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Topic owner	
Topic author(s)	*Dawn Jenkin, Specialty Registrar in Public Health, Bryony Lloyd, Specialty Registrar in Public Health*
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Executive summary

Introduction

Healthcare associated infections (HCAIs) are those associated with healthcare delivery in any setting. This may include in hospitals, long-term care facilities such as nursing homes or a person's own home.[1] For an infection to be 'healthcare-acquired', the patient must neither have had the infection, nor have been incubating the infection, prior to attending the health care setting[2], or prior to the healthcare professional visiting the patient in their own home.

Despite recent successes in reducing incidence rates, HCAIs remain a cause of significant illness and early mortality.

> "Infections prolong hospital stays, create long-term disability, and increase resistance to antimicrobials, represent a massive additional financial burden for health systems, generate high costs for patients and their family, and cause unnecessary deaths." [2]

A significant proportion (at least 20%) of HCAIs are preventable.[3] There is considerable evidence that infection prevention and control strategies are cost-effective.[4]

HCAIs pose a particular risk to individuals in poor health or with weakened immune systems, due to frailty in old age, medical interventions such as surgery or chemotherapy and existing medical conditions. Their impact for individuals is broader than the physical implications. They can cause individuals and their families to lose confidence in the carers and organisations that should be supporting them through illness.[1]

It has been estimated that in developed countries up to 10% of hospitalised patients develop infections every year.[1] In the UK it has been estimated that 300,000 HCAIs occur annually.[5] The cost to NHS hospitals of caring for people that acquire an HCAI has been estimated conservatively as over £1 billion a year. Of this £56 million (5.6% of total NHS costs) is estimated to occur following discharge from hospital.[5]

Under the Health and Social Care Act 2012 all providers of health and social care services must declare themselves compliant with the Essential Standards of Quality and Safety and its supporting document 'The Code of Practice on the prevention and control of infections and related guidance'.[6]

Infection prevention and control is the responsibility of all organisations and staff involved in the provision of health and social care. Patients also have a responsibility to understand and maintain good personal hygiene practices. The Community Infection Prevention and Control Service is commissioned to provide

comprehensive specialist advice, support and local surveillance relating to infection prevention and control to community-based services

A Health Needs Assessment was completed for both Nottinghamshire County and Nottingham City in 2014, to inform a full service review for Community Infection Prevention and Control (CIPC). Findings from the needs assessment are summarized and updated within this chapter.

The full needs assessment completed by Nottinghamshire County Council Public Health is available here.

Unmet need and gaps

- Nationally and locally, risk of HCAIs in community is increasing due to shift in care provision from acute hospital to a variety of community settings including “care at home”.
- Nationally and locally, anti-microbial resistance is an ongoing significant risk to public health.
- A substantial number of preventable infections, including E.coli bacteraemia, may be linked to catheter care in community. However the extent of unmet need has not been established. The number of catheters used in community settings and the quality of catheter care is unknown.
- There is limited local surveillance data for HCAIs, which limits evaluation of local trends and service effectiveness.
- National surveillance data does not allow comparison with other areas, as it does not take into account variation in population demographics.

Recommendations for consideration by commissioners

The recommendations arising from the Health Needs Assessment are provided below. Many of these are being addressed following the recommissioning of the Community Infection Prevention and Control Service in 2014.

Strategic Recommendations:

1. Agree and communicate clear leadership, roles, responsibilities and structure for an integrated Infection Prevention and Control function (Addressed)
2. CIPC services should be commissioned in line with current and future need, with greater provision made for Mansfield and Ashfield and Nottingham City (Addressed)
3. Commissioned capacity should plan for a widening of IPC focus beyond MRSA and CDI targets.
4. Review, via the IPC forum, NHS England Local Area Team and CCG prescribing leads, the implementation of prescribing guidelines on antibiotic prescribing.

Service Recommendations :

5. Local Surveillance should be included within CIPC contract (Addressed)
6. Establish the level of need due to catheter associated UTIs in community and develop a work plan to address this.
7. Review education and training approaches to better reach new target audiences (Addressed)
8. A comprehensive IPC support package should be offered to all care providers, including care in the home, learning disabilities residential units and residential care homes (Addressed)
9. Embed risk assessment for infection control within the standard care processes of healthcare professionals in community settings.
10. Commission MRSA screening and decolonisation appropriate to the need of the local population (Addressed)

What do we know?

1) Who is at risk and why?

Risk of infection increases with increased contact with healthcare interventions, including frequent (chronic health conditions) or prolonged (in-patient and care home settings) exposures. Social care interventions also carry an increased risk of infection due to the number of different professionals visiting a client's home and the close personal contact including in procedures such as continence care.

Risk of HCAI is associated with a number of factors:

Patient level factors - the very young and the very old are at increased risk of infection. The immune system does not fully develop until around 6 months of age. Old age is associated with declining immune system function as well as long term conditions which weaken immune responses. [1] Since an increased prevalence of long term conditions is seen in deprived populations, an increased risk of HCAIs linked to deprivation is expected.

Medical interventions – any intervention which breaks the first line of defence of the body (the skin, secretions and normal microbial flora) carries an increased risk of infection. This includes surgery, intravenous lines, artificial ventilators and antibiotic use which destroy the normal gut flora. Some interventions such as chemotherapy increase risk through compromising the immune system. [1] In community care, interventions would include chronic wound management, urinary catheter care and minor surgical procedures.

Care settings – in long term care settings, where many patients are cared for together, risk is increased due to increased opportunity for spread of micro-organisms. Also, the frequent use of antibiotics in these settings leads to the presence of resistant micro-organisms. Carriage of CDI has been shown in some studies to be as high as 20% in residents of long term health care facilities, compared to 3% in the adult population.[1]

HCAIs are caused by a wide range of different infectious micro-organisms, and can affect many different areas of the body, including the bloodstream, the gut, the skin, and the respiratory and urinary systems.

Five infections (central line associated bloodstream infections, catheter-associated urinary tract infections (CAUTI), surgical site infections, Clostridium Difficile Infection and healthcare associated pneumonia) account for 85% of HCAIs in the industrialised world.[7]

Prevalence of HCAIs in acute settings is estimated in England via the annual national Point Prevalence Survey (PPS). This found that prevalence in a sample of the acute trust population was 6.4% in 2011. More than half of the recorded HCAIs were classed as respiratory tract infections, urinary tract infections (UTIs) or surgical site infections (SSIs).[3]

Blood stream infections (including MRSA bacteraemia) and gastrointestinal tract infections (including *Clostridium difficile*) account for only 16% of recorded HCAIs, or a population prevalence of 1%.

Specific factors are likely to produce population increases in HCAIs:

Changes in Population Age

With an aging population, the number of contacts for vulnerable older people with health and social care interventions in hospitals, nursing and residential care homes and in the patient's own home will increase. This increases the opportunities for HCAIs to develop.

Anti-microbial resistance

There are few public health issues of greater importance than antimicrobial resistance in terms of impact on society (DOH 2013). Antimicrobial medicines such as antibiotics have been the mainstay of

treating infections for over 60 years. Although a new infectious disease has been discovered nearly every year over the past 30 years, very few new antibiotics have been developed. This means existing antibiotics are used to treat an ever greater variety of infections and infectious diseases.[8]

The term antimicrobial includes: antibiotic, antiprotozoal, antiviral and antifungal medicines. Antimicrobial Resistance arises when the micro-organisms which cause infection survive exposure to a medicine that would normally kill them or stop their growth.

Resistance is a natural biological process but is increased and accelerated by various factors such as misuse of medicines, poor infection control practices and global trade and travel.

This is a particular concern with antibiotics. With continued misuse, antibiotics become less effective as diseases evolve and become resistant to existing antimicrobial medicines.

