The Management, Prevention and Control of Healthcare Associated Infections in Acute NHS Trusts in England – International Comparison and Review

Report prepared for the National Audit Office

by

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B Cookson undertook the work as private consultant; the views expressed do not represent the Health Protection Agency.

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Executive Summary

Introduction

Research Questions

1. The objective of the research for the NAO was to prepare an international review to address the following key questions that they specified as:

    - How does NHS Strategy compare with that of other countries?
    - Are the initiatives set out by the Department in their strategy evidence based?
    - How do the resources invested in tackling Healthcare Associated Infection (HCAI) in the England compare with those in other countries?
    - Do we have international comparisons of costing on HCAIs?
    - What are the barriers to improving infection prevention and control (IC) of HCAI in other countries?
    - Are there comparable data on extent of HCAI in other countries?

Methods and Context

2. Three perspectives were used to undertake the review: a country survey comparing England with a selected group of other countries; an analysis of aggregative European data from the DG SANCO funded Improving Patient Safety in Europe (IPSE) project which used consensus standards and performance indicators (SPIs); and a review of selected research papers relevant to IC and antimicrobial stewardship were undertaken. Country profiles were compiled from national web pages for the countries in the survey and their associated professional organisations; web pages and reports (e.g. IPSE) and conference papers of International Agencies e.g. WHO, EU including HELICS, and CDC. The relevant material was explored for each country to identify strategies that had been adopted to prevent and control HCAI and develop antimicrobial stewardship

3. The countries reviewed were the large English speaking countries, USA, Australia, and Canada; other UK countries: Northern Ireland, Scotland and Wales; and Belgium, Denmark, France, and Chile, The developments in these countries were compared with those in England over the past five years. The review of England provided a structure in which to trace developments elsewhere. The themes that were developed were: organisation and governance,

surveillance, interventions and resources and costs and the prevalence and incidence of rates of HCAI.

4. European data were compiled under the auspices of DG SANCO-funded IPSE which included data from a survey of 27 European countries, an important source of information about trends in the EU. This was augmented for this review by a special analysis (conducted by Barry Cookson, who lead this part of the IPSE team and a consultants on this study), which considered the English preventive measures using the IPSE consensus Standards and Performance Indicators (SPIs).

5. The third perspective used in the analysis was a review of the international literature. Searches were undertaken from 2003 to 2008 for material reported by the search engines Medline©, Embase©, Pubmed© and the Cochrane database. Words cited were 'hospital acquired infection, healthcare associated infection, nosocomial infection, surveillance, prevention, antimicrobial resistance, multidrug resistance, MRSA and *C.difficile,* costs of HCAI and cost-effectiveness. This was supplemented by search using the terms, 'guidelines, audit, faster tests, care bundles, venous line infections, urinary tract infections and ventilator associated pneumonia'. Checks were made on indexes of the main academic journals in this field to locate any relevant article not picked up by the search engines. Abstracts of all articles that appeared to have made a significant contribution to the management of HCAI were reviewed by both consultants and significant articles that contributed to the evidence base or contained important messages were included. For the purposes of analysis, the review focused on the following themes: risk factors associated with clinical practices, estimates of incidence and prevalence rates, governance, and economic evaluation and costings. These articles are discussed in Chapter 4.

Limitations

6. Whilst the review was extensive, it was difficult to obtain data on strategies and policies that were imbedded in the national data bases, thus it was not possible to ensure the review included all significant factors. A more targeted survey study, such as that carried out by Pratt et al (2004), would have provided standard responses to certain strategic, structural and factual questions, but would not have captured some of the difficulties and processes involved in their implementation which were of concern to the NAO. Although the review was comprehensive, it was not a systematic review. It is a descriptive account of the material that contributed to the development of prevention, control and management of HCAI over the past five years. Not all articles included met the ORION criteria for methodological rigour, Stone et al, (2007), but they included a group of articles offering new, or confirming existing, hypotheses about IC that could be validated in future studies.

7. It became clear early on in the enquiry that it would not be possible using these methods to meet the objectives 3 and 4 about international investment in research and costs of HCAI. Focussed questionnaires to countries may have yielded more results, but as the sources of funds for research are multiple and include investment by the facilities themselves, even this approach would not yield definitive conclusions. Cost data were disappointing with few studies found all of which solely reflected hospital bed days and covered disparate groups of patients and facilities making comparisons difficult.

Context

8. The review was set in the context of the attributes of HCAI that pose difficulties for management to prevent and control infection. These aspects include the bounded nature of knowledge relating to infectious disease and the lack of transparency in the execution of tasks. This made it difficult to attribute cause to individual agents. Failures in control led to the adoption of slogans such as 'IC is Everyone's Business' being adopted in an attempt to engender cultural change. The management of the complex processes of infection is thus difficult and subject to change as more information emerges about vehicles of infection and characteristics of organisms. It was suggested that analysis of these processes should be undertaken from the perspective of agency and new institutional economics.

Results

Governance

9. In England the Chief Executive Officer CEO is now responsible for the implementation of IC policies and antimicrobial stewardship. Responsibility assigned in this way empowers the CEO to ensure that good practice guidelines for which s/he was responsible are upheld. The assignment of responsibility to an individual CEO, as in England and Northern Ireland was not common. In most countries the CEO worked to the Hospital Trust Board. In England a Director of Infection Prevention and Control (DIPC) is appointed to each Trust Board. These arrangements are similar in each UK country; in Wales there is also an executive officer appointed to the board to oversee cleanliness. This is a novel development. The IPSE study of 27 European countries found that many are implementing stronger governance structures, although most already had national Infectious Control Committees (ICCs) which include infection control experts.

10. The other tendency that is emerging is the use of fiscal instruments to penalise those who do not follow the guidelines. These policies attack the weaknesses in the hinterland of infectious control, shown up in the enquiries into outbreaks and in the reports of inspection teams. There are individual lapses

and failures to comply with good practice by unobserved or uninformed staff may incur that are often beyond the reach of the governance structures in place in the overall system. English Primary Care Trusts (PCTs), the purchasing authorities, can withhold funds (up to 2%) if hospitals do not fulfil obligations and Modern Matrons can withhold fees from cleaning contractors who fail to meet their obligations. These strong incentives can have perverse effects; see Walker et al (2008).

11. Penalties have also been introduced in the USA from October 2008. These allow the payments to be withheld for Centers for Medicare & Medicaid Services (CMS) patients who have an HCAI deemed to be preventable. As there is a substantial difference between healthcare costs of infected and uninfected cases this is a strong incentive to improve IC. The system is to be extended to include other preventable infections in 2009 Graves, (2008).

12. Countries that are funded by insurance have to meet accreditation standards and threats to withdraw accreditation or to seek legal remedies are major incentives to adopt good practice provision. Some countries have made litigation easier, for example, litigants in France are now able to assume that certain infections are hospital acquired. There is a general tendency in all countries for patients to seek legal redress for infections acquired in hospital and so even greater need to work to agreed guidelines to minimise infections.

Although governance structures have been strengthened internationally, those imposed in England are some of the strongest of any country reviewed.

13. Good governance is central to the organisation of IC and antibiotic stewardship, but very little literature could be located from the reviews undertaken. It is an important area that needs further study. Input from economists specialising in organisational and institutional aspects of team working, networks, agency and transaction costs is needed. These issues cannot be properly addressed by standard economic evaluations.

More research work on governance structures appropriate for HCAI is needed.

14. Audit has emerged over the past five years as a powerful instrument of governance of IC and antimicrobial stewardship. Regular local audits can identify weaknesses and opportunities for improvements that can be added into good practice procedures and guidance. This is sometimes referred to as ‘process surveillance’. It oversees the implementation of good practice guidance and indicates where improvements are needed. In certain countries e.g. Denmark, France and Chile, a national process surveillance system is in place which reviews IC and antibiotic stewardship processes annually. Where national guidance has been agreed elements of this can be added to the system to ensure developments are kept up to date.

Audits at local and national levels should be used to ensure best practices are adopted into the system of IC and antimicrobial stewardship.

These audits in many English Trusts and are often augmented by the newer approaches such as root-cause analysis and statistical process control. However, England could reflect on the national systems that are in place elsewhere.

Having reported these aspects derived mainly from the Country profiles we can now look at the aggregative picture that has emerged from the IPSE study.

Results of the IPSE study

15. The IPSE project provided a timely summary of the European national strategies for the prevention and control of HCAIs and the relevant aspects of antimicrobial stewardship. The responding European countries are moving in concert to put in place structures and resources to deal with the challenges of HCAI. Although there are many commonalities, there are also important differences in priorities and systems. However, following a very thorough exploration of proposed standards and performance indicators (SPIs); a remarkable consensus was achieved. The finalised SPIs were used to analyse the current situation in England, which has performed very well. Although deficiencies are apparent in surveillance, education and resources, these are being reviewed via the Healthcare Commission inspection programme, or are being addressed by other initiatives.

Rates of infection

16. Prevalence studies are cheaper to perform than prospective incidence surveillance but they produce higher rates than incidence studies, largely because cases with infection tend to stay longer in hospital and are more likely to be included. As lengths of stay reduce, the two measures will tend to converge, but both will miss those patients discharged into the community. The published surveys are not very reliable for comparative purposes as definitions and collection methods and range of hospitals or patient conditions often differ. They are more useful for comparing trends within countries over time. France and Denmark have regular prevalence studies every three and five years respectively. Comparisons, even when methodological issues are dealt with, have to be interpreted with care as differences in rates may represent different phases in the spread or occurrence of disease.

17. The Third National Prevalence Study was recently conducted in England, Wales, Northern Ireland and Eire, and a separate study in Scotland. England had higher rates than Wales, Northern Ireland and Eire, whilst Scotland, which also conducted a validation study, had the highest rates. Studies of the prevalence of specific infections were also part of the prevalence studies it has been pointed out that potential biases still exist, Wilson et al, (2008) which may account for differential rates. These include the mix of voluntary and compulsory inclusion of hospitals, and different sampling fractions according to size of specialty; see Tables 2.2-6 in Appendix 2.

18. There is support for prevalence studies and pressure for their publication. The ECDC intends to undertake some prevalence studies; Long Term Care Facility prevalence studies will also be carried out in 2009-10, these will use the same methodology, making it easier to make comparisons though with the above provisos.

Well designed repeated prevalence studies may aid management of HCAI in England.

19. The same principles apply to incidence surveillance, they must use the same definitions and be collected in the same way for rates to be comparable within the same, or between different institutions. However, rates are probably more useful than most prevalence studies for comparative purposes. USA NNIS methods widely used for comparative studies have been questioned as not being suitable in Australian provinces and in Scotland. In England they have been adapted to a minor extent for Surgical Site Infections (SSIs) following consultations with the relevant healthcare workers. Validation work is needed in the HELICS hospital infection surveillance network, now transferred to ECDC, so that comparability between countries can be assured.

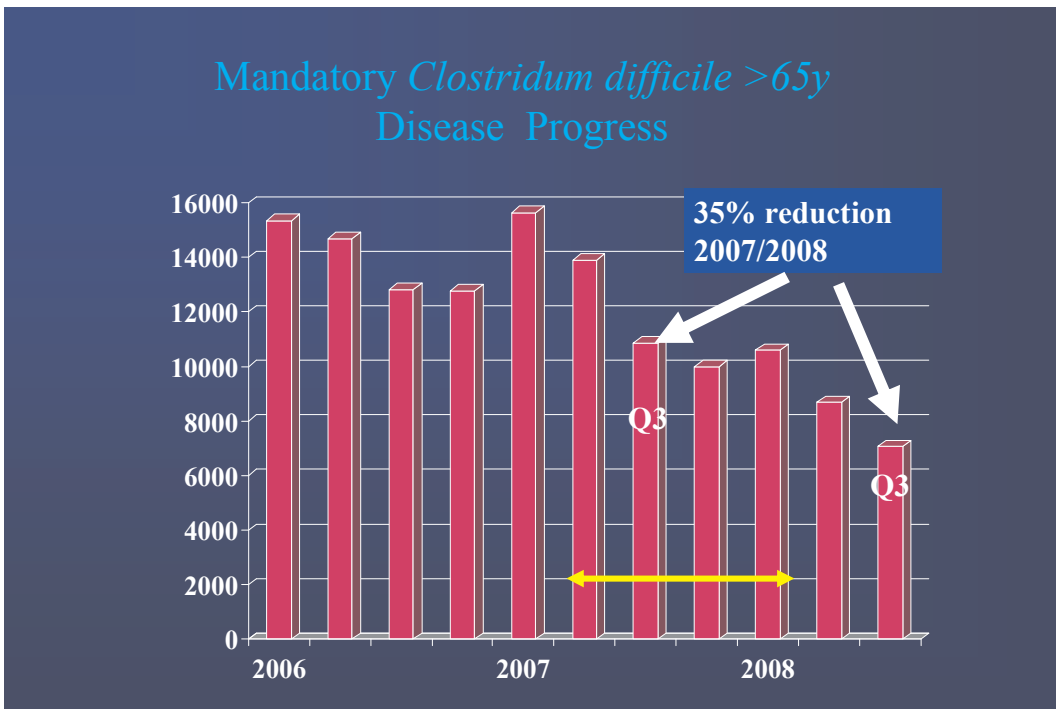
Surveillance in England is about to be reviewed, the issues which will need to be addressed include:

- **Validation work is needed to achieve consistent and comparable surveillance measures of incidence so that they can be used in the IC strategies nationally and internationally.**
- **New modules are required such as Intensive Care Unit (ICU) and other high risk unit surveillance, post discharge surveillance**
- **Other modules should be provided for local use so that meaningful surveillance is enabled locally e.g. urinary tract infection surveillance.**
- **Inter Agency working on English surveillance data are apparent but should be strengthened.**

20. Suetens et al (2008) now at ECDC, but previously the lead surveillance worker for the HELICS network of networks, has recently brought together European data on prevalence from various studies, including HELICS, since 1997. A prevalence of 7% and an incidence rate of 5% in Europe were

described, based on 2001 figures. This represents 5m infections per year from acute hospitals in Europe, there was an estimate of 1% direct mortality and 2.7% contributory mortality. Each case stayed in hospital on average for four extra days.

21. Mandatory surveillance is being used increasingly in the EU and elsewhere. Data derived from mandatory laboratory reports are probably the most consistent and are easier for the public to interpret. These can be monitored and used very effectively for control and research purposes. The introduction of English mandatory surveillance provided a basis for the novel introduction of targets: a 50% reduction by 2008 was set and met. *C. difficile* infections in England are now the subject of a targeted reduction of 30% by 2011. This has shown a 35% reduction in 3rd quarter of 2008 compared to 2007: diagram showing this reduction is reproduced below and Appendix 2.



England has also developed a typing network approach and is tracking the spread of different C. difficile strains.

22. In USA the requirement for surveillance was incorporated into law in many States and, some have laid down detailed procedures to be followed for a colonised or infected case, for example, isolation, decontamination and antibiotic prophylaxis. However, the requirements were unevenly enforced, and some states were not as rigorous as others. Some European states have adopted a "search and destroy" policy for MRSA. The low rates of MRSA in

The Netherlands and Denmark are attributed to this approach, which is very similar to that described in the original UK MRSA guidelines in 1986, Ayliffe et al (1986).

23. Anyone found to be colonised or infected with MRSA is isolated and contacts in hospital and in the community are tested and eradication treatment implemented. Search and destroy policy is probably best suited to countries that have low rates, as it requires a robust infection control facility.

England needs to review the cost effectiveness and applicability of search and destroy strategies especially if MRSA infection rates improve (e.g Bloodstream infections BSIs and Orthopaedic infections)

24. As mentioned above, *C.difficile* is now the HCAI that is attracting most attention. Current strains appear to be very contagious, with significant mortality. Infection control and antimicrobial stewardship measures need to be put in place quickly and cleaning must be very thorough to remove the spores, see DH and HPA, (2009). Alcoholic hand rubs do not destroy the spores and soap and water is recommended. *C. difficile* reporting has been in place in England since 2004 and a 30% reduction set by 2011.

25. Large outbreaks in Northern Ireland and in France were attributed to slow recognition of the problem by over stretched epidemiological resources. The simultaneous occurrence in adjacent hospitals was missed until the typing data was available and ribotype 027 identified. Scotland has instituted extra IC controls for any case of *C.difficile* whilst waiting for the typing result. Typing seems to be a useful step in identifying outbreaks. Northern Ireland has recommended that a 'root cause analysis' should be carried out when any case of *C.difficile* had been entered as the main cause of death on Part 1 of the death certificate and in a sample of those where it is mentioned as a contributory cause in Part 2. The report *Clostrdium Difficile: How do we deal with it*? DOH (2009) emphasises the seriousness of the condition and provides information and guidance and suggest that each case should be assessed by an expert team. Mandatory surveillance is used in some countries including England but other countries focus on tracking individual cases, undertaking typing and following up cases where death is attributed to the infection.

England should reflect on other countries that also employ *C. difficile* typing or root cause analysis to explore the contribution of these methods.

26. Surveillance is a useful research resource and is the focus of research used extensively for at the Statens Serum Institut in Denmark. In Scotland observed patterns in led to the modification of practice and a substantial reduction in transmission in ICUs. This has been recognised by the EU HELICS surveillance programme. The management of surveillance is developing rapidly as the new technologies are being brought to bear on it. The use in

England of a web-based data entry is a much needed advance already used e.g. in USA and Bulgaria.

Research capacity to analyse surveillance data should be assured.

Intervention

27. Many studies of interventions or potential interventions have taken place in the past five years. The ones selected have been included because of the insights they offer and some of these would need further validation.

28. Screening is a powerful intervention strategy that can contribute to better treatment for cases and a reduction in transmission. Screening is thus vital to many HCAI prevention and control programmes. European countries that adopt a 'search and destroy' policy for MRSA utilise aggressive screening techniques, isolate suspects, trace contacts and decontaminate those colonised or infected. This is in sharp contrast to systems were patients infected or colonised wait in wards until tests results arrive which, until recently could be as long as 3-7 days. Faster testing techniques that can deliver results in 2 to 3 hrs make it is possible to obtain results before an operation even for some trauma cases. The ultimate goal is to produce a near-patient test. This approach gives time to alert the operating team and to take action to protect the patient.

29. Other faster tests that can deliver results in 18-48 hrs can be used effectively for managing elective cases. Models have been constructed to test the cost effectiveness of such faster tests - Richie et al (2007) and Faster Testing Report (2008) - and trials have taken place Jeyaratnam et al, (2008), Harbarth et al, (2008), Keshtgar et al, (2008) and other papers are in press. Some of these trials suggest that it would be more cost effective to spend money on infection control than on rapid tests for MRSA testing Harbarth *et al*, (2008), Jeyaratnam *et al*, (2008).

New faster testing technologies have a contribution to make to IC.

Near patient versions of these tests may change the configuration of some services.

30. Many innovative intervention studies have been undertaken based on new information about IC and the interaction between antibiotics and the selection of antimicrobial resistance. Hand hygiene is one of the most commonly advocated interventions mentioned in all countries surveyed. England is amongst the first to have a national hand-washing campaign and many other countries have now held campaigns as part of the WHO programme. Evaluative studies of hand hygiene can show reductions in infection rates,

although it is sometimes difficult to ascertain the contribution to these reductions as other interventions are also in place. There is a proliferation of evaluations in connection with the use of catheters and ventilation in ICUs. The evidence is impressive and there is thus a strong presumption of failure to apply the guidelines if infection arises; hence the adoption of indicators of compliance being built into accreditation procedures and the relentless progress to removing payments to hospitals alluded to above.

31. Consideration has been given to developing systems (root-cause analysis and care bundles) which ensure, for example, that venous catheterisation is reviewed constantly; indwelling urinary catheters are audited to reduce the time they are in place and to ensure that they are not forgotten. Another key question addressed frequently in the literature is what type of catheter should be used: antimicrobial-containing catheters, silver alloy coated catheters or even heparin coated catheters. The use of treated catheters should be considered where infection rates are high. An unexpected finding was that those who had recently had an endoscopic examination had excess infection rates. Other invasive procedures should be kept under review in the light of these findings.

England IC professionals and indeed all healthcare workers should remain alert to invasive devices that may be vehicles for infection.

32. Antimicrobial policies and other stewardship strategies have been addressed and schemes launched to reduce inappropriate prescribing. England has dealt well with inappropriate prescribing in the community but it needs to be addressed better in hospitals. Guidelines exist about prophylaxis: choices of appropriate drug, optimal time of administration, dose, duration are available but not always followed. Therapeutic use of drugs is still a matter for some debate and a UK systematic review was only able to establish an evidence base in certain areas. Evaluation of one drug at a time is not considered appropriate, as the interaction amongst drugs used, and the purpose for which they are used, are all vital components of good stewardship.

33. Some European countries attribute their low rates of AMR to conservative antibiotic prescribing. Greater care is being given to these matters, including emphasising the importance of sending specimens for culture and testing for antibiotic susceptibilities. Monitoring for the development of MRSA, ESBL Gram negative rods and GRE is being orchestrated as improved antimicrobial stewardship attempts to preserve our antimicrobials as viable treatment options. The situation is further confounded by the role inadequate IC plays in spreading AMR organisms. Methods, including modelling approaches which explore these dynamics, are still being developed.

