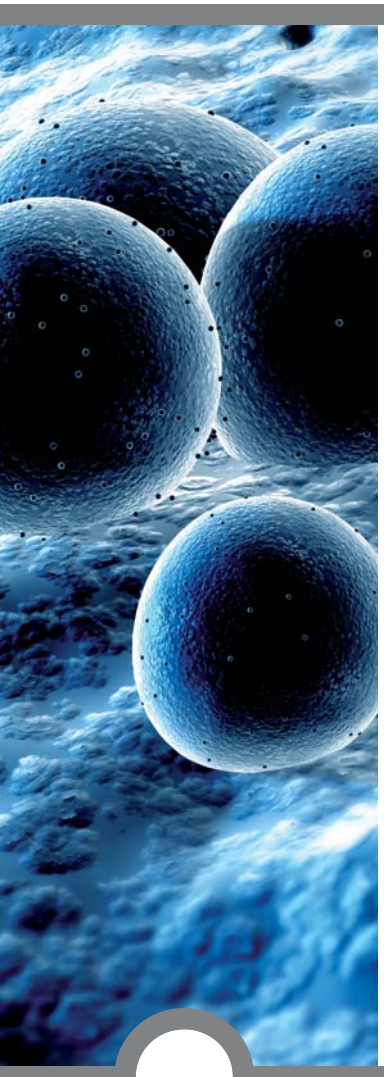
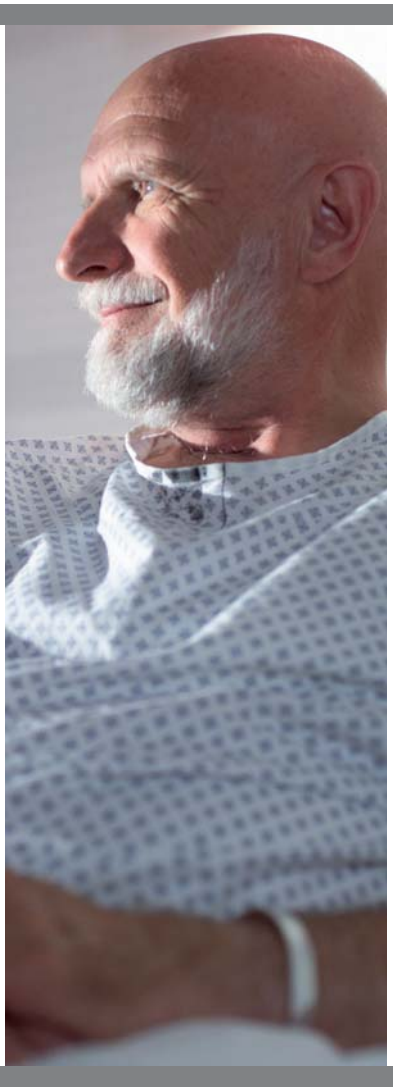
MRSA:
Separating Fact from Fiction

The Role of Treatment within MRSA Management

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The MRSA Working Group | Separating Fact from Fiction

NATIONAL CONCERN FOR HEALTHCARE INFECTIONS
NCHI

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Contents

Introduction

The very high level of media focus on healthcare-associated infections in general, and MRSA in particular, has resulted in significant political and policy interest. However, the role of treatment within MRSA control – and the care of patients who have already been infected – is getting lost in the debate. This report is intended to tackle this issue, correct misconceptions about MRSA and place the role of treatment in the proper context.

This report has been produced by the members of a multi-disciplinary expert editorial panel – the MRSA: Separating Fact from Fiction Working Group. The patient group National Concern for Healthcare Infection (NCHI) was also consulted to provide a patient perspective.

The members of the Working Group and the NCHI agreed the following points need to be addressed to ensure that the general public is better informed and that people with MRSA receive the best possible care:

- **Provision of accurate, easy-to-understand information about MRSA and other healthcare-associated infections, is vital**
- **People with MRSA need to be informed of their possible treatment options (including home treatment, if appropriate) and be involved in treatment decisions**
- **Specialist teams, including microbiologists, should be consulted on the management of patients with healthcare-associated infections, including MRSA**
- **Hospital trusts need to have arrangements in place to enable appropriate patients to receive MRSA treatment at home**
- **People discharged from hospital with MRSA need to have appropriate support and follow-up and have ongoing access to information and advice.**

How this report is structured

The first part of the report 'Dispelling misconceptions about MRSA' addresses common myths and misunderstandings about MRSA and provides clear information on the real facts.

This is followed by an 'executive summary' which summarises the key information in the rest of the report. The summary is split into numbered sections, which correspond to the sections in the main body of the report. Reading the executive summary will give a good overview of the main points and the relevant sections of the rest of the report can be referred to for more-depth discussion of any subject area.

Supporting references for the information in the report are provided and reference listings can be found at the end of the executive summary and at the end of the main body of the report.

At the end of the report is a 'glossary of terms' and a 'further information resources' section, which provides a list of relevant organisations with detail on where more information about MRSA can be obtained.

Introduction

Contributors to the report

This report has been produced by the MRSA: Separating Fact from Fiction Working Group in consultation with patient group NCHI.

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National Concern for Healthcare Infection (NCHI)

The charitable association, NCHI, welcomes this report that dispels many of the widely held myths about MRSA and other healthcare-associated infections (HAI) and promotes good clinical practice.

Where possible and when it is clinically prudent, patients who have been infected or colonised by MRSA should be treated in the safety and comfort of their own homes. Out of sheer ignorance, many people who have been infected by an HAI, including MRSA, have unjustly been made to feel ostracised. This and the wider issue of HAI transmission needs to be addressed by the whole of our society. This can only be achieved through the provision of understandable information and education, and the promotion of the idea that not only healthcare providers, but every individual across the UK, has a responsibility to prevent the spread of these debilitating and life-threatening diseases.

The members of the Working Group and NCHI would like to thank the Patients Association for their input, medical writer Clare Griffith for her editorial support and Pfizer for its generous support for the publication of this report.

Foreword

For thousands of years mankind has had to deal with infectious diseases. From plague in the Middle Ages to more recent pandemics of smallpox, influenza, measles and typhus, millions of people have died. Through the understanding of sepsis and antisepsis, and with the introduction of immunisation against common diseases such as diphtheria, polio, mumps, hepatitis, measles, rubella and tuberculosis, many diseases have become controllable and, in some cases, eradicated.

Put into this context MRSA produces a relatively small burden of disease. However the attention that MRSA has received in the media has put great fear into the minds of patients and the public.

This report serves to put MRSA into context and gives the facts about the organism and the infections that it causes. Through the presentation of clear, accurate information by a team of internationally renowned experts, some of the myths about MRSA will be dispelled. The fact that MRSA is not much different from many organisms that cause infections in patients in health services all over the world might also put the problem into some sort of perspective.

The use of a question and answer format in the section on the misconceptions surrounding MRSA will hopefully offer the reader a useful tool to answer concerns, address uncertainties and offer reassurance that infections that are caused by MRSA can be contained, minimised and treated with modern medicines.

Governments all over the world are focusing on the importance of infectious diseases and ways in which their impact might be minimised. In the UK all MRSA blood infections have to be reported. This "target" has become the focus of NHS managers and clinicians alike and information is readily available to the public.

Originally classed as a "hospital-acquired infection", MRSA is now more accurately called a "healthcare-associated infection" as cases have been identified in people who have not been in hospital (so-called community-acquired MRSA). Whatever the source of infection, the focus over recent years has been to promote good infection control measures and ensure sensible antibiotic use is achieved in all healthcare environments.

The Alliance for the Prudent Use of Antibiotics (APUA) Report provides a useful reference source for MRSA in particular, and the prevention of infectious diseases in general.[1] It offers simple general advice that should be promoted such as:[1]

- Do not demand antibiotics from your doctor
- When given antibiotics, take them exactly as prescribed and complete the full course of treatment; do not hoard pills for later use or share leftover antibiotics
- Wash your hands properly to reduce the chance of getting sick and spreading infection
- When having contact with a sick person whose defenses are weakened, soaps and other products with antibacterial chemicals are helpful, but these should be used according to established procedures and guidelines

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Reference

1. The Alliance for the Prudent Use of Antibiotics (APUA). http://www.tufts.edu/med/apua/Patients/patient.html

Dispelling misconceptions about MRSA

MRSA is a 'superbug'

This is a term used by the media and may be misleading. MRSA stands for methicillin-resistant *Staphylococcus aureus*. It is a bacterium from the *Staphylococcus aureus* species that is resistant to some, but not all, antibiotics. The antibiotics that do not work against MRSA include penicillin-related antibiotics such as methicillin. However, several antibiotics can be used to treat MRSA infections, and the results can be good. *S. aureus* is a type of bacterium that commonly causes skin infections such as boils, abscesses and wound infections; it can also cause pneumonia and bloodstream infections. *S. aureus* is often found in the noses and on the skin of healthy people. About one in three people in the general population (30%) are 'carriers'. It has been suggested that about one tenth of them are carrying the MRSA strain of the bacteria (i.e. about 3% of the general population)[1] but this will vary according to the population and the age and hospital contact of the individual.

MRSA and *S. aureus* will not normally cause infection in a healthy person. However, if the bacteria enter particular sites in the body – for example, a surgical wound or the bloodstream – infection can occur. This may happen in the carriers themselves – for example, if they have a break in the skin (such as a wound or ulcer) or a catheter. Alternatively, the bacteria may be passed to another person. This is most likely to occur via someone's hands.

Therefore, the term 'superbug' is not generally helpful, as MRSA are generally no more virulent than other types of *S. aureus*, although selecting an antibiotic to treat infections effectively is more difficult. Also, patients who get MRSA infection tend to have other conditions (e.g. recent surgery or other illnesses) that complicate their treatment.

If you get MRSA you will die

This is the exception rather than the rule. MRSA can be carried without any ill effects. The problems caused by MRSA and other bacteria occur when they gain access to sites where they can cause infection and do harm, such as in open wounds, or get into the bloodstream where they might enter via a catheter or tubes.

It is important to remember that even with serious bloodstream infections, many people are successfully treated with antibiotics specially designed to treat MRSA and can recover full health. Statistics can be a bit misleading, as people infected with MRSA are often already very ill with other conditions (which is why they are in hospital),[2] and this sometimes reduces their chance of recovery from MRSA infection. Older people are more at risk of the serious consequences of MRSA infection. Recent research funded by the Department of Health found that most patients who died following MRSA infection in NHS hospitals in England between 2005 and 2007 were elderly: 80% were over 70 years of age, and there was only one MRSA death in a person under 50 years.[2]

If you go into hospital there is a good chance you will get MRSA

Less than one in a thousand people in hospital will get a serious MRSA infection.[3,4] While this is still a high number, which needs to be reduced as a priority, it is important that people going into hospital, and their families and carers, have the correct information available to them, to enable them to make informed judgements for themselves about the relative risks of all aspects of their treatment.

MRSA comes from dirty hospitals

It is clearly essential that hospitals are kept clean, and some types of healthcare-associated infections are more likely to be spread from contact with dirty surfaces – such as *Clostridium difficile*. However, there is actually little evidence that MRSA is transmitted because of dirty floors or contaminated surfaces.

Even if a hospital is spotlessly clean, bacteria can still be brought in by the patients themselves or be transmitted by staff and visitors. Practising good hand hygiene is the most important way to prevent the spread of MRSA and other infections.

