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The burden of healthcare-associated infections, and disease threats old and new

Contents

Fundamentals of Infection Prevention and Control: Theory and Practice, Second Edition. Debbie Weston.

Introduction

This introductory chapter is in two parts. The first part looks at the burden and impact of healthcare-associated infections on the NHS as an organisation and on patients, including risk factors for, and risk factors contributing to, the development of these infections, and the threats to public health posed by old and new infectious diseases. The second part briefly reflects on the changing face of healthcare and summarises some of the key differences and challenges regarding infection control in acute and community care settings.

Learning outcomes

After reading this chapter, the reader will be able to:

- Define healthcare-associated infections (HCAIs).
- List six patient risk factors for the development of HCAIs.
- List 10 general factors that can increase the risk of HCAIs.
- List six ways in which HCAIs can affect patients and healthcare providers.
- Understand the continuing threat to public health from old and new diseases.

Background

The problem of healthcare-associated infections (HCAIs) is not a new one. In 1941, seven years before the creation of the NHS, the British Medical Council recommended that 'control of infection officers' be 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.

Fact Box 1.1 The first Infection Control Nurse

The first Infection Control Nurse was appointed in the United Kingdom in 1959 (Gardner *et al.*, 1962). The appointment of Miss E.M. 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 (see Chapters 5 and 20) had been causing problems in UK hospitals since 1955, and staphylococcal surveillance at Torbay Hospital 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.

Miss Cottrell was appointed for an experimental period to assist in the collection of surveillance data and advise healthcare staff 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 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* (see Chapter 10) and *Proteus* started to overtake *Staphylococcus aureus* as agents of cross-infection (Selwyn, 1991). (There are Fact Sheets on all these organisms on the companion website.) *Pseudomonas* in particular established itself as a major **opportunistic** hospital pathogen in those with underlying illness. 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 methicillin (known as meticillin since 2005), which gave rise to meticillin-resistant *S. aureus* (MRSA). MRSA really started to become problematic in the 1970s, and it exploded during the 1980s (see Chapter 20). Since then, antibiotic resistance has become increasingly common with most strains of bacteria now resistant to one or more antibiotics, and as discussed in Chapter 10, the emergence of pan-resistant strains currently represents a major threat to public health.

The problem of HCAIs

Fact Box 1.2 Definition of a healthcare-associated infection

A healthcare-associated infection can be defined as 'an infection occurring in a patient during the process of care in a hospital or other healthcare facility, which was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge and also occupational infections amongst staff of the facility' (World Health Organization [WHO], 2011). An infection occurring within 48–72 hours of admission is considered to be community acquired (unless there is a link with a previous hospital admission); an infection occurring more than 48–72 hours post admission is healthcare associated. HCAIs, especially those that are avoidable, are harm events.

HCAIs are a global concern affecting hundreds of millions of patients per year, with the highest prevalence in developing or low-income countries (WHO, 2011), where resources are limited and reporting and surveillance strategies are weak. In 2011, the publication of the *Report on the Burden of Endemic Healthcare Associated Infection Worldwide* by WHO identified that:

- The prevalence of HCAIs in low and middle-income countries varies between 5.7% and 19.1%.
- Infection rates in newborn babies are 3–20 times higher in low and middle-income countries than in developed or high-income countries; in the former, HCAIs are responsible for 4–56% of deaths in the neonatal period (and 75% of neonatal deaths in Southeast Asia and Sub-Saharan Africa).
- The proportion of patients with infections acquired in intensive care units in low- and middle-income countries ranges from 4.4% to 88.9%.
- The incidence of surgical site infections is up to nine times higher than in developed countries.

As far back as 1995, the Department of Health (DH) (Department of Health and Public Health Laboratory Service, 1995) estimated that:

- Hospital-acquired infections (as they were referred to then) were responsible for the deaths of 5000 patients in the United Kingdom each year.
- HCAIs were probably a contributing factor, but not the primary cause, in at least 15 000 other deaths.
- At any one time, one in 10 patients receiving care in acute hospitals had a hospital-acquired infection, and a significant but undetermined number of patients discharged from hospital into the community also had, or developed, infections related to their hospital stay.
- While it was not possible to prevent all infections, there were several recognised risk factors which increased the risk to patients.
- Between 15 to 30% of infections could be prevented through good clinical or infection control practice.