Monitoring of the aspects of antimicrobial stewardship should continue to be a high priority.

Data from AMR surveillance needs to interpreted in relation to antimicrobial stewardship and usage data

Environmental factors

34. In hospitals improved contracts for cleaning have been instituted but these still need refining to ensure they include attention to non-flat surfaces such as switches, telephones, handles that are often neglected. Presence of multi-drug resistant organisms in the community, where these have been monitored, can be high. Pets, such as cats and dogs, can be innocent bystanders in for MRSA (and indeed CA MRSA) and may be important in continuing transmission in the home. Norovirus and *C difficile* in particular can occur in the community and be introduced into the hospital and then spread further.

The contracts for cleaning must be specific about areas that need to be cleaned

Shorter lengths of stay is resulting in HCAIs presenting in the community and their surveillance needs to be addressed

Greater attention needs to be paid to infections such as CA MRSA, *C. difficile* and Norovirus which are also arising there and are causing problems following their admission to hospitals and other healthcare facilities.

Training and Education

35. Good training programmes are needed, that attract staff and alert them to the IC problem. Many countries are introducing programmes, Chile, for example, has a Masters Degree programme for young professionals. This capacity has also been reviewed by IPSE in Europe. The Diploma in Hospital Infection Control soon to be renamed as the Diploma in Healthcare Associated Infection Control in the UK is targeted at infection control professionals and has been referred to by the Healthcare Commission in questionnaires as a bench mark for IC professional education.

36. The epidemiological constraint is acute in some places because of the lack of trained personnel. In Northern Ireland it was considered that *C.difficile* outbreaks would have been identified more quickly if more epidemiologist time had been available to interpret the data. Clearly attention to training and employing epidemiologists and increasing the competencies of IC professionals must be addressed. The position of epidemiology within the governance structure of hospitals should be reviewed to ensure good epidemiological advice is available promptly and links are in place between those managing cases and outbreaks within hospitals and the wider public

health Weaknesses in these areas affected outbreak management of *C.difficile* in England, Canada. Northern Ireland and possibly France.

37. There is a lack of nurses in infection control; many countries recognise that they have still not achieved the ratios recommended by Haley and his colleagues in the 1970s and '80s. Good written material, which provides guidance and explains the reasoning behind the precautions, is made available to staff in most countries. These, like those available in UK, are based on evidence or expert opinion. Some work has been directed towards establishing a viable infection control team. However, staffing structural norms as outlined in the USA many years ago have not been met in England, the rest of the UK, and many European countries (see para 8 below).

There is a lack of epidemiological expertise and infection control practitioners in many countries.

The position of epidemiology in the IC process should be assessed to determine whether the present configuration is appropriate for both management of outbreaks and research purposes.

Resources

38. Resources allocated to infection control vary in terms of the numbers and grades of staff involved. Some work has been directed towards establishing a viable infection control team van den Broek et al, (2007), Voss et al, (2007). Although substantial extra funding for HCAI has been made available in recent years, staffing norms remain low in England. In the review, there are examples where states or countries had made funds for extra staff or buildings available for IC e.g. Canada and Australia. The source of funding differs because of the underlying differences in health care systems; systems that deliver care that are funded by the insurance schemes or privately have to incorporate and support extra funding with a business plan; see Perenchevich (2007). Other countries may receive funds in the form of grants. It would be necessary to carry out substantial studies to disentangle the sources of funds for HCAI internationally.

39. However, it is not just the amount of resources that matter but also the use to which the resources are put. There is increasing evidence that seems to suggest that high occupancy rates are risk factors for HCAI. This is understandable given that the time interval for cleaning would be short and the cases occupying the beds would be greater. The English occupancy is higher than other countries in Europe and higher than rates in the USA.

40. In England the research base has been supported by the Department of Health, the UKCRC, MRC and the Health Technology Assessment panel and funds

have also been made available in other UK countries. Funds for research have also been forthcoming from national sources elsewhere, see, for example, work undertaken under the auspices of the CDC or the work of Statens Serum Institut in Denmark. This research has strengthened the evidence base and provided a platform for other research and experimentation.

41. Much research is undertaken in Universities and large teaching hospitals funded from various sources. England the DH has commissioned an HCAI and antimicrobial stewardship research collation and a priority-setting exercise. Because of the multiplicity of sources for research funds, it is not possible to derive adequate comparative profiles for the various countries. Further details would require a postal questionnaire to the various countries of interest if more specific details are required.

A separate survey would be required to gather comparative data about funds available for research and expenditure on IC nationally and internationally.

Cost effectiveness or costing studies

42. There are few studies on economic evaluation. The costing study carried out in England by Plowman et al (1999) stands out internationally as one of the most comprehensive studies of costs. Other estimates derive costs by using length of stay data often without addressing the attribution problem. The formulae derived from the Burden of HAI study by the DOH Plowman et al, (1999) are probably the most useful tool for establishing rough estimates of costs internationally.

43. Some studies have looked at specific interventions or programmes such as studies on catheters, nursing resources, length of stay and faster testing. There are a number of studies advocating an economic approach, some of these are illuminating, but others do not take the essential characteristics of infection into account. Because there is a dearth of data, several models have been constructed to assess the effectiveness of interventions, these are cheaper, can be refined and populated with data as these become available.

44. Recent estimates by Suetens et al for ECDC (2008) suggest costs of HCAI in Europe to be between €13-24 b per year, these estimates are for attributable costs and are said to include direct and indirect costs. However, the full methodology of the estimates has not been assessed.

Basic costing studies and economic evaluations of interventions to control infections or improve antimicrobial stewardship are needed.

Barriers and achievements

Achievements over the period

42. The following achievements have been realised since 2004:

- Improved governance - CEO being made personally responsible, with the Hygiene Code to provide the standards;
- Improvement brought about by the compliance with the provisions of the Hygiene Code and the launch of the cleanyourhands hand hygiene campaign;
- Improvement brought about by targets where England has taken the lead internationally but other countries concerns about "naming and shaming"; and
- Use of process surveillance and mandatory surveillance of outcome data on specific organisms.

Barriers to further change

43. The following barriers continue to be evidenced:

- Cultural values that do not regard HCAI as an important risk factor;
- Gaming may become a threat as more penalties are introduced into the English system;
- Lack of professional involvement at all levels;
- The adequacy of the hospital infrastructure and trained personnel;
- Lack of trained epidemiologists
- Education and training improvement is still needed especially among undergraduates;
- Neglect of community HCAIs and those arising in the community de novo may rebound on hospitals;
- Lack of information about the long term burden of disease may distort investment decisions;
- Lack of costing data at all levels and dearth of economic evaluative studies;
- Little apparent appreciation of the need for infection control to be taken into account in contracts with the multiplicity of providers in the reformed NHS; and
- Apparent absence of involvement of public health professionals or infection control procedures in the contracting process – a considerable weakness especially if community acquisition becomes a significant factor.

Possibilities for further developments

44. **The following possibilities exist for further development:**
    - **Review of the national surveillance programme to consider how best to augment current activities (e.g. ICUs, UTIs, post discharge work and repeated prevalence studies).**
    - **Foster a better balance between surveillance for national and local needs, ensuring that Trusts have access to modules that enable them to pursue local surveillance objectives.**
    - **Tie in guidelines to monitor compliance as has been adopted in Chile.**
    - **Consider the differences between current policies and 'search and destroy' approaches.**
    - **Engender greater involvement of patients and their carers in policies and practice of infection control.**
    - **Improve access to routine statistical data for researchers and public - currently web pages of major stake holders are neither user friendly nor consistent.**

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- The preliminary results of the IPSE were presented at the 18th European Congress of Clinical Microbiology and Infectious Diseases Barcelona, Spain, 19–22 April 2008 (Accessed 28th August 2008). www.blackwellpublishing.com/eccmid18/abstract.asp?id=69029

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An International Comparison and Academic Review of the Management and Control of Healthcare Associated Infections

Chapter One Introduction and Methods

1.1 Background

This report was commissioned by the National Audit Office as part of the fieldwork for its third Value for Money study of healthcare associated infections (HCAI), due for publication in June 2009. The third report follows its previous studies on hospital acquired infections which assessed the situation (NAO, 2000) and the subsequent report that assessed how the recommendations made in the earlier report had been addressed (NAO, 2004). This follow-up report identified patchy improvements and indicated that more emphasis was needed to gain control of the problem. The third in the series of studies, *Reducing Healthcare Associated Infections in Hopistalss in England,* aims to assess whether the changes that have been implemented by the Department of Health and the NHS, to reduce infection, have worked.

The NAO commissioned an international comparison to examine the extent of the problem and the organisational structures and strategies that have been adopted to control its spread in other countries. They also wanted to identify any innovative cost-effective approaches to controlling infections; and evidence of, and barriers to, the implementation of good practice. The countries of interest to the NAO are mainly developed nations (other UK countries, Western Europe, North America, Australia etc) but they also hope to identify good practice and contrasting approaches elsewhere.

The NAO asked us to address five key questions, which are in line with the criteria they are using to evalauate findings from other parts of their methodology:

- How does NHS Strategy compare with that of other countries?
- Are the initiatives set out by the Department in their strategy evidence based?
- How do the resources invested in tackling HCAI in the UK compare with other countries?
- Do we have international comparisons of costing on healthcare associated infections?
- What are the barriers to improving prevention and control (IC) of HCAI in other countries?
- Is there comparable data on extent of HCAI in other countries?

1.2 Methods

1.2.1 Review of the country profiles. A review of web pages of International agencies e.g. WHO and the EU, including the project *Improving Patient Safety in Europe* (IPSE) and national web pages for the countries in the survey and their associated professional organisations was undertaken. Each country's web page was used to explore strategies that had been adopted to prevent and control HCAI and antimicrobial stewardship. Strategies that had been adopted in relation to governance, surveillance, guidelines and penalties and incentives were considered. Web locations for individual countries are given in the relevant section of the Report. General Media searches for material on HCAI were undertaken for each country reviewed.

1.2.2 Scope of the Literature Review and Methodological Issues

A review of the international literature was undertaken from 2003 to 2008 for material reported by the search engines Medline©, Embase©, Pubmed© and the Cochrane database. Words cited were 'hospital acquired infection, healthcare associated infection, nosocomial infection, surveillance, prevention, antimicrobial resistance, multidrug resistance, MRSA and *C.difficile,* costs of HCAI and cost-effectiveness*';* extended by 'guidelines, audit, faster tests, care bundles, venous line infections, urinary tract infections and ventilator associated pneumonia'. A literature search was also made of the main academic journals in this field to locate any relevant article not apparently picked up by the search engines: Journal of Hospital Medicine, Journal of Infectious Disease, Journal of the American Medical Association, the Lancet, the Lancet Journal of Infections, British Medical Journal, Journal of Emerging Infections, Infection Control Hospital Epidemiology and American Journal of Infection Control.

The material reported in the peer reviewed journals concerning HCAI has increased substantially over the period. Although the review was comprehensive, it was not a systematic review. It is a descriptive account of the material that contributed to the development of prevention, control and management of HCAI over the past 5 years. Not all articles met the ORION criteria for methodological rigour (Stone et al, 2007), but they included a group of articles offering new, or confirming existing, evidence for hypotheses about infection control that could, if necessary, be re-examined in a more rigorous manner. Abstracts of all articles considered to have made a significant contribution to the management of HCAI were reviewed by both consultants and articles selected which were thought to contribute to strengthening the evidence base or that contained important messages. The articles have been grouped around a number of themes*: risk factors associated with clinical practices, estimates of incidence and prevalence rates, economic evaluation of interventions and costings, and governance and organisation* and discussed in Chapter 4.

1.2.3 Country Surveys

A country review was undertaken from the available literature and web pages. Country by country data were not always accessible in English and this limited the extent to which we could perform a thorough investigation of some countries in the time allocated. The country reviews include three large federated English speaking nations (Australia, Canada, and USA), the other UK countries of Northern Ireland, Scotland and Wales and three European non-UK countries (Belgium, Denmark, France). We were also able to obtain data from a South American Spanish speaking country (Chile) with a long history of legislation relating to HCAI prevention and control. The material from individual countries and international agencies with a public health remit is considerable, we have attempted to present an account of approaches being taken, what has been done to gain control of HCAI and the barriers to progress. These reviews, offer a broad perspective of the approaches used and the stages reached in the development of infection prevention and control internationally. The country review differs from that undertaken by Pratt et al (2004) who obtained data from a survey of national bodies involved in HCAI control. The present review lacks the focus of that survey but provides insights into the operation of the strategies adopted in the greater detail required to answer the posed questions.

1.3 Comparative Account

In order to provide a comparison between England and other countries we have adopted as far as was possible the same framework as that used to summarise changes in England unless items were not available or entangled in other procedures and policies. This section begins with a brief review of strategies adopted in England followed by a review of HCAI in USA as the projects and methods developed there have influenced many other countries. We also include data from a survey of 27 European countries performed by the DG SANCO-funded Improving Patient Safety in Europe (IPSE)), an important source of information about trends in the EU. There is also the consensus on Standards and Performance Indicators (SPIs) from this project which was used in a special analysis for this report by one of the consultants (Barry Cookson) of English HCAI prevention and control measures.

1.4 Analytical Framework

1.4.1 Governance of HCAI

In undertaking the comparison we need to be aware of the issues that any policy to control HCAI should consider. Such policies have to address the special characteristics of HCAI and its control. These comprise uncertainty, information gaps and lack of transparency all issues addressed by new institutional economics. This will inform our analysis. The complexity of the infection route and the difficulty of attributing the direct causal relationship between the route,

procedures used and actions taken in the healthcare setting by agents – clinical and support staff – make governance of infection prevention and control (IC) difficult.

Many factors contribute to IC and numerous agents are involved, so each individual's contribution is unclear. In economic terminology there is an 'agency problem', attribution of cause is difficult. In addition there are real gaps in knowledge termed 'bounded rationality,' which means that even those involved in implementing the control policies may not have sufficient information. In this situation opportunism can play a significant role, as blame can be shifted amongst the various parties who can take advantage of the gaps in knowledge by allocating blame to others. Opportunism by staff and contractors may involve self interest, usually of the kind that cuts corners and saves the staff-agent time and effort.

1.4.2 **Contracting** Other opportunistic behaviour may be involved in contracting. Transaction costs will be high: both the *ex ante* transaction costs and cost associated with seeing that the contract is properly 'implemented and completed', i.e. *ex post* transaction costs. These costs may be high, but if the contracting and monitoring processes are not designed carefully, transaction costs will occur in the form of work not completed, or with unacceptable risks being taken. Control mechanisms may thus fail with HCAI rates high and redressing them costly.

Because monitoring is difficult, individuals need to be motivated to change their behaviour and comply with good practice guidelines designed to improve their knowledge base. However, the monitoring and attribution problems make it difficult to give economic incentives to agents on an individual basis, and it is not surprising that the policies in England and elsewhere were designed to make IC 'Everyone's Business'; dealing with compliance on a cultural basis. Health professionals in England and in many other countries have been exhorted to comply with control policies on the basis of trust. However, such trust is difficult to engender. Recent developments in inspections, audit and latterly creation of care-bundles which are monitored and require 100% compliance, have been put in place to address these problems.

Thus, in this review, we will consider how far complex issues of infection control have been dealt with in England and in other countries operating in different systems of healthcare with different public health structures.

1.5 Questions to be addressed in the Review

1.5.1 The first task that we have been asked to address in the International Review is, 'How do the reforms that have taken place in England compare to those that are taking place in other countries? Are there any lessons that can be learnt from the application of preventive programmes elsewhere?' In doing this we are to consider the evidence base to the English guidance and look at the resource inputs and the costs and cost-effectiveness of interventions.

1.5.2 We were also asked to address two other questions: How do the resources invested in HDAI in England compare with those invested in other countries? And Do we have international comparisons of costs of health care associated infections? In spite of extensive searches in these areas we are not able to provide definitive or even probable estimates in answer to these questions. This is partly because of the method used did not address these questions directly to the countries concerned but mainly because of the complexity of obtaining such information as funding comes from multiple sources and much of the investments are imbedded in the wider deployment of resources used for patient care. Where there is some information we have reported it but details were not available for all countries.

1.5.3 To compare developments in England with other countries we first need to set out briefly the strategies that have been developed there since the last NAO report in 2004. For the purposes of this comparison we will look at strategies adopted for organisation and governance, surveillance and screening, antimicrobial stewardship, evidence and guidelines, care-bundles, audit, publication, evaluation of interventions, education, and barriers to further improvements.

Chapter Two - Country Profiles

2.1 Controlling HCAI in England

2.1.1 Organisation and Governance

The strategy adopted towards governance structure for infection control is perhaps the most important change that has occurred in England in the past five years. The strengthened system of governance has increased the regulatory power of the DOH, and made the Chief Executive Officers (CEO) of hospitals accountable for seeing that HCAI control policies and antibiotic policies are in place. Another position the Director of Infection Prevention and Control (DIPC) was also created. This was announced in Winning Ways DOH, (2003). This post holder should report directly to the Trust Board. This strengthening of the regulatory capacity is based on the Health Act 2006 that included the Code of Practice for the Prevention and Control of Healthcare Associated Infections DOH, (2006), that laid down a framework for action and thus for accountability.

The implementation of the control programme builds on earlier work, introduced to prevent and control infections, Ayliffe et al, (1998) and Pratt et al, (2007). An inspectorate has been set up (the Healthcare Commission) and this is to be strengthened in 2009 when the Care Quality Commission is established. The Care Quality Commission will have the power to impose fines on hospitals not meeting the required standards. In addition power of enforcement has been introduced at other levels within the system. Governance is mostly through authority chains but governance through financial pressures on contracts is also apparent. Modern Matrons DOH (2002) have been given power to enforce contracts for cleaning to ensure that the standards are met and can withhold funds for non-compliance with the contract. Model contracts for cleaning have been drawn up to strengthen hospitals' contracting capacity at local level and so avoid some of the gross failures of earlier contracting arrangements reported by Crawshaw et al (2003). A further intervention that should strengthen the enforcement is the power to be given to Primary Care Trusts (PCTs) to withhold up to 2% of funds from hospitals that fail to measure up to the new standards.

This international review will address strategies for strengthening governance and accountability, and the use of economic penalties in other countries.

2.1.2 Surveillance

Governance structures and penalties are not workable unless there is clear information about the extent of the problem and systems are in place to facilitate monitoring against clear standards that will alert the infection control teams of emerging problems. When the first NAO Report was tabled in 2000, hospital managers admitted that they did not monitor infection control practice. They

considered that there was no suitable infrastructure for doing so and that surveillance was too expensive. They focused instead upon providing the amount of services contracted for and only if HCAI seemed to be interfering with this did they address infection control at all, Allen and Croxson, (2006), and Allen et al, (2002).

The awareness and emphasis on IC has grown over the past 10 years and lack of monitoring is no longer acceptable. In addition to prevalence studies for HCAI mandatory surveillance studies of incidence of MRSA and *C.difficile* and components of orthopaedic surgery are undertaken and reported regularly. The mandatory surveillance for MRSA that had been put in place produced data that were difficult to interpret, so enhanced surveillance methods were introduced DOH (2005). The new definitions used ensured all cases were included and allowed a distinction to be made between community infections (those infections that were identified within 48 hours of admission) and those deemed to be healthcare acquired that arose later. Targets for reductions in MRSA bacteraemia have been set and met in many Trusts, and targets have now been set for reductions in *C. difficile* DoH (2007d).

Surveillance is a useful tool to monitor the HCAI rates and track any changes that can be attributed to interventions and changes in policy, but to intervene on a case by case basis to prevent transmission of infection and to allow precautions to be applied when treating colonised cases, screening is also necessary. The screening strategy for MRSA began the period as a tool to identify 'at risk' cases likely to be colonised with MRSA. This was used by hospitals on a voluntary basis and operated unevenly across institutions. Those patients considered to be 'at risk' usually included those who had been in another hospital within the past month, readmitted infected patients or those admitted from a residential home. Persons about to have high risk surgery were particularly targeted e.g. orthopaedic patients. Recently a study by Rao et al (2007) pointed to the lack of precision of the risk assessment methods of selection and to the practical difficulties of instituting such a programme in a busy admissions ward.

The idea of universal screening was mooted and changes were announced DoH, (2007d). The current policy aims to introduce mandatory universal screening for elective cases by March 2009 and for emergency cases by 2011 (see the Hygiene Code [DOH, 2006, Revision 2008]). The effectiveness of screening can be limited by delay in identifying positive cases who might transmit infection and by those unaffected retained in bays or rooms until a negative result is obtained. Newer faster testing methods in theory make this process easier in that they allow full control procedures to be instituted immediately to prevent further spread and to ensure that those who are found to be colonised are treated appropriately. Faster testing is now available and in the process of being more widely adopted.

The most common type of surveillance has traditionally been of outcome measures, where the number of infected patients was merely counted (e.g. MRSA

bloodstream infections (BSI) isolates, surgical site infections (SSIs) etc). As the knowledge base has built up strategies have changed and it has been suggested that process measures such as the use of catheters, hand-washing etc, should be included. This is often combined with audit of processes, feed back of data and modification of policies as appropriate - process surveillance.