Dispelling misconceptions about MRSA

MRSA is out of control and infection rates are soaring

In the UK, all serious cases of MRSA infection that are serious enough to reach the bloodstream have to be reported, which does not happen in most countries. This means that we have very accurate figures about the numbers of very severe cases here.

According to figures published by the Health Protection Agency (HPA), which is responsible for collating reports of MRSA bloodstream infections in the UK, rates of such infections have fallen recently. Dr Georgia Duckworth, a hospital infection expert at the HPA, has said that: "In 2006, MRSA numbers were beginning to show a slight fall, but it was premature to state then that this marked a downturn in the trend. However, the downward trend has continued and we are now confident that this heralds a real change."[4]

Alcohol hand gels are sufficient to kill all bacteria

Good hand hygiene is vitally important. Alcohol-containing hand gels (or wipes) are very helpful, easy to use and effective against most types of bacteria, but hand washing with soap and water is necessary to remove other types (e.g. *Clostridium difficile*) and will also remove MRSA. It is also important to dry hands thoroughly after hand washing, as bacteria tend to thrive in moist conditions.

Uniforms of doctors and nurses are to blame for the spread of MRSA

The spread of MRSA is caused by a number of different factors. Although poor hygiene practices by hospital staff can contribute, a recent report from the Department of Health Working Group on Uniforms and Laundry concluded that there is no firm evidence that uniforms (or other work clothes) pose a significant hazard in terms of spreading infection.[5]

MRSA is a problem because of the NHS

All the countries of the developed world are affected by MRSA infections. Countries in the EU are affected to a greater or lesser degree. High rates of MRSA are seen in the USA and Japan, which have very modern healthcare systems.

It is not safe for people with MRSA to be at home

This is wrong. It is in fact quite safe for people with MRSA to be at home, as long as they are otherwise well enough to be discharged from hospital. Sensible precautions to prevent the spread of MRSA (especially good hand hygiene) need to be taken if there is anyone at home who is particularly vulnerable (such as those with open sores/wounds or intravenous lines/catheters).

People with MRSA should not be in care homes

This is not true. It is safe for people with MRSA to be in a care home, as long as basic hygiene precautions are followed. Indeed, recent Department of Health guidance on infection control in care homes stated that: "People affected by MRSA do not present a risk to the community at large and should continue their normal lives without restriction. MRSA is not a contraindication to admission to a home or a reason to exclude an affected person from the life of a home."[6]

People with MRSA are a danger to other people

People with MRSA do not represent a danger to healthy people. The risk is to people with open sores or wounds and those with intravenous lines or catheters. Providing sensible precautions (especially good hand hygiene) are taken, the risk of spread of MRSA to such people is low.

There is no treatment for MRSA

This is not true. MRSA is sometimes more difficult to treat than other types of bacteria, as it does not respond to the most commonly used antibiotics. Also, people with MRSA infection sometimes have other illnesses that complicate the treatment. However, there are several antibiotics available to treat MRSA effectively.

The antibiotic vancomycin is the last line of defence against MRSA

Vancomycin is an antibiotic commonly used to treat MRSA. There are several alternative antibiotics that can be used to treat MRSA infections, and some of these can be given by mouth as tablets.

Dispelling misconceptions about MRSA

We will never get rid of MRSA from our hospitals

It is very important that hospitals continue with their policies to drive down the levels of MRSA infection. However, about 3% of the general population may carry MRSA and some of them will continue to need to be admitted to, or visit, hospitals.

There will therefore be a continued risk of MRSA infections developing, even in spotlessly clean hospitals where excellent hand and other hygiene standards are maintained. However, as newer antibiotics are introduced these will help to manage the challenge.

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Executive summary

1. MRSA – the facts

1.1. What is MRSA?

MRSA stands for methicillin-resistant *Staphylococcus aureus (S. aureus)*, so called because it is resistant to methicillin and related antibiotics such as penicillin and amoxicillin. It is otherwise no different from other *S. aureus* bacteria. MRSA is found in the noses and on the skin of about 3% of the general population, in whom it usually causes no harm.[1,2]

1.2. What happens when *S. aureus* and MRSA cause harm?

If *S. aureus* bacteria (including MRSA) enters the body through a wound or gets into the bloodstream, infection can occur.[2] This can lead to skin infections, pneumonia (lung infection) and bacteraemia (bloodstream infection). MRSA infection can be very serious, leading to prolonged hospital stays and sometimes death. MRSA is one of the most common healthcare-associated infections in the UK.[3]

1.3. History of MRSA

S. aureus was identified as a cause of wound infections in the 1880s.[2] Before the discovery of penicillin in the 1940s, most people with *S. aureus* bloodstream infection died.[4] By 1959, most strains (types) of *S. aureus* had developed resistance to penicillin. Following the development of methicillin, rare cases and outbreaks of MRSA were reported in the 1960s and 1970s.[2] MRSA became more widespread in the 1980s, and certain strains established themselves in UK hospitals in the mid-1990s. MRSA of different types from those found in hospitals can be contracted outside hospitals, so-called community-acquired MRSA, though this is currently rare in the UK.[5]

1.4. Effects of MRSA

MRSA may enter the body through a wound, causing wound infection or abscesses, and can also infect or grow in skin ulcers. If it enters the bloodstream, e.g. through intravenous lines or catheters, the patient is said to have bacteraemia.[2] The bacteria can then spread to other parts of the body, causing deep abscesses. Septicaemia (systemic infection of the blood) is the most serious type of MRSA infection. If MRSA enters the lungs of a patient in intensive care who is supported on a ventilator, it can cause pneumonia.[2]

1.5. Who is at risk from MRSA?

In general, healthy people are not at risk of MRSA infection in hospital. Factors that increase the risk include length of stay in hospital, use of multiple antibiotics, severity of illness, recent surgery, use of invasive procedures and presence of medical devices (e.g. catheters and tubes).[6] The problem can be made worse by poor compliance with hand cleaning and other hygienic practices by healthcare staff, patients and visitors, and the lack of availability of single rooms for isolation of people with MRSA infection.

1.6. What is the size of the problem?

It is believed that 9% of patients in hospitals in England (about 100,000 people per year) have healthcare-associated infections, many of which are due to MRSA.[3] There are between 6,000 and 7,000 MRSA bloodstream infections each year in patients in NHS hospitals in England.[7] In 2005 in England and Wales, 1,629 death certificates mentioned MRSA as a contributory factor, and MRSA was cited as the main cause of death in 467 of these cases.[8]

2. The financial costs of MRSA

2.1. Costs to the NHS

The main factor contributing to the direct hospital costs of infection is length of stay,[3] and different types of infection are associated with significant differences in cost.[9] The cost of each day of hospital care ranges from several hundred pounds to £1,000/day, depending on the type of ward.[10] It has been estimated that healthcare-associated infections cost the NHS in England £1 billion a year.[11] The cost in Scotland has been put at £262 million a year.[12]

2.2. Costs to patients, carers and the economy

As well as the sometimes enormous physical and emotional burden of MRSA, infection also imposes financial costs on patients and their family/carers as a result of missed work and increased expenditure after discharge from hospital.[11] The total loss to the UK economy as a result of MRSA infections has been put at between £3 billion and £11 billion annually.[10]

Executive summary

3. Management of MRSA

3.1. The role of prevention in management of MRSA

3.1.1. Infection control measures

The two main aspects of infection control are hospital environmental hygiene and hand hygiene. The hospital environment must be visibly clean, and equipment must be decontaminated appropriately. Hand cleaning with alcohol-based gel/rub removes some (but not all) micro-organisms such as bacteria. Hand washing with soap and water is needed to remove other micro-organisms and visible dirt.[13]

3.1.2. What must the hospital do?

The 2006 Code of Practice for the Prevention and Control of Health Care Associated Infections sets out 11 duties of all hospitals with respect to healthcare-associated infections. These include a duty to maintain a clean environment and a duty to provide information to patients and the public.[14]

3.1.3. What can patients, relatives and visitors do?

Patients, relatives and visitors also have a role in preventing the spread of infections by cleaning their hands, avoiding touching dressings etc, and not bringing too many unnecessary personal items into the hospital.

3.1.4. Screening and testing for MRSA

The English and Scottish Departments of Health are both introducing policies to screen people for MRSA when they are admitted to hospital.[15] Some hospitals already screen patients admitted for surgery. People carrying MRSA in their noses or on their skin can then usually be treated before they undergo surgery to reduce the likelihood of infection developing or spreading later.

3.1.5. Altering the way some medical equipment is used

An important strategy to reduce the risk of MRSA infection is to avoid the use of medical devices such as intravenous lines and catheters i.e. either by using these devices less often or for shorter periods of time. It is very important that the devices are used with care and protocols are followed which are designed to reduce the chance of infection occurring.

3.1.6. Improving the capacity to isolate patients

In 2004, the National Audit Office report on reducing the risk of hospital-acquired infection acknowledged that higher bed occupancy was not always consistent with good infection control,[16] and in October 2007, at a hearing of the Parliamentary Health Select Committee, Lord Darzi, Parliamentary Under Secretary of State at the Department of Health, accepted that a bed occupancy rate of over 90% led to a high risk of MRSA infection.[17] Many hospitals also do not have the facilities to isolate patients with healthcare-associated infections in single rooms,[18] and this should be addressed in designs for new hospitals.

3.1.7. Improving the prescribing of antibiotics

Inappropriate and intensive use of antibiotics can promote the spread of resistant bacteria. Antibiotic use should be carefully monitored to ensure that neither under-use nor over-use occurs, as both can be harmful.

3.1.8. Other guidelines and targets for MRSA prevention

The government's 2004 target of halving MRSA bacteraemia rates by 2008 appear unlikely to be achieved.[19] The Department of Health has allocated £60 million for a 'deep clean' of hospitals in England in the first quarter of 2008.[20]

3.2. The role of treatment within control of MRSA

How MRSA infection is treated depends on the site and extent of the infection. Infected wounds are cleaned and covered with specialised dressings. Contrary to what many people believe, a variety of antibiotics are available to treat MRSA infection. Some of these need to be given intravenously, while others are available for oral use.

3.2.1. Which antibiotic treatment?

The antibiotic used should be tailored to suit the individual patient, taking into account the site and severity of the infection and the scientific evidence available to guide choices. Ideally, this will involve specialist advice and laboratory testing to help select the most appropriate antibiotic.

3.2.2. Can people with MRSA infection be treated at home?

People who have an infection caused by MRSA have traditionally been treated in hospital with intravenous antibiotics. In many cases, if appropriate treatment was available and the patient has no other medical reason for staying in hospital, it is possible for MRSA infection to be treated outside hospital. This can have a number of

benefits for the patient and may make the chances of reinfection with MRSA less. People with MRSA infection are not a danger to healthy people[21] and cannot be refused admission to a residential or nursing home.[22]

3.2.3. Methods of home antibiotic treatment
People can receive antibiotic treatment outside hospital via outpatient parenteral (intravenous administration) antimicrobial therapy (OPAT) or through the use of oral antibiotics. OPAT involves patients being given intravenous infusions in the community; it is safe and effective,[23] but is less well established in the UK than in some other countries. Use of oral antibiotics avoids the necessity for an intravenous line;[24] various antibiotics active against MRSA are available in tablet form.

3.3. Cost-effective MRSA infection management

3.3.1. Savings from efficient antibiotic use
More efficient use of antibiotics for MRSA can reduce length of stay in hospital and thus NHS costs. Both OPAT and use of oral antibiotics have been shown to reduce the length of time people with MRSA infections need to stay in hospital.[24,25]

Therefore, in addition to benefiting patients, and reducing the risk of infections spreading to other vulnerable patients, treating MRSA infections outside hospital can potentially decrease costs to the NHS and reduce the pressure on hospital accommodation.

