Outbreaks of infection in community settings: the nursing implications


Abstract

Outbreaks of infection are managed by specialist practitioners in public health and infection control. However, the occurrence of an outbreak impinges on the work of other nurses employed in the affected service. In most cases the effects will be self-limiting and although inconvenient at the time, are not far-reaching. However, media reports have fuelled concerns about outbreaks of infection among health workers as well as the public. The aim of this article is to provide an understanding of outbreaks of infection and the implications of outbreak situations for nurses employed in community settings, drawing on the lessons learned from a wide range of outbreaks past and present.

Aims and learning outcomes

THE AIM of this article is to provide an understanding of outbreaks of infection in community settings for nurses in clinical roles. After reading this article you should be able to:

- Explain the meaning of the following terms: epidemic, pandemic, endemic disease, and give examples of each.
- Discuss factors that affect the occurrence of infectious diseases and outbreaks of infection in a population.
- State how epidemics are detected.
- Explain the principles underlying the investigation of an epidemic.
- Discuss the implications of outbreaks for members of the public.

Introduction

Outbreaks of infection are frequently reported in hospitals and the community in western countries and the developing world (Lashley and Durham 2007). They often attract media attention and are a source of anxiety to patients and the public as well as to health professionals (Lynn et al 2004).

Outbreaks are managed by specialists in public health, and when they take place in hospital by infection control teams. In community settings the expertise of the infection control team may also be drawn on, for example in the case of an outbreak in a nursing home. Senior managers are involved, especially when dealing with the media and when additional resources such as extra staff are deployed (Lynn et al 2004). When an outbreak occurs it will inevitably impinge on the work of nurses employed in the affected service, either directly or indirectly.

Nurses are well placed to notice early symptoms of infection and can play an important part helping to recognise and report outbreak situations. Contact with infected patients can place nurses at risk of developing infection. Some infectious conditions that give rise to outbreaks are mild and self-limiting (Lynn et al 2004). Others can pose a serious threat to health (Loeb et al 2004). Some of the nurses who had contact with patients infected by the sudden acute respiratory syndrome (SARS) in 2003 became very ill and there were a number of fatalities (Loeb et al 2004).

Epidemiological terms

Epidemiology is the study of diseases and patterns of the distribution of disease in populations, either in hospital or the community (Last 2000). Traditionally, the term was used only when referring to communicable disease, but epidemiologists now study the rate and risk of all diseases, whether they are transmissible or not (Lashley and Durham 2007).

The work of the epidemiologist in relation to communicable disease entails surveillance (Box 1) to identify incipient outbreaks and assess the impact of strategies for control (Last 2000). The discipline of epidemiology has its own terminology.
Surveillance is a process of monitoring infection to identify changes in the baseline rate that will identify epidemiological trends so that rapid action can be undertaken to control outbreaks (Thacker and Berkelman 1988). Infection prevention and control teams in hospital monitor the number of cases of meticillin-resistant Staphylococcus aureus bloodstream infections and infections caused by Clostridium difficile and report them to the relevant statutory bodies in England and Wales, Scotland and Northern Ireland.

**Box 1: Surveillance**

Surveillance is a process of monitoring infection to identify changes in the baseline rate that will identify epidemiological trends so that rapid action can be undertaken to control outbreaks (Thacker and Berkelman 1988). Infection prevention and control teams in hospital monitor the number of cases of meticillin-resistant Staphylococcus aureus bloodstream infections and infections caused by Clostridium difficile and report them to the relevant statutory bodies in England and Wales, Scotland and Northern Ireland.

**1. Terminology**

Go online or use a standard textbook to check your understanding of the following terms: epidemic, pandemic, endemic disease, prevalence, incidence.

**Epidemic**

Epidemics are not precisely defined. Much depends on the type of infection, the population in which the epidemic has occurred and the last time the infection was detected in the population (Hawker et al 2005). According to one of the most widely accepted definitions, an epidemic is considered to have occurred if there is an increase in the expected number of infections in a population, locality or institution (Last 2000). A single case of a communicable disease long absent from a population or of a condition not previously recognised would require investigation, as would two cases related in time and place (Last 2000). Epidemics have been reported in schools, nurseries, hospitals, hotels and on cruise ships. Cases can emerge over a long period or explosively over a very short time, sometimes within a few days (Curran and Wilson 2008).