The growth of these measures has facilitated the development of care-bundles. Care bundles are made up of a number of evidence passed processes considered to be necessary for the control of infection but not sufficient to achieve improvement unless accompanied by a number of other processes. These processes all become modules that together make up the bundle and which can be seen as the responsibility of the person or post holder who is responsible for ensuring that a task is completed and who should also be aware of any items not completed and take action. Monitoring and audit of the bundles can be instigated. There are usually about 6 evidence based items of care that must all be complied with. Care bundles were originally proposed in the USA by Berenholz (2002) and bring together standard setting, guidelines and accountability into one monitoring instrument that takes into account the complex nature of control that encompasses many procedures that may be symbiotic, negating or enhancing the contribution of other procedures. They have been widely advocated by national agencies such as Centre for Disease Control (CDC) , professional bodies such as Institutes for Health Improvement (IHI)and the Modernisation Agency of the Department of Health in England. They have become part of the Saving Lives programme and adopted widely in each of the four UK national schemes, http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/ImprovementsStories/WhatIsa Bundle.htm

We will compare the development of outcome and process surveillance and screening strategies and the development of care bundles in England with developments elsewhere.

2.1 3 Antimicrobial Resistant Organism (AMR) Infections

Three policy goals in the English antimicrobial resistance programme can be identified: 'the immediate goal of protecting individual patients; control of transmission of the organism within the population and preserving antimicrobial therapeutic options' MRSA Report on Faster Testing, Roberts et al (2007). These goals may not always be compatible and judgements will need to be made between benefits to patients and hospitals and the impact on the wider issue of preserving therapeutic options. Extensive work has been progressed on AMR infections by the AMR sub-committee of the House of Lords, Specialist Advisory Committee on Antimicrobials SACAR, (2001) which produced Guidelines for antimicrobial use in hospitals and in the community. SACAR was replaced in 2007 by the Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infections (ARHAI).

The governance of antimicrobial policy has changed dramatically over the period. Now the CEOs and Boards of Hospital Trusts are responsible for having a Specialist Advisory Committee on Antimicrobials SACAR, (2001) which produced Guidelines for antimicrobial use in hospitals and in the community and for having an antimicrobial policy that corresponds to the guidelines in place. Primary prevention of resistance included items such as a surveillance, the linkage of prescribing to resistance data and clinical outcomes, avoidance strategies to prevent resistance amongst new antiviral drugs by appropriate prescribing and advice about prophylaxis cover and decontamination.

The concern about antimicrobial resistance is widespread; we will track the approach that is being taken in other countries to deal with the problem.

2.1.4 Guidelines

Policy on interventions needs to be supported by information and guidance for infection control teams (ICTs). A number of well-designed systematic reviews have been undertaken. It must be borne in mind that evidence from randomised control trial (RCTs) or systematic reviews will not always be available, see 'bounded rationality' above, and advice of professional experts may be used. A recent systematic review of the clinical effectiveness and cost-effectiveness of central venous catheters treated with anti-infective agents in preventing bloodstream infections (Hockenhull et al, 2008) used strict entry criteria in selection of articles but few were comparable, a common feature of many systematic reviews.

The systematic review of Surgical Site Infections SSI: NHS (2008) is a good example where first rate evidence was often unavailable and a wide range of evidence was considered, including expert opinion and experience, to inform the guidelines. The systematic review of screening also used a multiplicity of sources and exercised judgement or employed modelling techniques where the evidence base was not well established or relevant, Richie et al, (2007). Indeed, it would probably not be timely or cost-effective to have evidence in the form of a RCT or systematic review for every nuance of treatment or IC procedures. Other systematic reviews available include Cooper et al (2003) on isolation units that used modelling methods to estimate the impact of isolation bays.

The evidence gleaned from the systematic reviews has been included along with more impressionistic evidence and examples of good practice in the series of guidance tools produced under The Saving Lives programme DOH (2005a). This programme has produced specific practical guidance on a wide range of issues that includes advice on the screening of patients, the adoption of eradication procedures, prophylactic treatment, and isolation procedures. Advice on isolation is provided in a Saving Lives publication: "*Isolating Patients with healthcare associated infection*" DOH (2007c). The Saving Lives, Antimicrobial Guidance, documents the aim of the programme to reduce the threat to existing antimicrobials by using them appropriately DOH, (2007b). The programme is comprehensive, covering

environmental as well as clinical aspects of control. Advice has been given by the National Patient Safety Agency, (NPSA 2007) about the specification for cleaning and decontamination in hospitals, as well as recommendations about use of equipment, linen and disposal of hazardous waste products. There had already been much work on the building design programme, NHS Estates, (2002).

We will consider the evidence base for the guidelines available and widely disseminated in other countries.

2.1.5 Publication

Initially it was thought necessary to withhold the identification of hospitals as, like most indicators, the data used were in need of careful interpretation if hospitals were not to be treated unfairly. There has also been concern that the disclosure of named hospitals in a voluntary reporting system would jeopardise the coverage of the surveillance. However, this strategy has been overtaken by subsequent debates about patient choice and the right-to-know that have led to publication of the data in England.

We will report the approaches taken in other countries to the publication of data from individual hospitals.

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2.1.6 Resources – for the service

It was evident in the earlier reports that there was a shortage of resources generally and the implementation of internal budgets approach caused difficulties for infection control teams. The infection control nurses and the infection control doctor often depended on individual budget holders, i.e. surgery budget holders, theatre budget holders, to purchase items related to infection control. These budget holders used their discretion and tended to economise on items related to IC re-using consumables, not replacing ward furnishings such as waste disposal containers and soap dispensers that were often broken and sinks which were some distance from the patients, so making hand washing more unattractive to busy staff, see Allen and Croxson, (2006). Now most wards have an adequate supply of hand washing facilities and gloves are displayed prominently and each ward and each bed should have a supply of alcoholic hand rub to disinfect the hands between actions relating to patient care. Infection control nurses in the past had to provide a detailed business case to the infection control committee to get even small amounts of money to improve practice. Many of these attempts to introduce, what appeared to be sensible, initiatives failed and infection control nurses were frequently frustrated, now there is an active search for new initiatives, see DOH (2008).

In addition to the general increase of resources being provided for health care, £130m was provided for MRSA screening and providing tighter controls and a further £140m has been set aside to reduce *C.difficile,* £50m has been spent on deep cleaning hospitals and £4m on translational research to ensure that findings

were put into practice quickly, some of which was allocated to Imperial College London to apply research in MRSA and *C. difficile*. Expanding the stock of isolation units is also taking place.

Resources for development of systems of control and research in other countries will be explored as far as possible given the complexity of tracking resources. A definitive account may not be possible.

2.1.7 Cost burdens and economic evaluations

Measurements of the economic implications of infection and its control are few. Large studies are not available for England since the estimates of Plowman et al (1999). The structure of costs undertaken in that study have been used widely in business plans and they have been modelled by the DOH into a calculator to aid estimates by individual hospitals. These estimates do not take into account the community costs fully. The long term sequelae are rarely explored. The exception is the audit of deaths of MRSA cases that is being undertaken as part of the surveillance policy. Other studies, are usually performed *ad hoc*, providing evidence of the cost-effectiveness of interventions or modelling exercises of particular policy options. The importance of the time profile of MRSA testing has been recognised Harbath *et al*, (2008). Tests that produce quicker results if adopted generally could, in theory, reduce exposure and transmission, facilitate decontamination and save expensive isolation bed days. Screening methods and turnaround times are included in the latest version of the Dr Foster the NHS Quality Index (http://www.drfoster.co.uk/search/?search=MRSA+testing).

Findings from studies using faster testing, however, have so far given mixed messages. Keshtgar *et al*, (2008) and Robicsek *et al* (2008) found an advantage to the test, but Harbarth *et al* (2008) and Jeyaratnam et al (2008), found no significant difference between the control and intervention periods in their cross over study of surgical cases. The work of Rao *et al* (2007) and NHS Quality Improvement Scotland (2007), recommend universal screening as the cost-effective option and accelerated testing (chromogenic media) rather than more rapid (genetic [e.g. PCR] or fast phenotypic system) testing. Detailed costings of the innovative testing procedures have rarely been estimated. Two recent papers, however Keshtgar et al, (2008) and Rao et al, (2007) both included costing data relating to the procedures used. A recent cross over study by Jayaratnam et al (2008) did not include costs, but provided good data on resource use. The NHS Quality Improvement Scotland (2007) study contains a detailed and rigorous costing component based on details from the health care system in Scotland together with estimates of costs of tests in a dynamic model based in part on Cooper *et al* (2003). Few costing studies of the control procedures themselves have been undertaken.

We will consider the work on costing that has been done in the past five years in other countries, where information is available.

2.1.8 Barriers to adoption of control procedures

Lack of resources is not the only barrier to the adoption of control practices. There is a need to change the culture of the system. This change is needed to move from a situation where taking risks is acceptable to one in which it is regarded as a deviant behaviour to be avoided. Some of the policies involve procedures that are visible and easily monitored, whilst others are more embedded in the system. However, all should take infection into consideration in the design of buildings and equipment and scrutinised for IC implications. England has done much in this respect, but it is unclear whether the recommendations are applied widely. There are areas in need of future work, one of which is HCAI in the community. These are a concern in themselves, but they also provide a reservoir of infection that can amplify that in the hospital sector, Cooper et al, (2003)

We will explore barriers in other systems.

United States of America

2.2 United States of America

2.2.1 Organisation and Governance

CDC Atlanta had recommended surveillance systems since the 1960s. By the 1970s surveillance, carried out by nurses trained in epidemiology, was piloted. Infection control teams were set up in 50% of the hospitals and a far reaching research programme, the Study on the Efficacy of Nosocomial Infection Control (SENIC), was initiated to find out whether infection control (IC) programmes reduced nosocomial infection rates. It was found that rates could be reduced by up to 32% in the four areas surveyed when a number of parameters were in place including the presence of specific infection control team resources. The National Nosocomial Independent Surveillance (NNIS) was established to describe the epidemiology of nosocomial infections in hospitals in the USA, promote 'epidemiologically-sound surveillance' methodology and to establish comparative rates that could be used to improve quality. NNIS monitored four components: Antimicrobial Use and Resistance, Intensive Care Unit – adult and paediatric - infections, and those in High Risk Nurseries and Surgical Patients, and published annual rates. At its most comprehensive NNIS had 320 hospitals reporting.

The NNIS system was in place from 1970-2004, when it was replaced by the National Healthcare Safety Network (NHSN) which brought together an internet-based surveillance system that integrated all surveillance systems (i.e. the National Surveillance System for Healthcare workers (NaSH) and a Dialysis Surveillance Network (DSN) previously managed as separate entities by the Division of Healthcare Quality Promotion (DHQP) at CDC. DHQP is organized into three branches: the Epidemiology and Laboratory, the Prevention and Evaluation, and the Healthcare Outcomes. It is part of the National Center for Infectious Diseases in the Coordinating Center for Infectious Diseases in CDC. The new strategy is intended to protect patients, healthcare personnel and provide safety, quality and value in the healthcare system. The objectives of NNIS are retained but will be achieved by simplifying protocols and using more electronically driven data capture and reporting. HCAI outcomes in the Patient Safety Component of NHSN and modules on healthcare associated infections were set up: the new strategy collects data on infections that are procedure related, device related, and medication related.

This is a significant shift in emphasis and reflects the growing body of evidence indicating the extent to which it has been found that procedures, devices and medications are implicated in infection rates. It is considered that these routes could be modified by correct control procedures. 'CDC strives to understand how HCAI happen and to develop appropriate interventions'. Latterly this has included the development and promotion of care-bundles, Berenholz (2002). Participating

members must include an annual survey of the facility, and a Patient Safety Module. The collection has to be coordinated by a trained Infection Control Professional (ICP) or a Hospital Epidemiologist. Over 1200 healthcare facilities are involved in the new system.

The governance role of this system is indirect, operating via State regulation that sets out standards for hospitals operating within that State. These are produced by the Department of Health and Human Services, CDC, Safer Health for People.

A number of US States have laws in place related specifically to the management of MRSA. In California (2008) SB 1058/Chapter 296 SB 158 the law states that rates have to be made public and in addition screening must be instituted for MRSA for certain incoming patients and prevention procedures introduced. In Illinois (2007) under SB 233 all hospitals are required to establish MRSA control programmes to identify infected and colonised cases in intensive care units (ICUs) and patients at risk. Appropriate isolation for colonised or infected patients is required and patients must be isolated and strict hand hygiene should be observed and the State will produce a report for the public:

- Maryland was reported as having legislation that would compel each hospital and nursing facility to have in place prevention and control programmes in line with the Society for Healthcare Epidemiology of America (SHEA) guidelines that involve screening high risk patients for MRSA using nasal swabs (active surveillance) to detect any patients positive on admission, isolating patients both infected and colonised, using extra precautions when treating the patients – gloves, masks, gowns, hand hygiene and disinfecting the hospital environment.
- In New Jersey 2007 S2580 Public Law 1007 c120 requires identification of colonised or infected patients and isolating those infected and the use of precautionary measures as advised by CDC.
- The same applies in Pennsylvania (2007) S968 where all admissions from nursing homes and other high risk patients are to be screened.
- In Minnesota (2007) HF 1078 each hospital has to have a MRSA programme in place to meet DOH standards but the active surveillance and precautions is only required when MRSA is 'not decreasing' but no base line for this is established.
- In Tennessee, 2008 Public Chapter No 999, merely a risk assessment is required from each hospital and no requirement is made for these assessments to be made to the State as reported by the Consumers Union, *A summary of state laws on MRSA* (2007).

As well as legislation, governance of hospital infection occurs by use of the accreditation system and reimbursement rules employed by insurance companies and government agencies. The system in the USA has moved on from one trying to control rates to more direct actions to penalise those who do not achieve improvements in rates. As evidence mounted showing the potential for prevention

policy, initiatives in the USA have adopted a new strategy: managing infection control systems by withholding payment for Centers for Medicare and Medicaid Services (CMS) cases who acquire certain infections and making it illegal for providers to make up any short fall by charging patients. As the differential cost of an infected and uninfected case is large, this is a severe penalty on providers. It is justified as being necessary to avoid the cost that the budget had to absorb because of infections.

From 1st October 2008, the CMS stopped re-imbursement to hospitals for the cost of treating nosocomial urinary tract infections, central line-associated bloodstream infections and mediastinitis after cardiac surgery. In 2009 the agency plans to add selected SSIs, Legionnaires' disease, ventilator-associated pneumonia, *Staphylococcus aureus* septicaemia and *Clostridium difficile*-associated disease to this list. This regulation is part of the 'Deficit Reduction Act', signed by the President on February 8th, 2006. The aim is to reduce growth in CMS spending by ceasing payments for conditions that both result in the assignment of a higher cost (for Diagnosis Related Group) and, in the eyes of the regulators, could have been prevented by the application of evidence-based guidelines. It is motivated by a perception that hospitals currently fail to implement relatively cheap IC practices to prevent relatively expensive infection-related conditions. CMS proposes to save costs and improve patient outcomes; each of these is a worthy goal, but it is possible that the rules become subject of gaming as agents act to distort rates to protect funding. Infections could go unreported or DRG drift might take place in a different way; see Graves and McGowan (2008).

Since the last review the strategy has involved increased governance and accountability in the system.

2.2.2 Surveillance

When Pratt et al (2004) reported for the NAO, the USA had adopted a 5 year plan for reducing risks of HCAI. These included the 'Seven Healthcare Safety Challenges': to reduce by 50%: catheter associated adverse events in healthcare settings, to reduce targeted surgical events, to reduce hospitalisations and mortality from respiratory tract infections among long term patients and to reduce the targeted antimicrobial resistant bacterial infections.

The latest report from CDC containing comparative HCAI rates for hospitals uses data from the National Healthcare Safety Network (NHSN) for the year 2006, is published in the American Journal of Infection Control (2007). MRSA rose from just 2000 cases in 1993 to 168,000 in 2006, and by June 2007, 2.4% of patients had MRSA according to the largest-event-study which would imply that there were 880,000 victims a year. The Report contains device-associated infection rates and device utilisation ratios for various types of ICUs and other patient care areas. SSI rates or antimicrobial use and resistance (AUR) rates, are not reported, as it was thought that the data available for these calculations were insufficient to produce

reliable rates. However, SSI and AUR rates that can be compared with the national aggregates are reported in the 2004 NNIS Report. CDC estimates that HCAIs in hospitals alone account for 1.7 million infections and 99,000 associated deaths each year. Of these infections, 32% were HCAI urinary tract infections (UTIs), 22% were SSIs, 15% were pneumonia (lung infections) and 14 % were bloodstream infections (BSIs).

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The USA surveillance strategy has changed since the last report. Emphasis is now on causal mechanisms – device related infections are reported together with device utilisation rates. Growing evidence for prevention of such infections is now quite strong so the existence of the infection can more easily be attributed to a hospital.

2.2.3 Guidelines

The Healthcare Infection Control Practices Advisory Committee (HICPAC) is a federal advisory committee made up of 14 external infection control experts. It provides advice and guidance to the Centers for Disease Control and Prevention (CDC) and the Secretary of the Department of Health and Human Services (HHS) regarding the practice of health care infection control, strategies for surveillance and prevention and control of HCAIs in United States health care facilities. It also produces many guideline documents. http://www.cdc.gov/ncidod/dhqp/hicpac.html

In Pratt et al (2004) they documented the long history of guidelines that had been produced by CDC. Guidelines were evidence-linked and developed from a consensus of expert opinion. The earliest guidelines were those related to UTIs associated with catheters, pneumonia, isolation, SSIs and intravascular device-related infections. Subsequently, they have introduced further guidance: Management of multi-drug resistant organisms (2003), Preventing healthcare associated pneumonia (2003), and Environmental infection control in healthcare facilities, 2003 and Isolation precautions (2007). See www.cdc.gov/ncidod/hip/Guide/guide.hmt

The guidelines provide a thorough review of the infection, its epidemiology, use of hospital resources as indicated by the length of stay and any available costs. These 'good practice guidelines' are the 'standard of care' that is expected from clinical practice in hospitals in U.S.A. Guidelines and position papers have also been produced by Society for Healthcare Epidemiology of America (SHEA). Recent publications include Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship, Dellit et al, (2007), and Requirements for Infrastructure and Essential Activities of Infection Control and Epidemiology in Hospitals and Recommendations for Metrics for Multidrug-resisitant Organisms in Healthcare Setting : SHEA/HICPAC position paper (2008)
see http://www.shea-online.org /publications /shea_position
papers.cfm.cdc.gov/drugresestance/healthcare/webresources.htm

In addition, emphasis has been placed on the development of care bundles that bring together advice and guidelines on a number of factors that will have a significant impact on infection these are listed and each item has to be completed. The process can be audited by giving responsibility for each individual item to an operator responsible for the care of patients for that item. An aggregate audit can be carried out of compliance rates in a unit or relating to a process. Early evidence suggests that infection rates can be reduced substantially by the use of care bundles. However, it must be emphasised that there are many other things relating to organisational and individual change that accompany the introduction of bundles.

There has been a long tradition of producing HCAI guidelines with strong supporting evidence in the USA. These are often used by other countries as a basis from which to review, update their guidelines. Care bundles that bring together a number of different guidance elements have been introduced; more scientific evaluation of their effectiveness is required.

2.2.4 Education and Research

The infection control practitioner and epidemiological organisations in the USA have for many years produced educational material. The Campaign to Prevent Antimicrobial Resistance published easy access information in a published series called, *Tools for Clinicians*. Their summaries of good practice come in the form of a 12 point fact sheets, pocket cards, slides and posters. They concern steps to prevent Antimicrobial Resistance (AMR) among hospitalised adults, children, surgical patients, long-term care patients and those on dialysis, http://www.cdc.gov./drugresistance/healtcare/patients.htm

In addition there are numerous training programmes and on-line facilities to inform professionals and the public about HCAIs and their prevention.

A number of research initiatives were launched based on participating States. These looked at an number of aspects. Two provided workshops for ideas for improving patient safety. One was undertaken by Michigan Keystone ICU project with some funding from AHRQ working in collaboration with experts in patient safety from Johns Hopkins University. http://www.mha.org/mha/keystone The other was undertaken by the Pittsburg Regional Health Initiative which convened experts to discuss various health care projects. CDC reported that this initiative had reduced the overall incidence of catheter related bloodstream infections by 63% in 4 years using a care bundle approach. This care bundle empowered nurses to intervene if the protocols were not followed. Another was the New Jersey collaboration on ICUs which showed a decrease in VAPs, catheter related bloodstream infections and lengths of stay. http:www.njha.com/qualityinstitute. A project in Maryland also saw a reduction in VAPs by 36%.

Education and research programmes at many levels are available and are well-supported by the IC Professional organisations and the government via CDC.

2.2.5 Public Involvement

The pressure on hospitals to reduce infection rates has been led by consumer groups intent upon the publication of rates. HICPAC has produced guidelines to aid those reporting such rates that advices that publication of whole hospital rates are contentious and should be avoided. Concentration they suggest should be focussed on: central line practices, surgical antimicrobial prophylaxis, influenza vaccination, central line BSIs or SSIs, all of which have validated collecting procedures, and for which evidence suggests reductions in rates are possible if their guidelines are followed. Such advice may have been useful to reporting agencies but there is a strong public demand for a reduction of rates and for their publication.