3.3.2. Changes in the way NHS services are funded: payment by results
Hospitals are now increasingly being paid for each episode of care at a set rate (or tariff).[26] If patients cannot be discharged within the time allowed for in the tariff, the hospital will incur extra costs not covered under the payment system (known as payment by results). Reducing the costs of healthcare-associated infections – by better prevention and more cost-effective treatment – can reduce waiting lists and free resources for treating new patients. As patients are likely to be keen to go home if they are able to, this is potentially a win-win situation.

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1. MRSA – the facts

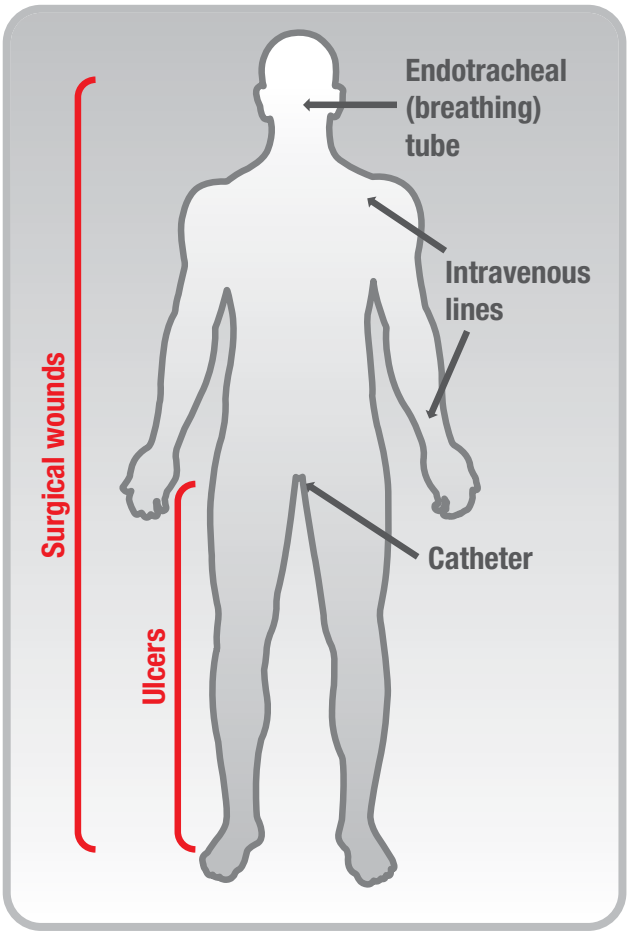
Key facts

- MRSA stands for **m**ethicillin-**r**esistant ***S**taphylococcus **a**ureus (S. aureus)*
- Many people (about 30% of the population) carry *S. aureus* bacteria in their noses or on their skin. *S. aureus* only causes infection if the bacteria rise and it enters the body or bloodstream (e.g. through a wound or via catheters or lines used to deliver medication)
- MRSA is a type of bacterium that is resistant to treatment with some, but not all, antibiotics (i.e. the bacteria cannot be killed by these antibiotics)
- About 3% of the population carry the MRSA strain of the bacterium at any time
- MRSA is not stronger/more virulent than those of other types of *S. aureus*, although selecting an antibiotic to treat it effectively is more difficult
- MRSA is often called a healthcare-associated infection because it is frequently associated with inpatient hospital treatment; however, some people develop MRSA and MRSA infection at home, even if they have not recently been in hospital
- Very young and very old people, and those with open sores/wounds or intravenous lines/catheters, are most susceptible to MRSA

1.1. What is MRSA?

MRSA is a form of a bacterium called *Staphylococcus aureus (S. aureus)*. MRSA stands for **m**ethicillin-**r**esistant ***S**taphylococcus **a**ureus*, so called because it is resistant to methicillin and related antibiotics such as penicillin and amoxicillin. This means that it cannot be treated with antibiotics commonly used first when infection is suspected but the type of bacteria present is unknown. When MRSA is present, different antibiotics have to be used. Otherwise, MRSA is no different from other *S. aureus* bacteria. So, to understand MRSA we need to know about *S. aureus*.

S. aureus is often found in the noses and on the skin (especially in folds such as the armpit and groin) of healthy people – a state known as 'colonisation'.[1] People who are colonised with *S. aureus* – about 30% of the general population – are known as 'carriers'. While the *S. aureus* remains in the normal carriage sites (such as the nose, armpit and groin), it is usually not causing harm and does not need to be worried about. In about one tenth of the people who carry *S. aureus*, it will turn out to be an MRSA type (i.e. about 3% of the general population).[2] Again, like any other *S. aureus*, it usually causes no harm.



Common routes of infection

1. MRSA – the facts

1.2. What happens when *S. aureus* and MRSA cause harm?

S. aureus, including MRSA, will not normally cause infection in a healthy person. However, if the bacteria enter the body or bloodstream (e.g. through a wound or via catheters or lines used to deliver medication), infection can occur. This may happen in the carrier themselves if they have a wound, or the bacteria can be passed to another person (e.g. on someone's hands or on infected equipment such as catheters).[2]

Skin infections such as boils, abscesses and wound infections are one of the more common types of infection, and *S. aureus* is one of the most common types of bacteria that causes them; it can also cause other infections such as pneumonia (lung infection) and bacteraemia (bloodstream infection).

When these types of infection occur in people who are in hospital or receiving treatment they are called healthcare-associated infections (or sometimes hospital-acquired infections or nosocomial infections).

Around 9% of patients in hospital in England develop a healthcare-associated infection, equivalent to roughly 100,000 cases every year, and around 5,000 of these people will die.[3]

Currently about 500 deaths each year are classed as being directly caused by MRSA infection, although this figure may be an underestimate.[4] MRSA is one of the most common healthcare-associated infections in the UK.[3] How serious the infection is will depend on a number of things.

As well as the human cost, it has been estimated that treating healthcare-associated infections, including MRSA, costs the NHS at least £1 billion every year,[5] largely because of the increased lengths of hospital stay needed for people with MRSA infection.

Thus, MRSA infection can be extremely serious. It may lead to prolonged hospital stay and sometimes death. Its prevention and treatment is an NHS priority.

Unlike in most other countries, cases of MRSA bloodstream infection have to be reported in the UK, so we now have very good information about the number of people affected in the UK. Figures published by the Health Protection Agency (HPA), which is responsible for collating reports of MRSA bloodstream infections in the UK, show a small reduction in MRSA rates recently. Dr Georgia Duckworth, a hospital infection expert at the HPA, has said: "In 2006, MRSA numbers were beginning to show a slight fall, but it was premature to state then that this marked a downturn in the trend. However, the downward trend has continued and we are now confident that this heralds a real change – something most specialists in the field would have thought impossible only a few years ago, after the inexorable rise in MRSA bloodstream infections throughout the 1990s".[6]

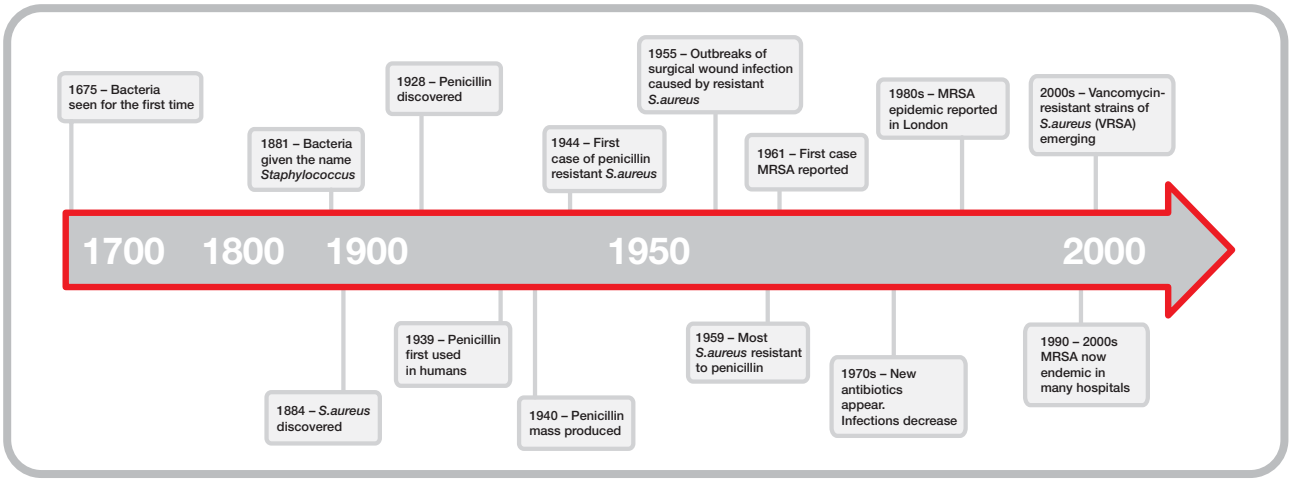
1.3. History of *S. aureus* and MRSA

S. aureus was first identified as a common cause of surgical wound infections in the 1880s.[2] These infections were often serious and frequently fatal. Before we had antibiotics that were able to treat *S. aureus* infections, 80% of people who had the most serious type of *S. aureus* bloodstream infection died.[7] This changed dramatically with the introduction of penicillin in the 1940s, which was also very important in reducing the burden of wound infections. However, when bacteria encounter any antibiotic, a small proportion of them may be able to survive. These surviving, 'antibiotic-resistant' bacteria can then multiply, potentially producing bacteria with even more resistance.

By 1959, most strains (types) of *S. aureus* had developed resistance to penicillin,[2] meaning that it no longer killed the bacteria effectively.

Methicillin (and other penicillin-related antibiotics) was developed to overcome the resistance problem, but even then rare cases and outbreaks of MRSA infection were soon reported.[2] MRSA remained uncommon during the 1960s and 1970s, but different strains began to become more widespread in the 1980s. It was only in the mid-1990s that certain strains of MRSA became firmly established in UK hospitals.[2]

1. MRSA – the facts



A history of MRSA

MRSA is no more infectious than other types of *S. aureus*, but in some settings people infected with MRSA are twice as likely to die from the infection as those infected with antibiotic-sensitive strains of *S. aureus*.[8,9] Despite the fact that MRSA is resistant to some types of antibiotics, there are several antibiotics that are effective against MRSA – treatment of MRSA is discussed in more detail in Section 3 'Management of MRSA' on page 24.

A healthcare-associated infection is one that is not present or incubating when the person is admitted to hospital.[3] This includes infections that are caught in hospital but develop only after discharge home and infections that are caught in nursing or residential homes. In the UK, MRSA usually occurs as a healthcare-associated infection. However, it is important to remember that different sorts of MRSA infection can also occur in people who have not been admitted to hospital – this is known as community-acquired MRSA.

The risk of serious infection with MRSA is lower outside hospital, but it is seen, for example, in elderly people living in nursing or residential homes.[1] In some other countries (such as the United States), cases of community-acquired MRSA have been described in prison inmates, the gay community, injecting drug users and people involved in close-contact sporting activity. Such cases are caused by strains of MRSA different from those seen in hospitals and are currently unusual in the UK,[10] but it is possible that this will change as people travel between countries.