Many of the medical advances in recent years, for example organ transplantation and cancer chemotherapy, need antibiotics to prevent and treat the bacterial infections that can be caused by the treatment. Without effective antibiotics, even minor surgery and routine operations could become high risk procedures if serious infections can't be treated.[9]

Anti-microbial prescribing practices have played a role in development of resistance in organisms causing HCAIs. We are now seeing new and emerging multi drug resistant (MDR) infections that are very difficult to treat. While the most serious MDR infections are in healthcare settings, these infections are now also spreading in the community.

Gram-negative bacteria such as E.coli are the most frequent cause of healthcare associated infection and pose a high risk to public health through development of multi-drug resistance. The 2011 Chief Medical Officer's report estimated that around 5,000 patients die of Gram-negative sepsis each year, with half due to an infection resistant to antibiotics.[10]

More information is available on emerging infections at the following link:

https://www.gov.uk/government/collections/antimicrobial-resistance-amr-information-and-resources

The appropriate and proportionate prescribing of these agents is seen as central to infection prevention and control. Any antibiotic use can carry with it the danger of developing resistance. Therefore maintaining good infection control practice in all care settings, to prevent infection and the need for use of antibiotics, remains critical.

2) Size of the issue locally

2.1) Overview

Data on HCAIs is collated via national mandatory surveillance programmes and categorised according to the organism causing the infection.

Mandatory surveillance includes:

- Blood stream infection (bacteraemia) due to Methicillin sensitive *Staphylococcus aureus* (MSSA)
- Blood stream infection (bacteraemia) due to Methicillin resistant *Staphylococcus aureus* (MRSA)
- Blood stream infection (bacteraemia) due to *Escherichia coli* (E.coli)
- Gastrointestinal infection and diarrhoea due to *Clostridium difficile* infection (CDI) in patients aged 2 years and over.

Mandatory surveillance data is the most comprehensive and reliable information available. However it gives an underestimate of the total burden of disease, because it only monitors 4 infections out of the wide range of infectious organisms known to contribute to HCAI

Improved infection control processes together with rigorous organisational targets to reduce MRSA bacteraemia and CDI have been successful in reducing the incidence of these infections by more than 70% between 2007 and 2011. A National Audit Office (NAO) report has estimated that between 2003-04 and 2008-09 reductions in MRSA saved the NHS between £45 and £59 million in treatment costs, and between £97 and £204 million from 2006 to end of 2008 by reducing the rate of CDI.[11]

By contrast, MSSA and E.coli bacteraemia do not have infection control targets. Nationally, infection rates for MSSA and E.coli bacteraemia have increased significantly between 2013/14 and 2014/15.

Public Health England (PHE) has identified a common pattern across all four mandatory surveillance data collections in 2014/15. A high percentage (between 60% and 80%) of infection cases would not traditionally have been defined as hospital-onset, and are thought to be community acquired. With the increasing proportion of ostensibly community acquired infections both control and surveillance measures will need to support this setting if reductions in infections are to continue.[12]

Numbers and rates of infections for Nottinghamshire County and Nottingham City are provided in the following tables. These figures do not take into account differences in age structure of local authority populations in Nottinghamshire, because infections by age group are not available. The figures show us the overall burden of recorded disease, but we cannot draw conclusions about differences in underlying need, service effectiveness or causes of infection between local authorities.

Number of infections for key organisms, 2014/15, with estimated costs of infection

Area	MRSA bacteraemia 2014/15	MSSA bacteraemia	C. difficile 2014/15	E.coli bacteraemia	Total number of infections
Nottinghamshire County & Nottingham City	17	241	358	1064	1680
NATIONAL	801	9,827	14,165	35,676	60469
Bassetlaw	3	13	27	84	127
Mansfield and Ashfield	4	48	103	181	336
Newark & Sherwood	1	33	42	112	188
Nottingham City	3	71	60	333	467
Nottingham North and East	3	40	67	142	252
Nottingham West	1	17	33	103	154
Rushcliffe	2	19	26	109	156
Estimated Cost per infection*	£7,000	£7,000	£10,000	£7,000	
Total cost – Nottinghamshire County & Nottingham City	£119,000	£1,687,000	£3,580,000	£7,448,000	£12,834,000

** Based on the Quality improvement guide, Prevention and control of healthcare-associated, infections* ***Costing template:*** *Implementing NICE guidance[6] Source: Public Health England Mandatory Surveillance data, financial year counts and Rates by Clinical Commissioning Group*

Rate of Infections for individual organisms and crude rate of HCAIs, per 100,000 registered population, 2014/15, by CCG compared to Nottinghamshire (including Nottingham City) and National rates

Area	MRSA	MSSA	C. difficile	E.coli	Crude rate of HCAIs per 100,000 registered population
Nottinghamshire County & Nottingham City	1.5	21.8	32.3	96.1	151.8
NATIONAL	1.5	18.2	26.3	66.2	112.3
Bassetlaw	2.6	11.4	23.8	73.9	111.7
Mansfield and Ashfield	2.1	24.8	53.1	93.3	173.3
Newark & Sherwood	0.9	28.2	35.9	95.8	160.8
Nottingham City	1.0	22.8	19.3	107.1	150.2
Nottingham North and East	2.0	27.1	45.4	96.2	170.7
Nottingham West	0.9	15.3	29.7	92.6	138.5
Rushcliffe	1.8	16.8	23.0	96.6	138.2

Source: Public Health England Mandatory Surveillance data, financial year counts and rates by Clinical Commissioning Group

As most E.coli bacteraemia and CDI occurs in those aged over 65, a rough standardisation can be applied by calculating rates of infection in the population aged over 65. Using this approach, Nottinghamshire County Council has significantly higher recorded infection rates for E.coli bacteraemia and CDI as compared to the England average.

Rates of infection by clinical commissioning group vary widely from year to year, so it is difficult to determine any underlying differences in health need.

Key highlights from the health needs assessment are presented below. Wherever possible, data presented includes the whole of Nottinghamshire County and Nottingham City. In some cases, data for Bassetlaw was not available, due to differences in service commissioning arrangements. Wherever data presented do not include Bassetlaw this is clearly indicated.

Additional information by CCG is available in **Appendix 1.**

2.2) Methicillin resistant and Methicillin sensitive *Staphylococcus aureus*

MRSA is carried on the skin by around 3% of the adult population.[13] It causes infection when it passes the protective barrier of the skin, and causes bacteraemia when it enters the blood stream.

Those in the population who carry MRSA on their skin are at increased risk of serious infection following surgery or other invasive procedures. Therefore screening for MRSA carriage is carried out nationally on all emergency and elective admissions, those testing positive are given decolonisation treatment. The aim of this is to reduce risk of transmission and infection. Community infection prevention and control (CIPC) services follow up with patients either directly or through the patient's GP.

Rates of MRSA bacteraemia nationally have decreased by nearly 70% between 2008/9 and 2012/13, similar reductions are seen in Nottinghamshire County. This follows introduction of national targets for hospitals and Clinical Commissioning Groups, which take a zero-tolerance approach to MRSA bacteraemia. The highest recorded rates are seen in those aged 65 and over.

In Nottinghamshire County Council, a review of each case of MRSA bacteraemia (2014/15) did not find any common infection control themes for improved practice.

Around 50% of MRSA bacteraemia in Nottinghamshire County and Nottingham City in the 5 years between 2008/9 and 2012/13 are considered to have developed in community settings and there is a significant role for community infection prevention and control to play in further reducing MRSA bacteraemia.

Nationally there was a 5.8% increase in MSSA bacteraemia rate from 17.2 per 100,000 population in 2013/14 to 18.2 per 100,000 population in 2014/15. [14] Infection rates for MSSA bacteraemia have remained relatively constant in the East Midlands since 2009. Local trends are limited, as mandatory surveillance was only recently introduced.

Rate of MSSA and MRSA bacteraemia processed by Acute Trust laboratories within the East Midlands region* per 100,000 bed days by quarter, April 2001 to March 2015.