The "Stop Hospital Infections" campaign mandate is to require the infection rates of hospitals to be published. There were 15 states in 2007 with mandatory HAI reporting and other States have bills ready to be enacted. In addition, litigation is used increasingly by those affected and attempts have been made to ensure the Guidelines are implemented, Jarvis, (2007).

There is increasing pressure to publish rates in response to public demand; about a third of states are doing this and others will follow.

2.2.6 Costs of HCAI

It is difficult to compare costs even in the same country. In a federal system of government such as that of the USA it is compounded, as States and even counties within States, have different systems of care and costing systems and include and measure different ranges of costs. The Office of Technology Assessment of Congress estimated that hospital costs caused by bacterial resistant organisms in 1992 cost $1.3b per year. Since that time there have not been many studies to estimate costs in any detail. However, Perenchevich et al (2007) did provide estimates derived from summarised costs from the literature. These estimate an attributable cost ventilator acquired pneumonia (VAP) as $ 22,873 with a range of $9,986 – 54,403; catheter related BSIs of $8,432 range of $3,592 – 34,410; and coronary-artery by-pass graft (CABG) -associated SSIs of $17,944 ($7874-26668); and catheter related UTIs of $1257 ($ 804 -1710). The amounts estimated have a certain face validity and are not out of line with estimates elsewhere.

Antimicrobial resistant infections have increased substantially. Cosgrove et. al. (2005), estimated that excess charges of MRSA compared to control groups was $41,079, an MSSA case $29,867 extra, and that the excess costs to ICU patients

having a vancomycin-resistant enterococcal (VRE) infection was $12,766, but there was a two fold increase in mortality in these patients so costs were lower. In 2003, Song et al (2003) reported excess costs of $81,208. In a submission to the State of Maryland Senate Finance Committee in 2006, Laximanan (2006) used up-dated estimates of costs from Haley's (SENIC) study in the late 1980s to make the case for targeting infections on economic grounds.

Perencevich et al (2007) took up the same theme and produced a template for those wishing to make a business case for infection control. Their paper 'Raising standards while watching the "bottom line": making a business case for infection control' gives a summary of the economic aspects of costing and evaluating interventions. The advice on costings is very practical, and takes on board the perspectives of those at different position in the healthcare systems, funders, directors and managers, healthcare professionals and patients. The business case is defined as being established if 'the intervention realises a financial return in a reasonable time frame. The case can be made 'by profit, loss reduction or cost avoidance.' Perencevich et al, (2007 [p 1122]) the paper begins with posing the difficult contextual problem that those who want to increase the investment in healthcare have to face: no one wants to invest their precious funds in infection control which is shared by many, making property rights difficult to assign, and is not a revenue generator.

Some of these issues are reminiscent of the problems faced when the system of clinical governance was introduced in the UK Crawshaw et al, (2002). Infection control, as such, is often a target for cuts, rather than increases in budgets, especially if the programme has kept the infection rates low. They suggest that more cost-effectiveness studies need to be conducted to show the benefits of infection control. However, since then the emphasis on infection control has increased, with the implementation of good practice guidelines required. Recent failures in infection control that led or are seen to have led to preventable infections with a financial impact on the hospital have raised the status of infection control. As mentioned above, this has led to the refusal of CMS programmes to reimburse hospitals for infections.

HCAIs in the community are also a high priority. SHEA/APIC provided *Guidelines for Infection Prevention in Long term Care Facilities* and were published in full in Journal of Infection Control and Hospital Epidemiology (2008). http://www.journals.uchicago.edu/doi/full/10/1088/592416

Few countries have seen a cash injection specifically for infection control, and it would be difficult to undertake such an investment in the largely privately funded hospitals systems. Instead, standards are made mandatory and the costs for achieving these standards will be met from bills which will be paid by State CMS or by insurance companies or individuals.

Thus although there is not a definitive costing study in the USA, there is considerable interest in the area, and tools are provided for those who want to make a business case for interventions. There is now a sea change happening with CMS not paying for many HCAIs. The pressure to resort to gaming strategies to avoid losing income will be immense.

2.2.7 Barriers to success

CDC has been criticised for 'failing to set high standards for cleaning and screening – the two methods required to stop the rapid spread of germs from patient to patient.' April 16th Congressional Hearing on Hospital Infections reported by Reuters www.reuters.com/article/presRelease/idUS186958+15-Apr=2008-PRN20080415. The speaker compared lack of hospital cleanliness with those of catering, which is (usually) much less deadly. The principal failure is seen to be the lack of testing hospital surfaces which was stopped on the advice of CDC and the American Hospitals' Association. 'How can it be more important to test for bacteria in a hot dog factory than in an operating room?' he asks. He then goes on to castigate them for failing to call on all hospitals to screen for MRSA. He pointed out that New Jersey, Illinois and Pennsylvania had legislated for screening - this he felt would have been unnecessary if the Guidelines published by CDC had not been so permissive. He feared that the relationship between the regulators and industry had become too cosy. It appears that CDC relies on State legislation to enforce compliance with guidelines and this, in the Federal State of USA, means that some States lag behind in achieving change and, as this is an infectious disease, this unevenness of application will have an impact on all. Another barrier is the uneven application of recommendations by States.

Australia

2.3 Australia

2.3.1 Organisation and Governance

When Pratt et al (2003) reported the findings of the international review Australia did not have national prevalence data for HAI. The last one mentioned took place in 1984. In 2001 the Australian Infectious Control Association (AICA) presented a report with data to the Commonwealth Dept of Health and Aged Care (CDHA), 'National Surveillance of HealthCare Associated Infection in Australia', (2008). This report included a discussion of prevalence and financial costs of HCAI by extrapolating data from the international literature. It was concluded at that time that the rates were similar for UK, USA and Canada. The report cited some work being done on specialties including cardiovascular and orthopaedic surgery in groups of hospitals.

Now HCAI has become a priority. The Australian Commission on Safety and Quality in Healthcare (ACSQHC) has nominated HCAI as a priority area for 2007-2010. They want action to achieve a measurable reduction in HCAIs. The HCAI programme, aims to 'build on facility and jurisdictional initiatives to develop a national approach to reducing HCAI by identifying and addressing systemic problems and gaps, and ensuring comprehensive actions are undertaken in a nationally coordinated way by leaders, decision makers in both public and private health sectors.' They intend to do this by making use of the surveillance data.

National governance and accountability structures in Australia have recently been strengthened and movement is being made to set up a programme to reduce HAI.

2.3.2 Surveillance

A report 'Reducing harm to patients from healthcare associated infection: the role of surveillance' has been produced Cruichsank and Ferguson (2008). This reviews surveillance practices in Australian and other countries. It includes recommendations and action points and shows the costs that infections impose on healthcare systems. It covers four areas: Prevention, detection and management, consumers and clinical capacity.

Surveillance practices are now part of the strategy and will be set up and refined in the next few years.

2.3.3 National Infection Control Guidelines

As part of this national initiative NHMRC is to undertake the production of new guidelines. This is to be achieved by examining the international literature and exploring with stakeholders the usefulness of existing guidelines produced by Commonwealth Department of Health and Aged Care (CDHA). An implementation strategy will be developed in consultation with the stakeholders. Indicators and plans for ongoing monitoring and evaluation of the guidelines and a plan for updating them will be included in this process. They are also to consider rapid response to emergency situations and to provide educational material and documentation for user groups.

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The Stakeholder Forums were held in March 2008 to discuss the key issues for consideration in the revision of the National Infection Control Guidelines. This project is scheduled to be completed by July 2009.

A hand hygiene guideline is being produced. This is being adapted from WHO Guidelines on Hand Hygiene in Healthcare to be nationally acceptable. Leadership of this project has passed under contract to Austin Health, Victoria. Professor M Lindsay Grayson, Director of the Infectious Disease Department expects that the National Hand Hygiene project will deliver: an education strategy, defined outcome measures, guidelines and audit tools.
www.safetyandquality.gov.au/internet/safety/publishing

Another guideline is concerned with 'antibiotic stewardship' at national, state, institution and community levels. The task of stewardship is to include antimicrobial prescribing and the encouragement of the use of drugs less likely to select resistant bacteria. It is recognised that, as a first step in exercising antimicrobial stewardship, there will be a need for surveillance systems to monitor the use of antimicrobials and any resistance that develops. The guideline will have four elements: a comprehensive surveillance programme of usage and resistance, strategies to improve correct usage and programmes to control secondary spread of resistance. www.asainc.net.au/

They point to the reduction of resistance and costs savings that can be achieved by successful programmes. To further the development of the programme a Forum was held on 11 September 2008 to establish in acute public and private hospitals in Australia a programme of antimicrobial surveillance and containment strategy that was to include antimicrobial stewardship and contribute to improve the use of antimicrobials.

Guidelines are in the process of development.

2.3.4 Managing Infections in the Commonwealth of Australia

Like many federal nations, USA and Canada for example, the Australian states have their own programmes for the reduction of HCAIs. These programmes differ and strengths and weaknesses appear at the State level in Australia. Richards and Russo (2007) in '*Surveillance of Hospital Acquired Infection in Australia - One Nation, Many States*,' captures some of these differences, and points to substantial programmes being initiated in Victoria, New South Wales, Queensland and South Australia on a State wide basis. The definitions of infections in these States, however, differ. The Australian Infection Control Association (AICA) use the same definition as the NNIS programme for SSIs and ICU central line infections; only two States use NNIS risk adjustment methods in reporting results.

Research by Friedman et al (2007) evaluated the association between the NNIS risk index and SSI rates for seven surgical procedures in Victoria; it was found to be appropriate for six of these but did not work well with infections following CABG operations. A study by Clements et al (2007) evaluated the use of NNIS risk indicators for SSIs in Australia and found them to be less compatible. Their data contained 43,611 items from 23 hospitals between February 2001 and June 2005. They found that NNIS risk indicators had poor discriminatory behaviour and their use as a prognostic tool in Australia was insufficiently sensitive. New efforts are being made to provide indicators throughout the Commonwealth that will provide information to patients on individual hospitals if 'nationally consistent reporting guidelines are developed'. It has been confirmed that there will be no penalties or compensation in connection with the published rates, Jenkins, The Australian 22nd July (2008) Hospital infection rates face exposure.
http:/www/Austrailian.news.com.au/story/0.23197,24061742-12977,00.ht,/

Comparisons in Australia are also made difficult, as States survey different types of surgical procedures and different process measures for items such as surgical prophylaxis. All States agree on the reporting of antibiotic use. The Public Health Act (2005) requires some hospitals to have an Infection Control Management Plan in place. The approaches in a number of States are documented below.

2.3.5 Queensland

Queensland had comprehensive Infection Control Guidelines in place in 2001. These included sections on multi-resistant organisms (MRO and MRSA) that distinguish between infected and colonised cases. Whilst advocating no treatment for colonised cases, it stressed the need to observe standard precautions to prevent transmission – it was regarded as important to reduce the antimicrobial load on 'animate and inanimate surfaces'. It has a section on antibiotic prescribing; advocating judicious use of antibiotics. Screening to identify people with MRO is not recommended as reinforcement of standard precautions is considered to be more cost-effective. Although the presence of an MRO does not preclude the admission or discharge of patients, the receiving institution should be informed of

the patient's status. For MRSA cases, the importance of hand hygiene is stressed as is the possibility of decontamination to eradicate nasal carriage may be considered during outbreaks.

The Infection Control Practitioners Association of Queensland has had an active role in maintaining a high profile for hospital infections; one of its objectives is to 'ensure that the guidelines used for practice in Infection Control are derived from current publications of recognised organisations'. Infection Control Practitioners Association of Queensland (ICPAQ) Inc, (2007), Guidelines for local networks page 1.

The Centre of Healthcare Related Infection Surveillance and Prevention (CHRISP) is a project of the Quality Improvement and Enhancement Programme (QIEP) funded through Queensland Health aims to monitor the performance of healthcare facilities for HAI continuously.

2.3.6 South Australia

In 2003 the South Australian Nosocomial Taskforce (SANIT) met at the CDCB to discuss the funding for infection control services, multi-resistant organism surveillance, the VRE draft guidelines, retention times for sterilisation records and microfibre cleaning systems,clinical indicators and ICD 10 codes and blood stream infection data.

It was announced the Department of Human Services in South Australia had approved the funding for the Infection Control Service (ICS). Five full time positions, unit head, infection control practitioner epidemiologist administrator and a data manager. All had been approved except the IT specialist. They also reported that multi-resistant organism surveillance had commenced. Guidelines for the management of patients with VRE were also discussed. Department of South Australia Department of Human Services Communicable Disease Control (2003).

2.3.7 Western Australia

Western Australia publishes a quarterly bulletin on reports of Hospital Acquired infections, www.public.health.wa.gov.au/2/37/3/healthdare_asso.pm. It has been possible since 2007 to enter data on line. In September 2007 it was reporting that MRSA infections were the lowest since the introduction of mandatory reporting in March 2006 at 0.1 MRSA HAI per 10,000 bed days. Infections were below the benchmark for: total hip arthroplasty, total knees arthoplasty, MRSA infections, Haemodialyis BSI and adult ICU central line associated BSI.

In 2007, the Director General of Western Australia Health endorsed the recommendation of the Healthcare Associated Infection Council of Western Australia (HICWA) that data on key HCAI rates would be mandatory for all public and licensed private health facilities that provided services for public patients in

Western Australia. The goals were to ‘ reflect the importance of HCAI within the WA clinical governance framework, help inform system-level priority setting, and evaluate prevention programs in WA’.
http://www.public.health.wa.gov.au/3/457/3/mandatory_indic.pm

The 2007/08 mandatory indicators for Western Australia were: SSIs following anthoplasty hip and knee procedures were made mandatory from October 2007 in all hospital performing these procedures; from the same date reporting of all MSSA and MRSA was made mandatory and notice of all contact with blood and body fluids was mandatory from January 2008.

2.3.8 Barriers

The chief barrier to improvements in HCAI policies in Australia are the discontinuities in practice across the various States as it has been shown that differences in definitions, approaches to collection and items surveyed vary markedly. The challenge is to gain the innovative drive that comes from individual programmes in the various States and to apply it to programmes nationwide. Governance systems are also diffuse and not described well in the literature available.

Canada

2.4 Canada

2.4.1 Organisation

The Canadian Hospital Epidemiology Committee (CHEC) and a subcommittee of the Association of Medical Microbiology and Infectious Disease (AMMI) Canada together with the Centre for Infectious Disease Prevention and Control (CIDPC) of the Public Health Agency of Canada (PHAC) forms the basis of public health provision of advice and surveillance of HCAI in Canada. The Canadian Nosocomial Infection Surveillance Program (CNISP) is a collaborative effort established in 1994, the objectives of CNISP are to provide rates and trends of healthcare-associated infections at Canadian healthcare facilities, thus enabling comparison of rates (benchmarks), and to provide data that can be used in the development of national guidelines on clinical issues related to healthcare-associated infections. There are 49 sentinel hospitals from 9 provinces participating in the CNISP network. Laboratory and epidemiological data are combined to determine rates of infection, up date guidelines and provide isolates of research.

Canada has an organisational structure in which to survey and study HCAI based on Public Health Agency. Governance between this structure and hospitals seems weak.

2.4.2 Surveillance CNISP surveillance programme includes the following:

Methicillin-Resistant *Staphylococcus Aureus* (MRSA)
Vancomycin-Resistant Enterococci (VRE)
Clostridium difficile Associated Disease (CDAD)
Severe Respiratory Illness (SRI)
Cardiac Surgical Site Infection (SSI)
Cerebral-Spinal Fluid (CSF) Shunt Infection
Central Venous Catheter-Associated Bloodstream Infections (CVC-BSI)
Pediatric Febrile Respiratory Illness
Lab-based Influenza Surveillance
Bloodstream Infections in Hemodialysis Patients
Extended Spectrum Beta-Lactamase (ESBL)
Point Prevalence Study
Re-Use of Single Use Medical Devices

A surveillance for MRSA was set up in 1995 by the National Microbiology Laboratory in colabortation with CRISP. This was intended to be an ongoing integrated surveillance programme combining both epidemiological and laboratory information about MRSA in Canada. The National Microbiology Laboratory provides a reference service as well as a surveillance and research into MRSA

http://www.nml.lnm.gc.ca/eb-be/ARNI-RAIN-MRSA-eng.htm A surveillance of MRSA took place in 2007 in 47 sentinel hospitals that participated in CNISP from nine Canadian provinces. Data were submitted for MRSA cases in hospitalized patients who were identified for the first time in a sentinel hospital. In 2007 there was a slight reduction in hospital cases and an increase in the number of community acquired cases. The surveillance for vancomycin resistant enterococci (VRE) was conducted in sentinel Canadian hospitals between 1999-2005. The rates are increasing but remain low.

Inspite of having in place a surveillance programme the popular view is that the strategy for control of infections in healthcare settings in Canada is not well developed. This reflects some disappointment with the sentinel system described above and the reliance on surveillance without attention to more general reporting or screening - a necessary steps in interventions to control infection. An editorial in the Canadian Medical Association Journal (2004), 'Nosocomial infections: What needs to be done?' recognises that some HCAIs are monitored and controlled but it considers that monitoring of a growing number of resistant microbiological agents is still 'in the dark ages'. They complain that neither patients nor staff are properly screened for these organisms and if they are there is 'flimsy' reporting of them and little attempt at containment. Containment they consider is made more difficult by the hospital infrastructure that is often a century out of date. There are 'multiple patients crowded into what are really single rooms sharing one toilet and a single sink also used by staff'. 'A wake up call, we said after SARS. But we are slumbering on.' http://www.cmaj.ca/cgi/content /full/171/5/421

'Hospitals are not required to report nosocomial infections like *C. difficile* to public health authorities, and neither provincial authorities nor Health Canada are tracking the infection. Outbreaks of 'C.difficile demonstrate that Canada needs a hospital based national nosocomial infection surveillance system that functions in real time and is available on the web to the public, such as the one in the UK.' Cruikshank and Ferguson (2008). As of May 2007 only 'Quebec and Manitoba had made *C. difficile* a reportable disease, even though the move was recommended for all provinces by the Public Health Agency of Canada's National Notifiable Disease Working Group'. Eggerton (2007). From 2007 CCHSA accreditation will be necessary for hospitals with Royal College of Physicians and Surgeons of Canada approved residency programmes all institutions seeking accreditation must report either *C. difficile* or MRSA which ever is most troublesome.

There is no doubt that *C.difficile* outbreaks have led to greater attention being paid to infections in hospitals throughout Canada. National structures are now being put in place to deal with the problem. There is a "chasm between public health and public health in the hospital," says Shirley Paton, Health Canada's chief of Nosocomial and Occupational infections new public health agency will examine the problem, "It would be useful to have national data," she says Eggertson (2008).

From September 2008, hospitals will begin reporting *C. difficile* cases and MRSA. VRE reporting will be added later. A campaign called "Just Clean Your Hands" is being launched.

The National Microbiology Laboratory is involved in Canadian Nosocomial Infection surveillance and it the hub of an series of research initiative to explore aspects of eg antimicrobial resistance and case control study of community associated MRSA. http://www.nml-lnm.gc.ca/eb-be/ARNI-RAIN-MRSA-eng.htm

There is extensive surveillance on sentinel sites being undertaking, little required reporting or screening .
Research is being initiated as part of surveillance programmes.

2.4.5 Guidelines The Public Health Agency of Canada publishes a series of Infection Control Guidelines which are produced as supplements to the Canada Communicable Disease Report. They represent 10 years evidence. The Guidelines are reviewed by the Steering Committee which is a national and multi-disciplinary committee mandated to provide timely infectious control and HCAI advice and draw attention to emerging issues concerning transmission during the provision of health care, infections cause by emerging diseases and new health care practices.

Prior to being published all Infection Control Guidelines are reviewed by the Steering Committee. This committee is a national and multi-disciplinary committee, whose mandate is to provide the Public Health Agency of Canada with timely infection control and healthcare infection epidemiologic advice on current and emerging issues concerning: **http://www.phac-aspc.gc.ca/nois-sinp/projects/index-eng.php**

2.4.6 Cost Estimates and resources

The Canadian Broadcasting Corporation, in a news broadcast investigation, said that 'the incidence of MRSA had increased 10-fold in less than a decade' www.cbc.ca/news/21 March. Canadian hospitals it was reported are failing to control infections resistant to antibiotics. These 'kill 8,000 patients and cost healthcare systems at least $C100m (£40m; ~US$80m; ~€63m) a year' the basis of the estimates was not given. It also reported that since 2003 *C.difficile* had killed more than 600 people in Quebec province alone. 'Many hospitals', said the reporter, 'do not even have the required minimum number of staff needed to combat infections. The government does not monitor hospitals' infection controls. Restaurants, though, must pass regular inspections or face closure'.

Andrew Simor, head of the microbiology department in a Toronto hospital, reports that one study showed that each patient infected with MRSA costs a hospital on

average about $C14,000 Projecting this bill across the whole country indicates that the cost of MRSA in Canadian hospitals alone would approach $C100m a year. 'Infection control should be a priority, with a minimum set of standards all hospitals must follow', Simor et al, (2001).

It is not merely funds available that affect IC but the environment in which it is carried out. In Canada the facilities were singled out for criticism in many reports. A survey was carried out on the infrastructure in Canada and 72.3% responded and in 42% of hospitals there was fewer that one infection control practitioner to 250 beds and few had trained practitioners involved, Dick et al (2003).

