1 Infection Prevention and Control: Past, Present and Future

INTRODUCTION

Starting with the appointment of the first infection control nurse in 1959, this introductory chapter sets the scene, looking at the profile of the prevention and control of healthcare-associated infection today in conjunction with the challenges facing infection prevention and control teams and the National Health Service as an organisation.

Disease threats old and new are discussed, along with the rising media profile of organisms such as meticillin-resistant *Staphylococcus aureus* and *Clostridium difficile*. The background to the latest Department of Health drives, guidance and initiatives is also discussed, emphasising the root and branch shift towards making the prevention and control of healthcare-associated infection a priority for the NHS and everyone involved in patient care.

THE DEVELOPMENT OF INFECTION PREVENTION AND CONTROL AS A SPECIALITY IN HOSPITALS

In 1941, the British Medical Council recommended that control of infection officers were appointed in hospitals to oversee the control of infection. This was followed in 1944 by the setting up of control of infection committees consisting of clinical and laboratory staff, nurses and administrators. The first infection control nurse, however wasn't appointed in the UK until 1959.[1] The appointment of Miss EM Cottrell, formerly an operating theatre superintendent, as infection control sister at Torbay Hospital, Devon, was in response to a large outbreak of staphylococcal infections, affecting both patients and staff. Staphylococci had been causing problems in hospitals in the UK since 1955, and staphylococcal ***surveillance*** revealed that the carriage rate amongst nursing staff on two of the major hospital wards was 100 %, with high staff absentee levels due to staphylococcal skin sepsis, and evidence of post-operative wound infections and skin sepsis amongst the patients.[1] Miss Cottrell was appointed for an experimental period to assist in the collection of surveillance data and advise on the prevention of cross-infection through rigorous adherence to the principles of ***asepsis***. In 1961, a report on the development of the post of

an infection control sister was submitted by Dr Brendan Moore, Director of the Public Laboratory in Exeter, to the Joint Advisory Committee on Research of the South West Region Hospital Board. Although the appointment of a nurse as a full-time member of the infection control team was nationally opposed by consultants, infection control sisters were subsequently appointed in many other hospitals.

During the 1960s, an increase in infections caused by Gram-negative bacteria such as *Escherichia, Klebsiella, Pseudomonas* and *Proteus* started to overtake *S. aureus* as agents of cross infection.[2] *Pseudomonas* in particular established itself as a major ***opportunistic*** hospital ***pathogen*** in those with underlying illness. The discovery of penicillin by Alexander Fleming in 1928, and its further development and subsequent use in clinical practice in the 1940s, completely transformed the management of infections and infectious diseases. Penicillin was seen as the 'golden bullet' (see Chapter 8 The Problem of Antimicrobial Resistance) and there was enormous expectation that the development of antibiotics would rid the world of infectious diseases. However, during the 1960s and 1970s antibiotic resistance was recognised as an increasing problem and lurking just around the corner were major resistance problems with staphylococci against meticillin, which gave rise to meticillin-resistant *Staphylococcus aureus*. MRSA really started to be become problematic in the 1970s, and exploded during the 1980s (see Chapter 9 Meticillin-resistant *Staphylococcus aureus*). Since then, antibiotic resistance has become increasingly common with most strains of bacteria now resistant to one or more antibiotics, thus representing a major threat to public health.

DISEASE THREATS, OLD AND NEW

It is difficult to predict when a new disease with the potential to wreak havoc and destruction on the human race will emerge, but an increase in the emergence of new diseases and the re-emergence of old ones such as tuberculosis (see Chapter 10) is almost inevitable. Micro-organisms previously unknown or unrecognised, or thought to only cause disease in animals can, and have, evolved to produce more ***virulent*** strains which can also affect humans, such as new variant CJD (Chapter 19) and avian influenza (Chapter 18). In fact, since the 1970s, more than 30 new infectious diseases have emerged worldwide[3], including Legionnaires' disease (Chapter 20) and HIV and hepatitis C (Chapter 16). An increase in the global population and global travel has led to an increasingly densely packed and mobile population, meaning that an infectious disease such as severe acute respiratory syndrome (Chapter 17), ***pandemic*** influenza (Chapter 18), pneumonic plague or smallpox could theoretically spread anywhere in the world within a matter of hours.