Some strains of *S. aureus* and MRSA (less than 2%) produce a toxin called Panton-Valentine leukocidin (PVL), which is associated with an increased ability to cause disease. These strains are more commonly contracted in the community and are rare in UK hospitals.[10,11]

1.4. Effects of MRSA

A common route of MRSA infection is through a wound, after either accidental injury or surgery.[2] An infected wound becomes red and inflamed and may fail to heal; a wound abscess (build-up of pus) may develop. MRSA can also grow in skin ulcers (such as bed sores, varicose ulcers and diabetic ulcers) if the skin is broken, making the ulcer harder to treat.[2] Another way MRSA may enter the body is through intravenous lines, which are needed to deliver some types of medication; this causes local inflammation with pus from which the bacteria can get into the bloodstream and cause bacteraemia (live bacteria in the blood).[2]

Once in the bloodstream, MRSA can lodge (settle) at various sites in the body (such as the lungs, kidneys, bones, liver or spleen) and cause deep abscesses.[2] These are usually very painful and can lead to fever, shivering and shock. Without treatment, the person's vital organs will begin to fail. The presence of MRSA in the bloodstream (known as bacteraemia) can also lead to septicaemia (a systemic or whole body infection of the blood), with high fever, shaking, raised white blood cell count, a tendency to bleed (clotting abnormalities) and failure of vital organs. Septicaemia is the type of MRSA infection with the highest death rate.[2]

1. MRSA – the facts

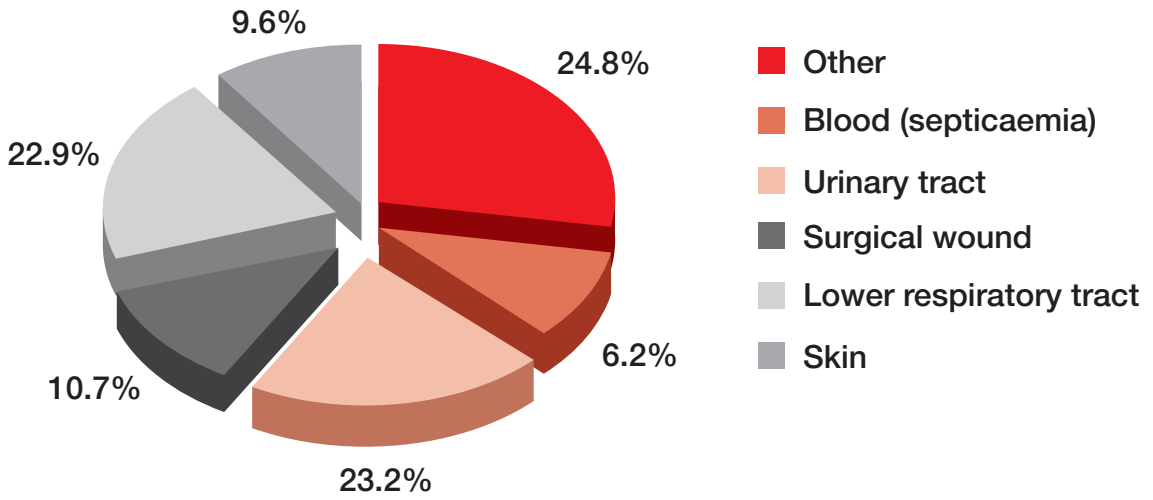
In intensive care units, many patients are on a ventilator via a tube in the trachea (windpipe); MRSA (or other bacteria) may enter the lungs via the tube and cause lung infections such as pneumonia, which in the worst cases can be fatal.[2] Throughout the world *S. aureus* is thought to cause on average about 20% of cases of ventilator-associated pneumonia in intensive care patients.[12] Of these, just over half are likely to be due to MRSA. People whose ventilator-associated pneumonia is caused by MRSA have been shown to stay significantly longer in the intensive care unit than those whose pneumonia is caused by other *S. aureus* strains.[12] However, because *S. aureus*/MRSA is just one of many infections that can cause ventilator-associated pneumonia, timely microbiology laboratory tests are needed to identify the cause and enable the selection of the best treatment to treat the specific bacteria responsible.

When infection is suspected, because of the presence of symptoms such as those described above, a sample can be taken from the suspected site of infection and sent for laboratory analysis. If bacteria are found, more tests will be done to see which bacteria are present and which antibiotics the bacteria are sensitive to (that is, which ones they are not resistant to).

This allows clinicians to choose the most effective treatments for the particular infection. If MRSA is suspected (especially if there are other factors that raise suspicion, such as the pattern of infection, use of previous antibiotic treatment or other cases of MRSA infection in the same ward), antibiotic treatment may be started immediately; it may then be modified if the results of the tests suggest this is the best thing to do.

"I got MRSA when my intravenous drip became infected. I didn't even know I was being tested for MRSA and was told by a nurse who simply gave me my positive results on paper, with no explanation, and incomplete information. All I knew about it was what was on TV – that people die of it – so I was extremely upset and frightened."

'Natalie', 39, former stock integrity organiser



Main sites of healthcare-associated infections[3]

1. MRSA – the facts

1.5. Who is at risk from MRSA?

In general, healthy people are not at risk of MRSA infection. Certain groups are more susceptible to MRSA infection than other people.[3] Very old people have less efficient immune systems, while the very young have immature immune systems; both of these groups are particularly susceptible to all infections – including healthcare-associated infections.

There are many factors that increase the risk of healthcare-associated infection.[14] Many of these relate to the underlying reason a person is in hospital – that is, the type of illness they have or the type of treatment they need. The length of stay in hospital is a major risk factor for infection, as are recent surgery, the use of multiple antibiotics, the severity of illness, the use of invasive procedures and the presence of medical devices (e.g. catheters). In general, a shorter hospital stay will reduce the risk of acquiring an infection. However, for people undergoing surgery, the risk is likely to be highest on the day of surgery and the days immediately following it.[3] This is because any break in the skin interferes with the body's normal defences against infection.

Poor compliance with hand cleaning and other hygienic practices by healthcare staff can exacerbate the problem of healthcare-associated infections. People who have been successfully treated for MRSA or other infections can remain infectious. This is because the bacteria can remain on their skin without causing them any harm, but can still be transmitted from one person to another.

Numbers of single rooms and hand basins available may not be adequate to implement some infection control measures, such as isolating infected patients.

Environmental factors such as dirty equipment, and dust on floors in clinical areas may also play a role.[14] Most people want to have a clean environment, but it is important to remember that good evidence for different cleaning approaches is not always there.

Multi-speciality referral hospitals tend to have higher infection rates. These hospitals may admit people with a wide range of serious illnesses from a large geographical area, so that different pools of patients are mixing within the care environment. They are also likely to be treating patients with more aggressive therapies that may, as a side-effect, have an increased risk of different infections.

More information that helps us to understand the problem of infection is being gathered all the time. For example, lower bed occupancy rates are associated with lower MRSA infection rates,[14,15] and there is a great deal of evidence to support the view that helping patients to get out of hospital sooner will reduce the rates of MRSA infection. The Government supports the strategy to get patients out of hospital and home quicker. When Patricia Hewitt was Health Secretary, she said that early discharge was "a pot of gold" and admitted that staying in hospital was not always a good thing.[16] One way to help patients spend less time in hospital is to support home and outpatient treatments. This will be discussed in more detail later in the report.

1.6. What is the size of the problem?

A report by the Government financial watchdog the National Audit Office (NAO) published in 2000 stated that, at any given time, 9% of patients in hospitals in England have a healthcare-associated infection – around 100,000 cases every year[3] or equivalent to the population of a town the size of Exeter. It is difficult to put a figure on the death rate from healthcare-associated infections, but it has been estimated that 5,000 deaths every year in the UK could be directly caused by healthcare-associated infections, with such infections being a contributory factor in a further 15,000 deaths.[3]

The Chief Medical Officer has reminded doctors that they should include information on relevant infections in death certification. MRSA is a common cause of healthcare-associated infections. About a quarter of all infections occurring in surgical wounds are caused by MRSA.[3]

The problem of healthcare-associated infections is not unique to the UK, and the rate of these varies between about 5% and 10% in Europe and other Western countries.[14]

1. MRSA – the facts

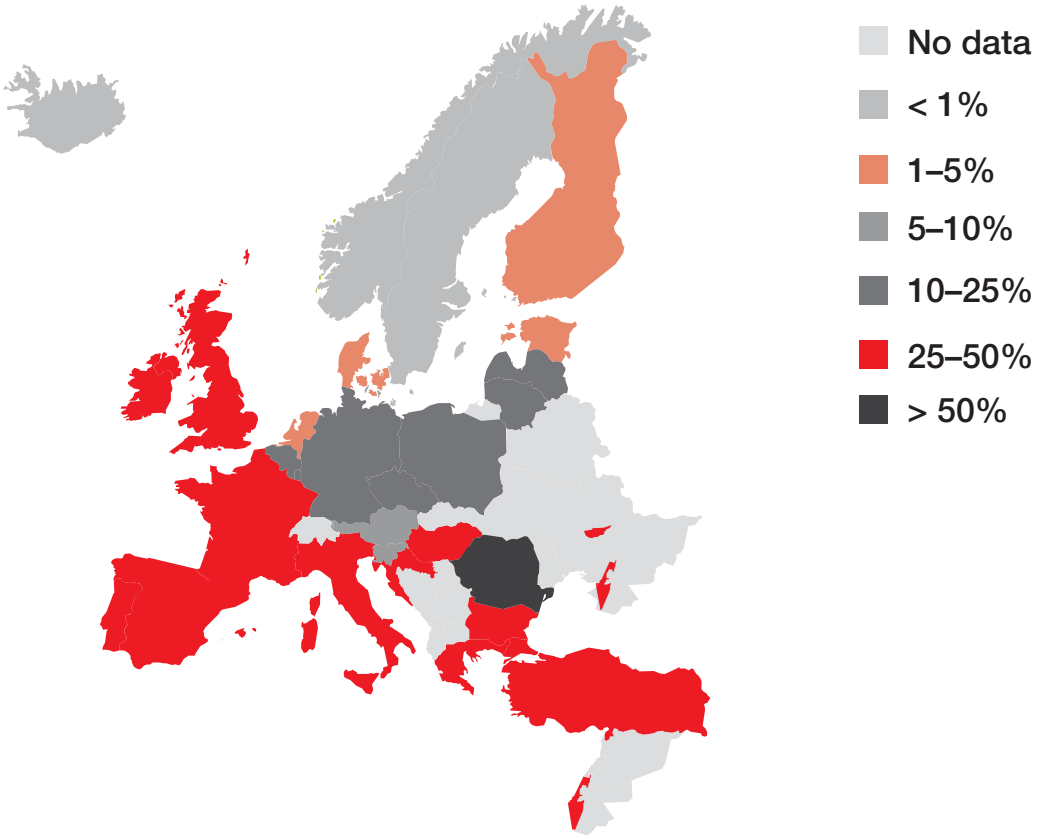
The UK is the only country in Europe, possibly the world, that counts each and every bloodstream infection caused by MRSA, and then publishes the numbers for all hospitals. We know that there are between 6,000 and 7,000 bloodstream infections caused by MRSA each year in patients in NHS hospitals in England (out of a total of about 12 million patients admitted to hospital).[6,17] This means that the risk of a patient having a bloodstream infection caused by MRSA is less than one in 1,000. These numbers are now falling; there has been a 10% decrease in the number of cases of MRSA bloodstream infection between 2006 and 2007.[6] Many MRSA infections do not lead to bloodstream infection and these infections are not counted, although individual hospitals may have figures for infections after particular forms of surgery.

