous vomiting and a headache. Reece's mother told the triage nurse that Reece had started vomiting two hours ago. The medical officer recorded the observation of 'projectile vomiting'. The medical officer put in a lab order for a stool specimen to test for norovirus. Reece was admitted to the paediatric ward for monitoring and rehydration.

Reece was placed in a single room on the unit. He continued to vomit on and off throughout the afternoon. To take his mind off his illness, his mother let Reece play with communal toys from the unit. The toys were placed back in the play room after he finished playing. The lab results confirmed the boy had norovirus.

24 hours later, Neya complained of stomach cramps and started vomiting. Neya was later diagnosed with norovirus and found to have the same strain that was found in Reece's stool specimen.

What happened?
Reece contaminated the toy with norovirus via droplet and contact routes. The toy had been returned to the play room without cleaning were Neya was able to play with the same toy. Neya's hands became contaminated with Norovirus through the indirect contact route. Neya had not performed any hand hygiene and the toy was not cleaned in between use.

How could this have been prevented?
Providing parent education on the importance of hand hygiene.
Reece should practise hand hygiene after going to the toilet and vomiting. This could also be included in patient and parent education programs
Personal effects, including toys and other communal devices, should not be shared between patients where practical and cleaned between uses when shared. Everybody, including visitors and carers, should clean their hands before and after contact with a patient, equipment or the surrounding environment.

1.3 Colonisation

Microorganisms are normally found on the skin surface, in the nasopharynx and in the human gut, and cause no harm to their human host when colonised in these usual anatomical locations. This is called colonisation of commensal microorganisms.

The commensal microorganisms of one person may be a pathogen for another person. Patients exposed to HWs and visitors may be at risk of acquiring an infection from these colonised individuals depending on the extent of exposure and their own immune status. A patient may be visited up to 18 times per hour by HWs or visitors. At least 27% of these visits involve physical contact. Therefore, there are plenty of opportunities for patients to be exposed and infected by microorganisms innocuously carried by HWs and visitors (48).

Colonisation in itself is not harmful to the patient and does not require treatment.

1.4 Infection

Infection may be preceded by colonisation. An infection is typically differentiated from colonisation by the presence of clinical signs and symptoms. There may be a systemic response (e.g. febrile illness,

elevated white cell count) and/or a local response (e.g. cough, localised inflammation). Infection in certain individuals may not be easily observable. For example, infected individuals who are elderly and/or immunocompromised may be unable to mount a strong clinical response to infection.

During most infections, an asymptomatic phase will precede the onset of symptomatic clinical illness. Depending on the causative microorganism, an individual may also shed infectious material during asymptomatic infection. As an example, the influenza virus is shed prior to the onset of flu symptoms (49). If the patient is immunocompromised, pregnant or is undergoing certain surgical procedures, having an asymptomatic infection may pose a significant clinical risk to the patient (50, 51).

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An infection may be considered to be latent whereby the infection is dormant; the infection may or may not reactivate at a later stage. An individual with a latent infection is not clinically unwell and does not usually shed infectious material during the latent phase. Reactivation of the infection is often triggered by the waning of the immune response. Latent infections are often associated with tuberculosis (TB), hepatitis B virus and varicella-zoster virus.

NSW Health Factsheet:
Tuberculosis

NSW Health Factsheet:
Hepatitis B

NSW Health Factsheet:
Chickenpox