PLAGUE

Plague has been described as one of the most explosively virulent diseases[4], although it is a term that is used to describe any outbreak of a pandemic nature associated

with a high ***mortality rate***. The bacterial cause of plague, *Yersinia pestis,* principally affects rodents and is transmitted to humans via the bite of infected fleas. It takes one of three forms. Bubonic plague, which has a fatality rate of 50 % unless treated promptly, affects the local inguinal, cervical or axillary lymph nodes draining the area of the flea bite, causing painful swellings known as buboes[5] which can spread to other parts of the body. It is not transmissible from person to person, unlike pneumonic plague. This is spread by the respiratory droplet route, and develops as a rapidly fatal secondary pneumonia in some people with bubonic plague, although it can also be transmitted as a result of inhaling respiratory droplets containing *Y.pesti.*[4,5] Septicaemic plague commonly occurs as a complication of bubonic or pneumonic plague, although it can also be acquired as a primary infection. The septicaemic rash that develops under the skin gives this form of plague its commonly referred to name of the Black Death.[5]

The infamous Black Death which swept through Europe between 1346 and 1350 killed an estimated 50 million people.[6] Regular ***epidemics*** occurred and in the Great Plague of 1664–1666, which began in London and rapidly spread to other parts of the country, 70,000 people died. London in the 16th century was a hotbed of extreme poverty, squalor and social deprivation, which created the perfect environment for a large rodent population and the spread of disease. As people fled the city, plague spread to other areas of the country that had previously been unaffected. It became ***endemic*****,** with outbreaks occurring throughout Europe, spreading across the continent via the trade routes. In an attempt to halt the spread, attempts were made to isolate infected communities and the Venetians were the first to introduce the concept of ***quarantine*** by making sure that incoming ships waited on an island for 40 days before entering the city. Although the number of outbreaks declined after the 17th century, plague remains one of the oldest ***notifiable diseases*** known to man and it is endemic in many areas of the world today, with 1,000–3,000 cases reported to the World Health Organisation (WHO) each year.[7] Areas of Africa such as the Democratic Republic of Congo, Zambia and Algeria are at risk of outbreaks of plague, together with parts of India and Asia, the former Soviet Union and the South Americas. The Democratic Republic of Congo in particular is a plague zone, and between February 2005 and October 2006 more than 1,100 suspected cases of pneumonic and bubonic plague were reported to WHO, which deployed field teams to the affected areas to provide support to the local authorities.[7]

In the wake of the September 11 2001 terrorist attacks, there are real concerns, although no actual threat as yet, that a ***biological agent*** could be deliberately released in the UK.[8,9] The Department of Health[10] has formulated national contingency plans detailing the public health response to the deliberate release of biological agents such as plague, smallpox, ***anthrax*****,** ***botulism*** and ***tularaemia*****.**

SMALLPOX

If plague is one of the oldest and most virulent infectious diseases, smallpox is one of the most devastating. Believed to have originated in India or Egypt more than

3,000 years ago, repeated epidemics swept through Europe for centuries and as late as the 18th century every 10th child born in Sweden and France, and every 7th child born in Russia died from the disease.[11] Although the last case of smallpox in the UK was in 1901, by 1967 it had threatened up to 60 % of the global population, and WHO launched a collaborative global plan that year to eradicate it. The last naturally occurring case was seen in Somalia in 1977, and WHO declared smallpox eradicated in 1979.[11] Although vaccination against smallpox was effective, it had serious adverse reactions and routine vaccination in the UK ceased in 1971 as the risks from vaccination outweighed the risk of contracting the disease.[11,12] Given that it is no longer a naturally acquired infection, outbreaks can only occur as a result of an accidental release, as in a laboratory incident in Birmingham in 1978[13] in which a medical photographer died and several other people were affected, or through a deliberate release of the virus. Following the Birmingham incident, WHO banned all research and all stocks were destroyed. The only two legitimate stocks of smallpox are held at two WHO approved high security locations – Atlanta, Georgia, USA and Koltsovo, Novosibirsk Region, Russian Federation.[14,15] The Centres for Disease Control (CDC), in Atlanta USA, declared smallpox a category A agent as it poses a potential public health threat if used as a biological weapon.[15] If there were a deliberate release of the smallpox virus, it would be catastrophic. The duration of immunity to smallpox is unknown but is thought to be no longer than 10 years so previously vaccinated individuals are unlikely to still be protected although the disease may be less severe. In response to the potential public health threat, the Department of Health published guidance in 2003[16] which details the action to be taken in the event of a deliberate release of the virus in the UK, focusing on the isolation of affected cases and the vaccination of contacts.