In 1999, a report by Plowman *et al.* arising from a project funded by the DH had identified that:

- Of hospital in-patients, 7.8% had one or more hospital-acquired infections, and 19.1% of patients reported symptoms of infection post discharge.
- Costs associated with treating patients with infections were 2.9% higher than the costs associated with uninfected patients, representing approximately £3154 per case.
- The average length of stay for patients with an infection was 2.9 times longer and equivalent to an additional 11 days.
- Patients who had an infection identified either in hospital or post discharge took longer to return to normal activities and had more days away from employment as a result.
- Patients with an infection were seven times more likely to die than uninfected patients.
- Hospital-acquired infections were estimated to cost the NHS in England £986.36 million annually.

Concerns regarding the burden of HCAIs and their management and control within the NHS have been highlighted by the National Audit Office (NAO) over the last decade with the publication of three NAO Reports in 2000, 2004 and 2009.

The first NAO Report (2000) stated that the prevention and control of HCAIs were not seen as priorities within the health service, and that the strategic management of hospital-acquired infections 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 the problem or the resulting financial burden. It also clearly, and significantly, stated that responsibility for the prevention and control of infection did not rest solely with Infection Prevention and Control Teams (IP&CTs). 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 second NAO Report, published in 2004, went on to identify that a root and branch shift across all levels of the NHS was required if infections were to be kept under control and the burden of HCAIs reduced. The Report acknowledged that although the profile of infection control had undoubtedly increased and there had been 'notable progress at trust level in putting the systems and processes in place and strengthening infection control teams . . . wider factors continue to impede good infection control practices'. The Report stated that the implementation of recommendations had been 'patchy', and that it was imperative that engagement at all levels had to be sought and obtained in order to effect change.

In the intervening years between the publication of the second Report and of the third Report, in 2009, a large number of **DH-led drives and initiatives** were developed and implemented. Amongst them were:

- The introduction of national MRSA bacteraemia reduction targets, which had to be investigated as adverse clinical incidents using root cause analysis (RCA) (replaced as of the 1st April 2013 by Post Infection Reviews, or PIRs) (see Chapter 2)
- Mandatory surveillance (beginning in 2004) for *Clostridium difficile* in patients over the age of 65, which was extended in 2007 to include patients aged two and over (see Chapter 3)
- The introduction of a national *C. difficile* reduction target in 2007 (along with the setting of local reduction rates with hospitals by primary care trusts [PCTs] in their role as commissioners of healthcare services) (see Chapter 22)
- The launch in 2005 by the DH of Saving Lives, a delivery programme to reduce healthcare-associated infections including MRSA
- Implementation of new legislation regarding healthcare associated infections with the introduction of the Health Act 2006: *Code of Practice for the prevention and control of healthcare associated infections* (DH, 2006).

The third NAO Report (2009) concluded that although there had been significant changes, including a change of culture, there were still numerous areas for improvement, particularly around strengthening surveillance, reporting HCAIs that contribute to death, significant disability or injury, and improving compliance with practice.

Reflection point

Box 1.1 lists the recognised patient risk factors for the development of HCAIs. How many risk factors can you identify in your patients?

Box 1.1 Patient risk factors for HCAIs

Age > 65 years (see Chapter 8)
Emergency admission to an intensive care unit
Hospital in-patient stay of > 7 days
Insertion of an invasive indwelling device (e.g. vascular access device, urinary catheter or endotracheal tube) (see Chapters 16, 17 and 19)
Surgery (see Chapter 18)
Trauma-induced **immunosuppression**
Neutropenic (see Chapter 9)
Rapidly, or ultimately fatal, disease
Impaired functional status.

Source: Data from WHO, 2011.