Government statistics show that in 2005 in England and Wales, 1,629 death certificates mentioned MRSA as a factor contributing to the death of those people. In 467 of these cases, MRSA was recorded as the main cause of death.[4] This figure is expected to increase as new guidelines from the Chief Medical Officer are implemented; this does not mean that increasing numbers of deaths are actually occurring, but instead that more accurate information is available. People with MRSA infection are often already very ill with other conditions,[18] and this sometimes reduces their chance of recovery from MRSA infection. Older people are more at risk of the serious consequences of MRSA infection. Most patients who died following MRSA infection in NHS hospitals in England between 2005 and 2007 were elderly: 80% were over 70 years of age, and there was only one case in a patient under 50 years of age.[18] However, most patients in hospital are elderly and the relationship of infection to the death is not always certain.

It is commonly reported that the 'rate' of MRSA infection in the UK is one of the highest in Europe; this 'rate' refers to the proportion of all serious *S. aureus* infections that are due to MRSA as opposed to the ordinary type of *S. aureus*; hence an MRSA rate of 40% means that four out of every 10 serious *S. aureus* infections are due to MRSA. The rate of serious MRSA infections is high in the UK, but similar rates are seen in several countries in Europe (those coloured in red on the map).[19] Even higher rates are reported in other countries, including the USA and Japan.

The reasons why MRSA rates are higher in some countries than others are complex. Factors that are believed to be important include: how commonly antibiotics are used and which types are used; the proportion of beds that are situated in single rooms (i.e. the ability to keep MRSA-positive patients separate from those who are MRSA-negative); and the proportion of beds that are empty at any one time (i.e. the slack in the system). It is important to note that maintaining a low rate of MRSA is probably much easier than turning a high rate into a low rate.

1. MRSA – the facts



Rates of serious MRSA infections in countries in Europe[19]

2. The financial costs of healthcare-associated infections including MRSA

Key facts

- The total cost to the NHS of healthcare-associated infections is an estimated £1 billion a year
- The cost of treating someone with one or more healthcare-associated infections has been estimated to be 2.8 times greater than for a person without an infection
- The main contributing factor to increased costs is length of stay – people who acquire an infection stay an average of 11 extra days in hospital
- MRSA is also costly to patients, their carers, social services and the national economy. Costs of MRSA to the economy have been estimated at between £3 billion and £11 billion annually in the UK

As well as the 'cost' in terms of patients' suffering, healthcare-associated infections impose a financial burden on the NHS, social services, the Department of Work and Pensions, the economy of the country and, above all, patients and their families or other carers.

2.1. Costs to the NHS

Despite the global impact of healthcare-associated infections, most economic analyses evaluate the direct costs of healthcare-associated infections primarily from a hospital perspective. They do not consider the indirect costs (e.g. cost of transport to hospital, time off work) or the intangible costs of the negative impact (e.g. anxiety) on quality of life of patients and their carers. These are significant costs that should not be under-estimated, and some examples are discussed below. The impact of healthcare-associated infections on the community and broader society is also poorly evaluated. A recent Canadian public health analysis of MRSA in the community and hospital suggested that the direct cost for managing people colonised (carriers) or infected with MRSA could rise from CAN$82 million in 2004 to CAN$129 million by 2010.[20] Such analysis encompassing a broader perspective would be valuable in the UK setting to give us a more accurate assessment of the true impact of these infections.

The main factor contributing to direct hospital costs of healthcare-associated infections is increased length of stay in hospital.[3] This is primarily accounted for by the cost of hospital overheads and nursing care, as opposed to the need for additional antibiotics, investigations or additional procedures such as surgery.[5] Different types of healthcare-associated infections lead to significant differences in cost. Bloodstream infections are the most costly.[21] The cost of each day of hospital care ranges from several hundred pounds up to £1,000 a day for intensive care.[7] The overall cost to just one UK hospital of a 2-year MRSA outbreak was calculated at over £400,000.[7]

A study commissioned by the Department of Health in one district general hospital, and reported in 2000, found that the cost of treating patients with one or more healthcare-associated infection was 2.8 times greater than for patients without infections, with an average additional cost of £2,917 per case.[5] People who acquired an infection stayed in hospital 2.5 times longer than other patients, an average of 11 extra days. They were also 7.1 times more likely than uninfected patients to die in the hospital.[5] People who had healthcare-associated infections identified after they have been discharged from hospital were found to have greater contact with their general practitioner, more frequent outpatient visits to the hospital and more frequent visits from the district nurse – all of which add to the cost to the NHS.[5]

Extrapolating the data to England as a whole, the additional hospital costs incurred by people with infections were estimated to be £930 million (equivalent to almost £5 million per NHS trust). Adding an estimated cost of £55 million for the cost to the NHS after patients have been discharged from hospital gives the often quoted total of almost £1 billion for the cost of healthcare-associated infections to the NHS in England.[5]

Similarly, a recent (2007) Scottish survey of healthcare-associated infections and their burden estimated that the prevalence of healthcare-associated infections was 9.5%, with an additional extra hospital stay of 6.6 days.[22] This was associated with an added cost of £3,003 per patient and an estimated total cost to the Scottish NHS of £262 million a year.[22]

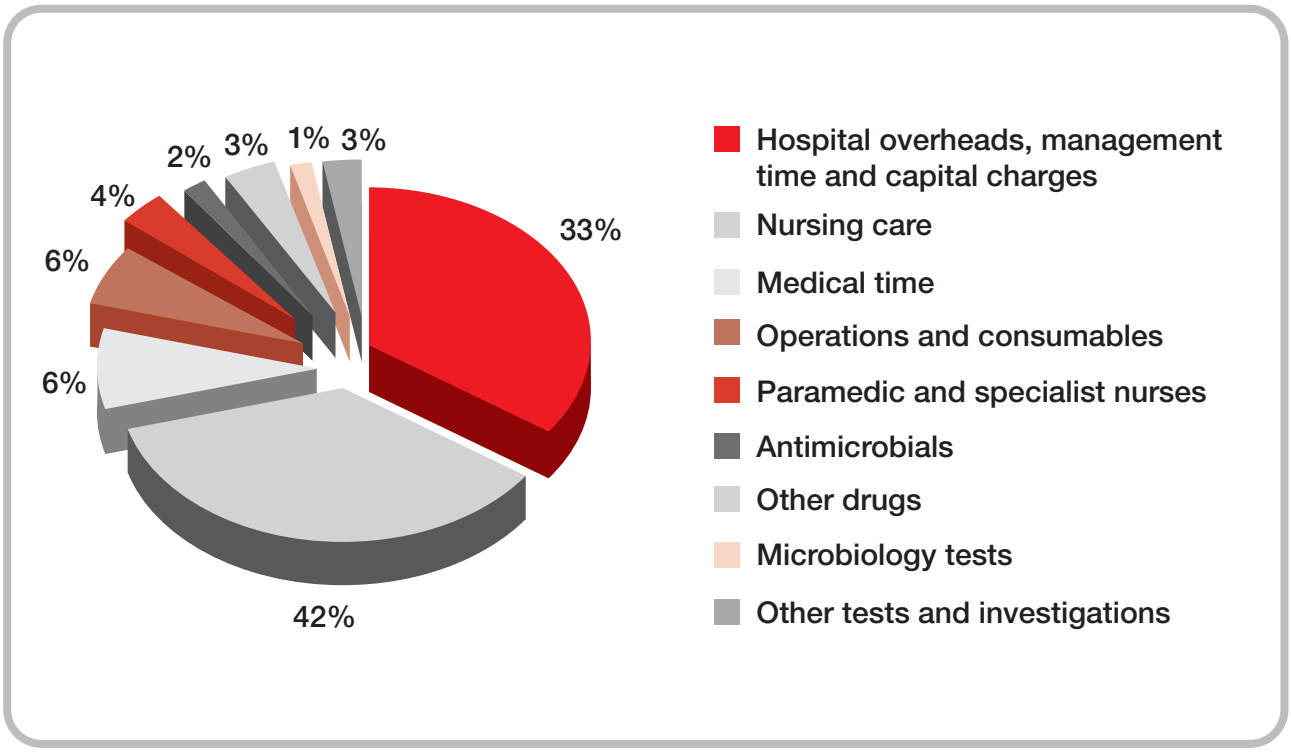
2. The financial costs of healthcare-associated infections including MRSA

These new figures are in keeping with previous Scottish and UK estimates, but also provide us with more specific data of the impact of certain infections and where they are acquired on overall length of stay. For example, the biggest impact on length of stay (an average of 13.7 days) was for infections acquired in care of the elderly wards, compared with 3.2 days in an obstetrics ward.[22]

Studies have consistently confirmed that MRSA infections are associated with a 1.2–2.0-fold increase in length of stay and hospital costs compared with other types of *S. aureus*.

Prevention by enhanced infection control (e.g. screening and/or isolation of MRSA) would appear to be a cost-effective strategy.[8] One such example is an NHS trust that changed its infection control measures for vascular graft patients, achieving a reduction in MRSA infection rate from 13% to 5% a year (the overall infection rate fell from 30% to 12%).[3] The extra costs of the new programme were £7,500 (£1,000 for antibiotics, £500 for pre-operative wash and £6,000 for MRSA screening), but the cost savings associated with the reduced length of stay were estimated at £195,000 per year.[3]

The financial watchdog, the National Audit Office, calculates that a reduction of 15% in healthcare-associated infections should be achievable through improved infection control measures, and that this would result in a saving to the NHS of £150 million per year.[3] Another way of looking at this is that if healthcare-associated infections could be reduced by 25% in a surgical specialty, an additional 4,800 cases could be treated annually.[22] This would clearly have a major impact on the effectiveness of surgical units in the UK.



Distribution of additional costs for patients with healthcare-associated infections[5]

2. The financial costs of healthcare-associated infections including MRSA

2.2. Costs to patients, carers and the economy

The Department of Health-commissioned study in 1997 in the single hospital referred to above also found that people with healthcare-associated infections had increased personal expenditure on items such as medicines and dressings. This was especially the case for those with infections identified post-discharge, who spent on average an extra £20 compared with people without infections. This represents an estimated £4.74 million a year in England alone.[5]

People with healthcare-associated infections took up to an average of 17 days longer to return to their normal daily activities than those without infections, amounting to 8.7 million days nationally – in other words, nearly a quarter of a million people every day are incapacitated by MRSA infection (238,356 people a day on average). People in paid employment took an average of six days longer to return to work if they acquired an infection in hospital, with an estimated value of up to £800 per patient.[5]

People with healthcare-associated infections, particularly those with infections identified post-discharge, received more care from informal carers (i.e. family members or friends) than did those without infections. The average additional need for such care for those with both pre- and post-discharge infections was six days, valued at £454 per patient.[5]

However, the costs of MRSA infection to patients are not just financial. People who have been infected with MRSA may have psychological problems, especially if they are still carrying the bacteria after leaving hospital. Other family members may be screened for MRSA, which can lead to anxiety. If the patient is admitted to hospital again in the future, they may need to be isolated in a single room, which can give rise to feelings of being ostracised.[8]

For the country as a whole, the lost work/output resulting from MRSA infection has an impact on the gross domestic product. This has been estimated as a loss of between £3 billion and £11 billion annually in the UK.[8]

"I contracted MRSA after I broke my right femur very badly in a car accident in October 2006. I needed several operations to remove the infected muscle and was told I might lose my leg. As well as the emotional and physical cost, I have suffered financially from having had MRSA – I had to shut my business, have lost my home and been declared bankrupt."
'Mark', 30, engineer

3. Management of MRSA

Key facts

- Many people with MRSA infection can be treated outside hospital with oral antibiotics or special services to provide intravenous antibiotics at home
- People with MRSA infection are not a danger to healthy people
- MRSA infection is not a reason to stop admission to a residential or nursing home
- Measures used to prevent the spread of MRSA include improved environmental and hand hygiene, screening of patients, improving antibiotic prescribing, isolating patients with infection and minimising use of invasive medical devices
- Several antibiotics are effective in treating MRSA
- Treating MRSA outside hospital is preferred by patients and is also very cost-effective for the hospital

In response to the increasing number of cases of MRSA in recent years, and the associated costs and media interest, various government agencies and other bodies have produced recommendations and guidance on the management of MRSA.