**Please note: At this point East Midlands did not include Northamptonshire. As of 1st July 2015, East Midlands boundaries changed to include Northamptonshire. We will be updating this graph to reflect this change in geographies in our next report.*
Source: Public Health England, including mandatory and voluntary surveillance

2.3) Clostridium difficile infection

Clostridium difficile (C. difficile) is found naturally in the gut of 3% of adults and up to two thirds of babies. However carriage can be as high as 20% in residents of long-term health care facilities, and up to 14% of hospitalised elderly patients on acute medical wards.[1]

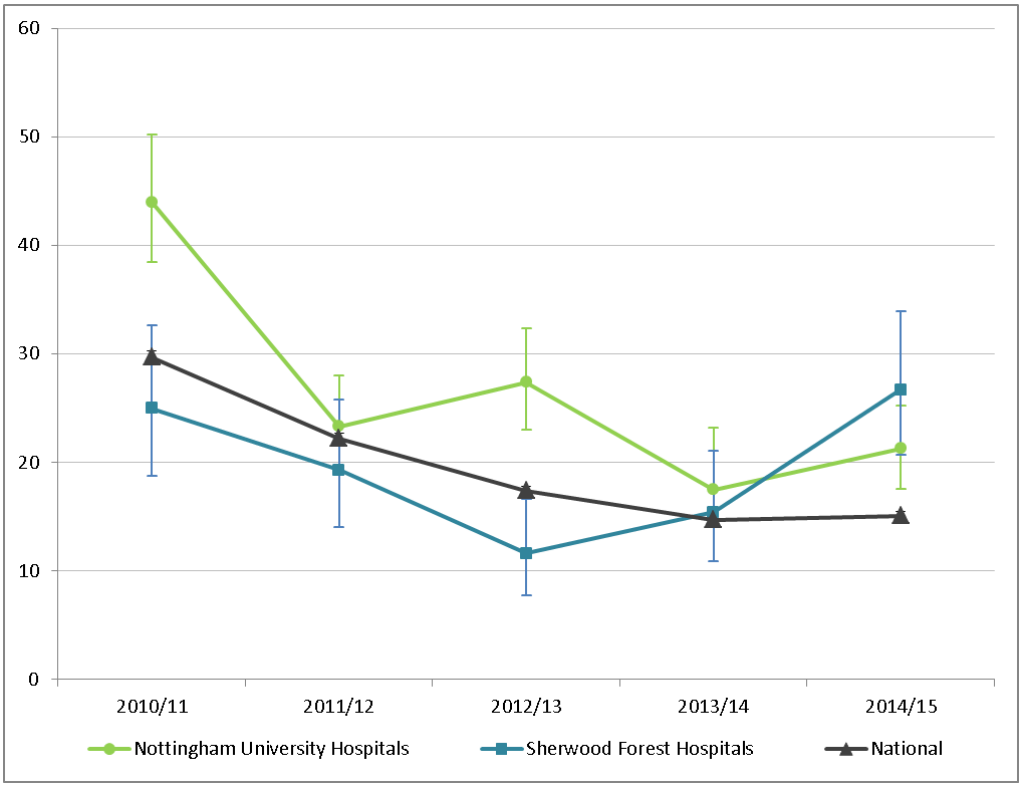
When the balance of bacteria in the gut has been affected by antibiotics, surgery, chemotherapy or other illnesses, C. difficile bacteria can multiply, producing toxins that can cause symptoms such as diarrhoea and inflammation of the bowel.

Whilst overall significant improvements have been made in lowering the rates of Clostridium difficile infection locally and nationally, this reduction has slowed over recent years.[15]

Public Health England notes that counts and rates of C. difficile infections have significantly increased nationally, with a 6.0% increase in infection rate from 24.8 per 100,000 population in 2013/14 to 26.3 per 100,000 population in 2014/15.[16] PHE are investigating the underlying causes of this increase.

Infection rates have increased for both Nottingham University Hospitals and Sherwood Forest Hospitals between 2013/14 and 2014/15. Rates for both hospital trusts are significantly higher than the national average.

C. difficile infection rate per 100,000 bed days (patients aged 2 years and over), trust apportioned cases from 2010/11 to 2014/15, Nottingham University Hospitals, Sherwood Forest Hospitals and National



Source: Public Health England Mandatory Surveillance data, financial year counts and rates, trust apportioned cases only

In Nottinghamshire County, each C. difficile toxin positive case undergoes mandatory assessment to determine the overall quality of the care provided and to identify any lapses in care. Key themes identified following these assessments in 2014/15 are summarised below.

Nottingham University Hospitals NHS Trust	**Sherwood Forest Hospitals Foundation Trust**
• Environmental cleaning / equipment decontamination • Bowel assessments and effective stool sampling • Antimicrobial Stewardship • Communication / documentation • Isolation	• Reduced adherence to the sepsis protocol • Sample sending • Environmental cleaning • Delay in isolation • Cross contamination • Reduced adherence to antimicrobial prescribing guidance

2.4) Escherichia coli bacteraemia

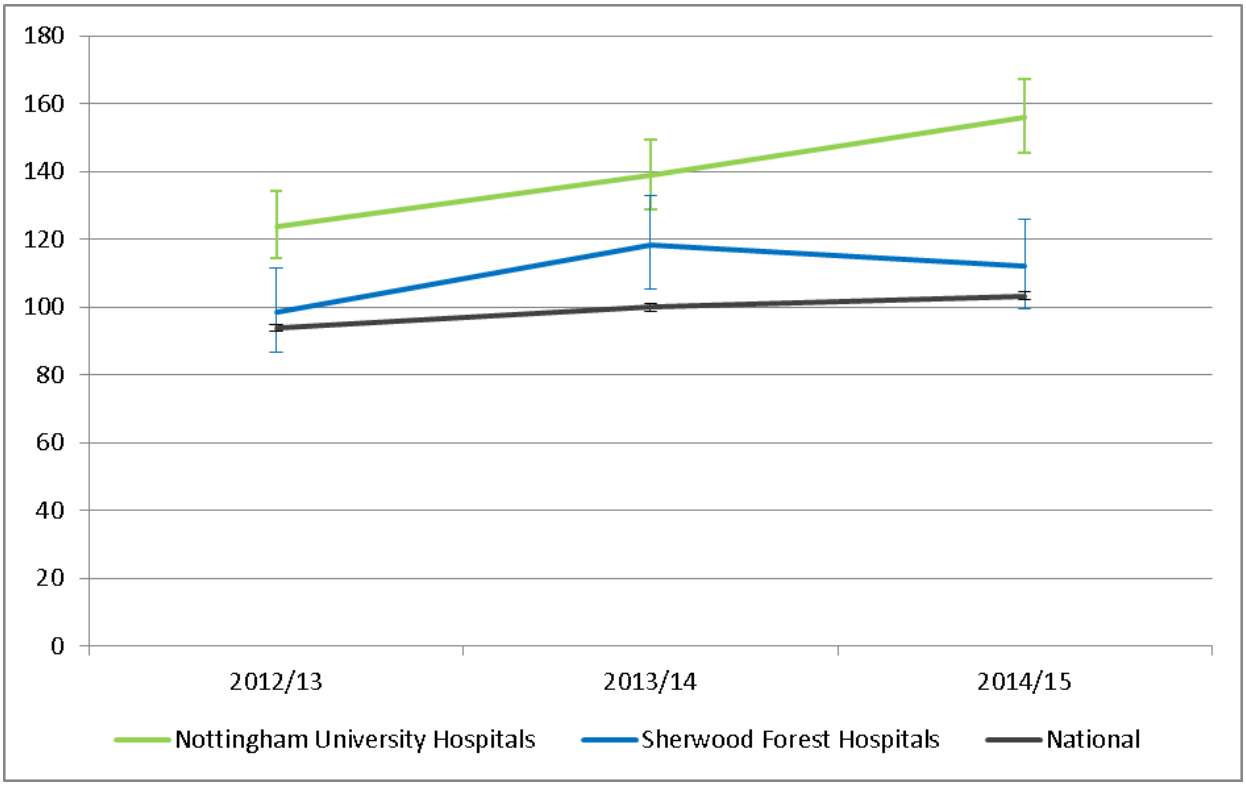
Escherichia coli (commonly referred to as *E. coli*) is a species of bacteria commonly found in the intestines of humans and animals. The commonest infection caused by E. coli is infection of the urinary tract, the organism normally spreading from the gut to the urinary tract.[17] *E. coli* is also the commonest cause of cystitis (infection of the bladder), and in a minority of patients the infection may spread up the urinary tract to the kidneys, causing pyelonephritis.