HCAI point prevalence surveys

HCAI point prevalence surveys provide a snapshot of the numbers of cases of illness or disease (e.g. HCAIs) in a population at a given time. A number of HCAI point prevalence surveys have been undertaken in the United Kingdom since the 1980s, as summarised in Table 1.1; Table 1.2 compares the prevalence of specific HCAIs.

Table 1.1 Summary of HCAI point prevalence, United Kingdom, 1980–2012

Year and location	Number of patients included in surveys	HCAI point prevalence
1980, United Kingdom	18 163	9.2%
1996, United Kingdom and Republic of Ireland	37 111	9.0%
2006, England, Wales and Ireland	58 775	8.2% England – 8.2% Wales – 6.3% Northern Ireland – 5.5% Republic of Ireland – 4.9%
2011, Wales	—	4%
2011, England	52 443	6.4%
2011, Scotland	13 558	4.9%

Source: Data from Meers *et al.*, 1981; Emmerson *et al.*, 1996; Hospital Infection Society and Infection Control Nurses Association, 2007; Welsh Healthcare Associated Infection and Antimicrobial Resistance Programme, 2011; Health Protection Agency, 2012; Health Protection Scotland and NHS National Services Scotland, 2012.

Table 1.2 Prevalence of specific HCAIs, 2006 and 2012

HCAI	2006	2012
Urinary tract infections	19.7%	17.2%
Pneumonia and respiratory tract infections	13.9%	22.8%
Surgical site infections	13.8%	15.7%
Gastro-intestinal infections	22%	8.8%
Bloodstream infections	6.8%	7.3%
MRSA prevalence	1.28%	<0.1%
C. difficile prevalence	1.98%	0.4%

Source: Data from Hospital Infection Society and Infection Control Nurses Association, 2007; Health Protection Agency, 2012.

Boxes 1.2 and 1.3 list the factors that contribute to the increase in HCAIs and the impact that HCAIs have on patients and the NHS.

Box 1.2 General factors contributing to the increase in HCAIs

Increase in the number of patients undergoing major surgery and invasive diagnostic procedures

An increasing elderly population with weakened immunity and increased susceptibility to infection

- > 18% of the UK population over retirement age
- 1.3 million people in the United Kingdom aged 85 or over
- 65% of hospital beds occupied by patients over the age of 65

Hospitals no longer able to cope with the patient population – design, layout, condition and maintenance of buildings and environment

Increased bed occupancy rates

Increased patient turnaround times

Increased movement of patients

Lack of isolation facilities

Use of invasive indwelling devices

Lack of equipment

Contaminated equipment and devices

Length of stay

Antibiotic resistance

Poor antimicrobial prescribing (see Chapter 10)

Poor infection control practice

Poor clinical leadership

Poor staff-to-patient ratios

Poor staff morale.

Source: Data from DH, 2000, 2004, 2007; Cunningham *et al.*, 2005; Wigglesworth and Wilcox, 2006; Griffiths *et al.*, 2008; National Office for Statistics, 2009; Poteliakhoff and Thomson, 2011; Imison *et al.*, 2012.

The challenge of disease threats old and new

It is difficult to predict when a new disease with the potential to wreak havoc and destruction will emerge, but an increase in the emergence of new diseases and the re-emergence of old foes such as tuberculosis (see Chapter 21) is inevitable, due to the astounding abilities that microorganisms possess, which enable them to diversify and mutate. Centuries-old infectious diseases such as

Box 1.3 The impact of HCAIs

- Effects on patients and their relatives – fear and anxiety, psychological effects of isolation in a single room or isolation ward, loss of earnings, harm, disability or death
- Increased length of stay
- Delayed discharges – lost bed days and loss of revenue
- Expenditure on litigation, antibiotic prescribing, extra equipment, extra staff and additional cleaning resources (outbreak situations)
- Financial penalties for failing to meet DH HCAI reduction targets and loss of Commissioning for Quality Innovation (CQUIN) funding (no avoidable infections)
- Public confidence in the NHS as an organisation and in local services badly dented
- Adverse publicity
- Poor morale amongst staff.

