Prevention by breaking the chain of infection

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We rely on antimicrobials to fight infections, but some microorganisms have become resistant to these agents. Antimicrobial resistance is a global threat, and nurses have a crucial role to play in the fight against it. They are constantly in contact with patients and conduct many interventions – each contact and intervention is an opportunity to prevent the rise of AMR. To do this, they need to understand how the chain of infection works and how it can be broken, therefore preventing infection.

The availability of antimicrobials to treat infections is at the heart of modern healthcare. It allows those who need them to live longer and healthier lives, and enables health professionals to safely deliver interventions, such as surgery and chemotherapy. However, bacteria and other microorganisms evolve and become resistant to antimicrobials. This is problematic, as antimicrobial resistance (AMR) is developing faster than new antimicrobials (O’Neill, 2014). In the UK, infections caused by resistant Gram negative organisms are increasing; the key bacteria causing increasing infections are E Coli, Klebsiella pneumonia and Pseudomonas aeruginosa. The WHO stresses that without urgent global action the world is headed for a ‘post-antibiotic era’ (WHO, 2014). To put a halt to AMR, countries need to put in place key measures, which include enhancing infection prevention and control (IPC), and prescribing antibiotics correctly and only when needed (antimicrobial stewardship) (WHO, 2015). Nurses and midwives are at the heart of these measures, who can use every opportunity to prevent infections and advocate appropriate antibiotic use.

Infection prevention and control Healthcare workers have a responsibility to prevent infection, but there are common misconceptions about IPC, such as assuming it is only about hand hygiene and cleaning. For nurses and midwives, it is important to understand how their role fits into the wider picture of AMR prevention, as well as the components of IPC (see Box 1).

IPC is essential and relevant in all health and social care settings, including acute hospitals, care homes, general practice, mental health and community hospitals and centres, learning disability units, schools and prisons. All inpatients and service users are susceptible to acquiring infections. We need to work together to understand the risk factors and implement the measures required to prevent infections. We need to strengthen our engagement across health and social care to prevent and control infections more effectively.

Surveillance data Public Health England monitors antimicrobial-resistant organisms and key infections that occur in healthcare environments through surveillance programmes and provides reports on the
numbers and trends of infections and resistance over time. This allows healthcare providers to know what the problems are and how well the control measures are working.

In England, surveillance data has shown a 6.6% decrease in the rate of total meticillin-resistant *S. aureus* bacteraemia reported since October/December 2012 compared with January/March 2016, which reflects a general decrease since April 2007. Decreases have also been seen in rates of *C. difficile* infections (CDIs): comparing January/March 2015 with January/March 2016, there has been a 14.4% decrease in the rates of CDI cases. CDI rates that are attributable to NHS trusts have also decreased by 14.6% during the same period (PHE, 2016a).

However, over the last four years, there has been an 18% increase in the number of *E. coli* bloodstream infections (PHE, 2016a). In 2015/16, 38,132 patients had an *E. coli* bloodstream infection – 12,594 more than all CDIs and *S. aureus* infections combined. The focus is now, therefore, on reducing these infections.

**Reducing the rates of infections**
Various strategies and interventions have been implemented in England that have had a significant impact on reducing MRSA bloodstream infections and CDI (Duerden et al, 2015; Holmes et al, 2015; PHE, 2016a).

Rather than a single intervention, a number of multimodal interventions implemented over a period of time have led to these reductions such as:
- Monitoring infections through surveillance to better understand the data;
- Setting targets to reduce infections;
- Disseminating guidelines;
- The health and social care act (2008) code of practice for the prevention and control of infections;
- Introducing patient safety alerts;
- Reviewing infections to understand their root cause;
- Implementing action plans, deep cleans and improvement programmes (Duerden et al, 2015).

The focus on IPC has led the government to set out new ambitions in order to reduce Gram negative bacteraemias (DH, 2016b):
- A 50% reduction in healthcare-associated Gram negative bloodstream infections (GNBSIs) by 2020;
- A 50% reduction in the number of inappropriate antibiotic prescriptions by 2020.

IPC is an essential element of all interventions and care provided. IPC interventions (particularly those targeted at routine care practices, environmental cleaning, disinfection and sterilisation, and
education of staff) minimise the spread of antimicrobials [Dar et al, 2016].

The chain of infection
Surely, prevention must be one of the most important ways nurses can tackle the global threat of AMR, so why do we not focus more on this? Why is prevention not highlighted more as a fundamental strategy for tackling resistance?

For a microorganism to spread and potentially lead to an infection, certain conditions need to be met. There must be an interaction between the microorganism, the host and the environment.

When the microorganism leaves the host (or reservoir) through a way out (known as the portal of exit), it passes on (via a mode of transmission) and enters a susceptible host. This is called the chain of infection [CDC, 2016], which is shown in Fig 1. Each step is a link in this chain, and if all the links are present, then an infection will develop. If one or more links are broken then the infection will not occur.

Every prevented infection lowers the need for and use of antibiotics, which lessens the development of resistance. The Nursing and Midwifery Council Code outlines that nurses and midwives ‘keep to and promote recommended practice in relation to controlling and preventing infection’ (NMC, 2015). Together, we can make a significant impact in reducing AMR.

Infection Prevention Week
International Infection Prevention Week is held in the third week of October. In 2016, it is planned for 16-22 October (APIC, 2016).

It is important that, as nurses and midwives, we remember how crucial our work is in tackling AMR. The recently published framework Leading Change, Adding Value outlines how nurses can break the chain of infection are listed in Table 1, which can be found in the PDF version of this article at nursingtimes.net/ChainInfection.