E.coli bacteraemia is also of concern due to the potential for the development of antimicrobial resistance, including Extended Spectrum Beta Lactamases (ESBLs).

Nationally E. coli bacteraemia have significantly increased, with a 4.1% increase from 63.6 per 100,000 population in 2013/14 to 66.2 per 100,000 population in 2014/15. PHE are currently working with the Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) to identify suitable healthcare interventions to reduce these infections.[11]

In Nottinghamshire County, E.coli bacteraemia infection rates are also increasing. Recorded rates for Nottingham University Hospitals are significantly higher than the national average. There are no targets set for E.coli bacteraemia, and no further investigation has been undertaken locally to determine factors contributing to increases in these infections.

E. coli bacteraemia rate per 100,000 bed days, all reported cases by Trust, from 2012/13 to 2014/15, Nottingham University Hospitals, Sherwood Forest Hospitals and National



Source: Public Health England Mandatory Surveillance data, financial year counts and rates of E. coli bacteraemia by NHS acute Trust (All reported cases)

It has been estimated that around one in ten people who have a urinary catheter develop a urinary tract infection.[18] The implications for patients of developing a catheter-related urinary tract infection (UTI) range from discomfort to bacteraemia.

Surveillance on catheter associated urinary tract infections is not currently collected. Conservative estimates indicate more than 2 in 5 UTIs are associated with recent catheterisation.[19] Based on this estimate and using recorded hospital episodes for Nottinghamshire County (excluding Bassetlaw) over 3 years from 2010/11 to 2012/13, a total of 7,642 UTIs are estimated to be catheter associated. This results in an additional cost of £10 million to the NHS for treatment of healthcare associated UTIs (at £1327 per case, Plowman report of 1999[20])

Improving catheter care in acute and community healthcare settings will contribute significantly to decreasing the burden of disease due to HCAIs.

2.5) Panton Valentine Leukocidin – *Staphylococcus aureus*

Panton-Valentine Leukocidin (PVL) is a toxic substance produced by some strains of *Staphylococcus aureus* (PVL-SA) which is associated with an increased ability to cause disease. This organism usually causes abscesses and boils in the skin. Although surveillance of PVL-SA is not mandatory, there is

concern about increasing numbers of cases reported both nationally and locally. PVL producing Staphylococcus aureus may be methicillin sensitive (MSSA) or resistant (MRSA). Because it is more easily spread in the community, particularly within households, it is an important consideration for community infection prevention and control teams, as a source of spread in the community of MSSA and MRSA infection.

PVL-SA can also cause very serious infection including necrotizing pneumonia, necrotizing fasciitis, severe osteomyelitis and sepsis syndrome.[1] Such cases have been recorded locally in Nottinghamshire County. The number of cases seen in Nottinghamshire County remains relatively small, compared with positive cases of MRSA, but numbers are increasing in the south of the county. In Nottingham City numbers have been increasing steadily since 2010. The age profile is different to that seen in other infections considered in this chapter, occurring mainly between 20 and 44 years. Cases may also be under-reported in the north of the county, as testing for PVL-SA is not as readily available at Sherwood Forest Hospitals, who send these swab samples to Nottingham University Hospitals for testing. In 2014/15 there were 60 recorded positive test results for PVL-SA, of which 42 were new cases, as compared to 36 cases in 2013/14. It is not known whether increases seen in recorded cases is due to increased testing for PVL-SA, increased infection rates, or better recording of cases locally.

3) Targets and performance

Information on performance of Nottinghamshire County acute trusts and CCGs against national targets for MRSA bacteraemia and CDI is provided below. Further detailed information on infection prevention and control performance is available in the Infection Prevention and Control – Healthcare Associated Infections Public Health Commissioning Annual Report (2014-15).

3.1) Methicillin resistant *Staphylococcus aureus*

There is a zero tolerance approach to MRSA blood stream infections. That is, all acute trusts and clinical commissioning groups are expected to meet a target of 0 cases.

Clinical Commissioning Groups have nationally set objectives to meet which comprise of both community and acute trust acquired infections and are population based with all cases in members of their population counted towards total figures.

All cases of MRSA blood stream infection are subject to Post Infection Review (PIR). The purpose of the review is to identify how a case occurred and to identify actions that will prevent similar cases reoccurring in the future. The outcome of the Post Infection Review will be to determine clinical learning and attribute responsibility for MRSA bloodstream infections.[21] Cases of MRSA bacteraemia are attributed based on where the infection was believed to have developed. Any infection where a sample positive for MRSA was taken within 48 hours of admission is attributed as community acquired. Infections developing later than 48 hours from admission are considered to be acute trust acquired.

Number of Hospital Acquired MRSA bacteraemia cases, Nottingham University Hospitals Trust (NUHT) and Sherwood Forest Hospitals Foundation Trust (SFHFT), 2007 – 2015

Year	NUHT	SFHFT
2014 - 15	4	0
2013 -14	2	3
2012 - 13	5	0
2011 - 12	8	0
2010 - 11	5	0
2009 - 10	21	6
2008 - 09	17	17
2007 - 08	53	26

Number of MRSA bacteraemia cases by Nottinghamshire County Clinical Commissioning Group – hospital acquired and community acquired, 2014 - 15

Clinical Commissioning Group*	Hospital Acquired	Community Acquired
Nottingham North and East	2	1
Nottingham West		1
Rushcliffe	1	1
Mansfield and Ashfield		4
NHS Newark and Sherwood		1

Source: Infection Prevention and Control – Healthcare Associated Infections, Public Health Commissioning Annual Report (2014-15)
**Bassetlaw cases are not reported here as Bassetlaw has separate commissioning arrangements for CIPC services, and are not covered by Nottinghamshire County CIPC service.*

Post infection review of all cases in 2014/15 found that 2 of the 4 cases at NUHT and 4 of 8 community acquired cases were unavoidable. There were no common underlying themes to inform learning from these cases.

3.2) Clostridium difficile infection

Diagnosis of a pre or post 72 hour Clostridium difficile case is based on the Public Health England definition:

Pre 72 hour / Community Acquired: diagnosis confirmed by a stool sample taken within 72 hours of admission to hospital or via GP sampling

Post 72 hour / Hospital Acquired: diagnosis confirmed by a stool sample taken 72 hours after admission to hospital

The Clostridium difficile infection (CDI) limit for Commissioning Groups is population based with all cases in members of their population counted towards their total. Acute trusts have a limit based on bed-day rate, with all Clostridium difficile infections identified after three days (post 72 hours) of admission counted towards their total.