THE PREVENTION AND CONTROL OF INFECTION – THE CURRENT SITUATION

As medicine and healthcare have progressed immeasurably over the last 50 years, so too has the microbial world and the nature of infections and infectious diseases. With more and more patients undergoing major surgery and invasive diagnostic procedures, they are actually now more at risk from potentially life-threatening infections than ever before. An increasing elderly population, with weakened immunity and increased susceptibility to infections as a result of underlying illness and disease, represents a huge challenge to healthcare teams. Many hospitals are now no longer able to cope with the population that they were originally built to serve. Higher bed occupancy rates, patient turnaround times and increased movement of patients between wards and departments places huge demand on facilities and resources and inevitably impacts on infection rates.[17] Many NHS Trusts cover large geographical populations, with different pools of patients with different conditions and needs admitted into overcrowded environments. A lack of adequate isolation facilities has often been identified and criticised as an issue that needs to be urgently

addressed[18], together with poor staff-to-patient ratios, and these factors can lead to fewer patients being isolated. The problems of competing organisms such as MRSA and *Clostridium difficile* (see Chapter 11) mean that the allocation of a side room to an infected or colonised patient has to be based on a multi-factoral risk assessment. Environmental issues around old, poorly maintained healthcare premises and concerns around poor standards of hygiene and hospital cleanliness[19] are also contributing factors. Inadequate supplies of equipment, especially equipment that is shared between patients, the lack of adequate resources for decontamination and an increase in invasive procedures and the use of invasive indwelling devices (see Chapters 6 and 7) compound the problems. Problems associated with antibiotic resistance and the emergence of multi-resistant bacteria can, to some extent, be controlled through more stringent antibiotic policies, restricted antibiotic prescribing only on the advice of a consultant microbiologist, and compliance with the basic infection control practices such as hand hygiene; but the stakes now need to be raised in terms of increasing the profile of infection prevention and control.

The political climate today, with the introduction of government targets to reduce waiting times in accident and emergency departments and on elective surgery waiting lists[20], has led to claims that there is now a 'target culture' within the NHS. The pursuit of targets at the expense of infection control, with short cuts taken in clinical practice and procedures and practices not always followed to the letter, will almost inevitably give rise to increased infection rates. The recent Healthcare Commission enquiry into an outbreak of *C.difficile* at Stoke Mandeville Hospital in 2005, in which 33 patients died[21] highlights this target culture as the main cause of the outbreak, in which the advice of the Infection Prevention and Control Team and the Health Protection Agency were ignored.

THE PROBLEM OF HEALTHCARE ASSOCIATED INFECTIONS

A healthcare associated infection (HCAI) can be defined as an infection caused by any infectious agent acquired as a consequence of a person's treatment by the NHS, or which is acquired by a healthcare worker in the course of their duties.[22] A hospital acquired infection (HAI) is one which is neither present nor incubating on admission to hospital. National ***prevalence*** surveys conducted in the UK in 1981 and 1996[23,24] found that 9 % of patients in hospital had an infection that was acquired in hospital, equating to 100,000 patients per year, and it has also been estimated that hospital-acquired infections kill 5,000 patients in the UK each year.[25] They are probably a contributing factor but not the primary cause in at least 15,000 other deaths[25,26] and while it is not possible to prevent all infections, there are several recognised risk factors which increase the risk to patients (see Chapter 5 Understanding the Immune System and the Nature and Pathogenesis of Infection). It is believed that at least 15–30 %, and maybe as much as 50 %, of HCAI infections can be prevented through good clinical practice[25] and applying the basic principles of infection control when undertaking patient care (see Chapter 6 The Principles

of Infection Prevention and Control). As well as saving lives, potential avoidable costs could be in the region of £150 million annually.[26]

Patients with an HCAI spend on average an extra 11 days in hospital.[27] Delayed discharges equate to lost beds days for the Trust and loss of revenue, along with money spent on litigation, empirical antibiotic therapy, extra equipment, personal protective clothing and hotel services. Public confidence in the Trust is also dented as a result of adverse publicity, which may mean that patients choose to receive their treatment elsewhere if a hospital is perceived to have problems with healthcare associated infections.

HCAI impacts on a Trust's financial position. Under the new Payments by Results tariff[28] where procedures will attract a defined tariff which will not take account of additional costs incurred by the treatment of an HACI, additional costs of between £160,000 and £400,000 could be incurred in excess of tariff income for the treatment of MRSA bacteraemias, and other HCAIs could increase this figure tenfold.[29]

SAVING LIVES AND GOING FURTHER, FASTER

In 2005, the Department of Health published *Saving Lives: a delivery programme to reduce healthcare associated infection including MRSA*.[30] This programme includes an assessment tool, which is presented as nine key challenges with actions, to support acute NHS Trusts in preparing an organisation-wide action plan integral to its overall strategic direction in reducing HCAIs. In addition, *Saving Lives* also includes six high impact interventions (HIIs) which are simple evidence-based audit tools. Their use is intended to provide a systematic method of measuring and improving compliance with specific clinical procedures such as hand hygiene compliance and insertion of invasive devices, and is designed to be used electronically using ward/department based PCs.