The issue is high on the political agenda, and is of great importance to patient organisations and other interest groups.

3.1. The role of prevention in management of MRSA

Much of the published guidance on MRSA relates to preventing its spread and reducing infection rates.

3.1.1. Infection control measures

The two main aspects of infection control are hospital environmental hygiene and hand hygiene. Guidelines on environmental hygiene recommend that:

- The hospital environment must be visibly clean, free from dust and soilage, and acceptable to patients, visitors and staff
- Increased levels of cleaning should be considered in outbreaks of infection where the pathogen concerned survives in the environment
- Shared equipment such as toilets, commodes and beds used in the clinical environment must be decontaminated appropriately after each use
- All healthcare workers need to be aware of their individual responsibility for maintaining a safe environment for patients and staff.[24]

As regards hand hygiene, the guidelines recommend that:

- Hands must be decontaminated immediately before each and every episode of direct patient contact/care and after any activity or contact that potentially results in hands becoming contaminated
- Hands that are visibly soiled or potentially contaminated (e.g. after removing gloves) must be washed with liquid soap and water
- Hands should be decontaminated between caring for different patients or between different care activities for the same patient; an alcohol-based hand rub should be used if hands are not visibly soiled, but hands should be washed after several consecutive uses of alcohol
- Before a clinical shift begins, all wrist and (ideally) hand jewellery should be removed, and cuts and abrasions should be covered with waterproof dressings
- Near-patient alcohol-based hand rub should be made available in all healthcare facilities.[24]

Effective hand washing with soap and water will clean the hands and remove many micro-organisms. It is essential that hands are dried after washing. Alcohol gels and rubs will also remove many micro-organisms but are not effective against others, including *Clostridium difficile*, and will not remove dirt and organic material.[24] In addition, overuse of these products can make hands chapped and sore, which makes people less likely to use them, and chapped hands are more likely to carry bacteria. The use of these products could also mean that people become complacent and less likely to wash their hands.

3. Management of MRSA

In addition to hand hygiene and equipment cleanliness, a number of other measures are routinely used to prevent the spread of MRSA between hospital patients, depending on the risk category and whether an outbreak (a number of confirmed MRSA cases in the hospital/ward) is occurring.[1] Antiseptic lotions (containing triclosan or chlorhexidine) may be used to reduce skin carriage in colonised patients, while a short course of nasal ointment may eradicate colonisation in the nose.[1]

A recent report from the Department of Health Working Group on Uniforms and Laundry concluded that there is no firm evidence that uniforms (or other work clothes) pose a significant hazard in terms of spreading infection.[25] However, the report acknowledged that there is a public perception that they do and, therefore, recommended that hospital staff should wear short-sleeved shirts/blouses and avoid wearing white coats when providing patient care.[25] Some hospitals have introduced policies that preclude the wearing of uniforms in public places.

3.1.2. What must the hospital do?

The 2006 Code of Practice for the Prevention and Control of Health Care Associated Infections lists 11 duties of all hospitals with respect to healthcare-associated infections.[26]

Duties of hospitals under the Code of Practice[26]

1. General duty to protect patients, staff and others from healthcare-associated infections
2. Duty to have in place appropriate management systems for infection prevention and control
3. Duty to assess risks of acquiring healthcare-associated infections and to take action to reduce or control such risks
4. Duty to provide and maintain a clean and appropriate environment for health care
5. Duty to provide information on healthcare-associated infections to patients and the public
6. Duty to provide information when a patient moves from the care of one healthcare body to another
7. Duty to ensure co-operation
8. Duty to provide adequate isolation facilities
9. Duty to ensure adequate laboratory support
10. Duty to adhere to policies and protocols applicable to infection prevention and control
11. Duty to ensure, so 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 healthcare-associated infections

3.1.3. What can patients, relatives and visitors do?

Patients, relatives and visitors can help to reduce the risk of MRSA and other healthcare-associated infections:

- Ensure that hands are clean; wash them with soap and water and/or use the gel (or wipes) available
- If staff are not seen cleaning their hands before or after they examine you, ask them to do so
- Do not touch your own or other people's dressings, tubes etc
- Do not visit people in hospital if you are unwell, particularly if you have had diarrhoea and/or vomiting in the previous 48 hours. This is not because of a risk of MRSA but to reduce spread of the organisms causing diarrhoea and/or vomiting
- Avoid bringing too many things to the hospital
- If you have concerns, talk to a member of staff or the patient liaison (PALS) officer.

3. Management of MRSA

Patients having planned operations or other specialist tests may need to have MRSA screening swabs taken before they are admitted to the hospital. This is done to check if they are carrying MRSA and allows it to be treated before they have their procedure, thereby reducing the risk of developing an infection. This is particularly relevant for people who have been in hospital before or who have longstanding medical conditions.

3.1.4. Screening and testing for MRSA

Screening – to identify who might be colonised with MRSA – is one way of trying to control MRSA infection. Indeed, the Department of Health in England announced recently that it wants us to move to a system whereby all patients admitted to NHS hospitals are screened (tested) to find out who is colonised by MRSA. The intention is to concentrate initially on those people who are admitted for surgery (see below), and then additionally to test all acutely unwell patients as they are admitted to hospital. Similarly, the Scottish Health Secretary has announced a £54 million programme that will include screening every patient in Scottish hospitals for MRSA.[27] However, whether it is realistic to screen every person and then ensure that MRSA-positive patients are kept separate from those who are MRSA-negative remains uncertain. This approach also ignores other types of *S. aureus* that cause infections in hospitalised patients.

Hospitals may have a policy of screening people with MRSA infection to assess if and where they are colonised, and to monitor if clearance treatment has worked. This is most commonly carried out before patients are admitted for surgery. One problem with this approach is that a single test is not absolutely reliable at ruling out the possibility of MRSA colonisation. MRSA colonised people can be given medicines to attempt to clear the bacteria; this is effective in 30–80% of patients, success rates depend on factors such as whether skin problems (e.g. ulcers) and devices (e.g. catheters) are also present.

Other patients who have come into contact with those who develop MRSA infection may also be screened for the bacteria, as may patients admitted from hospitals or care homes with a known MRSA problem. In cases of an outbreak of MRSA, staff may sometimes be screened for colonisation (non-symptomatic carriage) with the bacteria. It is often not possible to work out if a person has recently acquired MRSA or was the source of MRSA that has been spread elsewhere.

Conventional ways of screening for MRSA tend to be slow, taking 3–5 days for a result to be available. New rapid screening methods are now available, but these are relatively expensive, need more skilled staff, and are difficult to perform in very large numbers compared with the conventional test methods. Studies are underway in the NHS to determine whether it makes sense to use these newer methods.

3.1.5. Reducing the use of some medical equipment

An important strategy to reduce the risk of MRSA infection is to minimise the use of medical devices. Around 80% of urinary infections, not usually with MRSA, can be traced to indwelling urinary catheters, while 60% of staphylococcal bloodstream infections are introduced by intravenous feeding lines, catheters or similar devices.[14] Because of this, the Chief Medical Officer has recommended that such devices should be used only when there is no suitable alternative, be inserted and maintained by trained staff, and be kept in place for the minimum time necessary.[14]

3.1.6. Improving the capacity to isolate patients

The same report from the Chief Medical Officer notes that the risk of healthcare-associated infections is greatly increased by extensive movement of patients within hospital, high bed occupancy and lack of isolation facilities.[14] Hospitals are recommended to assess the infection control impact of their bed management policies and review the provision of isolation facilities.[14]

In 2004, the National Audit Office report on reducing the risk of hospital-acquired infection acknowledged that higher bed occupancy was not always consistent with good infection control,[15] and in October 2007, at a hearing of the Parliamentary Health Select Committee, Lord Darzi, Parliamentary Under Secretary of State at the Department of Health, accepted that a bed occupancy rate of over 90% led to a high risk of MRSA infection.[28]

Many NHS hospitals have only a small proportion of their beds in single rooms (typically about one in every five beds).[29] This means that it is often not possible to nurse all patients who have a potential healthcare-associated infection, such as MRSA, in single rooms. A recent study found that the likelihood of not being able to isolate a patient, even when it was believed to be necessary by the infection control team, varied between 0% and 57% in different clinical specialities.[29]

3. Management of MRSA

Where wards had at least 30% of the beds provided in single rooms, isolation of people with MRSA was possible. Thus, new hospitals should ideally be designed to have a good proportion of their beds in single rooms.

Observation of patients in single rooms is more difficult than in open wards and so needs more staff for safe care. Isolation can have psychological effects on patients, so sometimes rooms with two or three beds in for patients with the same infection make sense. Rooms need to have en-suite facilities so that patients do not need to share toilets, bathrooms and other accommodation where cross-infection can occur.

"I was supposed to be put in isolation but there were no rooms, so I was left in a passage with plastic around me. The situation was not explained clearly so I was left feeling isolated and very upset by it all."

'Charles', 68, retired company chairman

3.1.7. Improving the prescribing of antibiotics

Antibiotics are important medicines that can improve people's health and save lives when used carefully. However, prudent prescribing of antibiotics is recommended, as intensive and inappropriate use of antibiotics can promote the spread of resistant bacteria. Indeed, more and more evidence is emerging to show that some types of antibiotics can promote the development of MRSA. The antibiotics do this not by actually creating MRSA but because they are ineffective against the bacteria; thus, MRSA can continue to grow in a patient receiving certain antibiotics, increasing in number and potentially spreading to other people. This is one of the reasons why patients who have had lots of antibiotics are at increased risk of MRSA infection. Of course, people who have had lots of antibiotics tend to have other illnesses and risk factors that also may increase the likelihood of MRSA infection. Hence, patients commonly have several risk factors for MRSA infection rather that just one.

So what does this mean? Despite increasing awareness of the potential downsides of antibiotics, they still tend to be overused. It is important to get the right balance between over- or under-prescribing of antibiotics, as either can potentially be harmful. Antibiotic use should be carefully monitored, particularly in some settings where it may be necessary to limit certain antibiotics, for example if the risk of infection by MRSA or *Clostridium difficile* is high.

3.1.8. Other guidelines and targets for MRSA prevention

The National Institute for Health and Clinical Excellence (NICE) has published a guideline for the prevention of healthcare-associated infection in primary and community care.[30] This stresses the importance of hand hygiene and the wearing of gloves by healthcare workers in the community. It makes recommendations on measures for preventing infections associated with three specific aspects of care: the use of long-term urinary catheters, enteral (tube) feeding systems and central venous (intravenous) catheters.