Number of CDI cases by Nottinghamshire County Clinical Commissioning Group –Pre and Post 72 hour, 2014 - 15

CCG	*C.difficile* target 2014-15	Actual Cases	Pre/post 72 hour	Summary
NHS Nottingham North and East	42	**67**	38 pre 72 hour 29 post 72 hour	Exceeded the limit by 25 cases (60%)
NHS Nottingham West	35	**33**	16 pre 72 hour 17 post 72 hour	Target Met
NHS Rushcliffe	28	**26**	16 pre 72 hour 10 post 72 hour	Target Met
NHS Mansfield and Ashfield CCG	85	**103**	54 pre 72 hour 49 post 72 hour	Exceeded the limit by 18 cases (21%)
NHS Newark and Sherwood CCG	40	**42**	29 pre 72 hour 13 post 72 hour	Exceeded the limit by 2 cases (5%)

4) Current activity, service provision and assets

All providers of health and social care services are required to be registered with the Care Quality Commission and therefore will have declared themselves compliant with the Health and Social Care Act 2012 and for Outcome 8 (Regulation 12) of the Essential Standards of Quality and Safety and its supporting document 'The Code of Practice on the prevention and control of infections and related guidance'. The guidance has 10 listed criteria that all commissioned health and social care providers should be able to demonstrate either compliance to those criteria or evidence to show that they are equivalent or better than those listed criteria.

Infection prevention and control is the responsibility of all organisations and staff involved in the provision of health and social care. The Community Infection Prevention and Control Service is commissioned by Public Health to provide comprehensive specialist advice, support and local surveillance relating to infection prevention and control. This service is available to community-based health and social care services (including independent contractors) to reduce the burden of avoidable health care associated infections across the health community. The service is available to support GPs, NHS Dentists, and care homes (residential and care homes with nursing beds)

A full service review and a Health Needs assessment was completed by Public Health over 2014-15. On completion of this work it was formally agreed that the existing team would transfer from local Authority to Mansfield and Ashfield Clinical Commissioning Group (CCG) as a hosted service from 1st April 2015. Public Health will provide significant investment into the service for three years following transfer to increase the current capacity in order that the agreed service delivery plan can be met across Nottinghamshire County.

The Community Infection Prevention and Control (CIPC) Team has recently been commissioned to work across five Clinical Commissioning Groups, Local Authority and NHS England Area Team. Once the service has been fully established with all roles recruited, it will have core responsibilities as summarised below:

Surveillance and Reporting

- Surveillance of HCAI in community settings
- Quarterly reporting of rates of MRSA, Clostridium difficile and PVL patients identified in the community requiring follow up within Nottinghamshire County.

Community prevention and management of HCAIs

- Follow up of all MRSA positive patients following discharge from hospital.

- Identify promptly patients in the community with HCAI, review the care required and advise where appropriate on the treatment and management of the individual with the clinician providing their care.

Audit

- Proactive IPC audits – every 2 years for GP practices /NHS dental practices and annually for all care homes including nursing beds and residential beds.
- Reactive IPC audits in response to infection prevention and control concerns/ non-compliance.

Training

- Provide targeted infection control training following serious incident reviews/concerns where current provision is inadequate

CIPC Promotion and Advice

- Proactive involvement in national and local campaigns to promote infection prevention and control best practice
- Proactive advice to clinicians and occasionally the public to reduce the risks from HCAI transmission in the community.
- Provide CIPC promotion and support of self- care to community based independent contractors, namely GPs, NHS Dentists, Care homes including residential homes.
- Advise Local Authority Commissioners on CIPC quality standards required in care homes contracts
- Reactive advice in response to reported outbreaks.
- Provide infection prevention and control expertise to minimise risks of HCAI acquisition spread by promoting best practice guidance when healthcare providers need new build /refurbishment advice.

Serious Incidents

- Identify, report and manage community acquired healthcare associated infection serious incidents including community outbreaks meeting reporting criteria

Root Cause Analysis

- Undertake or support root cause analysis investigation (including Post Infection Review for all MRSA bacteraemia) where a community based infection meets NHS England serious incident reporting criteria
- Undertake pro-active root cause analysis investigations for some cases of e-coli bacteraemia and Meticillin sensitive *staphylococcus aureus (*MSSA)
- Provide a thematic review annually, so that trends can be identified and addressed

Assurance

- Provide assurance to the Director of Public Health that appropriate system and processes and working practices are fit for purpose.

Integrated Networking and Leadership

- Provide advice/interpret best practice / National guidance and provide leadership across the Health community driving service improvements.

5) Evidence of what works

5.1) Overview and Key Themes

Evidence of best practice clearly identifies that effective infection control requires a whole health economy approach. Individuals are exposed to HCAI through a complex interaction of community delivered care, antibiotic use, long term residential facilities, out-patient and in-patient hospital stays, etc. So infection control services need to be viewed in the context of the wider health and social care system.

It is not possible to single out one specific intervention which will alone deliver significant impact on healthcare associated infections. Instead infection control needs to be seen as a seamless system of high quality care delivery where all healthcare workers in all settings adhere to rigorous standards in every care process.

Infection control will be successful in reducing the burden of disease if there is:

- Consistent effective implementation of infection control practices at individual level,
- Clear leadership, priority and accountability at organisational level and
- Agreed systems and standards to govern the interface between different care settings.

Within the past 10 years there has been significant investment nationally in healthcare infection control systems and processes, in order to tackle growing numbers of HCAIs and developing anti-microbial resistant strains such as MRSA. National campaigns, rigorous targets for reductions in CDI and MRSA infections, together with the widespread application of rigorous standards for infection control have been credited with the large and continued reductions seen in these infections since 2007.

Some interventions seen to have played a key role in effective infection prevention and control relating to MRSA and CDI are summarised in Figure 1

Key success factors in the reduction of MRSA and CDI incidence, collated from various sources

1. Changes in prescribing practices for antimicrobial agents
2. Detailed surveillance and targets focussing attention of care providers on MRSA and CDI.
3. High profile campaign and focus on hand hygiene
4. Consistent meticulous intravenous central line care

A review of available research literature and guidelines was undertaken in 2014 as part of a health needs assessment. Key themes are listed below. The full evidence review can be found within the health needs assessment report.

1. **Leadership, engagement, accountability, and clear roles and responsibilities in multi-agency working**
2. **Consistent application of basic infection prevention and control processes**
3. **Comprehensive and effective use of surveillance, audit, monitoring and documentation of care processes**
4. **Effective use of Root Cause Analysis**
5. **Antimicrobial prescribing guidelines/ antibiotic stewardship**
6. **The use of staff induction, assessment of competence in care procedures and on-going training**
7. **The use of screening and decolonisation in reducing MRSA infections**
8. **Effective management of infectious disease outbreaks in care homes, following community guidance**
9. **Reducing the use and improving the sterile management of invasive medical devices in community**
10. **Building-in infection control for new builds and refurbishment**
11. **Developing new approaches to the changing balance of care in the community and in the home, including empowering patients and carers**

5.2) MRSA Screening and Decolonisation

Current practice is to screen all elective and emergency admissions to hospital and to carry out decolonisation treatment for those found to be carrying MRSA. Economic analysis from the Department of Health finds this approach is not cost-effective at current prevalence of MRSA.

The most recent guidance from the recommends a more focused approach to MRSA screening. The most cost effective policy is one based on screening admissions to high risk specialties. It is recommended that the current practice of mandatory MRSA screening of acute and elective admissions to NHS hospitals in England is streamlined to the following:

- All patients admitted to high risk units.
- All patients previously identified as colonised with or infected by MRSA.[22]

Decolonisation—treatment to eradicate MRSA carriage—is often considered as a measure to prevent S aureus infection. The evidence for this approach is mixed. Large reductions in MRSA bacteraemia have been achieved since the introduction of routine screening and decolonisation, but there has also been a concurrent national drive to improve infection prevention and control as a whole.

Eradication of MRSA carriage has generally been difficult, and the role of decolonisation as an MRSA infection control measure is uncertain. The efficacy of decolonisation of patients with community-associated MRSA has not been established, and the routine use of decolonisation of non-surgical patients is not supported by data.[23]

Evidence in the literature shows that treatment only achieves long term decolonisation in 50 to 60% of patients.[24] Given this evidence, the approach taken by CIPC services to follow up and decolonisation needs to consider how limited resources can be used to deliver the greatest impact on MRSA infection rates.