The cleaning is also mentioned many times in reports from Canada. 'Top-quality cleaning and lower occupancy rates were thought to be needed to defeat hospital-acquired infections – not just telling people to clean their hands' said Michael Hurley, President of OCHU, a workers' council of the Canadian Union of Public Employees (CUPE), on 26th September 2008. "We're suffering at least 2,000 deaths a year, at least 30 per cent of which are preventable."

There is some state funding for individual projects and the Canadian Patient Safety Institute (CPSI) and the Canadian Health Services Research Foundation (CHSRF) is to provide funding for a patient safety programme as part of the CHSRF 2009, Research, Exchange, and Impact for System Support (REISS) competition. Quebec has provided some $20m for improvements. Many of the reasons for the problems with *C. difficile* - old hospitals, low priorities for infection control, poor Clinical and Corporate Governance processes and higher priorities for increasing patient throughput - resonate with those mentioned by the Healthcare Commission when it inspected Stoke Mandeville following their *C. difficile* problems Cookson, (2007).

Structural issues are being recognised in the hospital infrastructure in Canada.

2.4.8 Provinces

Infection control is largely determined by Provinces and there is considerable difference in the progress that has been made in each. Much of the recent activity has been stimulated by *C. difficile* outbreaks. The absence of a national surveillance system that includes all hospitals was said to have played a part in slowing down the response to the epidemic in Quebec, Pepin, quoted by Burman and Fragomenti (2008). Support for this was found in a subsequent review that indicated that 'the outbreak ran from May 1, 2006, to Dec. 31, 2007, starting(ed) seven months earlier than originally thought, and …about four times as deadly'. It has been linked to an estimated 2,000 deaths in Quebec since 2003. 'Quebec coroner Catherine Rudel-Tessier conducted an investigation into the deaths and found the hospital's administration partly to blame for failing to prevent the spread of the infections.' It is now to be the object of litigation and is reportable in Quebec. http://www.thespec.com/News/Local/article/365792

A report produced in the Hamilton Spectator 26th September by Powell and Walters (2008) documents some grave findings in the hospital at the centre of the outbreak, Jo Brand' which indicates a breakdown of governance and lack or resources. 'Problems included a room where a fluorescent scan revealed it had not been cleaned for three days, and poorly cleaned and maintained bathrooms. In the emergency room, patients shared space with equipment that would normally be housed in a dirty-utility room. A waste hopper was located close to patients and near clean supplies. Housekeeping staff had too many duties. Along with cleaning, they had to stock fridges, deliver meals, stock medical supplies, change linens and reprocess surgical equipment. The number of cleaning staff had also been cut back in 2006 and 2007. The outbreak period covered by Gardam's report was from May, 2006 to December, 2007.

Cleaning procedures in rooms with infected patients were not clear or consistent. Rooms for patients with *C. diff* are supposed to be cleaned twice daily, according to guidelines issued by the Provincial Infectious Diseases Advisory Committee. ….And, although medical staff tried to follow good hand hygiene, there were too few handwashing sinks. For a time, the hospital was prevented from installing alcohol-gel devices outside rooms (*NB this of course would not have been appropriate for C.diff*) due to objections from the Fire Marshall about hallway overcrowding. General overcrowding and too many patients in need of long term care led to "gridlock in the hospital's emergency room." The congestion forced the hospital to treat patients in hallways and allowed the bug to spread more quickly from patient to patient.

The report said that at 15 per cent, the number of private rooms was inadequate and that all inpatient rooms are too small. Experts agree that antibiotics -a risk factor for acquiring *C. diff* - should be carefully controlled. Jo Brant at first had no measures in place to address overuse of these drugs. Then when it made attempts to bring in controls, a pharmacist was not included. Jo Brant did not have an effective system to communicate with its 300 doctors, all of whom have private practices as well as hospital admitting privileges. That meant it was difficult to update doctors about the outbreak or relay antibiotic recommendations. From 2005, fragmented staffing in infection control led to less frequent communication with senior hospital administration. This may have contributed to delayed identification of the outbreak.'

During an outbreak there was a complete breakdown of governance arrangements and lack of basic resources to reduce spread.

In some regions in Quebec, authorities are trying to bridge the chasm between public health and hospital management of infection. Montréal public health, for example, provided resources for surveillance in area hospitals to look at the six-month rate and severity of *C. difficile* and Quebec's government has recently

announced an increase of $C20m in funds for hospital infection control. Preliminary findings showed that *C. difficile* infections in the province's hospitals had dropped substantially from the previous year, "Preventable infections are out of control in Canadian hospitals," declared an April 2005 headline in the *British Medical Journal.* BMJ (2005);330: 275. There is, however, no province-wide surveillance. Zoutman, chair of the Ontario SARS Scientific Advisory Committee, recommended that Ontario should create a Centre for Infectious Diseases. More recently, the Ontario Expert Panel on Infectious Diseases recommended creating regional communicable disease and infection control networks. Mandatory reporting *of C.difficile* is now in place in Ontario and Quebec.

Issues with cleaning and sterilization of medical equipment, as well as infection prevention and control, were identified in the East Central Health Region in March 2007. Dave Hancock, Minister of Health and Wellness, immediately ordered an investigation of the situation by the Health Quality Council of Alberta, and a review of infection prevention and control policies, practices and procedures province-wide. The Health Quality Council of Alberta blamed a sterilization and superbug scare in Vegreville in March on a "strained working relationship" between the hospital and the East Central Health authority, confusion over who was responsible for infection control, and the "lack of a widespread patient safety culture." http://www.cbc.ca/canada/calgary/story/2007/07/25/report-stjoes.htm.

The findings of both reports indicated a need for provincial infection prevention and control standards. The Minister directed Alberta Health and Wellness is to include those standards in the Alberta Infection Prevention and Control Strategy, which was already in development. The strategy is accompanied by four provincial IPC standards. The standards address the first two directions of the strategy – leadership and accountability, and, standards and monitoring. These standards require 'health regions to appoint a senior executive to be responsible and accountable for infection prevention and control; develop an IPC Committee with representation of specific disciplines and expertise which reports to that senior executive; and implement, as well as monitor and report on compliance with the provincial standards. The standards clarify the roles, accountability and responsibility of the regional Medical Officers of Health and the Chief Medical Officer of Health for IPC.'

There are also standards for sterilization of reusable medical devices. These specify requirements for 'handling, transportation, cleaning, disinfection, sterilization and storage of reusable medical devices; the assessment and purchase of medical devices, processing equipment and re-processing services, and addressing occupational health and safety, as well as education and training requirements.' They have included managing MRSA and cleaning and sterilization and hand hygiene which include 'access to hand hygiene products and facilities in healthcare and community settings; education for the public, including children at a young age; education and training for professionals, and; evaluation and research.'

http://www.gov.ab.ca/home/NewsFrame.cfm?ReleaseID=/acn/200707/21846FE6B604A-AF77-9036-F12BE01AD2FB9CAD.html …

2.4.9 Barriers

The greatest barrier is the lack of a link between public health concern about HCAI and the governance structure in hospitals, Hospitals lacks the capacity to introduce control mechanisms systematically and are largely under resourced. There is also a lack of a country-wide strategy or at least consistent provincial policies that could apply nationwide. There is a lack of explicit governance at national and province level and lack of surveillance, other than sentinel surveillance on a national level. This lack of data makes policy formation and implementation difficult to achieve.

Northern Ireland

2.5 Northern Ireland

2.5.1Organisation In Northern Ireland the Regulation and Quality Improvement Authority (RQIA), has the responsibility for quality of services in health and social services. It is a non-departmental public body established under the Health and Personal Social Services (Quality, Improvement and Regulation) (Northern Ireland) Order 2003. The sponsor of the Authority is the Department of Health, Social Services and Public Safety (DHSSPS). The initial remit was to undertake the surveillance programme for elective orthopaedic cases. This role was extended to include an Antibiotic Resistance Action Plan which in 2002 established six priority areas – 'prudent use in the community, in hospitals, and in animals; and infection control, education and surveillance'. In 2004 a Control Assurance standard was set up. This included clauses about IC to manage risk in the environment for patients, staff and visitors and to embark on education programmes. A circular was issued on isolation rooms, including ventilated rooms and capital building. In 2005 a further circular on cleaning was issued 'Cleanliness matters'. Following the report of the Stoke Mandeville outbreaks the cleanliness code was strengthened 'Quality our driving force.' Later a ward sisters' charter was launched which gave senior nurses a role in maintaining cleanliness in their wards. www.Rqia.org.uk – regulation and quality improvement authority.

The Health Board system was reorganised in 2005, and revised systems were put in place as reported in "Infection Prevention and Control is Everyone's Responsibility" in 2006. This set out a series of strategic aims and objectives. The principle aim being to reduce the occurrence of HAIs. This included a strengthened governance structure; 'All organisations must ensure there are visible structures, processes and roles and responsibilities in place to deliver, monitor and promote safety and quality improvements in the provision of health and social care. This process is known as governance.' A new Governance, Accountability and Audit scheme was put in place by May 2007. The final accountability resides with the Chief Executive. In addition a person to be a 'lead for infection and prevention and control' was to be identified. The person appointed to lead IC was to have the necessary skills and competence to fulfil the role. This person has the responsibility of reporting to the Board and convening and chairing the Infection Prevention and Control Committee. It was also recommended that another person be named as responsible to the Board for antibiotic prescribing. It was recommended that there should be a policy on pharmaceuticals for all Trusts and Guidelines on prescribing should be available. The Trust was to produce a Infection Reduction Plan each year that would be submitted to the DHSSPS.

The governance structures were to be audited by an inspectorate that was to explore governance structures that were in place in all areas of medicine from human resources to clinical management.

Governance structure were in place throughout Northern Ireland

Attention was to be given to IC in the commissioning or provision of services, and a campaign was launched in 2006 to raise the profile of infection control amongst staff, patients and visitors based on the WHO Global Patient Safety Challenge Hand Hygiene Guidelines (WHO guidelines on hand hygiene in health care (advanced draft**)**
http://whqlibdoc.who.int/hq/2006/WHO_EIP_SPO_QPS_05.2.REV.1_eng.pdf

A Control Manual was produced by the end of 2006. Each trust has a duty to see that the quality of care it commissions or provides meets the required standards. A 24 hour advice line to the specialist team was to be established. Advice was issued that attention to infection control and prevention matters should be mandatory for all staff and linked to appraisal and individual performance reviews. Training was to be in place for all new staff from 2007 and for all staff by 2008.

Attempts were made to raise the profile of hospital infection and training advice was made available

2.5.2 Rates

A prevalence survey co-ordinated with the rest of the UK took place in 2006 to assess the number of HCAIs in patients in acute hospitals. This indicated that the prevalence of infection rates in Northern Ireland was 5.4%, compared with 8.2% in England and 6.3% in Wales. We need to be cautious about the national comparisons however because the countries differed, some used voluntary participation of hospitals whilst others mandated hospitals to participate, Wilson et al (2008). Older patients in Northern Ireland had a higher rate, 8.7% for those aged 65 and over, whilst those under 65 had a rate of 5.6%. Most infections were SSIs (4.2%), followed by UTIs and gastro-intestinal infection at 1.7%, and pneumonia 1.2%. Of the mandatory surveillance infections the prevalence rates were 1.2% for MRSA infection and 1.7% for *C. difficile* but 2.3% in those over 65 years old.

Surveillance of incidence of HCAI in orthopaedics took place annually for surgical site infections. In addition Northern Ireland participated in the Pan-Celtic surveillance a combined surveillance by Northern Ireland, Scotland and Wales. In the surveillance that took place in 2001-3, SSIs were reported from 53 of 13,891 reported operations. The rate in operations conducted by consultant surgeons was 1.2%, this was slightly lower than for junior staff, three quarters of the infections were superficial incisional, primary procedures were less likely to become infected than revisions, hemiarthoplasty was the condition with highest rates and those over 66 years of age were more likely to get an infection. It was found that these UK operations tended to be shorter than those in USA and considered that the NNIS risk index performed less well for orthopaedics. The rates were broadly comparable with those published in other countries. It was pointed out that some deep seated infections are unlikely to appear before 12 months after the operation. Reporting

was mandatory for four procedures arthroscopy of knee and hip, hemiarthroscopy of the hip and open reduction of the trochanteric of the femur.

Mandatory surveillance for *C.difficile* began in November 2005 it focussed on the 65 year old and over population. Numbers peaked in 2006 partly because of reporting changes and then fell slightly.
www.hisc.n-i.nhs.uk- H I S C – Northern Ireland Healthcare Associated infections – surveillance

2.5.3 The system in operation

Although regulations in place can appear seamless, there can be problems when any system confronts an unusual event. In Northern Ireland it was possible to gain further insights into the procedures of governance and control procedures by considering the review that took place into an outbreak of *C.difficile*. In January 2008 an outbreak of *C.difficile* ribotype O27 was identified for the first time in Northern Ireland in the Northern Trust. There had been a rise in the number of cases and in the virulence of cases with additional mortality. Nearly 300 cases were reported in the twelve months following the first case in June 2007. An independent review was instigated which was to report in October 2008 called Changing Culture. A 'Root Cause analysis', was to be used, 'which attempted to locate the cause of the problem and distil lessons from it, patients and carers were interviewed as well as staff in the hospitals.

The review adopted a systems approach and did not seek to allocate blame. Failures to control the system in the early stages were found to be attributable to the lack of knowledge of the virulence of the organism and its ability to produce many spores and to cause a relapsing illness facilitating further transmissions of the disease. There was significant patient transfers amongst the five hospitals and it was not recognised that the outbreak was a 'hospital systems outbreak' for some time. In addition there was pressure on beds and a shortage of nursing staff and cleaners. The cleaning processes in place were not sufficiently robust to deal with the ribotype 027.

There was a delay in obtaining surveillance data from the system that would have alerted the teams to the outbreak. This delay was thought to be the result of lack of epidemiological expertise to communicate the problem, delays in getting information from the three monthly survey and the specification of the disease by organism not by type disguised the outbreak. There was little time for senior members of the epidemiological teams to study the data and report their findings. Serious Adverse Incidents (SAI) notice was in place but this did not lead to further reports of outbreaks in another two hospitals and the DHSSPS requirement that notification should be made using a circular HSSMD9/27 was not adhered to until January 2008. Once an outbreak was declared and an Outbreak Control Team was

put in place actions, such as setting up a dedicated ward and control procedures took place promptly.

The review found a deficiency in the number of staff available for infectious disease control at all levels: from microbiologists, pharmacists, nurses and administration and clerical support staff. The review also pointed to the poor communication system that did not enable staff to determine whether cases had had previous episodes of *C.difficile* and asked for improvements in information technology. It also pointed to the dilapidated condition of some of the buildings and noted that a refurbishment programme was underway. The Review recommended that a system be put in place to provide the rapid deployment of isolation wards in the event of an outbreak. It was also recommended that a 'root cause analysis' should be carried out, when any case of *C.difficile* had been entered as the main cause of death on Part 1 of the death certificate and in a sample of those where it is mentioned as a contributory cause in Part 2.

rqui.org.uk/cms_resources/C.diff Report 1 June 2008.pdf

Renewed efforts have been put in place following the review. One such measure is the introduction of a care bundle for *C.difficile.* Many of these events and responses resonate well with the experiences in England following similar outbreaks.

Care Bundle for *C.difficile*

This comprised:

- Rapid isolation of patient
- Enhanced Environmental Cleanliness
- Prudent Antibiotic Prescribing
- Scrupulous hand hygiene
- Personal Protective Equipment
- All the above measures are required at all times.

On October 2008 the Regional Prevention and Control Manual, devised by a consultant microbiologist, was made available on the internet to both healthcare staff and the general public as part of the Department of Health, Social Services and Public Safety's Changing the Culture action plan. It was intended that 'best practice should become standard practice'. The Health Minister, announced that they were adopting a zero-tolerance strategy. Whilst it was keen to stress the responsibility was everyone's business, authorities have adopted a central regulatory framework. A programme of unannounced inspections of all hospitals has been announced together with restrictions on visiting times and a dress code for health care staff.

These changes built on a series of new initiatives to deal with HCAIs that had been put in place in January 2008. These included many aspects of hygiene - cleaning, environmental condition, waste disposal, patient equipment, linen handling,

decontamination of medical devices together with clinical practice issues such as hand hygiene, personal protective equipment.

Renewed effort is being put into the hand hygiene campaign. MRSA screening for high-risk patients will continue. Funds have been made available to provide a pharmacist in each trust to work with staff to get safer prescribing of antibiotics. These developments are part of a £9m package of long term policies to reduce hospital infections especially *C. difficile* and MRSA, investments include the provision of more single rooms in new hospitals. Many of these initiatives are like those adopted in England.

Surveillance systems in Northern Ireland was in place but was not sufficiently robust to pick up a hospital systems outbreak.

2.5.5 Inspections

Whilst these measures are being put in place, another programme was being launched: namely unannounced inspections. Five independent inspections have been reported. Use was made by the inspector of the definitions included in The Independent Audit of Environmental Cleaning Standards in HCS Hospital Facilities (DHSSPS 2008). The inspections did not involve prior notice. The Chief Executive was informed at 9 o'clock on the day of the visit and a request was made that someone was available at reception to receive the team. The following categories were included in the audit:

- Environment
- Waste disposal
- Linen
- Hand Hygiene
- Patient equipment
- Kitchen
- Sharps
- Personal Protective Equipment

Three grades were used to classify compliance: >85% was defined as compliant, 76-84% as partial compliant , <75% as non-compliant.

The audits have indicated many issues in the hospitals visited, these range from the separation of clean and dirty laundry, the failure of collection of sharps boxes, to problems with general cleanliness and management of the estate. The inspectors issue a report at the end of the visit that outlines failures and sets a time table for corrections to be put in place. A high proportion of these are in the 'immediate' action category.

2.5.6 Barriers

Much has been learnt from the outbreak and the inspections that should provide material to refine the control programme in the future. This system has been in place in England for some time now. The main barrier, as was indicated in the reports of the inspection was the culture of infection control in hospitals, hospital infrastructure, poor IT facilities and lack of expertise and staff shortages.

Scotland

2.6 Scotland

2.6.6 Organisation and accountability

A series of criteria are set out to show the accountability framework for each step in the control programme. This includes the statement of the criterion the guidance offered and methods that might be used to monitor success of achieving the goals under the heading 'Examples of Verification' – a sort of audit trail for checking compliance. An adaptation of this has been reproduced below.

Figure 2.6.1 Governance and Responsibility and action in Scotland.

Criterion	Statement of criterion
Criterion 1	Responsibility for infection control is clearly defined and there are clear lines of accountability for infection prevention and control matters throughout the organisation to the Trust Board.
Criterion 2	There is an Infection Prevention and Control Committee, directly accountable to the Chief Executive and Trust Board, that endorses all infection prevention and control policies, procedures, and guidance, provides advice and support on the implementation of policies, and monitors the progress of the annual infection prevention and control programme.
Criterion 3	There is an appropriately constituted and functioning specialist Infection Prevention and Control Team.
Criterion 4	Prevention and control of infection is considered as part of all service development activity
Criterion 5	An organisation wide annual infection prevention and control programme with clearly defined objectives is produced by the Infection Prevention and Control Team.
Criterion 6	Written policies, procedures and guidance for the prevention and control of infection are implemented and reflect relevant legislation and published professional guidance.
Criterion 7	There is an annual programme for the audit of infection control policies and procedures.

Criterion 8	Timely and effective specialist microbiological support is provided for the infection prevention and control service.
Criterion 9	Surveillance of infection is carried out using defined methods in accordance with agreed objectives and priorities, which have been specified in the annual infection control programme.
Criterion 10	A comprehensive annual infection prevention and control report is produced by the Infection Control Team and is presented to the Trust Board.
Criterion 11	The Infection Prevention and Control Committee and Infection Prevention and Control Team have access to up-to-date legislation and guidance relevant to infection control.
Criterion 12	Education in infection prevention and control is provided to all healthcare staff, including those employed in support services.
Criterion 14	The system in place for infection control is monitored and reviewed by management and the Trust Board in order to make improvements to the system.
Criterion 15	The Trust Board seeks independent assurance that an appropriate and effective system of managing infection control is in place and that the necessary level of controls and monitoring are being implemented.
Criterion 16	An organisation wide hand hygiene policy and mechanism to ensure effective implementation are in place.

Each criterion has an attached detailed framework for action, an auditing function and bibliographical source material. This schedule provides a progression of task and responsibility mapping that can be used by managers and auditors to assess the compliance with the goals of the system. The 'examples of verification', however, are many and would take time to assess and would be subject to reporting and interpretation biases. Accountability is to a committee or team with little individual accountability: the COE is 'responsible on behalf of the Trust Board'. This weakens to some extent the authority and power of the CEO. Notable in the items considered in the criterion document is the issue of payment for outbreaks and the requirement for mandatory training for all staff.

Accountability has been thought through but the detailed items may be difficult to monitor.