**Example**

Give an example of an epidemic. What was the source of your information? What was the causative organism and how many people were involved?

Epidemics provide excellent human interest material for journalists (Boyce et al 2009). It is therefore likely that you will have obtained your information by reading a newspaper or from the radio or television. Examples of organisms that have caused outbreaks of infection in recent years and which have attracted considerable media attention are listed in Box 2. The list is not exhaustive and it is possible that you may have suggested an example that took place locally and which has not been widely reported.

When an epidemic is reported the reaction of the public is usually one of fear and sometimes outrage, especially if there is a perception that the situation could have been prevented. The outbreaks of Clostridium difficile reported from Stoke Mandeville Hospital in Buckinghamshire between 2003 and 2005, and Maidstone and Tunbridge Wells NHS Trust between 2005 and 2006 received wide media coverage for months, prompting public outcry regarding the state of hygiene, environmental cleanliness and the quality of patient care in British hospitals. Both incidents were followed by public enquiries.

There were striking similarities between the two hospitals. In both it was concluded that the epidemics constituted untoward incidents waiting to happen, with failure to implement guidance from the resident infection control teams. Both organisations had recently undergone difficult mergers and the reports suggested that managers were preoccupied with financial issues and imperatives to meet government-imposed targets at the expense of responding to important clinical issues. The patient care environment

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**Box 2: Some organisms that have given rise to outbreaks on infection in the community**

- Norovirus
- Influenza viruses
- Escherichia coli 0157
- Legionella pneumophila
- Salmonella
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Table 1  Notifiable infections (England and Wales)

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<td>Cholera</td>
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was poor in both cases including old buildings that were difficult to clean, dormitory-style wards, lack of single rooms and nursing shortages. Unacceptable standards were reported, including high levels of environmental contamination and poor hygiene. Coupled with an increase in the number of cases of *C. difficile* reported nationally, these two epidemics helped to increase the profile of infection prevention in the UK and led to the introduction of mandatory reporting of *C. difficile* from April 2007. Reported cases in the UK have since declined (Gould 2010).

There are other examples of large hospital outbreaks of infection affecting public health policy and changes in legislation. The Stanley Royd incident is still widely quoted as an example. In 1984 an outbreak of *Salmonella* food-poisoning at the Stanley Royd Hospital in Wakefield, Yorkshire affected 355 patients, mostly those who were frail and old, resulting in 19 deaths (Department of Health and Social Security (DHSS) 1986). The subsequent enquiry revealed poor practices in the hospital kitchen highlighting the risk of foodborne infection to vulnerable older people. The incident eventually resulted in the removal of Crown Immunity which until 1987 had protected hospitals from prosecution by environmental health officers (DHSS 1986).

**Pandemic** A pandemic is defined as the simultaneous occurrence of the same infection among large numbers of people, usually on a scale involving several countries or entire continents (Hawker *et al* 2005). History is full of examples (Boxes 4 and 5 page 37). Such accounts continue to attract attention because they contain messages about the past behaviour of communicable disease that can offer valuable contemporary information (Last 2000).

The influenza pandemic that killed 20 million people throughout the world in 1918 is of particular interest because it contains information about the behaviour of the influenza virus and important messages for modern approaches to prevention, especially in the light of the H1N1 (swine 'flu) pandemic in 2009 (Phillips and Killingray 2003). H1N1 infection proved not to be as serious as originally feared: the virus caused a relatively mild infection.

Most people are reported to have recovered uneventfully without healthcare intervention or medication (Health Protection Agency (HPA) 2009). However, when a pandemic occurs, concern is inevitable as the infection moves from one country to another. The more serious the infection is, the greater the need for forward planning.

Health officials charted the progress of SARS in detail, including its emergence in Hong Kong in February 2003, its rapid appearance in other parts of Asia, North America, Canada and Europe and its effect on the populations and healthcare systems in affected countries (Fung and Cairncross 2006). Throughout 2003 there were 8,098 probable cases with a mortality rate of 9.6 per cent (Parashar and Anderson 2004). The modern management of a pandemic demands collaboration between the public health agencies in affected countries (MacLehose *et al* 2001). In addition, these agencies receive advice and support from the World Health Organization (WHO), which produces guidelines for the control of communicable disease.