5.3) Urinary Tract Infections linked to Catheter Use

Catheterisation can be a leading cause of urinary tract infection (UTI) and bloodstream infection. There is considerable evidence in the literature of the overuse of urinary catheters, both in frequency and length of use.

NICE guidelines are available for the performance of catheterisation, enteral feeding and the use of vascular access devices in community settings.[25] They highlight the importance of aseptic technique and the detailed assessment of the patient needs prior to procedure. Everyone involved in care should be educated on infection control and trained in hand decontamination, the use of personal protective equipment and the safe use and disposal of sharps.

Where applicable patients and carers should be educated in the care and use of medical equipment such as vascular access devices and long term urinary catheters. This is one method of extending effective infection control into the patient's home.

Simple interventions such as reminders to review the need for urinary catheters with a view to removing them as soon as possible can reduce the number of associated infections. NICE guidelines recommend the use of intermittent rather than indwelling catheters, and that catheter insertion, changes and care should be documented. For the change of long term catheters, antibiotic prophylaxis should not be offered routinely, but considered in cases where there is a history of UTI associated with catheterisation or experience of trauma during catheterisation.

An evidence report by the United States Centers for Disease Control and Prevention (2007) found that printed or computer-based reminders with use of automatic stop orders may reduce unnecessary urethral catheterisation.[26]

5.4) Anti-microbial Resistance

The appropriate and proportionate prescribing of anti-microbial agents is seen as central to infection prevention and control.

Many of the actions needed against antimicrobial resistance must be lead at national and international levels. However, local prescribing guidelines and professional education and training can serve to optimise prescribing practice, whilst public engagement and awareness of the dangers of misuse of antibiotics can result in better adherence.

Measures relating to antibiotic prescribing have been developed as part of the Quality, Innovation, Productivity and Prevention (QIPP) programme, as a performance management approach to improving prescribing practice. Guidance on antibiotic prescribing is issued by specialist bodies nationally, from which local policies can be developed. These policies should reflect the local burden or resistant organisms.

The Department of Health produced the UK Five Year Antimicrobial Resistance Strategy 2013 to 2018 with seven key areas for action.

The UK Five Year Antimicrobial Resistance Strategy 2013 to 2018: 7 key areas for action

1 improving infection prevention and control practices
2 optimising prescribing practice
3 improving professional education, training and public engagement
4 developing new drugs, treatments and diagnostics
5 better access to and use of surveillance data
6 better identification and prioritisation of AMR research needs
7 strengthened international collaboration

5.5) Emerging Evidence on Clostridium Difficile Infections

Recent research in Oxfordshire has shown that 45% of all hospital or community CDI were genetically distinct, that is not acquired through transmission between cases. It is now thought that transmission from environmental sources other than symptomatic patients is a major route of infection. Interventions involving changes to antibiotic prescribing, in particular, reductions in the use of fluoroquinolones and cephalosporin are thought to have played a major role in reducing CDI incidence.[27]

5.6) Guidelines

The relevant legislation governing the conduct of infection prevention and control functions is "The Health and Social Care Act 2008: Code of Practice on the prevention and control of infections and related guidance." This applies to NHS bodies and providers of independent healthcare and adult social care in England, including primary dental care, independent sector ambulance providers and primary medical care providers. The Code of Practice document was revised to reflect the structural changes that took effect in the NHS from 1st April 2013 and the role of infection prevention in optimising anti-microbial use and reducing antimicrobial resistance.

A range of further guidelines exist to advise on the infrastructures, care processes and care settings required for effective infection control. Key guidelines are signposted in Appendix 2.

6) What is on the horizon?

6.1 Carbapenemase-Producing Enterobacteriaceae

Enterobacteriaceae are a large family of bacteria that usually live harmlessly in the gut of all humans and animals. However, these organisms are also some of the most common causes of opportunistic urinary tract infections, intra-abdominal and bloodstream infections.[28]

Carbapenemase-Producing Enterobacteriaceae (CPE) represent one of the most serious emerging infectious disease threats that the UK faces.[29] These organisms are resistant to a group of antibiotics (carbapenems) normally reserved as a last resort for serious infections caused by drug-resistant Gram-negative bacteria. There are growing numbers of these resistant organisms being recorded in the UK, with up to 25 positive samples per week reported nationally in England in 2014. The spread of these organisms poses a serious risk to patient outcomes and healthcare costs in the NHS.

In response, national guidance and toolkits have been developed for the early detection, management and control of CPE. This guidance is available from Public Health England:

https://www.gov.uk/government/publications/carbapenemase-producing-enterobacteriaceae-early-detection-management-and-control-toolkit-for-acute-trusts

6.2 Impact of older populations with more complex health needs

The risk of acquiring an HCAI increases with older age (as long term conditions become more prevalent, and increasingly frail individuals come into greater contact with healthcare interventions) and increases with

deprivation (deprived populations experience a higher prevalence of co-morbid long term conditions and complex care needs). Nearly 5% of all MRSA bacteraemia occur in patients with established renal failure.[3]

However, there is no evidence by which to model the possible impact of these factors on underlying need at population level.

Data on the demographic profiles, prevalence of long term conditions, income deprivation affecting older people index 2010 are presented below

Population projections for Nottinghamshire County and Nottingham City CCGs (registered), and Nottinghamshire County Council, East Midlands, England (Resident)

Organisation	Numbers aged 65+ Period			Proportion of total population Period		
	2015	2020	2025	2015	2020	2025
England	**9,737,700**	**10,673,700**	**11,806,600**	***17.8***	***18.9***	***20.2***
East Midlands	**880,700**	**975,300**	**1,081,600**	***18.9***	***20.3***	***21.9***
Nottinghamshire County	**161,700**	**178,100**	**196,400**	***20.1***	***21.6***	***23.2***
Nottingham City	**37,200**	**40,000**	**43,600**	***11.9***	***12.5***	***13.2***
County CCGs Total	**158,659**	**174,586**	**192,646**	***19.8***	***21.2***	***22.8***
NHS Bassetlaw CCG	23,217	25,832	28,552	*20.4*	*22.3*	*24.1*
NHS Mansfield and Ashfield CCG	34,579	37,951	42,039	*18.4*	*19.7*	*21.3*
NHS Newark & Sherwood CCG	26,887	29,673	32,898	*20.6*	*22.1*	*23.8*
NHS Nottingham North and East CCG	29,521	32,324	35,417	*19.8*	*21.0*	*22.4*
NHS Nottingham West CCG	19,222	20,740	22,564	*20.4*	*21.2*	*22.4*
NHS Rushcliffe CCG	25,233	28,165	31,352	*20.4*	*22.0*	*23.7*
NHS Nottingham City	**40,043**	**42,783**	**46,965**	***11.1***	***11.6***	***12.4***

Source: Secondary analysis of HSCIC registered populations (2015, April) and ONS Sub-National Population Projections (2012)
Note: England, East Midlands, County and City are based on resident populations and CCGs are based on registered populations
Note: CCGs population projections are a local secondary analysis using HSCIC registered populations (2015, April) and ONS Sub-National (resident) Population Projections (2012 based)

Number and percentage of older people affected by income deprivation, and number and proportion of the total population estimated to be living with a long term condition

Organisation (resident basis)	Income Deprivation Affecting Older People (IDAOPI) 2015		Estimated Burden of Long Term Conditions			
	Aged 60 and over	2012	Aged 65 and over	2012	Aged 18 and over	2012
	Number	*Percent*	Number	*Percent of age-specific population*	Number	*Percent of age-specific population*
England	**1,954,600**	***16.2***	**-**	**-**	**-**	**-**
County CCGs Total	**26,829**	***13.4***	**103,000**	***69.9***	**268,600**	***42.7***
NHS Bassetlaw CCG	4,243	*14.3*	14,800	*69.7*	38,500	*42.9*
NHS Mansfield and Ashfield CCG	7,830	*17.0*	22,600	*69.8*	61,500	*41.9*
NHS Newark & Sherwood CCG	3,675	*11.7*	17,300	*69.8*	44,200	*43.1*
NHS Nottingham North and East CCG	4,757	*13.2*	19,100	*69.9*	49,800	*42.7*
NHS Nottingham West CCG	3,704	*13.1*	12,700	*70.1*	32,400	*42.8*
NHS Rushcliffe CCG	2,620	*9.2*	16,500	*70.1*	42,200	*43.2*
NHS Nottingham City	**12,548**	***25.9***	**27,500**	***70.3***	**101,600**	***36.1***
County and City Total	**39,377**	***15.9***	**233,600**	***70.0***	**370,200**	***40.7***