2.6.2 Surveillance

Surveillance has been put in place for SSIs, Neurosurgical SSIs, MRSA and MSSA, Catheter-Associated Urinary Tract Infection Surveillance (CAUTI) infections in ICUs, Paediatric Respiratory Syncytial Virus Surveillance, *C. difficile* and outbreaks of HCAI are reported. Data on *S. aureus* bacteraemia, both MRSA and MSSA, and infections recorded as being associated with a device will be reported at a National and Board level. The Scottish MRSA Reference Laboratory (SMRSARL) isolates are also submitted to the European Antimicrobial Resistance Surveillance System (EARSS). Current epidemiological findings from ongoing studies of antimicrobial resistance data and strains circulating in Scotland The *Staphylococcus aureus* bacteraemia quarterly report of cumulative data from all NHS boards in Scotland http://www.hps.scot.nhs.uk/haiic/sshaip/publicationsdetail.aspx?id=30248.

The report was redesigned to be consistent with the Health improvement, Efficiency, Access and Treatment (HEAT) plan, see http://www.isdscotland.org/isd/3317.html The *S. aureus* bacteraemia data are expected to relate better to the Health improvement, Efficiency, Access and Treatment (HEAT) target of 30% reduction in S. aureus bacteraemia by 2010. Details of the HEAT targets can be found at http://www.isdscotland.org/isd/3317.html.. Guidance and advice on outbreaks for each surveillance group are available (this has been developed over the years from 2002 to 2008 for *C.difficile*) and a 'frequently asked questions' file has been set up to support the process of surveillance. Details of the HEAT targets can be found at http://www.isdscotland.org/isd/3317.html.
There is a need to communicate current epidemiological findings from ongoing studies of October 2008 antimicrobial resistance data and strains circulating in Scotland. www.documents.hps.scot.NHS.uk/hai/sshaip/publications/MRSA-quaterly-reports/SAB-2008-10

Surveillance is accompanied with advice about practice. Procedures involved in avoiding device related infections have been gathered together in 'care-bundles': a series of related activities each of which might be a contributory factor in disease acquisition but need to be part of a coordinated series of activities to maximise the safety of procedures. The following is an example of documentation of one bundle it gives an example of CVC Maintenance Bundle Standard Operating Procedure and a audit form for application when treating a case adopted in the Scottish health system.

Figure 2.6.2 Care bundle for CVC

Example of a Central Vascular Catheter (CVC) Maintenance Bundle Standard Operating Procedure

Statement	CVCs cause insertion site sepsis. They are the leading cause of device–related blood stream infections. Complications arise directly from their use and in particular if the care is sub optimal. We have a duty to our patients to optimise CVC care and to ensure that our CVC care does not cause the patients harm. Monitoring our CVC care will assist us to optimise procedures and reduce the risk to patients.
Objectives	Objectives: To optimise Central Vascular Catheter use in OUR ward and reduce as far as possible infection complications. To be able to demonstrate quality CVC care in OUR ward.
Requirements	Before the CVC Bundle Procedure is performed. Signed commitment from the clinical team: consultants; junior doctors, ward manager and nurse team to optimising CVC care. Signed agreement from all consultants that named individuals on a weekly/named basis will undertake a CVC bundle. Named individuals competent in performing the bundle as written. Prior to starting the CVC Bundle Procedure Ensure there is alcohol hand gel at the bedside of all patients.
Procedure	Perform hand hygiene. Collect a bundle sheet and complete the top boxes: name, location, observer. Proceed to the first patient with a CVC. Introduce yourself to the patient/relative and explain that you are checking all catheters to see if any need removed. Ask the nurse in charge of the patient the questions as stated on the bundle. Look for documentary evidence to support the nurse's statements. Ask 'buddy nurse'* to confirm hand hygiene procedures and alcohol hub procedures have been optimal. Perform hand hygiene. Record actions in the bundle. If the CVC is considered not to be required refer to medical staff. Repeat steps 3-10 until all patients in the ward with a CVC have been visited.
After care	Complete form. Give it to: Discuss and display the data when it has been returned. (Keep bundle forms for xx time).

Copied from http://www.hps.scot.nhs.uk/index.aspx

A short version on the bundle is the one that can be used for each patient and audited and monitored.

'The Bundle

1. Checking ***the need for a CVC has been reviewed and recorded today***
2. Ensuring ***the CVC dressing is intact and was changed within the last 7 days***
3. Ensuring ***alcohol CVC hub decontamination is performed before each hub access***
4. Checking ***hand hygiene before and after, is performed on all line maintenance/access procedures.***
5. Ensuring ***Chlorhexidine gluconate 2% in alcohol is used for cleaning the insertion site during dressing changes***.'

http://www.hps.scot.nhs.uk/haiic/ic/CVCMaintenanceCareBundle.aspx

A quarterly report has been provided on *C. difficile* associated diarrhoea Between April-June 2008, 1732 cases of were reported, a 7% reduction on the previous quarter (January – March 2008) and a 9.5% reduction compared to the same period the previous year. HPS considers that it should be assumed that any outbreak is caused by hypervirulent-strains and dealt with accordingly, as any delay between diagnosis and typing may result in inappropriate control measures. However other studies of *C.difficile* suggest that ribotype O27 may not be as virulent as has been assumed from some of the outbreak studies Cookson et al, (2007), Morgan et al, (2008)

The *Staphylococcus aureus* bacteraemia quarterly report of cumulative data from all NHS boards in Scotland http://www.hps.scot.nhs.uk/haiic/sshaip/publicationsdetail.aspx?id=30248. The report was redesigned to be consistent with the Health improvement, Efficiency, Access and Treatment (HEAT) plan, see http://www.isdscotland.org/isd/3317.html A target of 30% reduction in S. aureus bacteraemia by 2010 has been adopted. The report describes device associated *S. aureus* bacteraemia. The Scotland NHS has targeted vascular catheter infections of *S. aureus* bacteraemia as there is research that clearly shows this is a risk factor for bacteraemia.

A comprehensive programme of surveillance is in place.

2.6.3 Interventions

Hand hygiene is an important intervention in the control programme and is audited. Health Protection Scotland published the latest Compliance with Hand Hygiene - Audit Report as part of the National NHS Hand Hygiene Campaign in October 2008. It is available from http://www.hps.scot.nhs.uk/haiic/ic/nationalhandhygienecampaign.aspx. This is the

fourth report to present hand hygiene compliance at a country level by HPS (the first report was published on 27 December 2007, the second was published on 17 April 2008 and the third was published on 3 July 2008) helping understand compliance throughout NHSScotland. Publicity on hand hygiene was made available to coincide with International Infection Prevention Week (IIPW2008).

This stressed (as do many other guidelines) that hand rubs were preferred except when:

- 'hands are visibly soiled
- the patient is experiencing vomiting and/or diarrhoea
- there is direct hand contact with any body fluids i.e. if gloves have been forgotten to be worn
- there is an outbreak of norovirus, *Clostridium difficile* or other diarrhoeal illness if these factors apply hands should be washed in liquid soap and warm water'

Collaborative work with Scottish Patient Safety Programme was also underway. http://www.hps.scot.nhs.uk/haiic/ic/nationalhandhygienecampaign.aspx.

Interventions in Intensive Care Units (ICUs)

ICU staff in NHS Lothian have developed a successful intervention in, 'The Intensive Care Unit of the RIE has participated in HELICS (Hospital in Europe Link for Infection Control through Surveillance) surveillance for the past two years. The second annual report from HELICS has been published and it highlights the achievement of NHS Lothian staff in reducing the incidence of central venous catheter line infection to seven cases in 2006/7 compared to 22 the previous year.' This it is believed was achieved by the implementation of an education and care package for the insertion of central venous catheters. The package was developed by staff at the Royal Infirmary of Edinburgh (RIE) where it was trialled. It is now being adopted at the Western General and St John's Hospital in Livingston." MRSA has been stable in the Lothian area for the last five years.

Carol Fraser, Interim Associate Director for Health Protection, NHS Lothian, said: 'Intensive care units face big challenges in preventing infections. They are obviously dealing with the sickest patients and devices such as central lines are vital to the patients' management. For this reason 'Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP) team at Health Protection Scotland (HPS) and the Scottish Intensive Care Society Audit Group (SICSAG) have collaborated to develop a system for surveillance of infections acquired in the ICU. It is intended that ICU infection data will be collected through the SICSAG Ward Watcher audit system currently in place in intensive care units throughout Scotland.' www.nhslothian.scot.nhs.uk/news/mediaroom/news.

The data meet the requirements specified by the HELICS. It is difficult to determine rates of infections in intensive care units because there is considerable

differences in type of ICU involved and the case definitions used Vincent et al, (2003). A surveillance of HAI in ICU will take place. It is intended to provide risk-adjusted rates that can be used in Scotland and throughout Europe. Data needed for HELICS Level Two surveillance of BSIs, Catheter Related Infections (CRI) and Ventilator Associated Pneumonia (VAP) will be collected in Scotland. Risk-adjusted rates will be made available that can be used for ICUs (benchmarking). In order to obtain sufficient precision of indicators, a minimum surveillance period of six months is recommended data on all patients – infected and uninfected cases - will be collected.

Devices
The prevalence survey also obtained information on the use of devices in acute and non-acute hospitals. These were 42.7% of cases in acute hospitals had a device of some form and 15.5% of patients in non-acute units. Of the acute cases with a device 36.2% had urinary catheters, 56.8% had peripheral catheters and 6.1% had central line catheters and 0.9% ventilators. In non- acute units 90.7 % of catheters were urinary catheters.

2.6.5 Rates

The first National Prevalence Study for Scotland was published in 2007, NHS Scotland (2007). It was commissioned from Health Protection Scotland by the Scottish Executive Health Department (SEHD). Its purpose was to develop a methodology to establish the burden of HAI and to undertake a national survey. Nearly 14000 inpatients were surveyed from October 2005 to October 2006. All acute hospitals in Scotland were included and a representative sample of non-acute hospitals. The prevalence was estimated to be 9.3% in acute hospitals and 7.3% in non-acute hospitals. The specialties with the highest rates in acute hospital were care of the elderly 11.9% surgery 11.2% and medicine 9.6%.

The most common infection was UTI 17.9%. SSIs 15.9% and gastrointestinal infections 15.4%. The organisms were identified as MRSA (93 cases), MSSA (48 cases) and *C.difficile* (95 cases). In non-acute hospitals the 11.9% were in medicine and 7.8% in care of the elderly, the types of HAIs were UTI 17.9% , 28.1% and skin and soft tissues 26.8%. 93% of *C.difficile* cases were found in care of the elderly and medicine groups of patients. The highest prevalence was in ICUs 27.1% and high dependency units, 16.5%. In general wards it was 9.2%. Attempts were made to deal with the tendency of prevalence studies to over estimate HCAIs as cases were in hospital for longer than usual and so biased the sample. This had an impact not only on rates but on the estimated incidence. They are also producing some costings data in the near future.

2.6.6 Barriers
Scotland had the highest rates in the UK but had carried out a substantial prevalence study and had developed a priorities agenda from it. Maintaining the momentum and ensuring implementation is the greatest challenge.

Wales

2.7 Wales

2.7.1 Organisation

Since devolution the programme for infection control in Wales has been developing independently of that in England, with which it had previously been managed. This independence has not prevented the collaboration with England and with the other nations in the UK on specific policies. Policies in Wales have also taken on board international developments in healthcare control. The National Public Health Service for Wales is organised around the domains of public health practise: which are summarised as Health Protection, Health Improvement , Health and Social Care Quality, Health Intelligence.

Figure 2.7.1 Organisation of infection control in Wales

National Director

Public Health Management Board
Public Health Executive Team
Director of Health Protection

Health Protection Management Group

Strategic Goals

Reduce the impact of infections

Reduce the impact of emergencies and other situations with the potential to affect public health and well being.

As the organisational chart in Figure 2.7.1 above shows, the organisation of HCAI IC is managed under the Directorate of Health Protection as part of the national public health service responsible to the Public Health Executive Team, which is overseen by the Public Health Management Board under the National Director. The Welsh Healthcare Associated Infection sub-group (WHAISG) of the Committee for the Control of Communicable disease developed a strategy for Health case Associated Infection in 2004. The strategy was aimed initially at the acute sector, although it was recognised that the community settings were also in need of some attention. It was intended that a clinical governance approach was taken and the teams were to be encouraged to take control of their own problems as recommended in the Improving Health in Wales – A Plan for the NHS and its partners http://www.wales.nhs.uk/sites3/news.cfm?orgid=379&contentid=2507

This structure is attributed to recommendations from the NAO's first report, The Management and Control of Hospital Acquired Infection in Acute NHS Trusts (2000). The strategy provides a package of tools to help clinical teams, who must work to national standards, identify problem areas and target preventive measures. The national standards will be kept up to date and made available on the Howis web site http://howis.wales.nhs/gsiteCW/documents/287/infectioncontrol.doc It is recommended that clear lines of accountability should be put in place for all staff. Each directorate will determine the priorities for action in their area of activity and local priority targets for measurable infection reduction must be registered annually with the HCAIP. Infection Control Audit has been put in place to ensure these requirements are met.

The CEOs are exhorted to work with local health boards and local authorities, but the corporate responsibility resides with CEOs and their Boards who will be responsible for the delivery of this strategy for Wales. The plan stresses the need for adequate resources to provide for specialist infection control staff to carry out the goals and the need for training programmes for specialist and non-specialist staff in the hospitals.

A strategy for hospital in Wales was set out in Healthcare Associated Infections – A strategy for Hospitals in Wales. www.neli.org.uk/IntegratedCRD.nsf/Responses/0C2F... - 24k This aimed at reducing healthcare associated infections in acute hospitals and was the first of what they refer to as a 'suite of documents' including: Strategy for The Control Of Healthcare Associate Infection in Community Settings; Core Guidance on Infection Control; Strategy and Management of Infectious Disease Emergencies. A Framework is set out in the strategy document outlines the items to be delivered, actions to be taken and responsibility with timescales where appropriate.

In November 2007 the Welsh Audit Office report on HCAIs was published, http://www.wao.gov.uk/assets/englishdocuments/HAI_report_eng.pdf It was reported that much good work was being done and most systems were in place, although it was considered that Infection Control Committees should be more involved with the Trusts' work on infections. They found that the staffing levels were below those required to meet the standards set in the USA which would imply the need for a further 50 infectious control nurses. Variable standards of housekeeping were found in spot checks by the inspectorate. There were some problems with access to staff changing rooms and only two trusts had laundry facilities for uniforms. Cleaning responsibilities were not clearly set out. The audit undertook a survey of public opinion on HCAIs and found that perceived cleanliness was the dominant theme followed by hygiene of staff and visitors and the wearing of uniform outside the hospital. Audit Report 2008, p 74. http://www.wao.gov.uk/assets/englishdocuments/HAI_report_eng.pdf.

One initiative that impacts on governance is the appointment of an executive to the board who oversees hygiene and cleanliness as a patients representative. This is a

unique feature. Not enough attention was given to monitoring infection in those cases undergoing high risk procedures. But this was also an area that reported success. One example was the management of ventilation in patients admitted to ICUs, a bundle has been instituted that includes elevation of the head at 30 degrees, preventative antimicrobials and monitoring that these procedures have been undertaken. This has resulted in a reduction in the East Clywd and Denbighshire Trust of VAPs from 30% to 9.4% (NHPA, 2008 [page 66]). It also found that in many instances people were being admitted with gastrointestinal problems who could, with support, have been managed adequately in the community which they foresaw would form part of reconfiguration of services. Insufficient information was given to patients and the report suggested that patients should be referred to material produced by the Board of Community Health Councils which explains how patients could reduce the risks of acquiring an infection. http://www.wales.njs.uk/sites3/Documents/236/G%5Fno%20hands.pdf.

An organisational structure with clear accountability for HCAI is set out for Wales. The audit facility that has been introduced allows continuous interaction to take place between the participants and good and bad practices to be shared.

2.7.2 Surveillance

The first mandatory surveillance in Wales in 2001 was of *Staphylococcus aureus* bacteraemias. Laboratory confirmed cases matched the system in England. Other surveillance includes : SSIs , ICUs – piloted in 2004, and laboratory confirmed *C. difficile*, in 2004. SSI surveillance follows the UK structure and is accepted by the European Union HELICS surveillance programme involving 22 countries from 2004.

Comprehensive surveillance and audit programmes are part of the strategy. The surveillance programmes includes the surveillance of:

- MRSA Blood Stream Infections (BSIs)
- MSSA BSIs
- Top ten BSIs
- SSI for Orthopaedic Procedures
- SSI for Caesarean Sections
- *Clostridium difficile* infections
- Hospital Outbreaks

The surveillance programmes are mandatory and every NHS Trust in Wales has to comply and report the data to the Welsh Healthcare Associated Infection Programme (WHAIP). The programme is interesting in so far as it does not single out MRSA and *C.difficile* but a hierarchy of organisms that have become resistant and a cause for concern. There are to be separate HCAI and sometimes separate Antibiotic Stewardship committees or sub-committees reporting to a single committee.

A comprehensive surveillance process is in place that operates to international standards using a hierarchy of resistant organisms not merely MRSA and *C.difficil*e infections.

2.7.3 Infection Rates
Prevalence

The Third Prevalence Survey took place in Acute hospitals in 2006 and was published in November 2007. This indicated that the prevalence rate for HCAIs in Wales was 6.35% with confidence intervals of 5.75 -7.01%. The prevalence amongst persons who had had a surgical procedure was 5.35%. Surgical site infections were most common, 18%, then UTIs and gastrointestinal systems at 15.5%, followed by lower respiratory tract infections at 14% and skin and soft tissue infections at 12.5%. Infection rates were highest for burns units 33.3% followed by bone marrow transplantation at 20%. Prevalence of MRSA was 38% in infections of skin and soft tissues followed by reproductive tract infections 33%, Eyes and ENT at 25%, surgical site 16% and primary blood stream infections were 12.5%. *C.difficile* rate was 1.1% and rota virus 0.99%.

The Welsh Healthcare Associated Infection Programme publishes data on the top ten blood stream infections annually. It might be seen in the context of the Saving 1000 Lives programme. The rate of MSSA and MRSA from 2001 is available; the MRSA rate shows a fall especially post 2005 although there is no similar fall in MSSA. *C.diffficile* data by month has risen in 2008. See www.wales.nhs.uk. It has risen most in Eastern Wales in Trusts bordering on England possibly suggesting a spread of infection from hospitals in England that have higher prevalence levels (Eleri Davies, personal communication, 2008).

The commonest BSI infections in Wales were with *Escherichia coli.* The rest of the top four infections were MSSA, Enterococcus species, and *Streptococcus pneumoniae* were considered to be mainly community acquired infections although *E.coli* and MSSA are also acquired in hospitals. MRSA is the 7th most common infection in Wales having dropped from 5th in the first report in 2004 reflecting a falling incidence in Wales. All trusts screen for MRSA according to local policy developed from expert guidance made available by the Hospital Infection Society. The Welsh Commission, however, consider that better ways of identifying risk should be adopted. WWW.wales.nhs.uk/page.cfm.

2.7.5 Costs
Most trusts did not know the cost of HCAIs but the National Public Health Service has estimated that it is in the region of £50m. The Audit report estimates a costs of MRSA BSIs at £2m and *C.difficile* infections at £10m. The Audit report makes the case for more costing data and for that data to be included in reports of HCAI.

Better costing systems and economic assessments are needed.

2.7.6 Barriers to more effective Control

Barriers to effective care were explored with the infection control teams as part of the Audit. The main concerns of the infection control teams were inadequate systems to limit spread, but the top concerns of the directorates was a lack of resources followed by lack of cleanliness and inadequate information given to patients. There was a different perception of barriers amongst this group on most themes: staff information, training and lack of strategic management for example were rated highly by teams but not by the directorate. In summary, the barriers to more effective care were, lack of management involvement, staffing levels, weakness in housekeeping and cleaning protocols, lack of physical provision of adequate and appropriate accommodation and lack of adequate information given to patients.

Belgium

2.8 Belgium

2.8.1 Organisation

The epidemiology unit of the Belgian Institute of Public Health has three goals: one is to prevent HCAI in Belgian hospitals, the second is to study infection control at national, international and district levels and the third is to educate and train 'hospital hygiene staff'.

Objectives of the HCAI programme are to:

Prevent HCAI in Belgian hospitals through the national surveillance of the infections in the hospitals (NSIH); study infection control and HCAI at the district, national and/or international level; and provide an education and training in infection control for the hospital hygiene staff.

The Belgian institute is also involved in international studies that include strategies for antibiotic prophylaxis in intensive care units (ESAP) and it participates in the HELICS network

A well ordered organisation and authority chain seems to have been in place for some time but is not specified in detail.

2.8.2 Surveillance

In 1992 the National Surveillance of Healthcare Associated Infections (NSHI) introduced a programme to survey HCAIs and AMR in Belgian hospitals. The National Surveillance of Hospital Infections (NSIH) ran from 1992 to 2007. The various programmes developed over this period. Surveillance for nosocomial septiceaemaia, and SSIs began in 1992; surveillance of MRSA in 1994, surveillance of ICU HCAIs in 1997, surveillance of Multi-Resistant *Enterobacter aerogenes* (MREA), ESBL *E. coli* (MRE) in 2000, surveillance of *C.difficile* in 2006, and surveillance of antibiotic use in 2007. The rates for MSSA and MRSA are reported in www.iph.fgov.be/nsih/surv_MRSA. A report of MSSA and MRSA in acute care hospitals 1994-2007 is reproduced. MREA has been monitored from 2002 until 2007. This began to show a decrease from 2006.