In 2006, *Going Further Faster: Implementing the Saving Lives Delivery Programme. Sustainable Change for Cleaner Safer Health Care*[29] was published as a result of work undertaken by the DH in conjunction with a number of Trusts that have made significant sustained improvements towards the national target of a 50 % reduction in MRSA bloodstream infections (bacteraemias).[31] The main findings and key recommendations for Trusts are as follows:

- HCAI costs the NHS £1 billion per year, and between £4,000 and £10,000 per infection
- HCAI affects all aspects of a Trust's performance
- Trusts have traditionally looked to infection prevention and control teams to reduce HCAI; however, achievement of the MRSA bacteraemia target will require the engagement and active involvement of all staff working at every level of the organisation, supported by the infection prevention and control team and identified 'champions'.
- Performance management should underpin the Trust's strategy to reduce HCAI and drive improvement.

- To realise system-wide change and sustainable improvement, all managers and clinicians need to understand the impact that HCAI has on their services, and work together with the infection prevention and control team to make this everyone's responsibility.
- Reducing HCAI benefits all aspects of the quality and efficiency of patient care. Sustainable improvement in HCAI requires board-level support and endorsement, with every Trust having a prioritised action plan that is integral to its overall strategic direction.
- Trusts must work towards a culture where there are no avoidable infections.
- Trusts must utilise the mandatory enhanced surveillance data for MRSA bacteraemia to focus and prioritise the action plan.
- Each MRSA bacteraemia should be treated as an adverse clinical incident and investigated using root cause analysis.[32]
- Trusts must use individual performance review (IPR) and personal development plans (PDPs) to increase personal responsibility for HCAI.
- Trusts must ensure productive clinical engagement, which is crucial to improve performance.

THE HEALTH ACT 2006

In 2006, the Department of Health published *The Health Act 2006: Code of Practice for the Prevention and Control of Health Care Associated Infections* (also known as the Hygiene Code), the purpose of which is to help NHS organisations plan and implement actions to prevent and control HCAI under three main headings:

Management, organisation and the environment [22]

Organisations have a duty to:

- protect patients, staff and others from HCA
- have in place appropriate management systems for infection prevention and control
- assess risks of acquiring HCAI and to take action to reduce or control those risks
- provide and maintain a clean and appropriate environment for healthcare
- provide information on HCAI to patients and the public
- provide information when a patient moves from the care of one healthcare body to another
- ensure co-operation
- provide adequate isolation facilities
- ensure adequate laboratory support.

Clinical care protocols [22]

- Organisations have a duty to adhere to policies and protocols

Healthcare workers [22]

- Organisations have a duty to ensure, as far as reasonably practicable, that healthcare workers are free of and are protected from exposure to, communicable infections during the course of their work, and that all staff are suitably educated in the prevention and control of HCAI.

The Code details the exact processes that NHS organisations must have in place and the specific arrangements and criteria that must be met in order to ensure that there is compliance with the Code. Each NHS body, whether it is an Acute Trust, Mental Health Trust, Ambulance Service Trust or Primary Care Trust (PCT) now has a statutory duty to put the code into practice and compliance with the Code of Practice will be assessed by the Healthcare Commission.[33] The Healthcare Commission (Commission for Healthcare Audit and Inspection) was created under the *Health and Social Care (Community Health and Standards) Act* in 2003, and replaced the Commission for Healthcare Improvement (CHI) in 2004. It has a statutory duty to assess the performance of healthcare organisations, and investigate where there have been allegations of serious failings that have a negative impact on the safety of patients, clinical effectiveness or responsiveness to patients.[21] Investigating outbreaks of serious HCAI is therefore part of its remit, and any failure to implement and comply with the Code of Practice means that the Healthcare Commission is empowered to issue an improvement notice where there has been a significant breach of the Code, or report the Trust to the Secretary of State for Health for significant failings and place it on special measures. These could include dismissal of the Trust board or individual members.[33]

THE INFECTION PREVENTION AND CONTROL TEAM

Against this background, infection prevention and control teams are facing increasing demands on their time and resources. They are the nursing and medical experts responsible for developing the Infection Control Annual Programme, the production of which has been standard practice since it became a requirement under the Controls Assurance Standards which were recently superseded by Standards for Better Health.[34] The annual programme is produced for the chief executive and the Trust board and describes the programme of work planned by the infection prevention and control team for the coming year. This may consist of the following activities, and may also identify additional work that needs to be undertaken by the Trust as a whole, as the responsibility for the prevention and control of healthcare associated infections does not rest solely with the team.