Source (IDAOPI): DCLG Indices of Multiple Deprivation 2015 including ONS Mid-year population estimates (2012)
URL: http://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

Source (LTCs): Secondary analysis of local registered populations (2012) and "Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study", Lancet 2012; published online May 10. DOI:10.1016/S0140-6736(12)60240-2.
Note: The LTCs considered in these estimates are wide-reaching and cover both physical and mental conditions including cardiovascular, respiratory, cancers, mental health, substance misuse and other conditions.
Note: LTC estimates are based on a simple (Age, Gender) model and do not take wider determinants into account e.g. measures of deprivation, ethnicity

6.3) Impact of changing settings of healthcare

Residential care home and nursing home populations are at greater risk of HCAI, due to the older age profile of the residents, the use of invasive devises such as venous access devices and urinary catheters and the ease of spread of infection between residents. Increased carriage rates of MRSA and CDI have been noted in the literature in care home settings.

There were 7,656 residents nursing and residential care homes across Nottinghamshire and Nottingham City (4% of the population aged 65 and over) at December 2012. Mansfield and Ashfield had the largest proportion of its older population in care homes (4.9%). Nottingham City and Mansfield and Ashfield had the largest populations in residential and nursing care homes.

The number of care homes in Nottinghamshire County and Nottingham City is provided in the table below.

Number of Care Homes in Nottinghamshire County and Nottingham City by CCG (as at 1st October 2015)

Organisation	Nursing Only	Nursing and Residential	Residential only	Grand Total
County CCG	**83**	**8**	**200**	**291**
NHS Bassetlaw CCG	11	2	31	44
NHS Mansfield and Ashfield CCG	23	2	56	81
NHS Newark & Sherwood CCG	8	1	34	43
NHS Nottingham North and East CCG	20	2	31	53
NHS Nottingham West CCG	12		18	30
NHS Rushcliffe CCG	9	1	30	40
NHS Nottingham City CCG	**21**	**2**	**62**	**85**
Grand Total	**104**	**10**	**262**	**376**

Source: CQC Active locations for providers registered under the Health and Social Care Act (1st October 2015)
URL: http://www.cqc.org.uk/content/how-get-and-re-use-cqc-information-and-data#directory
URL: http://www.cqc.org.uk/sites/default/files/HSCA%20Active%20Locations.xlsx

The shift in settings of care, between care in acute hospital, community hospital, care home and 'hospital at home' has implications for HCAIs which are yet to be fully understood and will need to be monitored going forward. The 2011 report of the Chief Medical Officer (CMO) notes it is particularly important that infection control in the home becomes a priority for patients with long term conditions.[30] Many HCAIs are diagnosed in hospitals but are acquired prior to admission in patients' homes and in community care settings. Transmission must be addressed with the same vigour that is now being applied in hospitals.[27] The report makes a recommendation that infection control policies must explicitly address the settings of care, including the home and community.

In many ways, the changing setting for healthcare provision highlights the need for the general public to learn and participate in taking responsibility for their personal hygiene measures. This will be increasingly important in delivering hospital at home and is likely to require a programme to provide training and follow up to ensure maintenance of adherence to these hygiene measures.[27]

Nottinghamshire County Council strategy is to reduce use of care homes and support more people in their own homes. In 2014, they commissioned homecare jointly with health and contracted with 25 providers. There were approximately 70 Home Care agencies registered with CQC to deliver services in Nottinghamshire County.

Numbers of people requiring care is growing, but with the growth of personal budgets and Direct Payments, the numbers of people that the Council commissions services on behalf of is reducing. This is not the same for NHS funded homecare, although there may be changes with the advent of Personal health Budgets.

7) Local Views

The views of clinicians using the CIPC service are routinely sought through consultation, and findings are reflected within public health reports.

What does this tell us?

8) Unmet needs and service gaps

Issues identified via health needs assessment (2013/14)	Current activity to address identified issues.
Risks to the health of residents and rising health care costs if infection control is fragmented.	An integrated CCG based community infection prevention and control service has been commissioned which provides service across Nottinghamshire County, excluding Bassetlaw CCG who commission their service separately.
Current infection rates are higher for a number of infections in Nottingham City and in Mansfield and Ashfield CCGs.	Variation across Nottinghamshire County Council has been noted within the CIPC service specification. The service is hosted by Mansfield & Ashfield CCG.
Lack of proactive community infection prevention and control (CIPC) support to nursing and residential care homes.	The new CIPC service is commissioned to provide a proactive programme of audits and support to residential care homes and care homes with nursing beds(excluding learning disability units these are audited reactively)
Multiple providers of care at home increases risk of poor infection control. PHE and the CMO have identified a gap in infection control support in these community care settings.	This remains a gap, locally and nationally.
Poor catheter care and over-use of catheterisation are possible drivers of increasing rates of E.coli bacteraemia. The burden of disease due to catheter associated UTIs in community needs to be assessed and work plan developed to address this.	This remains a gap. CIPC service is working with local partners to review the management of urinary tract infection. Review of e-coli bacteraemia will start 2016 and themes and actions for prevention will be used to form future work planning
Evidence from variation in QIPP performance on antimicrobial prescribing targets, as well as anecdotal evidence, that poor prescribing practices are prevalent within some local CCGs.	Anti-microbial prescribing practices are monitored and addressed via medicines management teams within CCGs. CIPC are reporting any identified antibiotic prescribing concerns to medicines management teams for closer review
A consistent strategy for MRSA screening and decolonisation is needed, which takes into account evidence of effectiveness and cost-effectiveness.	A local policy for follow up of MRSA patients in community by the CIPC has been agreed. A plan to introduce pro-active admission screening to care homes is under development.

9) Knowledge gaps

- A substantial number of preventable infections, including E.coli bacteraemia, may be linked to catheter care in community. However the extent of unmet need has not been established. The number of catheters used in community settings and the quality of catheter care is unknown.
- As there has been a limited review of e-coli bacteraemia cases to date both nationally and locally there is a gap in what is known regarding the key themes and prevention strategies that may assist in reducing the increasing numbers currently seen

- Local variation has been identified in the prophylactic management of UTI and further work is required to further understand the factors influencing this, including antibiotic prescribing in line with known sensitivities
- There is limited local surveillance data for HCAIs, which limits evaluation of local trends and service effectiveness.
- National surveillance data does not allow comparison with other areas, as it does not take into account variation in population demographics.
- The reasons underlying increases in MSSA and E.coli bacteraemia and CDI nationally in 2014/15 are not yet understood and are being investigated by PHE.
- Prescribing practices for anti-microbial agents are subject to locally agreed guidelines for acute trusts, and GP prescribing is monitored by Clinical Commissioning Groups medicines management teams. However there is no shared understanding across the Nottinghamshire County health economy of patterns of prescribing and key risks to address.

What should we do next?

10) Recommendations for consideration by commissioners

Strategic Recommendations

- Agree and communicate clear leadership, roles, responsibilities and structure for an integrated Infection Prevention and Control function
- CIPC services should be commissioned in line with current and future need, with greater provision made for Mansfield and Ashfield and Nottingham City
- Commissioned capacity should plan for a widening of IPC focus beyond MRSA and CDI targets.
- Review, via the IPC forum, NHS England Local Area Team and CCG prescribing leads, the implementation of prescribing guidelines on antibiotic prescribing.