plague, one of the oldest notifiable diseases known to humans, remain endemic in many parts of the world today; smallpox was eradicated in 1979, but it is recognised as posing a potential public health threat in the event of a deliberate release as an act of bioterrorism. Childhood diseases such as measles (see Chapter 5) and pertussis, both of which are preventable through vaccination, still cause outbreaks. Since the 1970s, more than 30 new infectious diseases have emerged worldwide, including Legionnaires' disease, new-variant Creutzfeldt–Jakob disease (CJD), HIV and hepatitis C (Chapter 24). As demonstrated with the severe acute respiratory syndrome (SARS) pandemic, and decades earlier with the 1918–1919 Spanish influenza pandemic, increases in the global population and global travel have led to an increasingly densely packed and mobile population, meaning that an infectious disease can spread anywhere in the world within a matter of hours. Fact Sheets on plague, smallpox, pertussis, Legionnaires' disease, CJD (along with new-variant CJD) and Spanish influenza are available on the companion website.

SARS

Somewhat prophetically in January 2002, a report by the Chief Medical Officer (DH, 2002) acknowledged that it was inevitable that new infectious diseases would emerge, as at least 30 new infectious diseases had emerged since the 1970s, and that it was therefore 'essential to expect the unexpected'. Ten months later, one such new disease emerged in Southeast Asia, leading to a global outbreak between March and July 2003.

The new disease caused widespread fear and panic, badly affected trade and the travel industry, overwhelmed the provision of healthcare services where the highest burden of cases was seen amongst healthcare workers, and took advantage of the fact that the world is now a highly mobile society by efficiently spreading across the globe. That new disease was SARS, and it was the first new viral disease threat of the twenty-first century. In July 2003, WHO issued a global statement declaring that the last human chain of transmission had been broken and the first global outbreak of SARS had been contained, and in May 2005 it declared that SARS had been eradicated, although whether it has gone forever remains to be seen.

Fact Box 1.3 SARS

SARS affected more than 4300 people in 32 countries, with an additional 8400 probable cases, and resulted in more than 800 deaths (WHO, 2003). The highest **mortality rate** was seen amongst healthcare workers.

Further information regarding the origin of the SARS virus can be found in Chapter 5.

Fact Box 1.4 The emergence of a novel coronavirus in 2012

In the late summer of 2012, reports emerged out of the Middle East of a novel coronavirus that was causing isolated cases of an acute, severe respiratory illness. The virus appears to be distantly related to, but different from, the SARS virus. Like SARS, the respiratory illness presents as pneumonia, but it does not appear to be (certainly at the moment) readily transmissible. As of the 12th May 2013, there have been 34 laboratory cases, including 18 deaths. Although much is yet to be learnt about this new virus (now officially known as Middle East respiratory syndrome coronavirus, or MERS-CoV), early indications are that, like the SARS virus, it is a **zoonosis**, and is linked to the bat coronavirus. Further information on this new disease can be found on the WHO and Health Protection Agency (HPA)/Public Health England websites (www.who.int and www.hpa.org.uk).

Pandemic influenza

Microorganisms previously unknown or unrecognised, or thought to cause disease only in animals, can and have evolved to produce more **virulent** strains which can also affect humans. Avian influenza is one such example (see Fact Sheet 1.1 on the companion website). The world has recently experienced an influenza pandemic, and although it was not as devastating as initially feared, there were a number of deaths globally.

Fact Box 1.5 H1N1 'swine flu' pandemic

The 2009 H1N1 'swine flu' pandemic was caused not by the emergence of a new strain of influenza, but from a triple re-assortment (genes derived from human, swine and avian influenza A viruses) North American swine influenza virus, which in turn had acquired genes from Eurasian strains of influenza.

The story of the H1N1 pandemic, and lessons learnt, can be found on the HPA/Public Health England website at http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/Influenza (HPA, 2013). Information about the influenza virus can be found in Chapter 5.