In December 2004, the government announced a target of halving MRSA bacteraemia rates by April 2008.[31] However, an internal Department of Health memorandum that was leaked to the *Health Service Journal* in January 2007 quoted the Director of Health Protection stating of MRSA bloodstream infections: "Although the numbers are coming down, we are not on course to hit that target and there is some doubt about whether it is in fact achievable."[32] The Department of Health has recently given hospitals in England four months and £60 million to carry out a 'deep clean' to tackle MRSA and other healthcare-associated infections.[33] A new hospital regulator has been given powers to close down wards in hospitals that do not meet the required standards.[34]

Clean hospitals are very important and are much more pleasant for patients; however, on their own, cleaner hospitals will not eradicate MRSA because some people are already colonised with MRSA bacteria when they come into hospital. Effective treatment of MRSA infection is complementary to the efforts to prevent MRSA infection through improved infection control and cleaner hospitals.

3. Management of MRSA

3.2. The role of treatment within control of MRSA

The most basic treatment of MRSA involves clearing carriage from the nose. Nasal carriage is associated with an increased likelihood that the organism will be found on the skin and may reach wounds. The antibiotic mupirocin can be applied inside the nose to clear MRSA. However mupirocin-resistant MRSA do occur and the antibiotic then may not work. Alternative antibiotics are not so effective or safe, also, mupirocin works much less effectively if MRSA are present in skin conditions such as leg ulcers.

Treatment of MRSA depends on the site and extent of the infection. In surgical, post-operative or post-traumatic infection, treatment begins with drainage of pus followed by removal of dead, damaged or infected tissue. Delayed closure of heavily contaminated wounds may be considered. Once the infected site has been adequately cleaned, wounds can be dressed with a variety of specialised dressings. Silver, honey and tea tree dressings have all been advocated and used in clinical practice.[35]

Contrary to what many people believe, MRSA can be treated with antibiotics. The resistance of MRSA bacteria to certain types of antibiotics makes choosing an effective antibiotic more difficult, but not impossible. How sick people are with MRSA varies – some people will only have redness and swelling surrounding a wound infection, for example. People with bloodstream infections or pneumonia will be much sicker. The type of treatment recommended for use in MRSA varies according to the site and severity of the infection.

Infections caused by other strains of *S. aureus* are often treated with the antibiotic flucloxacillin. However, flucloxacillin is not effective against MRSA. The antibiotics that are most often used to treat MRSA are glycopeptides (either vancomycin or teicoplanin), which have to be given intravenously. This is often inconvenient, especially in people with less serious infections when an oral option would be good. Sometimes laboratory tests (sensitivity or susceptibility tests) can show that there are other oral options and these can be used to treat an infection. Depending on the type of infection, possible alternative antibiotics include tetracyclines, trimethoprim, nitrofurantoin and clindamycin,[36,37] all of which can be given by mouth. In these cases it is important that the laboratory testing has been carried out and that the antibiotic chosen is also suitable for the particular site of the infection (for example, nitrofurantoin is **only** suitable for infection in the urinary tract).

If these oral antibiotics are not suitable – for example, for particularly serious infections or a deep infection – then there are alternatives. As already mentioned, most strains of MRSA are susceptible to (i.e. can be treated with) glycopeptides – vancomycin or teicoplanin – or with other intravenous antibiotics which MRSA are likely to be sensitive to, such as daptomycin or tigecycline. To treat MRSA these antibiotics have to be given by injection or infusion. Another alternative is linezolid, which can be given by either intravenous infusion or orally (tablet form).[36,37] There are also other antibiotics that are active against MRSA that have recently become available or are in late development which will need to be considered in future.[38]

"I was told that I would have to have both my legs amputated after I got MRSA following foot surgery in 2004. Fortunately my secretary found a surgeon at another hospital who specialised in treating infection surgically. I saw him and he was able to operate and save my legs. I am a shadow of my former self and find it difficult to keep going, but am determined to get better."

'Charles', 68, retired company chairman

3.2.1. Which antibiotic treatment?

Evidence-based guidelines for the treatment of MRSA infections in the UK were published in 2006.[39] These recommend that tetracyclines are used if the strain is susceptible for skin and soft tissue infections unless the risk of bacteraemia is high, in which case a glycopeptide antibiotic (e.g. vancomycin) or linezolid should be used. Skin and

3. Management of MRSA

soft tissue infections include cellulitis, abscesses, diabetic foot infections and surgical site infections.

Tetracyclines are the first choice therapy for urinary tract infections. Bone and joint infections often require lengthy treatment with a combination of vancomycin and either rifampicin or fusidic acid.[39] As new evidence and experience develop it is important to consider whether these need to be incorporated into guidelines.

Like any other medicine, antibiotics may also have unwanted effects. It is important that the choice of antibiotic is tailored to suit the individual patient, taking into account the extent and site of their infection and the scientific evidence available to guide choices. Ideally, this will involve specialist advice and laboratory testing to identify the cause and help select the most appropriate antibiotic. In many cases, the first choice of antibiotic can be refined when more information becomes available from the laboratory. If people are better informed they can judge the different options and contribute better to the choices made.

3.2.2. Can people with MRSA infection be treated at home?

People who are colonised but do not have an active infection with MRSA (about 3% of the general population) are able to be at home without any treatment. Traditionally, people who have an infection caused by MRSA have been treated in hospital, usually by intravenous antibiotics. Intravenous medicines need to be given by a healthcare professional, such as a nurse, and in some cases it is only the need for intravenous antibiotics that keeps a person in hospital when they are otherwise medically fit to go home. In many cases, it is thought that if appropriate treatment was available, it would be possible for the MRSA infection to be treated outside hospital – obviously it is important that the patient has no other medical reason for staying in hospital and that this is properly explained to them. Outside of hospital and care homes, the patient is much less likely to be challenged or infected by hospital organisms.

For example, many people with MRSA, as with other *S. aureus* infections, can go home with appropriate wound dressings and regular visits from the district nurse. For others who need antibiotic treatment, this could be provided for them to take in their own home or in a residential or nursing home either with oral antibiotics or with special services that provide patients with regular visits from nurses to administer intravenous antibiotics. Studies have suggested that up to a third of people with MRSA could be discharged from hospital with an oral antibiotic.[40,41]

Patients' relatives or other carers may be concerned about people with MRSA leaving hospital and spreading infection. However, although MRSA can easily be transmitted to other patients in hospital, through wounds or medical devices as a result of clinical and social contact, it does not usually harm healthy people, including healthy elderly people, pregnant women, children and babies.[42] It is usually only people with open wounds/sores or intravenous lines or catheters who are at risk.

In the past, there have been cases in which people with MRSA have been refused admission to a residential or nursing home when they are ready for discharge from hospital. The government has made it clear that there is no justification for this. It is not appropriate for any facility to discriminate against people who have MRSA by refusing them admission to a nursing or residential home or by treating them differently from other residents.[43,44] If the good basic hygiene precautions that should be routine in all such establishments are followed, residents with MRSA are not a risk to other residents, staff, visitors or members of their family. It is safe for them to share a room as long as neither occupant has open sores or wounds, drips or catheters, and they can join other residents in communal areas provided any sores or wounds are covered with a dressing.[44]

Recent Department of Health guidance on infection control in care homes reiterated that: "People affected by MRSA do not present a risk to the community at large and should continue their normal lives without restriction. MRSA is not a contraindication to admission to a home or a reason to exclude an affected person from the life of a home."[43]

3. Management of MRSA

3.2.3. Methods of home antibiotic treatment
There are two ways in which people can receive antibiotic treatment for MRSA infections outside hospital:

1. Outpatient parenteral antimicrobial therapy (OPAT; also known as outpatient and home parenteral antibiotic therapy or OHPAT)
2. Oral antibiotic treatment.

With OPAT, community nurses, patients, carers or outpatient clinic staff administer antibiotics by intravenous infusion or intramuscular injections to patients in the community (i.e. outside hospital). OPAT was shown to be a safe, efficacious and cost effective way of treating patients with serious bacterial infections more than 30 years ago in the USA, where it has long been recognised as a standard of care offering patients an alternative option for parenteral therapy.[45] Since then its use has expanded to other continents,[46] and is associated with favourable clinical, economic, safety and patient satisfaction outcomes.[47]

A clinical trial in New Zealand compared inpatient treatment and OPAT in 200 people with cellulitis who needed intravenous antibiotics.[48] The clinical outcomes did not differ between the two groups, but patient satisfaction was higher in the OPAT group. Only one in 20 of the people treated in the community said that they would have preferred hospital treatment, while one in three of those treated in hospital thought that home care would be preferable.

OPAT is less well established in the UK than in some other countries. A growing number of centres in the UK now offer OPAT services in a variety of forms and for an array of infections,[49] but it is not yet available throughout the country. A survey of UK infection specialists found that the main barriers to its development were organisational – for example, sources of funding, links between hospital and community services, and identification and training of staff.[50]

Data from one of the largest OPAT centres in the UK, in NHS Tayside, with a population of around 350,000, has shown that over a 6-year period to 2007, around 750 patients were treated, with bed savings of more that 12,000 bed days (D Nathwani, personal communication). Each year about 30 orthopaedic patients with infections are treated with OPAT, representing approximately 1,500 bed days (D Nathwani, personal communication).

The UK government's emphasis on promoting clinically effective and cost-effective ambulatory healthcare based in the community or non-inpatient settings will undoubtedly lead to further expansion of these services.

"I was called in to see a 52 year old man with an MRSA infection at a surgical wound site. He had received 10 days of IV antibiotics. When I entered the patient's room I found the man very distressed, crying and saying to his wife that he did not want any more needles to be inserted – he explained to me that he had had four different catheters inserted just for the antibiotics to be given; also, he had needed to have blood samples taken to monitor blood levels of the drug. I was able to switch the patient onto oral antibiotics that didn't require monitoring. The patient was even able to go home for the last two weeks of his antibiotic therapy."

Consultant microbiologist, West Yorkshire

The second way that MRSA patients can be treated outside hospital is through the use of oral antibiotics. This is a particularly attractive approach for people who are otherwise well enough, as it often means that they can be treated outside hospital and have freedom from having intravenous lines to deliver their medicine. It also reduces the risks associated with such lines, which is especially important in this context as we know that intravenous access is the most common underlying risk factor for *S. aureus* and MRSA bacteraemia and also increases the risk of local complications such as phlebitis (inflammation of a vein). In addition, the insertion of such devices causes discomfort and distress to many people.

3. Management of MRSA

Conversations with people who have had the option of oral therapy often indicate that this is a strongly preferred option, as long as it is explained that oral treatments can be effective against MRSA and people know how to seek further help and advice should they need it.

Of the antibiotics most commonly used to treat serious MRSA infections, some (e.g. teicoplanin) are only available for use by infusion or injection, but many others are available for oral use. Examples that are increasingly being used either alone or in combination include erythromycin and clindamycin, tetracycline, trimethoprim, linezolid, fusidic acid and rifampicin. What is important is that the choice of antibiotic treatment should be made with expert input from an infection specialist.

A recent study conducted in London found that 29% of people with MRSA infection could potentially be switched from intravenous to oral antibiotic treatment and discharged from hospital,[40] while a US study found that 31% would have been suitable for early discharge.[41] A follow-up implementation study to the London study sought to find out if a dedicated team approach could deliver this benefit. In this 'Going Home' study, 41% of patients were successfully switched to oral antibiotics and discharged home earlier. Another 11% were able to be switched to oral antibiotics but remained in hospital to complete their treatment.[51]

3.3. Cost-effective MRSA infection management

The extra costs to the NHS incurred by people with MRSA infections are mainly related to the length of stay in hospital, with fixed overheads and nursing care being the most costly elements.[52] The cost of antibiotic treatment makes a relatively small contribution to overall costs. This has consistently been estimated to represent 2–4% of the overall cost of managing an episode of infection.