Service Recommendations

- Local Surveillance should be included within CIPC contract
- Establish the level of need due to catheter associated UTIs in community and develop a work plan to address this.
- Review education and training approaches to better reach new target audiences
- A comprehensive IPC support package should be offered to all care providers, including care in the home, learning disabilities residential units and residential care homes
- Embed risk assessment for infection control within the standard care processes of healthcare professionals in community settings.
- Commission MRSA screening and decolonisation appropriate to the need of the local population

Key contacts

Healthcare Associated Infections lead, Public Health England East Midlands
Field Epidemiology Service, Public Health England East Midlands
Consultant in Communicable Disease Control with lead for Nottinghamshire County
Nottinghamshire County Community Infection Prevention and Control Service, Mansfield & Ashfield CCG
Public Health Consultant lead for Health Protection.

References

[1] Damani, N. N., Damani, N. N. Manual of infection control procedures. *Manual of infection prevention and control*. 3rd ed. ed. Oxford ; New York: Oxford University Press, USA; 2012.

[2] Health care-associated Infections Factsheet. World Health Organisation. Available: http://www.who.int/gpsc/country_work/gpsc_ccisc_fact_sheet_en.pdf [Accessed 12 November 2013].

[3] English National Point Prevalence Survey on Healthcare-associated Infections and Antimicrobial Use, 2011Preliminary data. Health Protection Agency. [Web page] Available: http://www.hpa.org.uk/servlet/Satellite?c=HPAweb_C&pagename=HPAwebFile&rendermode=previewnoinsite&cid=1317134304594 [Accessed 18 September 2013].

[4] Tackling healthcare associated infections through effective policy action. British Medical Association. Available: http://www.his.org.uk/files/7113/7085/4796/3_BMA_Tackling_healthcare_associated_infections_through_effective_policy_action.pdf [Accessed 13 November 2013].

[5] NICE Clinical Guideline 139: Infection - Prevention and control of healthcare-associated infections in primary and community care. (March 2012) National Institute for Health and Care Excellence. Available: guidance.nice.org.uk/cg139 [Accessed 20 October 2013].

[6] Department of Health, The Health and Social Care Act 2008: code of practice on the prevention and control of infections and related guidance https://www.gov.uk/government/publications/the-health-and-social-care-act-2008-code-of-practice-on-the-prevention-and-control-of-infections-and-related-guidance

[7] Jones, A. M., Kuijper, E. J., Wilcox, M. H. Clostridium difficile: A European perspective. The Journal of infection. 2013;66(2):115-28.

[8] https://www.nice.org.uk/news/press-and-media/safeguarding-our-defences-against-disease-nice-sets-out-approaches-to-stop-infections-developing-resistance-to-antimicrobial-medicines

[9] https://www.gov.uk/government/collections/antimicrobial-resistance-amr-information-and-resources

[10] Davies, S.C. Annual Report of the Chief Medical Officer Volume Two, 2011 Infections and the rise of antimicrobial resistance. (2013) London: Department of Health. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/138331/CMO_Annual_Report_Volume_2_2011.pdf

[11] Reducing Healthcare Associated Infections in Hospitals in England. (June 2009) National Audit Office. Available: https://www.nao.org.uk/report/reducing-healthcare-associated-infections-in-hospitals-in-england/ [Accessed 5 October 2013].

[12] PHE Annual Epidemiological Commentary: Mandatory MRSA, MSSA and E. coli bacteraemia and C. difficile infection data, 2014/15 (9 July 2015) https://www.gov.uk/government/statistics/mrsa-mssa-and-e-coli-bacteraemia-and-c-difficile-infection-annual-epidemiological-commentary

[13] Turner, Rachel. Health care associated infections: Stemming the rise of the superbug? Kings Fund. Available: http://www.kingsfund.org.uk/publications/healthcare-associated-infections [Accessed 8 October 2013].

[14] National HCAI update by PHE for 2014/15, PHE Annual Epidemiological Commentary: Mandatory MRSA, MSSA and E. coli bacteraemia and C. difficile infection data, 2014/15 (9 July 2015) https://www.gov.uk/government/statistics/mrsa-mssa-and-e-coli-bacteraemia-and-c-difficile-infection-annual-epidemiological-commentary

[15] Clostridium difficile infection objectives for NHS organisations in 2015/16 and guidance on sanction implementation. https://www.england.nhs.uk/wp-content/uploads/2015/02/clostridm-difficile-infect-objct-15-16-guid-feb15.pdf

[16] National HCAI update by PHE for 2014/15, PHE Annual Epidemiological Commentary: Mandatory MRSA, MSSA and E. coli bacteraemia and C. difficile infection data, 2014/15 (9 July 2015) https://www.gov.uk/government/statistics/mrsa-mssa-and-e-coli-bacteraemia-and-c-difficile-infection-annual-epidemiological-commentary

[17] Escherichia coli General Information: What types of disease does E. coli cause? Public Health England. Available: http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/EscherichiaColi/GeneralInformation/ [Accessed October 2013].

[18] Urinary Catheterisation - Risks. (2013) NHS Choices. Available: http://www.nhs.uk/Conditions/Urinary-catheterization/Pages/Risks.aspx [Accessed October 2013].

[19] Davies, S.C. Annual Report of the Chief Medical Officer Volume Two, 2011 Infections and the rise of antimicrobial resistance. (2013) London: Department of Health. Available: https://www.gov.uk/government/publications/chief-medical-officer-annual-report-volume-2 [Accessed 15 October 2013].

[20] Surveillance of Catheter Associated Urinary Tract Infections Annual Report 2005. (June 2005) Health Protection Scotland. Available: http://www.documents.hps.scot.nhs.uk/hai/sshaip/publications/cauti/cauti-annual-report-2005-06.pdf [Accessed 2 November 2013].

[21] https://www.england.nhs.uk/wp-content/uploads/2014/04/mrsa-pir-guid-april14.pdf

[22] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345144/Implementation_of_modified_admission_MRSA_screening_guidance_for_NHS.pdf

[23] Simor, A. E. Staphylococcal decolonisation: an effective strategy for prevention of infection? Lancet Infect Dis. 2011 Dec;11(12):952-62.

[24] Screening for Meticillin-resistant Staphylococcus aureus (MRSA) colonisation: A strategy for NHS trusts: a summary of best practice. (2006) Department of Health. Available: http://webarchive.nationalarchives.gov.uk/20130107105354/http:/www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_063187.pdf [Accessed November2013].

[25] NICE Clinical Guideline 139: Infection - Prevention and control of healthcare-associated infections in primary and community care. (March 2012) National Institute for Health and Care Excellence. Available: guidance.nice.org.uk/cg139 [Accessed 20 October 2013].

[26] Prevention of Healthcare-Associated Infections Closing the Quality Gap: Revisiting the State of the Science Executive Summary. (November 2012) Agency for Healthcare Research and Quality. Available: http://www.ahrq.gov/research/findings/evidence-based-reports/gaphaistp.html [Accessed November 2013].

[27] Eyre, David W., Cule, Madeleine L., Wilson, Daniel J., Griffiths, David, Vaughan, Alison, O'Connor, Lily, et al. Diverse Sources of C. difficile Infection Identified on Whole-Genome Sequencing. New England Journal of Medicine. 2013;369(13):1195-205.

[28] Public Health England, Acute trust toolkit for the early detection, management and control of carbapenemase-producing
Enterobacteriaceae
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/329227/Acute_trust_toolkit_for_the_early_detection.pdf

[29] Carbapenemase-producing Enterobacteriaceae awareness: letter to NHS trust executives and directors of nursing
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/329250/Letter_to_Trust_CEOs_and_nursing_directors.pdf

[30] Annual report of the Chief Medical Officer 2011: volume two
https://www.gov.uk/government/publications/chief-medical-officer-annual-report-volume-2