Surveillance in ICUs was in place and this was used to explore cases of pneumonia. It found that 80% of the cases had been ventilated. They reviewed the organisms concerned and assessed their antimicrobial resistance patterns. A reporting system of SSIs is also in place that includes data on age, operation, duration of operation, classification of wound, procedures and uses NNIS scores for operation and risk

categories. Data are collected according the national protocols by a multidisciplinary team and reported back to hospitals in confidence.
Using a standard protocol data were collected from acute hospitals that had volunteered to join the programme for at least three months. Feedback was confidential, results for the unit reporting and the national data were the only items fed back into the system. An overview of the programmes in operation from 1992-2007 is provided in www. Iph.fgov.be/epidemiology. The methods used and the trends are compared to those in seven other European countries, cross reference to HELICS. The reduction in MRSA rates is attributed to the concerted action of the control strategy.

Surveillance comparable to other developed western countries is in place in Belgium

2.8.3 Research and Education

The Belgium system has a strong research base.

Studies on infection control and hospital infections have included specific infections, MRSA prevalence and carriage in Flemish nursing homes; *Enterobacter aerogenes* blood stream infections; and the use of antibiotics in Belgian hospitals using the data from the surveillance studies of SSIs.

An educational programme and tools to be used in local hospitals were designed. The Belgium team have also spent some time estimating what should constitute the ideal infection control team. It was decided that it should consist of 9.3 FTE per 1000 beds. The members should include a physician, possibly with a training in either microbiology or infectious disease, other members should have a training in infectious disease and epidemiology, van den Broek et al, (2007), Voss, (2007).

2.8.4 Costs

Costs of hospital acquired infection were estimated in three Belgian hospitals (Pirson, 2004). It was estimated that HCAI increased the length of stay by 30 days (including 6 days in ICUs) at an additional cost of €16,709 reducing the average profit per case of €446 to an average loss of €2,431. This shows that there is a clear financial benefit to be gained from reducing the number of hospital acquired bacteraemia.

Charge data are quoted, but costing data would be interesting but are unavailable.

2.8.5 Barriers

Concerns about the adequacy of teams available for Infection Control and lack of costing data.

Denmark

2.9 Denmark

2.9.1 Organisation/governance

The National Centre for Antimicrobials and Infection Control, Statens Serum Institut is a public enterprise operating as a market-oriented production and service organisation under the Danish Ministry of Health and Prevention. The Institute's activities to prevent and control infectious disease are part of a 'prevention cycle' in which infectious diseases are monitored continuously, outbreaks Statens Serum Institut traced back and interventions evaluated. The costs of infection are met from funds allocated to hospitals. There are currently no moves to add penalties for not applying good protection policies, but the culture encourages compliance. www.ess-europe, www.ssi.dk/graphics/dk

The control programme of Statens Serum Institut is research-based and kept up to date. The expertise in the methods of epidemiology and microbiology provides a base from which SSI are able to intervene to 'break chains of transmission'. The technological developments such as the diagnostic Polymerase Chain Reaction (PCR) will, they believe, make identification of infectious agents more rapid and thus enable, in theory, infection controls to be put in the place faster.

There is a well-developed management system to deal with outbreaks. This includes: confirmation of outbreaks, case-definitions, verification, and descriptive epidemiology, the formation of a hypothesis and testing its predictions and evaluating the intervention. The implementation of this management strategy they see as having contributed to early recognition of outbreaks, contact tracing and the avoidance of further spread.

Denmark has a well developed organisational framework and research network.

2.9.2 Surveillance

SSI undertake surveillance based upon data from the Danish National Health Service. This surveillance is comprehensive. It includes incidence and clinical characteristics, treatment complications, vaccination coverage, and has 'permanent operative preparedness for biological threats' and 'bio-terror'.

Antimicrobial resistance

An important area of surveillance is for *staphylococci*. As part of this surveillance all *staphylococci* isolated from blood cultures in Denmark are phage typed and DNA typing performed on all MRSA. This all helps to determine the source of outbreaks and facilitate early interventions as part of the 'search and destroy'

policy. In addition much effort is put into surveillance of AMR. SSI participates in DANMAP – a net work of the Danish Veterinary Institute, the Danish Veterinary and Food Administration, the Danish Medicines Agency and Statens Serum Institut and DANMAP surveys the use of antimicrobial agents and the AMR in bacteria from food animals, foods and humans in Denmark. The Statens Serum Institut has contributed to many international studies on antimicrobial resistance and tools for hospital infections.

***Staphylococcus aureus* surveillance**

The rate of *S. aureus* has stabilised since 2000. There are 1000-1500 cases of *S. aureus* BSIs reported in Denmark every year, of these cases 20 % of the patients die. In 2006 22% of these deaths were directly attributable to *S.aureus*, whilst it was a contributory factor in the rest. Of all BSIs, 34% were hospital acquired, 25 % were acquired from other health care facilities including nursing homes, 31% were community acquired and in 11 % the source of the infection was not known. 71 % of the cases had comorbidities. Cancer, heart disease, kidney disease and diabetes were the most common co-morbidities. Phage types have been stable over the period, with the most common being: Group 1, 11 and 111 and 95. 15% were resistant to all antibiotics.

Statens Serum Institut recognised that Denmark has fewer problems relating to AMR than other countries. This is attributed to the restricted use of antibiotics in Denmark. MRSA accounts for less than 1 % of all *S. aureus* BSIs in Denmark, whereas it is much higher in other countries in southern Europe and England. Detailed surveillance of staphylococcal infections was considered necessary to maintain this position. This was to include sampling, typing and the determination of antimicrobial resistance to provide information that can be used to limit MRSA outbreaks both in hospitals and in the community. It is considered that the benefits of surveillance depends on the quality and communication of the basic reports. Thus schemes to enhance the system and produce better communication and coordination are being developed.

Clinical and epidemiological information has been compiled from all patients with *S. aureus* bacteraemia in Denmark from1960 to 1999. In addition each isolate of S. aureus has been phage typed and its antimicrobial susceptibility tested. These data are available in '*Phagetypes and resistance patterns in Staphylococcus aureus cases compared with all reported Staphylococcus aureus cases*' www.ssi.dk/sw3425.asp The report has included mortality, age, sex, co-morbidity since 2000. This information is derived from the discharge summary for each patient.

Thus in Denmark surveillance is not as an end to itself but an integral part of the intelligence about infectious disease which can, by linking registries, contribute to the better understanding of infectious diseases. Denmark is also involved in gastrointestinal disease and have a programme concerned with the resistance of

Salmonella spp. In this way surveillance can become part of the research programme.

Statens Serum Institut has a large research programme that includes: optimal antibiotic treatment via studies of pharmaceutical processes; mechanisms that underlie the development of antibiotic resistance genes; development of new diagnostic products and new antimicrobial drugs; exploration of new methods to prevent infections and analysis of the cost effectiveness of these interventions.

Surveillance in Denmark is very advanced with follow up of all MRSA cases. PCR techniques and typing are used as part of their search and destroy policy.

Surveillance is also an important resources in the extensive research programme

2.9.3 Guidelines

Guidelines and instructions concerning prevention of nosocomial infection of patients and employees are published and available widely. Guidance about sterilisation of medical equipment is provided and auditing services of professional quality evaluation of the hygienic standards are offered.

2.9.4 Education

SSI has provided interactive educational material and hand hygiene haandhygiejne@ssi.dk . It is responsible for the education of infection control nurses (ICNs) and provides advanced studies for medical personnel and others involved in health services.

2.9.5 Barriers

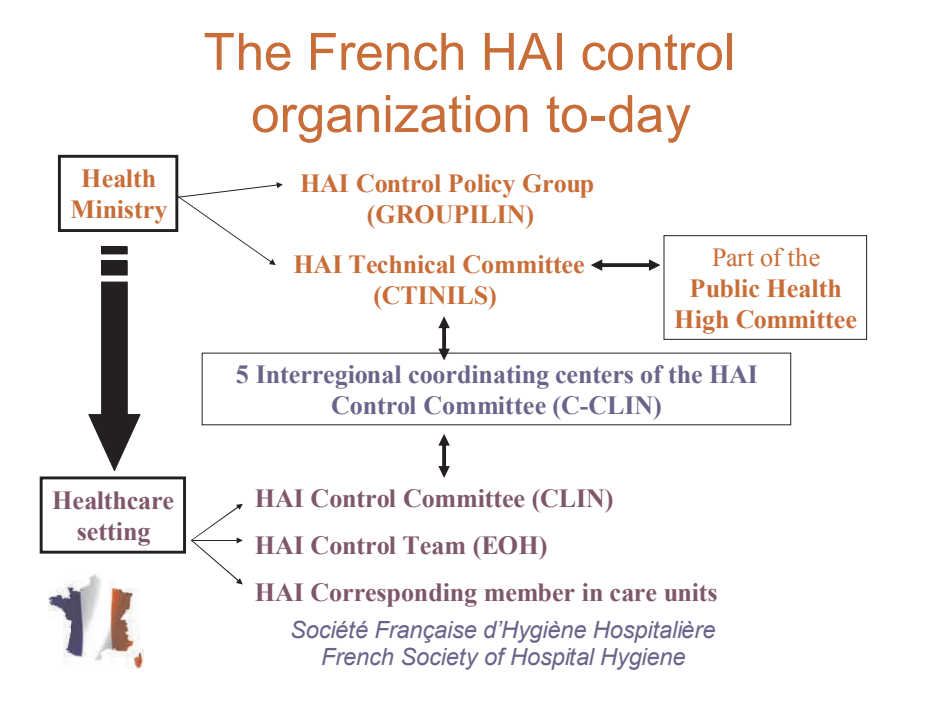
Cultural and professional commitment to reducing HCAI are clear and, as long as this remains so, policy in Denmark to control HCAI should continue to be excellent.

France

2.10 France

2.10.1 Organisation and governance

The organisation of the HAI infection in France is organised from the Health Ministry by two committees; a policy group, Nosocomial Infection Unit and a Committee of experts Comite Technique National Nosocomiales (CTIN). The technical committee is subdivided into 5 interregional coordinating centres, (CCLN). These relate to the healthcare settings which each have an infection committee, required by Law, and an infection control team.



Philippe BERTELOT, Jacques FABRY, Pierre PARNEIX Olivia KEITA-PERSE, Serge AHO 2008

The data collection standards adopted followed the NNIS guidelines.

A national plan for HAI was put in place from 1995 -2000. Since 1999, governance structures have been strengthened and all providers must set up a committee (CLIN) responsible for developing yearly action plans for reducing NI as well as a specific team for monitoring the quality of hygiene in each hospital. As is apparent in the diagram above there are 'Five regional networks, Co-ordinating Centers of HAI Control Committee(C.CLIN) co-ordinating the monitoring and data collection

on hospital infections, and which produce guidelines for good practice for improving hospital hygiene. A technical committee at the national level (CTIN) sets the priority areas and provides technical recommendations for organising individual networks and for the implementation of necessary actions.'

It is reported that there was a 45% reduction in the nine years to 2003 of SSIs in southeast France (1995–2003) Couris et al, (2003). A downward trend was observed that did not vary, although the diversity of patients and the mixture of surgical wards changed over time. The national plan was extended to 2004. The objectives of the plan were to enforce staffing norms and the acceptance of guidance and education. A national surveillance prevalence study was also introduced. This was to be undertaken every five years. A network was to be set up to monitor SSIs, and BSIs.

In the French plan for infection control the emphasis was on the structural aspects, infrastructure – having staff in place, having education and guidance available, and measuring the achievement of reaching certain targets for these. An evaluation of this plan is reported by Berthelot, et al (2008). The results were rather disappointing: 69% of hospitals had control teams established, and the ratio of staff to beds was not adequate in 85% of these.

Incentives and penalties were also introduced. In 2002 the Public Health code (article L1142 -1) was modified to place the responsibility for healthcare infections on the hospitals and patients could ask for compensation damages incurred without having to prove liability. Now, unless the hospital can prove that the infection was contracted outside, it will be responsible for the compensation.

There is a clear accountability structure in France although this does not reside in one person but in Boards and Teams

2.10.2 Surveillance

A second national HAI programme 2005-8 was intended to improve clinical practices. This was related to infection risks from invasive procedures by optimising HCAI surveillance, improvements in the quality of the information and by developing readily accessible indicators. In an attempt to accelerate the progress in containing hospital infection the Ministry of Health established a system of Benchmarking hospitals IRDES, (2007). This has become one of the principal drivers to control infection in the period 2005 – 2008. Five indicators are used in the Benchmarking. These include a composite index "ICALIN" constructed on three dimensions: the resources allocated to reducing infections, organisational structure and activities undertaken. The five indicators to be used are a mixture of input measures that are seen as indicators of HCAI control, such as consumption of alcohol-based products, antibiotic control and outcome measures such as SSIs and MRSA BSIs. As a result of this programme, a reduction in SSIs of 12% and of

MRSA BSIs by 40% is reported. Prevention has focused on the application and evaluation of effective measures.

The rates were published in February 2008. Each provider was given a score (A for the best to E for the worst). This initiative in IC is part of the move in France to use benchmarking more generally as an indicator BSIs for other aspects of quality of healthcare.

Action in the past few years in France as reported by Bertelot et al (2008) include two large national programmes under the auspices of the Ministry of Health: 'Improvement in the prevention of HAI as shown by the 3rd Nationwide Prevalence in 2006' and following the application of preventive measures known to be effective and the adoption of 'HCAI as indicator of quality and safety of patient care'. Progress has thus been made.

Objectives to be achieved by end 2008 included the following goals:

1. '75 % of the Healthcare settings (HCS) perform evaluation of preventive measures
2. 100 % of the HCS have organized the mandatory report of serious or unusual HAI
3. 100% of the HCS have implemented an antibiotic committee
4. 100% of the HCS give information to the patient about their HAI programme using a written document
5. 100% of the HCS publish their five indicators', Berthelot et al (2008)

This is one of the few examples of targets being set on structural aspects of control and procedural targets being used in infection control.

As well as these targets, hospitals have performed internal evaluation of preventative measures, mandatory reporting of the serious infections has been achieved and all hospitals have an antibiotic committee. Patient information is provided as a written document to patients and all hospitals publish their five indicators.

Outbreak Incident . Outbreaks of *C.difficile* ribotype 027 occurred in Northern France in 2007. The first cases were noticed in Northern France on the 27th March 2006, when a cluster of cases were notified via the national healthcare-associated system to the Institut de Veille Sanitaire (InVS). Cases had appeared from 24th January to 9th April 2006 within 0 to 128 days following admission. The cases were predominately female, the median age was 82 years, 13 persons died, but none of these deaths were attributed to *C.difficile*. The source of the outbreak is not clear but in this part of France there is much movement between nursing homes in Belgium and French hospitals, see Cookson, (2007), as well as inter hospital transfers between the two countries. No positive tests have been identified from

these cases, but Belgium had experienced ribotype 027 *C.difficile* cases in 2005 i.e. before the outbreaks in France.

Extensive control measures were put in place on 21 March by the infection control team at the hospital that was at the centre of the epidemic. The local teams were helped by the regional coordinating centre. The interventions were based on internationally recommended guidelines and involved enhanced standard precautions, hand washing with soap and water, use of gloves and gowns and isolation or cohorting cases as necessary. The areas infected were subjected to cleaning with hypochlorite and the geriatric wards that had seen most cases were closed for one week. These measures brought the outbreak to an end by 9th April. As in the other outbreaks of *C.difficile* the initial failures to recognise the outbreak and the transmission routes and the lack of typing information, that would have alerted the authorities to the virulence of the organism, were factors contributing to the extent of the outbreak. Following the outbreak, changes were made in the procedures for reporting, investigation, surveillance and control of *C.difficile* in France. Numbers of reported outbreaks have since reduced dramatically and ribotype O27 no longer predominates (personal communication to the authors).

France has an extensive surveillance system but, as in Ireland it was did not recognise an outbreak as a 'hospital system outbreak' for some time.

2.10.3 Public information

Since the "debacle" of 1999 when a guide, 'Le guide des hôpitaux', was produced by some journalists providing mortality rates for hospitals in France, attempts have been made in France to produce some material on quality indicators of hospitals and include some information about HCAIs. In 2003, the Ministry of Health and the High Health Authority (HAS) launched a project to develop a number of indicators that could be used for benchmarking hospitals and which had the support of hospitals and health insurance funds. By 2006, 25 indicators had been approved for acute hospitals. These indicators did not include rates of infection, but did include some dimensions that are deemed important in controlling them. Details of the benchmark indicators were made publicly available from 2007.

While data on prevalence/incidence of specific types of infections are available through regional infection centres (CCLIN), it is not possible to have individualised data on infection rates for a given healthcare provider. As in other countries there is a demand in France for information. Public perceptions tend to overstate the problem, for example, despite declines in infection rates over recent years, 65% of those questioned thought hospital infection rates were rising. More generally, over the past 10 years, the improvement of information systems on quality (as well as cost) of hospital care has become a priority both for implementing the proposed reforms on hospital funding and for satisfying the public's need for reliable information on quality.

It is likely that public disclosure will continue to be an issue.

2.10.5 Resources and costs

About €68 million, mostly for creating more than 700 new positions, have been devoted to the prevention of nosocomial infections in the past six years (numbers from the Ministry of Health). Further details about costs and resources allocated would be more effectively obtained by direct questions to the Ministry in France.

2.10.6 Barriers

Much depends on the ability of the system to meet the high targets for compliance that have been set and whether the benchmarking will provide a real impetus for change.

Chile

2.11 Chile

2.11.1 Organisation and Governance

There has been a national programme relating to infections in hospitals in Chile since 1983. This was under the auspices of the Ministry of Health. This is a comprehensive programme including elements on regulations, training and surveillance. It also encompasses an accreditation programme in infection control that is applicable to all hospitals in Chile.

This programme has been developed in four phases. In the first phase from 1983-85 the system was introduced into the health sector. Some of the early goals were to raise awareness amongst health care workers of the importance of controlling HCAI. This involved the setting up of a training module. Work was also undertaken on drawing up preliminary guidelines and the introduction of passive surveillance systems. Estimations were made of the impact of the introduction of the programme of controls in the early years and showed a considerable benefit in reducing infections and, indeed, outbreaks.

Between 1985 and 1990 there was the establishment of 'active and selective' surveillance systems. The organisational structure was also strengthened with an ICC set up in each hospital. Part of this development was the employment of Infection Nosocomial Nurses (INNs) in every hospital working to improved guidelines published by the Ministry of Health and participating in training programmes.

Consolidation of this work continued from 1990-2000. During this time the accreditation in nosocomial infection was widely adopted, the emphasis being on evidence based practices. Since 2000 the focus has been on patient safety and quality assurance systems. This involved consideration of costs and controls. It was also a period in which the surveillance systems were overhauled and updated. The tasks of the Chilean system were to control infections in hospitals and this included a focus on surveillance with an emphasis on diagnostic facilities nationwide. Norms and regulations have been amended to facilitate implementation and ensure compliance.

Clinical governance has been clarified and strengthened, revised regulations and accreditation processes are in place and infection control committees have been established

2.11.2 Surveillance

Surveillance of SSIs and UTIs included both outcome and action oriented measures and used adapted NNIS definitions and classification codes. Reductions in UTIs are apparent but SSIs improvements are more difficult to interpret; there have been considerable reductions in infections in hernia operations and Caesarean sections. Cholecystectomy operations are complicated in that laporoscopic operations have increased and the case mix may have changed over time accounting for the increase in infections. Diarrhoeal diseases amongst children have declined. The action-based indicators show a reduction in mechanical ventilation in neonates, children and adults between 1996 and 2003. Central venous catheterisation has declined over the period in adults, although neonatal umbilical nutritional catheterisation presented a more complex pattern.