3.3.1. Savings from efficient antibiotic use

That more efficient use of antibiotics can reduce the time patients spend in hospital was shown in a US study of people with community-acquired infections. Patients who were cared for by an infectious diseases specialist were discharged earlier than those cared for by other hospital doctors. This was because the infectious diseases specialist was more likely to use OPAT or to switch patients from intravenous to oral antibiotics. The earlier discharge had no detrimental effect on the outcome for the patients.[53]

Decreasing the length of hospital stay by discharging patients to oral antibiotic therapy at home or OPAT will reduce overall costs and increase the efficiency and cost-effectiveness of treatment. It will also indirectly reduce the potential risk of the infection spreading to other vulnerable patients in the hospital and in some cases (e.g. in orthopaedic surgery) may allow the opportunity to increase the efficiency of bed use by freeing-up beds. In NHS Tayside in Scotland, an OPAT service to the orthopaedic infection department has treated 120 patients over nine years, representing a total of 1,110 bed days for patients who would have otherwise needed inpatient treatment. This has allowed these orthopaedic beds to be used more efficiently (D Nathwani, personal communication).

Studies of the impact of oral antibiotic treatment of MRSA compared with continuing intravenous antibiotic treatment have consistently shown reductions in length of stay for patients receiving oral treatment.[41,54–57] The Going Home study mentioned above found a saving of 1,215 bed days (median 14 days per person; range 1–84) as a result of early discharge after switching to oral antibiotic for 64 patients. An additional 511 days of inpatient intravenous therapy were prevented by switching to oral therapy in people who could not be discharged home.[51]

There is not a great deal of health economic analysis of the impact of home treatment of MRSA from the UK. However, OPAT has significantly reduced length of stay for treatment of skin and soft tissue infections, some of which are caused by MRSA; for the treatment of bone and joint infections, OPAT offered reduced costs compared with inpatient treatment.[58]

Most of the other studies are from North America or Australia, but their findings are consistent in revealing reduced overall costs compared with inpatient treatment and are worthy of consideration as they provide some insight into the potential impact on resource use in the UK.

3. Management of MRSA

"When I went home after my knee replacement surgery I noticed there was pus on the wound and told the district nurse. I was readmitted and spent two weeks in hospital being treated with IV antibiotics for MRSA. I was really lucky because my hospital had a service where I could go home to continue my treatment. Being at home with my family was wonderful. The district nurse visited every second day to inject my antibiotics – the only drawback was sitting and waiting for her to come."

'John', 72, former engineer at an ice skating rink

An Australian study assessed the cost-effectiveness of OPAT in patients with serious bacterial infections. The results showed that using OPAT cost an average of at least Aus$112 (about £50) per day less than inpatient therapy.[59] Another Australian study found that the cost of OPAT was approximately half that of inpatient therapy.[60]

A Canadian study looked at the savings associated with a three-year OPAT programme at one teaching hospital. In all, 117 patients had received 140 courses of OPAT for a wide variety of infections. Over the three years, the costs avoided by the hospital as a result of the OPAT programme were calculated to be Can$1,730,520 (£850,000), while the saving to the Ministry of Health was put at Can$1,009,450 (£496,000).[61]

3.3.2. Changes in the way NHS services are funded: payment by results

Until recently, hospitals were given block sums of money to provide for the health needs of the community. Increasingly, hospitals are now paid for each episode of care at set rates or tariffs – this is known as payment by results (PbR).[62] Under PbR, hospital trusts are paid for the patients they care for, with the tariffs set according to groups of similar treatments. Thus, there is a fixed cost for caring for a patient with a specific condition.

The price tariff set for any given condition or treatment (e.g. a particular surgical procedure, such as hip replacement) assumes that patients will need a certain number of days in hospital. However, if a patient cannot be discharged within this time, the hospital will incur extra costs that are not covered under PbR. In addition, the bed cannot be used for another patient and thus may increase waiting lists. Therefore, preventing infections will mean that resources can be directed at treating new patients. Furthermore, if patients with infections can be safely treated at home, either with an oral antibiotic or OPAT, the hospital will potentially be able to reduce its costs and its waiting lists. This may also have benefits for patients, including the opportunity to convalesce at home rather than in hospital and reducing the chance of acquiring a healthcare-associated infection (for patients both leaving and remaining in hospital) because of lengthy stays.

As patients are likely to be keen to go home if they are able to, this is potentially a win-win situation. The outcome that everyone wants for people with MRSA is for them to be at home and healthy.

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Glossary of terms

Antibiotic	Medicine that either kills or prevents the growth of bacteria
Antimicrobial	Substance that kills or inhibits the growth of micro-organisms such as bacteria, fungi, viruses or parasites
Antiseptic	Substance that is often used on the surface of the body that kills or inhibits bacteria
Bacteraemia	Bacterial infection in the bloodstream
Carriage/carrier	The presence of a micro-organism in a person that is not causing symptoms. Carriage rates are often much higher than infection rates. Carriers can pass on micro-organisms and make other people ill without experiencing any symptoms themselves. Bacteria such as MRSA have high carriage rates in the UK population, with most people being unaware that they carry MRSA
Catheter	A hollow tubular medical device for insertion into canals, vessels, passageways, or body cavities, usually to permit injection or withdrawal of fluids. The most common catheters are urinary catheters (used to drain urine from the bladder) and intravenous (IV) catheters inserted into veins to administer fluids such as medicines
Cellulitis	Inflammation of the connective tissue underlying the skin, which can be caused by a bacterial infection
Chlorhexidine	Antiseptic agent that may be used to clear skin carriage of MRSA
Clindamycin	Generic **antibiotic** used to treat some types of **MRSA infections**, such as skin, soft tissue and lung infections
Colonisation	The establishment of a species of micro-organism in an area without causing infection. **Infection** (as opposed to carriage) is classified when the presence of bacteria becomes detrimental – i.e. causes symptoms
Flucloxacillin	Generic name for an **antibiotic** used to treat ***S. aureus* infections**; not effective against **MRSA**
Fusidic acid	Generic name for an **antibiotic** used to treat some types of **MRSA infections** – usually in combination with other antibiotics
Glycopeptides	Class of antibiotics used to treat resistant infections. Glycopeptide antibiotics include vancomycin and teicoplanin
HAI	Healthcare-associated infection (also known as hospital-acquired infection or nosocomial infection)
Infection	**Infection** (as opposed to carriage) is classified when the presence of bacteria becomes detrimental (i.e. causes symptoms)
Linezolid	An antibiotic used to treat resistant healthcare-associated infection and pneumonia
MRSA	Methicillin-resistant *Staphylococcus aureus* – a strain of the bacteria *Staphylococcus aureus*, that has grown resistant to treatment with some antibiotics
Mupirocin	Antibacterial agent that may be used to eliminate nasal carriage of MRSA
Necrotizing fasciitis	Necrotizing fasciitis – commonly known as 'flesh-eating bacteria' – is a rare **infection** of the deeper layers of skin and subcutaneous tissues. Many types of bacteria can cause necrotizing fasciitis; Group A streptococci is the most common cause

Glossary of terms

Nitrofurantoin	Generic **antibiotic** used to treat urinary tract **infections**
Nosocomial infection	An alternative term used for a healthcare-associated infection. An infection acquired in a hospital. Specifically, an infection that was not present or incubating before the patient was admitted
Obstetrics	The surgical specialty dealing with the care of a woman and her baby during pregnancy, childbirth and the period shortly after birth
Panton-Valentine leukocidin (PVL)	Panton-Valentine leukocidin (PVL) is a cytotoxin (a substance toxic to cells). It causes leukocyte (white blood cell) destruction, **pneumonia** and **necrotizing fasciitis**. PVL has played a role in a number of outbreaks of fatal bacterial **infections. MRSA** is particularly difficult to treat when it carries PVL
Parenteral	Medication delivered by a route other than orally. This includes intravenous infusions and injections, and intramuscular and subcutaneous injections
Payment by results (PbR)	An NHS policy aimed at providing a transparent, rules-based system for paying hospital trusts. Set payments (tariffs) are provided for hospitals for each procedure (such as operations and treatment of heart attacks)
Pneumonia	Infection of the lung tissue
Resistance	The failure of an infection/disease to respond to treatment. A resistant bacterial infection cannot be treated with standard antibiotics
Rifampacin	Generic name for an **antibiotic** used to treat some types of **MRSA infections** – usually in combination with other antibiotics
S. aureus	*Staphylococcus aureus* – a type of bacterium that 30% of people carry on their skin or in their noses; can cause infection if it enters the body
Teicoplanin	Generic antibiotic in the glycopeptide class. Used to treat drug-resistant healthcare-associated infections
Tetracycline	Generic **antibiotic** used to treat some types of **MRSA infections**, such as skin, soft tissue, urinary tract and lung infections
Triclosan	Antiseptic agent that may be used to clear skin carriage of MRSA
Trimethoprim	Generic **antibiotic** used to treat urinary tract **infections** caused by **MRSA**
Vancomycin	Generic **antibiotic** in the glycopeptide class. Used to treat drug-resistant healthcare-associated infections

Further information resources

List of useful organisations with details on where more information about MRSA can be obtained.

Government/NHS patient information services

NHS Direct
NHS Direct is a 24-hour health service that aims to provide information and advice about health, illness and health services, to enable people to make decisions about their healthcare and that of their families. Information on MRSA on this site is at http://www.nhsdirect.nhs.uk/articles/article.aspx?articleID=252
Website: http://www.nhsdirect.nhs.uk
Phone: 0845 4647

NHS Direct Wales/Galw IECHYD Cymru
NHS Direct Wales is a health advice and information service for patients in Wales, available 24 hours a day, every day. Information is available in English and Welsh.

Website: http://www.nhsdirect.wales.nhs.uk/
Phone: 0845 4647

NHS Helpline in Scotland
The NHS Helpline gives access to information on the Scottish health services and health matters, as well as information on social care services.

NHS Helpline free on 0800 22 44 88 (8.00 am to 10.00 pm, seven days a week)

NHS24 – Scotland
NHS24 provides comprehensive up-to-date health information and self care advice for people in Scotland.

Website: http://www.nhs24.com/content/
Phone: 08454 242424

Health Protection Scotland (HPS)
Health Protection Scotland (HPS) was established by the Scottish Executive to strengthen and co-ordinate health protection in Scotland. HPS took over the functions of the Scottish Centre for Infection and Environmental Health (SCIEH).

Website: http://www.hps.scot.nhs.uk/index.aspx

Health & Social Care in Northern Ireland
This site contains links to the Acute and Community Services provided by the five health trusts, general practitioner surgeries and clinics, health boards and agencies and central government healthcare services in Northern Ireland. There is advice about healthy lifestyles, the latest local, national and international health news, and online access to medical databases.

Website: http://www.n-i.nhs.uk/

NHS Choices
NHS Choices is a service that aims to put patients at the centre of their healthcare. It has been developed to help patients make choices about their health, from lifestyle decisions about things like smoking, drinking and exercise, through to the practical aspects of finding and using NHS services. Information on MRSA on this site is at http://www.nhs.uk/Conditions/MRSA/Pages/Introduction.aspx?url=Pages/What-is-it.aspx

Website: http://www.nhs.uk/Pages/homepage.aspx