Changes within the NHS and the provision of healthcare

The healthcare arena has changed significantly since the early days of the NHS, and the NHS itself has undergone immense re-organisation over the last 60 years. It now faces what is widely deemed to be its most radical shake-up yet, with the implementation of the Health and Social Care Act 2012 and the controversial NHS reforms. These are too complex and too numerous to mention here, but the 'story' of the NHS reforms can be read on the Kings Fund website (www.kingsfund.org.uk) in *Never Again? The Story of the Health and Social Care Act 2012: A Study in Coalition Government and Policy Making* (Timmins, 2012), and also at www.nuffieldtrust.org.uk. Further information and updates regarding these reforms and healthcare generally (including HCAIs) can also be found on the DH website (http://www.gov.uk/government/organisations/department-of-health) by using the Search tool. Quite what the implications of these reforms will be regarding the prevention and control of HCAIs within acute trusts and community settings remains to be seen. At the time of writing, all healthcare providers are under tremendous pressure to rein in spending; budgets have been slashed, resources reduced, jobs downgraded or lost, and wards closed. Most healthcare providers have been through some kind of internal re-organisation and re-structuring and yet the pressures on the NHS continue to grow and grow. Certainly the political climate within the last decade, with the introduction of government targets to reduce waiting times in accident and emergency departments and on elective surgery waiting lists (DH, 2000), had an adverse knock-on effect as far as infection prevention and control were concerned, generally giving rise to claims of a 'target culture' within the NHS. The pursuit of targets and the avoidance of associated financial penalties were widely viewed by many frontline staff, including IP&CTs, to be at the expense of infection control, with short cuts taken in clinical practice and procedures and practices not always followed to the letter, giving rise to increased infection rates and some high-profile outbreaks of HCAIs (Healthcare Commission, 2006, 2007).

Secondary versus primary care: infection control in acute trust and primary care settings

Care within the NHS is divided into primary and secondary care, and NHS Trusts are divided into Clinical Commissioning Groups (CCGs), Acute Trusts (including Foundation Trusts), Ambulance Trusts, Mental Health Trusts and Care Trusts.

Fact Box 1.6 Primary care

Eighty percent of patient contact with the NHS happens within primary care settings, which encompass GP surgeries, health centres, walk-in clinics, dental clinics, polyclinics (essentially 'super-surgeries' offering a range of specialist treatments on an out-patient basis), residential and nursing homes, patients' own homes, hospices, schools and nurseries, prisons, podiatry, physiotherapy, speech and language therapy, occupational therapy and community mental health care (National Clinical Guidelines Centre, 2012; National Health Service, 2013).

NHS acute trusts (secondary care)

Acute hospitals provide a range of in-patient and out-patient services and have patients with health-care needs of varying complexity, many of whom require specialist care and invasive interventions. Increasingly within hospitals, ambulatory care wards or units have become commonplace, whereby certain medical conditions are managed as day case attendees. Patients may be referred by their GP or directly from the Emergency Department, negating the need for an emergency hospital admission and reducing the pressure on acute beds. Hospital at Home Teams, working as an arm of an Acute Trust, can facilitate the early release of patients who require long-term intravenous therapy, and provide that care in the patient's own home. Virtual Wards aim to prevent emergency admissions to hospitals through the provision of multi-disciplinary care in the community which is provided along the lines of care within a hospital ward (see Nuffield Trust, 2013).

Much of the focus on the prevention and control of HCAIs generally has been within the acute hospital setting as this has historically been where the risk to patients has been perceived to be the greatest. This is because of the mixing of different patient populations, patients admitted as medical or surgical emergencies and often presenting with associated co-morbidities, rapid turnaround times, high bed occupancy, length of stay, invasive procedures (both diagnostic and surgical), the use of invasive indwelling devices and exposure to pathogens associated with HCAIs. However, care in this type of setting is more controlled, and facilities and resources are more likely to be conducive to best practice. Infection prevention and control within the primary care community present many challenges, some of which are summarised in Box 1.4.