Promoting a culture of improving the population’s health is a core part of practice, which aims to:

- Increase the visibility of nursing and midwifery leadership and input in prevention;
- Assist individuals, families and communities so they can make informed choices about their health;
- Promote research and evidence-based tools;
- Enhance skills in, and knowledge of, AMR and IPC;
- Use technology to improve outcomes;
- Ensure the right staff are in the right place at the right time. (NHS, 2016).

Taking an active role in optimising antibiotic usage and breaking the chain of infection at every interaction is fundamental. By understanding the chain of infection, the portals of exit and entry, and the modes of transmission, nurses and midwives are in a unique position to influence breaking the chain of infection.

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**TABLE 1: HOW NURSES CAN BREAK THE CHAIN OF INFECTION**

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<th>Location in the chain of infection</th>
<th>Examples of how nurses can break the chain</th>
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<td><strong>1. Causative organism</strong>&lt;br&gt;Bacteria, virus, parasite, fungus. Influencing factors in the development of an infection include the ability of the organism to multiply, invade or enter tissue and lead to disease</td>
<td>A. Improving knowledge and information&lt;br&gt;● Learn about microorganisms and how they are transmitted&lt;br&gt;● Understand the role of microorganisms in a patient developing an infection&lt;br&gt;● Know your local surveillance data&lt;br&gt;● Know about infections from local root cause analysis&lt;br&gt;● Vaccinate to stop infections; this will lower antibiotic use and potential resistance</td>
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<td><strong>2. Reservoir or host</strong>&lt;br&gt;The path by which microorganisms live, grow and multiply, such as in humans, animals, food, water, the environment. Moist, warm, unventilated areas support microbial growth more than dry, cool, airy areas</td>
<td>B. Understand reservoir/host and apply effective cleaning and decontamination&lt;br&gt;● Understand the role of microorganisms as a reservoir and that they are part of our environment, food, water and normal flora</td>
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<td><strong>3. Portal of exit</strong>&lt;br&gt;The place where microorganisms leave the host: respiratory tract (mouth or nose during coughing, sneezing or breathing), skin (lesions or skin cells) gastrointestinal tract (through stool or vomit), urinary tract (urine), blood and other body fluids such as wound drainage</td>
<td>C. Deliver focused and safe interventions, ensure standard precautions are implemented at each patient contact and isolate the patient with transmissible organisms or diarrhoea as per local policies&lt;br&gt;Respiratory tract&lt;br&gt;● Wear a surgical mask or FFP3&lt;br&gt;● Follow cough etiquette (use a tissue to cover nose and mouth, and dispose of tissue in waste)&lt;br&gt;● Perform hand hygiene&lt;br&gt;Skil (lesions or wounds)&lt;br&gt;● Aseptic technique for all dressings; discard wound dressing safely&lt;br&gt;● Use personal protective equipment when appropriate&lt;br&gt;● Perform hand hygiene&lt;br&gt;Gastrointestinal tract&lt;br&gt;● Safely handle and discard body fluids; use protective articles (gloves, gown, mask)&lt;br&gt;● Perform cleaning of any spillage&lt;br&gt;● Perform hand hygiene&lt;br&gt;Blood&lt;br&gt;● Safely handle sharps; use safety devices&lt;br&gt;● Use gloves in case of risk of exposure&lt;br&gt;● Safely transport and dispose of sharps&lt;br&gt;● Safely transport specimens&lt;br&gt;● Decontaminate equipment&lt;br&gt;● Perform hand hygiene</td>
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<td><strong>4. Mode of transmission</strong>&lt;br&gt;The way a microorganism is transmitted from the reservoir to the host. This can be via direct (contact between infectious host and susceptible host) or indirect transmission (which involves an intermediate carrier, such as an environmental surface or piece of medical equipment)</td>
<td>D. Apply IPC precautions to prevent transmission&lt;br&gt;● Practise hand hygiene&lt;br&gt;● Wear personal protective equipment appropriately&lt;br&gt;● Decontaminate instruments and equipment (between patient use)&lt;br&gt;● Decontaminate surgical instruments and other reusable medical devices&lt;br&gt;● Clean the environment&lt;br&gt;● Isolate patients with alert organisms or potentially infectious agents (diarrhoea)&lt;br&gt;● Safely handle food and water&lt;br&gt;● Safely handle and decontaminate linen</td>
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<td><strong>5. Portal of entry</strong>&lt;br&gt;This is where the microorganism enters the susceptible host and is able to multiply or cause harm: mucous membranes, cuts in the skin or open wounds, tubes such as urinary catheters, feeding tubes or vascular access devices</td>
<td>E. Delivery of safe practices at every patient intervention for device and procedures&lt;br&gt;● Aseptic technique for safe urinary catheter insertion and care&lt;br&gt;● Safe peripheral and central venous catheter care, arterial and peripherally inserted central catheter lines&lt;br&gt;● Safe enteral and parenteral feeding practices&lt;br&gt;● Safe ventilator practices&lt;br&gt;● Safe device (any invasive device) insertion and care&lt;br&gt;● Safe surgical procedures and surgical prophylaxis</td>
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<td><strong>6. Susceptible host</strong>&lt;br&gt;Person who is likely to develop an infection; several factors raise susceptibility to infection, like genetic or constitutional factors, specific immunity and non-specific factors. Factors that disrupt the host’s ability to defend against the microbe include malnutrition, alcohol misuse and disease or treatment that impairs the non-specific immune response</td>
<td>F. Perform and act on risk assessment&lt;br&gt;● Do a risk assessment when you assess patients to assess whether they are vulnerable to infection&lt;br&gt;● Ensure patients are well hydrated and regularly monitor their fluid balance&lt;br&gt;● Ensure patients receive adequate nutrition or refer them to a dietitian, if needed&lt;br&gt;● Encourage vaccination&lt;br&gt;● Device maintenance</td>
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