**Endemic disease** An endemic disease is one that is always present at low levels in a population (Hawker *et al* 2005). The number of cases depends on factors that allow the organism responsible to multiply and the susceptibility of people in the population. Malaria is endemic in many parts of the world where mosquitoes carrying the infective...
organisms (plasmodia) are able to breed because economic conditions are poor and there is a lack of resources and infrastructure to drain the stagnant water which harbour them. Malaria is a huge global problem. According to WHO (2013) it causes over a million deaths every year, mostly in Africa. Infants, small children and pregnant women are at greatest risk (WHO 2013).

The infection is responsible for enormous suffering and economic loss. Most cases reported in the UK are contracted abroad, although travellers incubating infection may not experience symptoms until they return home. Failure to take prophylaxis is the main cause of malaria contracted in this way (Hill 2006).

Infections can also become endemic in hospitals and nursing homes. In the 1980s, meticillin-resistant Staphylococcus aureus (MRSA) was continually present in many hospitals in the UK (Duerden 2007). Legislation introducing improved surveillance, coupled with more strictly enforced infection prevention and control precautions in NHS trusts, has since resulted in a decrease in the number of MRSA bloodstream infections.

**Identifying epidemiological trends**

Surveillance plays an important role in identifying unexpected occurrences and upsurges of infection. In NHS trusts, local infection prevention and control teams undertake this activity for key healthcare-associated infections (Box 1, page 33). Surveillance in the community is undertaken by the HPA in England, Public Health Wales and Health Protection Scotland. They monitor the number of cases of notifiable infections reported to them by clinicians (Table 1). A similar system is in place in Northern Ireland. These bodies suggest where and how preventative action should be taken or the need for health promotion. For example, upsurge in measles, mumps or rubella would indicate the need for a renewed campaign to encourage uptake of the immunisation.

Responsibility for notification falls to local authorities, which have a statutory responsibility to control communicable disease reported within their boundaries. They are also permitted to follow up other infectious conditions not listed in Table 1. For example, human immunodeficiency virus is not notifiable, but there is a confidential voluntary referral scheme. Sexually transmitted infections are reported anonymously to the Department of Health.

**Investigating epidemics**

When an epidemic is detected, the pattern of its distribution throughout the affected population can be illustrated on a graph by plotting the number of new cases against their date of onset.
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Figure 3  Propagated outbreak

![Propagated outbreak graph](Adapted from Gould and Brooker 2008)

Figure 4  Cyclical epidemiological curve

![Cyclical epidemiological curve graph](Adapted from Gould and Brooker 2008)

Figure 5  Timeline graphs

![Timeline graphs](Adapted from Curran and Wilson 2008)

The (first) index case appeared on day 1. Two more cases appeared sporadically on day 5 and day 7. On day 10 three new cases were detected. Therefore it can be inferred that the incubation period is around 3-7 days and the first patient must have been exposed to the infectious agent 3-7 days before symptoms were detected. No new cases were detected after Day 10, indicating that infection control precautions have been effective.

(Adapted from Curran and Wilson 2008)

2005). It usually occurs when the incubation period is short (hours or days) and recovery is rapid (Figure 2, page 35). This is the pattern often seen with foodborne illnesses, when contaminated produce has been consumed at a party or in the same restaurant.

Propagated outbreak In a propagated outbreak the epidemiological curve is shallow because the causative organism has a longer incubation period (weeks or months) and new cases appear gradually (Figure 3). Successive waves on the graph represent secondary spread from one person to another. A propagated outbreak might occur with an enteric pathogen such as *Salmonella enteritidis*, which causes nausea, vomiting and diarrhoea. The incubation period is 12-72 hours but symptoms take up to seven days to appear. Person-to-person spread can occur in the same household or ward, resulting in the secondary peak illustrated in Figure 3. Secondary spread indicates that any infection control measures implemented up to that point have not been successful, either because they were not the right ones or, despite being appropriate, have not been properly implemented. Further investigation is required to provide more information (Curran and Wilson 2008). For example, in the case of an outbreak of food poisoning, food storage, handling and preparation would be investigated by the environmental officer of health.