Guidelines that are specific to the primary care setting are available in the DH document *Prevention and Control of Infection in Care Homes – an information resource* (DH/HPA, 2013); the National Institute for Health and Clinical Excellence (NICE) Clinical Guideline *Infection Control: Prevention of Healthcare-associated Infections in Primary and Community Care* (National Clinical Guideline Centre, 2012) and the 2009 publication by the Care Quality Commission, *Working Together to Prevent and Control Infections: A Study of the Arrangements for Infection Prevention and Control between Hospitals and Care Homes*. Also relevant is the *Code of Practice on the Prevention and Control of Infections and Related Guidance* (DH, 2010). In 2007, the DH published *Essential Steps to Safe, Clean Care*, a series of review tools, audits and self-assessment exercises designed to be used by staff providing patient care outside of acute hospital settings, in order to reduce or prevent HCAIs and implement evidence-based best practice in infection prevention and control. These can be accessed at: http://webarchive.nationalarchives.gov.uk/20120118164404/hcai.dh.gov.uk (National Archives, 2012). Infection control advice to care homes, health care centres, hospices and GP surgeries may be given by the local Health Protection Unit (Public Health England), or covered by the Community Infection Control Team. There may be some that do not have any formal infection control 'cover' from an IP&CT at all, hence the importance of the guidelines as described above.

Box 1.4 Infection prevention and control in primary care – challenges

- Patients' own homes – poor standard of living, poverty, neglect and poor standards of hygiene/cleanliness
- Clinics and health centres – older buildings may be cramped, over-crowded and not fit for purpose

- Nursing and residential homes – designed to be 'homely' for residents (e.g. soft furnishings, fixtures and fittings, carpets and shared facilities)
- Décor and estates issues – can impede effective cleaning
- Patients with complex healthcare needs and associated co-morbidities – wounds, intravenous (IV) access and drug-resistant organisms
- Resources and facilities: medical devices (equipment and instruments) – single use (disposable) and re-usable; facilities for the cleaning and decontamination of medical devices that conform to national best-practice standards; adequate levels of staff and appropriate skill mix; and storage of equipment and medical devices
- Environmental cleaning: walls, floors, surfaces, beds, examination couches, chairs and other furnishings and furniture
- Staff in residential care facilities may have dual roles, such as caring for residents plus cleaning duties, and this can pose challenges during outbreaks.
- Staff education and training regarding standard precautions (e.g. hand hygiene, personal protective equipment [PPE], sharps, linen, waste, cleaning and decontamination), the method of delivery of mandatory training and updates, and measuring and ensuring compliance with best practice
- Staff knowledge around the different types of infections that can affect patients, residents and their management; access to policies, protocols and guidance documents
- Compliance with legislation and regulations (e.g. Control of Substances Hazardous to Health Regulations [COSHH], Reporting of Injuries, Diseases and Dangerous Occurrences Regulations [RIDDOR] and waste regulations)
- Implementation of audit and surveillance.

Chapter summary: key points

- Healthcare-associated infections are not a new problem, but they have had an increasingly high profile over the last 10–15 years.
- Community-acquired infections are infections present on admission, or occurring less than 48–72 hours after admission (unless there is a link with a previous episode of healthcare); HCAIs are infections which develop more than 48–72 hours after admission.
- The prevalence of HCAIs has decreased from 8.2% to 6.4% over the last 5 years, and during this time, a number of initiatives and drives to reduce HCAIs have been implemented.
- An increasingly elderly population, changes in healthcare provision, the re-emergence of old infectious diseases, the emergence of new ones and the emergence of novel pathogens mean that the threat of infections and infectious diseases is ever present.
- Although there are many general patient risk factors that increase the risk of HCAIs developing, and many other factors that compound the risk, HCAIs must not be accepted as an inevitable consequence of healthcare intervention.

Further resources are available for this book, including interactive multiple choice questions. Visit the companion website at:

www.wiley.com/go/fundamentalsofinfectionprevention

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