- Mandatory surveillance of MRSA bacteraemia (see Chapter 9).
- Mandatory surveillance of *Clostridium difficile* (see Chapter 11).

- Surveillance of other 'alert' organisms such as *Mycobacterium tuberculosis* (see Chapter 10) and *Streptococcus pyogenes* (see Chapter 12) resistant Acinetobacter and Vancomycin-Resistant Enterococci (VRE) (See Chapter 8).
- Reviewing and updating existing infection control polices and guidelines in line with evidence-based practice/DoH recommendations.
- Undertaking and commissioning audit projects which may be carried out solely by the team or in conjunction with the clinical audit department and/or clinical directorates, e.g. audit of *Saving Lives High Impact Interventions*; environmental ward/department audits; spot audits of IV cannula/central venous catheters and urinary catheters to ensure compliance with Trust guidelines; audit of antimicrobial prescribing.
- Education – delivering mandatory infection training for all staff who have day-to-day contact with patients; infection control training for medical staff on induction and participation in training for junior doctors; training for contracted domestic and portering staff; ad hoc training for wards/departments where required; participating in training run by other specialist teams where appropriate.
- Running an infection control link nurse programme – holding regular meeting/education sessions and an annual conference.
- Promoting the hand hygiene programme.
- Ensuring that the Trust complies with the management and monitoring of Legionella (see Chapter 20).
- Monitoring standards of cleanliness – day-to-day advice on cleaning issues; advise contractors on cleaning and domestic issues; participate in Executive PEAT visits.
- Giving infection control advice on new builds and site development, including the reconfiguration of clinical services.
- Reviewing Trust performance against the Healthcare Standards and Code of Practice.
- Continuing the day-to-day management of the infection prevention and control service – provide ad-hoc advice on the management of patients as appropriate; day-to-day management of all issues pertaining to infection prevention and control; respond to enquiries from patients and their relatives and members of the general public seeking advice; respond to media enquiries and give local television, radio and newspaper interviews as required; manage outbreaks of infection, e.g. Norovirus (see Chapter 14) and generate outbreak reports.
- Serve as members of various groups/committees e.g. infection control committee; clinical management board; risk management committee; drugs and therapeutics committee; tissue viability committee; heads of department meeting; health and safety committee; matrons forum; ward managers meetings; emergency planning group; medical devices group; consumable user review group; clinical practice forum; nutrition group; waste group.

As the only specialist nursing and medical team with responsibility for patients, staff, the public and the environment, infection prevention and control teams can find their

resources stretched to the limit. In 2000, the National Audit Office[26] identified what they perceived to be as 'a growing mismatch between what is expected of infection control teams in controlling hospital infection and the resources allocated to them' (page 40). The SENIC study in the 1970s[35] recommended that there should be one infection control nurse per 250 inpatient beds and although there are no hard and fast rules in the UK, this is the figure that is widely quoted and generally accepted. The reality is that infection control as a specialty is hugely under resourced.

THE WAY FORWARD

In February 2000, the National Audit Office[26] stated that the prevention and control of HCAIs was not seen as a priority within the health service. The strategic management of hospital acquired infection needed to be strengthened nationally and at NHS Trust level as it was clear that the NHS did not have a grip on either the extent of problem or the resulting financial burden. It also clearly stated that responsibility for the prevention and control of infection did not just rest with infection prevention and control teams. While factors compounding the problem of trying to control infections were acknowledged, the message was clear; the NHS as an organisation had to get its act together, and individual NHS bodies had to accept responsibility and start to take action.

The subsequent development of initiatives and programmes such as *Saving Lives*, and *Going Further, Faster* and the publication of the Code of Practice continues to drive home the importance of the prevention and control of HCAI, and the need for all Trusts to ensure that they have in place a prioritised, targeted and sustainable action plan to specifically improve compliance with infection prevention and control and drive down rates of HCAI. Engagement at all levels has to be sought and obtained, otherwise nothing will change. As the National Audit Office identified in 2004,[36] a root and branch shift across all levels of the NHS is required if infections are to be kept under control and the burden of HCAIs reduced, and while the profile of infection control has undoubtedly increased, there is still a long way to go. Those directly involved in patient care must be responsible for their practice and ensure that they comply with infection control policies, procedures and protocols in order to reduce the risk of infection to patients and provide good quality and effective care. The prevention of HCAIs must continue to be given a high priority and practices and organisational culture must continue to change for the better.