Cyclical epidemiological curve Some infectious agents give rise to epidemics that occur cyclically every few years. This was common for the classic childhood infections such as pertussis (whooping cough), measles and mumps before immunisation programmes were introduced. Outbreaks were reported when cohorts of children lacking immunity had developed in the community, peaking when the maximum number of cases occurred and waning as the availability of potential victims declined (Figure 4). Between outbreaks, cases of infection became sporadic until a new cohort of children lacking immunity had developed once more.

Time-line graphs To illustrate which patients have become infected and when, time-line graphs can be used (Figure 5). Looking at Figure 5 it is possible to infer when exposure to the source of infection happened as initial contact with the infectious agent must have taken place before the appearance of the first (index) case. However, time-line graphs cannot reveal what has happened to trigger the infection without additional information. Nursing insights can be important. They can alert the infection prevention and control team to a new clinical practice or failure.
Box 3 Factors influencing the development of outbreaks

- Demography
- Social and behavioural factors
- Advances in healthcare technology
- Climate change
- Wars
- Natural disasters

(Lashley and Durham 2007)

to implement an existing practice or the presence in the community of a possible source of infection.

Communicable disease and the development of epidemics

Epidemics develop when substantial numbers of people in a population are susceptible to the infectious agent, suitable environmental conditions prevail and the pathogen is able to cause disease readily in the available hosts. Factors that can influence the occurrence of epidemics are shown in Box 3 (Lashley and Durham 2007).

Risk is increased when a large cohort of susceptible people exist together, explaining why outbreaks so commonly occur in closed or semi-closed environments such as schools, hospitals and nurseries (Lashley and Durham 2007). Demography is important. The rapid growth of a population, changes in its profile, such as increased birth-rate or aging, migration, housing conditions and the way that a population is distributed within a country, all influence the pattern of communicable disease. For example, increased life expectancy in developing countries has fuelled the need for nursing home accommodation where frail, older residents undergo frequent transfers between the home to hospital. They may acquire MRSA during admission and still be carriers on discharge: the incidence of MRSA carriage in nursing homes in the UK is 20 to 30 per cent (Barr et al 2007). Other infections commonly reported from the nursing home sector and which may cause frail, older residents undergo frequent transfers are norovirus (Wu et al 2005) and infestations of scabies (Johnston and Sladden 2005).

Overcrowding and poor living conditions have traditionally been associated with increased risk of infectious disease and outbreaks. The Black Death in the 14th century (Box 4) was possible because human habitations were frequently infested with rats carrying the fleas that acted as the vectors of disease. Although cases of bubonic plague are still sometimes reported, the possibility of a major outbreak in a western country is highly unlikely. A vaccine has been developed to protect travellers who venture to the regions, mainly in China and Russia, where cases are occasionally still reported. Members of the public can be reassured that person-to-person transmission is not a feature of this infection (Hays 2005).

Social and behavioural factors are important contributors to the changing patterns of communicable disease in populations and influence the occurrence of epidemics. For example, more liberal attitudes and behaviour have resulted in an upsurge in sexually transmitted disease for people of all ages in England and Wales (HPA 2010a). The rise has been greatest for people aged between 18 and 24 years, but there has also been an increase among middle-aged people who become single again after marital breakdown.

The Family Planning Association has responded by launching the Middle-age Spread campaign (tiny.cc/middleagespread). Generally, these individuals are less confident than younger people about

Box 4 The Black Death

The Black Death (bubonic plague) which swept across Europe in the 14th century is a much-quoted example of a pandemic of historical significance (Hays 2005). Bubonic plague is caused by the bacterium *Yersinia pestis*, which is carried by fleas infesting rats. The nature of the infection is indicated by descriptions of the typical, florid symptoms that victims developed: blackened skin and enlarged, discoloured lymph nodes ("buboes"). When the symptoms are less distinctive it is harder to deduce the cause of a pandemic occurring long ago and impossible to be certain about the numbers of people affected because records, often obtained from sources such as parish registers, do not provide accurate or complete information.

Box 5 Legionnaires' disease

Legionnaires' disease is a modern phenomenon that has arisen because *Legionella pneumophila* thrives and multiplies in the modern built environment, in complex water systems where water is allowed to stagnate. The first recorded outbreak was reported among delegates attending a convention of the American Legion in Philadelphia in 1976. Two hundred and twenty one mainly middle-aged and older men developed pneumonia and 34 died (Newsom 2008).

*Legionella pneumophila* lives harmlessly in the environment but at the time little was known about it because the bacteria are difficult to grow in the laboratory and their pathogenic potential was unsuspected. They survive in the still water of cooling towers and ventilation systems in tall buildings, especially in sections that are unused, and are disseminated in aerosols, including those created by showers.

The outbreak in Philadelphia was possible because of a unique combination of factors. The hotel was an old building with an antiquated water system and the delegates were predominantly middle-aged and older men, who are especially susceptible to Legionnaires' disease. The outbreak attracted intense media interest because of the mysterious nature of the infection and the emergence of a large number of cases in a luxury hotel.

Over the years a number of outbreaks have been reported in the UK. Overhaul and replacement of old heating and water systems and maintaining water at temperatures able to destroy the bacteria have proved effective control measures (Newsom 2008).
accessing sexual health services and are at particular risk if there is no need to use barrier methods of contraception to prevent pregnancy. They may be more receptive to information and advice from nurses they meet during other routine health consultations, for instance in the general practice setting. The campaign website provides health promotion resources designed for use by nurses in non-specialist roles.

Air transport is another important factor adding to the risk of introducing communicable disease previously rare or unknown in a given population. Individuals can incubate SARS or malaria without showing signs of infection until after arrival (Hill 2006). The risks of respiratory infection are increased on aircraft because air is recycled.

Advances in health technology enable some pathogens to infect human hosts for the first time, or help to increase existing risks (Box 5, page 37). Antibiotic-resistance among bacteria emerged as an adaptive response that enables them to survive and multiply at the expense of antibiotic-sensitive strains, giving them selective advantage (Ayliffe et al 1998). The higher susceptibility of older and very sick people coupled with increasing use of invasive devices has placed large numbers of patients at risk of infection by the bacteria (Gould 2009).

Advances in technology have also reduced the incidence of some communicable diseases and the risk of outbreaks. The introduction of vaccines that provide protection against Haemophilus influenzae and Neisseria meningitidis have dramatically reduced the incidence of menigitis. Climate change, wars and natural disasters have all been associated with increased risk of communicable disease and the occurrence of epidemics (Lashley and Durham 2007).

Susceptible hosts
Infectious agents depend for their survival on a supply of new hosts. Public health measures to reduce the number of people affected focus on immunisation programmes, especially those aimed at children and young people. The purpose of immunisation is to create a state of herd immunity in the community.

Herd immunity
Herd immunity depends on ensuring that levels of susceptibility to a particular infection are low. What is the public health challenge of maintaining herd immunity and the nursing implications?

A state of herd immunity will only persist in a community if everyone or nearly everyone who is potentially susceptible has been immunised and the vaccine is effective. It is generally accepted that more than 90 per cent of a population must be immune for this state to exist. An important part of the role of health visitors, practice nurses and school nurses is to ensure that high levels of uptake of immunisation are attained to promote the health of the individual child and of all children in the population. However, immunisation will never be able to offer every individual or all populations complete protection.

There are many infections, for example malaria and most sexually transmitted diseases, for which vaccines are not yet available, compliance may be poor and in developing countries governments may be unable to bear the cost of immunisation programmes or lack the infrastructure to administer them. Some vaccines must be administered annually because antigens on the surface of the causative organism are capable of undergoing mutation so that the existing vaccine becomes ineffective (antigenic drift).

In the UK, people in the groups eligible to receive immunisation for influenza (people over 65 years and those with chronic conditions) are invited to receive the vaccine every autumn because the virus undergoes antigenic drift (Mayon-White 2005). For a small minority of people, immunisation is considered unsafe. Some vaccines are prepared from attenuated organisms (ones that have been weakened but are still alive). These are not suitable for individuals whose immune response is impaired through ill health or treatment such as cancer chemotherapy.

‘New’ infections
Over the years ‘new’ infections have emerged as changing conditions in populations have placed individuals at risk for the first time and advances in technology have made it possible to detect the organisms responsible (Box 4 page 37). Box 6 provides some examples of ‘new’ infections detected for the first time throughout the second part of the 20th century. Sometimes existing pathogens are found to be responsible for new, serious infections. Escherichia coli is a normal inhabitant of the human gastrointestinal tract able to cause healthcare-associated infection. Outside hospital it is most frequently responsible for urinary tract infections and diarrhoea in overseas travellers.

In recent years a strain called E.coli O157 has gained notoriety for causing foodborne infection which can have severe health consequences, especially in young children. An outbreak reported in 1996 in Lanarkshire, Central Scotland resulted in 20 deaths. The source was a butcher’s shop that supplied meat and meat products to other business outlets (Williams and Ellison 1998). Numerous recommendations for food handling, training, minimising contamination,
regulations and enforcement, and managing outbreaks were published by the Pennington Group, which was established by the government to investigate all aspects of the Lanarkshire outbreak (Pennington Group 1997).

Other outbreaks and sporadic cases of *E. coli* 0157 have been reported since 1996. Most have been attributed to the consumption of contaminated food, but in 2009 an outbreak was traced to a ‘petting’ farm in Surrey resulting in hospital admission for 12 children, some of whom required renal dialysis. It is likely that new recommendations for such recreational visits involving contact with animals will be made in the wake of this widely publicised event.

Managing outbreaks of infection

The HPA has drawn up standards and an action plan for managing outbreaks of infectious diseases (HPA 2012). These are meant to provide a blueprint for best practice, but they must be adopted according to local need and are meant to be used flexibly. The primary objective is to protect the public and prevent further spread. The guidelines suggest that once an outbreak has been recognised, investigations should begin within 24 hours with immediate risk assessment and formally convening an outbreak control team.

The next step is descriptive epidemiology to document the number of cases, type of epidemic curve, description of the key characteristics of the people affected (such as age and gender), geographical spread and risk factors. This information is used to generate a hypothesis concerning the likely source of the infection and how spread should be controlled to protect the public.

Risk assessment will need to be repeated throughout the course of the outbreak and it may be necessary for the outbreak control team to seek legal advice. The outbreak is declared over when the number of new cases has declined, there is no longer a threat to public health and the probable source of the outbreak has been identified and withdrawn.

The public health bodies in the UK also play a major role drawing up and implementing guidelines to help prevent outbreaks of infectious disease. For example, the HPA has issued guidance on the management and control of norovirus outbreaks (Norovirus Working Party 2011) and plans in the event of an influenza pandemic (HPA 2010b). Nurses with special expertise in the relevant area may be invited to contribute to the working groups responsible for compiling such guidance, usually through their membership of a professional body such as the Infection Prevention Society.

Outbreaks and the media

Epidemics and pandemics attract intense media attention because they capture the ‘human interest’ angle so well (Boyce et al. 2009). Stories are especially newsworthy if they affect frail older people, such as the *C. difficile* outbreaks reported in Stoke Mandeville Hospital and Maidstone and Tunbridge Wells NHS Trust, children, as in the 2009 *E. coli* outbreak described above, or affect people in luxury surroundings such as hotels that are assumed to offer high standards of cleanliness and hygiene (Box 5, page 37). Senior managers, public health nurses and members of the infection prevention and control team work together in outbreak situations to prepare statements for the press containing material that is accurate, factual and honest.

To avoid confusion other members of staff are usually requested not to speak to the press. The HPA provides information on its website specifically designed to help the media report cases of infection and outbreaks in an accurate, non-alarmist fashion. Nevertheless media reports are frequently inaccurate and sensational. This is a major cause for concern as lay people appear to obtain most of their information about infections, especially healthcare-associated infections, from the media and are thus at risk of being misinformed (Washer and Joffe 2006).

Implications for the public

Members of the public are deeply concerned about the risks of infectious conditions, including health care-associated infections (Gould et al. 2009).
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which contains regularly updated information written to meet the needs of a lay audience and is free of charge. Communication is also part of the work outbreak control teams. The website provides an excellent resource for lay people and health workers concerning all matters related to infection.

Conclusion

In the UK and other developed countries sophisticated surveillance systems are in place to monitor the rates of communicable disease in the population, enabling prompt action to be taken if an unusual infection is detected or if the number of cases of a given infection increases. However, communicable diseases still offer a threat to people in this country and globally, especially throughout the developing world. Outbreaks of infection are a source of anxiety to members of the public and disrupt patient care and service delivery in modern healthcare systems. They affect the work of nurses by increasing workload and the need to cope with the questions and concerns of people who are affected and members of the public who are anxious.

References


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