Figure 2.11 1: Urinary Tract Infection data for 115 Hospital Medical departments, 65 Surgical and 46 Intensive Care Units between 1996 and 2003

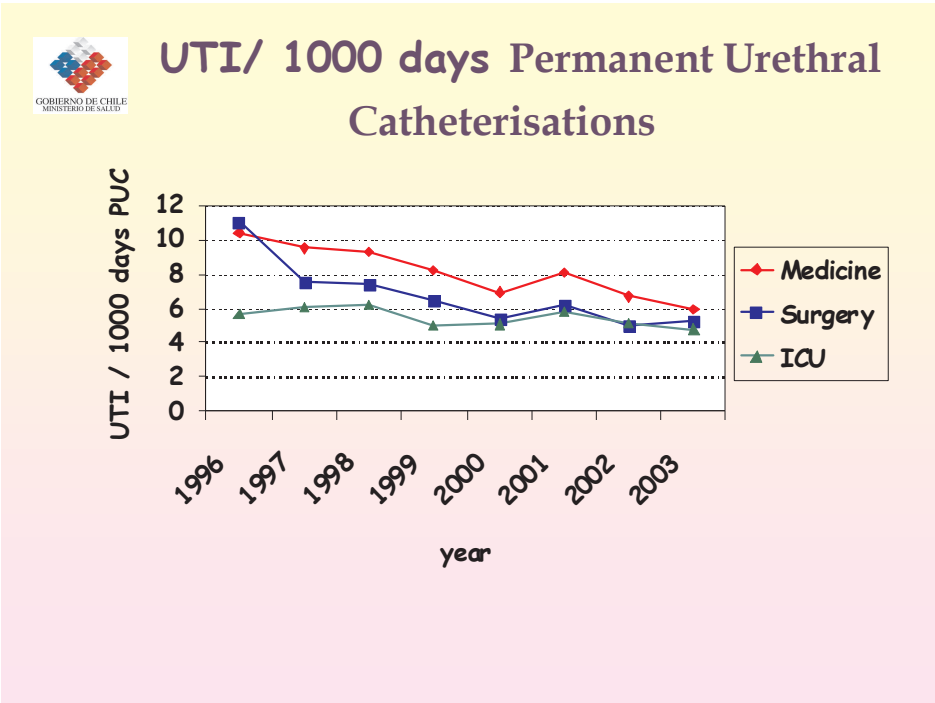


Figure 2.11.2: Surgical Site Infection data for 62 Chilean hospitals between 1996 and 2003

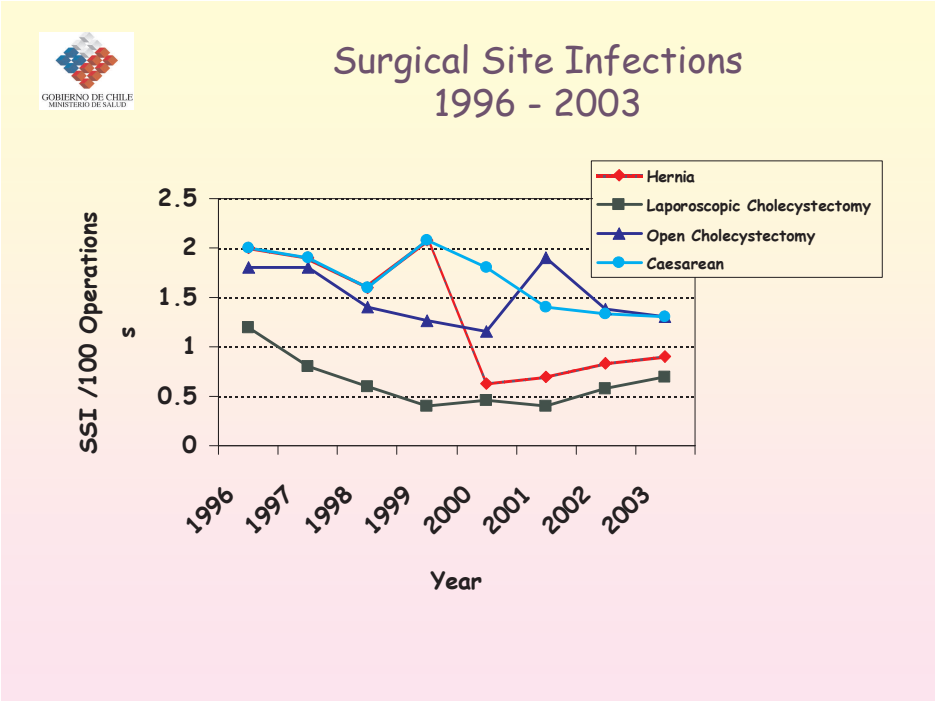
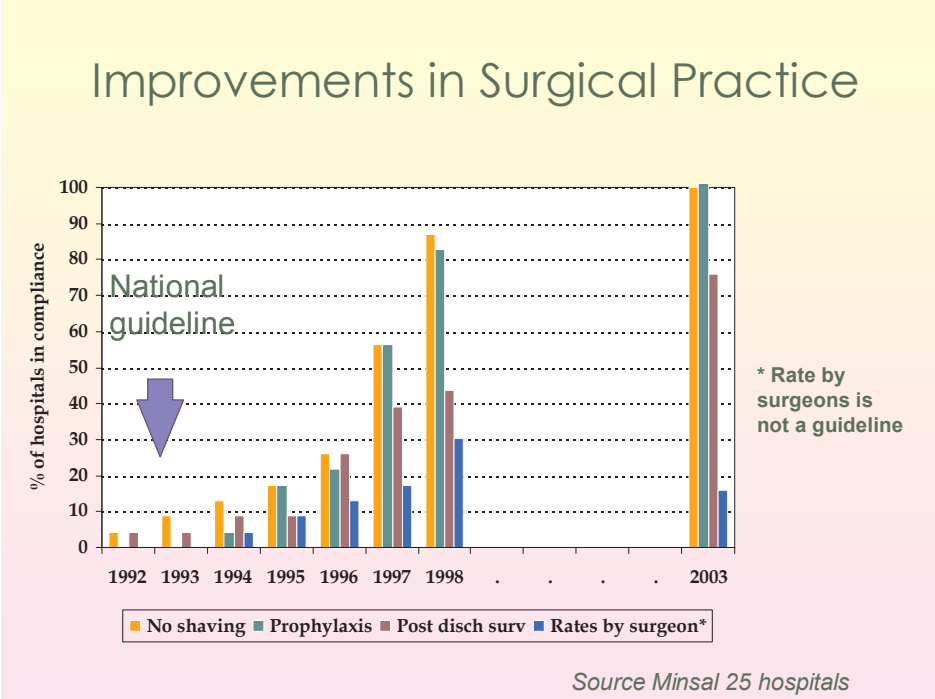


Figure 2.11. 3: Changes in surgical practice following the introduction of national Chilean guidelines



There has been a great improvement in compliance with surgical practices which interestingly have been monitored after Chilean surgical infection guidelines were introduced.

By 2003 there was full compliance amongst the hospitals surveyed with shaving and prophylaxis and over 70% compliance with post discharge surveillance. The compliance rates amongst surgeons – for whom no guideline is produced was much less at just about 15%.

2.11.3 Objectives of Chilean Infection Control Programme

The objectives revolve around evaluation. It is intended that practices should be evaluated and aspects requiring improvement identified and changes in relevant practices promoted. Its approach is that the improvements should be documented making clear to all the trends that emerge whilst emphasising quality assurance aspects. There is a clear commitment to improving standards in a number of fields including organisation, surveillance, clinical and support services, personnel and environmental issues.

The programme has established a strong epidemiological base and is intensely concerned with applications of scientifically-based practices and focuses on quality. In future it aims to develop cost-effective infection prevention and control interventions.

- **The success of the programme is seen to be the coverage – it is a nationwide approach and its link to accreditation.**

2.11.4 Barriers

The main barriers have been obtaining the political support to implement new, and sometimes more expensive strategies, and to recognize the impact and relevance of the programme. Changes in priorities can affect the programme in terms of human resources, budget and time.

2.12 Summary of the Country Profiles.

The dominant themes that have emerged from the country profiles are briefly summarised.

2.12.1 Dominant infection

The dominant infection that is the focus of much concern in most of the countries surveyed over the past five years is *C.difficile*. There have been many outbreaks and there is particular concern about the emergence of *C.difficile* BSIs ribotype O27 which has the reputation for increased virulence. In fact experience around the world has varied regarding increased morbidity and mortality with this strain Cookson, (2007) and a case controlled study in East Anglia found no greater mortality than for other strains, Morgan et al, (2008).

These outbreaks revealed a weaknesses in apparently very good surveillance systems in respect of timeliness and coverage in that similar outbreaks in adjacent hospitals were not identified. Regardless of the emerging evidence reaction to the organism which has led some countries, such as Scotland, to treat any outbreak as being of a virulent strain, Northern Ireland has instituted a root cause analysis for any case where *C.difficile* is associated with a death either as the main cause or as a contributory factor. In Canada, the outbreaks of *C.difficile* have lead to concerted action to improve hospital surveillance and control methods for HCAI nationally. Recently a report *Clostrdium Difficile: How do we deal with it*? DOH (2009) has been produced that emphasises the seriousness *C. difficile* and provides information and guidance for its management.

2.12.2 Surveillance

A further focus of attention over the period is on surveillance systems both in countries that already had systems in place and for countries that lacked such systems. In general there has been a tendency for countries already involved in surveillance to standardise measurements and infections covered bringing them more in line with the international systems particularly NNIS. The move towards web-based data entry systems as in the USA and England means that data can be analysed and fed back quickly (or analysed locally reducing duplication of effort. The EU has done much to improve the state of the art regarding international comparisons of HCAI data (see Chapter 3), and England participates in the HELICS system as do the rest of the UK.

However, there has also been a movement towards questioning the applicability of the NNIS measures, particularly the risk adjustment mechanism, to other countries. Work in Australia and in Scotland has indicated that the measures are not

sufficiently sensitive for local purposes. In England it has used focus groups and steering committees to inform the design of the surveillance systems and ensures that definitions are owned by the surgeons for example.

Surveillance systems have also shifted from those that were essentially outcome based e.g. SSIs, UTIs , to those that pick up compliance with 'good practice' e.g. compliance with handwashing or checking catheters. This movement to 'action' (process surveillance) from 'outcome' indicators (infection surveillance) is associated with growing evidence of the preventability of some infections, provided the necessary care is taken in hospitals. It is also a recognition that HCAI infection, as with other high risk activities (such as flying), are best avoided rather than counted after the event. Increasingly items that contribute to risk of infection are being monitored. This is broadest in France and Chile which survey structural and intervention-related features.

The use of the action based approach has facilitated the use of surveillance data as a tool that can be used to penalise those not complying with the code. This use of penalties varies by country. In the UK it takes the form of withholding funding or fining institutions that don't comply. In the USA penalties are via the CMS system: extra payments are with held for cases with infection; the cost of such cases had previously been high pushing the charge into the higher DRG bands. Also in the USA and in other insurance based systems the surveillance data have been used together with good practice guidelines to form the basis for litigation.

Monitoring is not easy and some activities may not be easily checked or evidence may be falsified e.g., consumption of antimicrobial hand-rubs could be over estimated. Care has to be taken least the system does not become affected by attempts to disguise problems: opportunistic behaviour and gaming. Problems with this approach have been described by Graves et al, (2008) and Walker et al, (2008). This is possible with both action and outcome surveillance systems and a mixture of both is probably necessary to ensure good management of infection. For there is little use in monitoring action if it is not realised in outcome and outcome measures may not be enough to ensure continued reductions in rates.

Surveillance has also moved from a mere monitoring device to a valued data base from which to analyse causal mechanisms and patterns that emerge. Denmark sees surveillance as a key to their investigations and research programmes. In Denmark, with the low rates of infection, it is possible to type each MRSA organism and do an analysis of cause of the infection as part of its 'search and destroy' policy. In Scotland observation of patterns seen in Lothian hospitals has led to the development of a tool to reduce HCAI in intensive care units that is now being piloted in Scotland and which is acclaimed in the HELICs annual report.

Whilst surveillance is one of the great achievements of the decade the systems still require attention to ensure that they report in a timely way especially cases that may be appearing in a number of places yet each not recognised as an outbreak.

Examples of failure to recognise hospital systems based outbreaks is apparent in the *C.difficile* outbreaks in Northern Ireland and France. In both cases there was considerable inter-hospital activity which was not connected up in the monitoring process and details came late. In Northern Ireland the outbreak was disguised because only the infection species *C.difficile* was recorded not the type; once ribotype O27 was identified and an outbreak identified and an outbreak team was convened and the infection was quickly halted. Some attention to the timing of reports and networking, as is done for gastrointestinal diseases, amongst areas where there is sharing of resources – sometimes, as in France, across national boundaries, is needed.

Surveillance of antimicrobial resistance is a feature of all countries' control programmes. Specialists have been appointed and committee structures are in place to monitor these policies in many countries and in several the specialist representatives has the remit of reporting on antibiotic policy and progress. The discipline to conform to these standards in the USA comes from the accreditation process which is required if hospitals are to enter the healthcare market place.

Surveillance of MRSA and other organisms resistant to multiple infections are an important element in all HCAI control systems. Monitoring these infections is an important plank in the attempts to reduce incidence of such infections and also protect against the emergence of AMR. During the period MRSA rates have to some extent stabilised. In Denmark only 1% of bacteraemia cases were MRSA demonstrating that extensive control policies can in fact reduce these rates to very low levels (they were very high in the 1960s). But Denmark has put in a great deal of effort into keeping MRSA at low levels, although these efforts have now been threatened (as in the Netherlands) by the emergence of community MRSA originating in pigs (something yet to be seen in the UK). Each case is typed and traced back to the likely source of the infection. MRSA screening on hospital admission is in place in many countries now, including USA - although screening is still restricted to high risk cases in some states. The screening on admission may well be transformed as the faster testing procedures are adopted. The potential for rapid pre-surgery tests *in situ* may greatly reduce the chances of colonised cases becoming infected and transmitting the disease to others.

The approach of Baker *et al* (2008), who tested all surgical patients preoperatively gives some insights into future possibilities. There are constraints associated with the new techniques that slow them down i.e. transport costs if laboratories are off site and further delays might occur because of the need to use batching techniques. The requirement to screen all patients in the Health Code DoH, (2006 [revised 2008]) in England and regulations in other countries increases the pressures to get results fast. However Harbarth *et al*, (2008), and Jeyaratnam *et al*, (2008.) consider that accelerated MRSA screening (with chromogenic media now the norm) is sufficient for most purposes and indicate the impact of good background control negates any value of more rapid tests. The role of near-patient or "hot laboratory" testing needs to be assessed.

2.12.3 Interventions and guidelines

In addition to generating more information about the extent of the problem, countries have paid more attention to general control strategies and like England have introduced guidelines on many issues from hand-washing and cleaning to managing surgical wounds and prescribing antimicrobials. Guidelines aim to be evidence based, implying a grounding in well-conducted research findings but, as these often do not cover all the issues, they are also based on expert opinion and good practice experience. Guidelines on hand-washing appear on the websites of most countries and international agencies such as WHO. They are provided in great detail with emphasis on the need for everyone to be involved and explain why so much importance is placed on hand hygiene. The introduction of benchmarking, eg in France and care bundles in USA and Europe mark important changes in control strategies and governance.

2.12.4 Rates

Prevalence Rates are available for a number of countries. France and Denmark embarking on studies at 3 and 5 year intervals. Scotland, after conducting a thorough and interesting study recommended that further prevalence studies should not be undertaken for some years, see Table 2.1 Appendix 2. Prevalence studies tend to overestimate infections as cases remain in longer and are more likely to be picked up. Unless they work to exactly the same methodological framework they will not provide reliable comparative data. Wilson et al (2008) point to the problems of comparability even in the recent studies that may have biased the rates. Although case definition and collection methods were the same, there were important differences as the study was of voluntary participants in some countries and prescribed for all hospitals in others. In addition, there were sampling differences by turnover which again may have biased the results. An excellent discussion of methodological issues that arise in obtaining comparable rates is provided in the Annual Report of ECDC. We report on recent prevalence rates in Tables 2.2-2.6 Appendix 2 below.

Incidence rates are more difficult to obtain and costly. We have incidence rates for particular organisms, sites of infection and procedures. These increasingly use similar definitions and methods of collecting data and are useful for comparisons between countries and over time.

Surveillance data on outcome data is readily available for many countries and is drawn together for Europe by the HELICS network of networks. The commonly available incidence data is reported in Tables 2.7 and 2.8, Appendix 2

2.12.5 Community Infection

Another emerging concern is the need to extend the coverage of healthcare

infections into the wider community that includes a pool of susceptible individuals and is a potential reservoir of colonised cases who can subsequently become infected themselves or who can be carriers of the infection into hospitals and residential care homes into which they may be admitted. A network of countries in the HELICs programme did conduct a survey in 2006 on the number of countries undertaking work with long term institutions in the community other than hospitals. This showed only a minority of countries had been involved and the systems in place were not comprehensive. Attention has been given to what a survey of community acquired infection might include and the methodological issues surrounding it have been expressed in publications produced by some countries , (e.g. USA . http://www.journals.uchicago.edu/doi/full/10/1088/592416 and Wales www.neli.org.uk/IntegratedCRD.nsf/Responses/0C2F) In Wales, detailed guidelines have been produced. Community HCAI has been acknowledged as important by most countries, but left to be developed subsequently. EU has funded a survey of antimicrobial prescribing in Long Term Facilities through ESAC. ECDC is about to award a contract to a group who will perform prevalence surveys of LTCF in the EU. The system that is created will be transferred to ECDC after two years.

Attention has been paid to the emergence of genuine community-acquired MRSA (CA-MRSA) strains, some of which are more virulent, that are particularly affecting the community in the USA. There is a general awareness of the issue but little investigations elsewhere although many EU countries are experiencing problems with such strains, although an MRSA originating in pigs and now some other farm animals is causing infections in pig farmers in several countries in Europe. A exploratory review of the situation is outside the scope of this report, but much information is available in two recent publications Nathwani et al (2008) a report has been prepared by the PVL sub-group of the Steering Group on Healthcare Associated Infection.
http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1218699411960

2.12.6 Long term impact of the infection

Another issue that is not addressed in any of the healthcare systems is long term impact of the infection and the sequelae of infection. Some work has been done indicating relationships between infections and early deaths. The data about the long term consequences of infection needs to be made available, as failure to include it will lead to inappropriate investment strategies being adopted. MRSA related death rates are being monitored in a number of countries, but no investigation has taken place of long or medium term health status of those who were infected. At present there is even a paucity of measures of the short-term impact of infection, as there is little surveillance after patients are discharged from hospitals – a growing information gap given the tendency to shorter hospital stay. The impact on an individual's life is not assessed in most studies, either by an attempt to measure the quality of life, using quality of life year measures (Qalys) or the willingness to pay approaches to evaluation or even an activity of daily living

inventory. Unless we have a profile of the burden of disease in the long term short term investment decisions may be non-optimal.

- **Studies are needed into the long term sequelae of infections.**

2.12.7 Public Disclosure

Having the surveillance information available has led to demands for its publication. Both the HELICS now run by European Centre for Disease Prevention and Control (ECDC) in the EU and NNIS system run by CDC in the USA have reservations about this because, as they are both reliant on voluntary participation in surveillance, they fear the data base could be compromised. Many factors contribute to the rates and it is thought important that the interpretation of rates be given alongside them to explain the situation.

In the USA, States are being advised to publish individual organism or site data that can be well supported and avoid the publication of rates for hospitals as a whole. The HICPAC in the USA produced a report examining in some depth the issues surrounding reporting of infections, McKibben et al (2005) http://webmail.aol.com/39997/aol/en-gb/Suite.aspx#_ftn1 . Four States had at that time enacted legislation requiring the publication of infection rates and other States were considering it. The States advocating it argued that it would facilitate choice and that patients had the right to know. Although not recommending mandatory reporting it does suggest ways in which the reporting might be approached http://webmail.aol.com/39997/aol/en-gb/Suite.aspx#_ftn2>
However, there is strong public support for publication of rates and consumer groups in Europe and in the USA are keen to see some transparency in this form of reporting. France and the UK did legislate to allow the information to be made public but a court ruling did not require the Netherlands to publish data, European Commission, (2004). Many countries are still weighing up the merits of publishing the rates of infection because of the usefulness in drawing attention to the problem and providing an indirect incentive to improve standards, and to give patients information so that they may exercise informed choice of hospital. Stress is placed on sufficient information being given to interpret the findings fairly. It may be that this issue will be forced by patient groups lobbying for more information.

In France early publication in 1999 of HCAI rates by journalists led to considerable anxiety and reluctance to participate in publications schemes. This has led to the development of a composite index linked to the benchmarking schemes that does not quote rates for individual hospitals. The tying-in of penalties with rates is strongly resisted especially in Australia, where it has led a politician to assert that the publication would not be ‘driven by some sort of penalty system’. Jenkins (2008).

In response to these concerns HELICS data was originally reported without

countries being named. As countries became more confident about the system and the various explanations as to why rates may differ countries have agreed to be named on the databases .
See http://ipse.univ-lyon1.fr/Working%20packages/WP4/HELICS_SSI_ESCAIDE07.pdf

Attention to publication will need to be considered internationally

2.12.8 Economic Impact

The main costs or attempts to assess the economic burden are estimated as aggregate costs for individual countries provided intermittently and often without the basis being given. The exception is Scotland, which has estimated national costs from modified prevalence data using the costing structures of Plowman et al (1999). Costs when they are estimated are usually associated with hospital stay, with little attempt to measure community costs or costs to family and the wider society. The formulae derived from Plowman et al (1999) by the NHS is one that could be used more widely to get ball park figures of costs.

There are few studies that have estimated whole hospital costs and, as with whole hospital rates, there is anxiety lest such measures should portray the hospital reporting unfairly as there may be differences in case mix, lengths of stay and patient throughput. The growing tendency has been to attempt to cost individual infections associated with the common forms of infection i.e. UTIs, SSIs, VAPs, BSIs e.g. related to central venous catheter usage, or costs to certain departments, e.g. adult or children's ICU. The costs are often not comparable in so far as the items included differ – some include all resources used to treat an infected case whether they are fixed costs, that will have to be covered regardless of an infection, or variable costs that would be incurred for each individual case, some of which will be attributable to the infection.

Care needs to be given to assessing the costs that truly are attributable to the infection and not to other factors related to the patient's health that need to be taken into account in the calculations. Only rarely are community healthcare costs included – this is a matter of some concern as lengths of stay in hospital are falling rapidly. Not many studies have attempted to assess the wider societal costs of infectious disease. Costs or lost productivity may arise because of the state of health of the infected person and those who look after them.

Costing infection control is rarely attempted. This is very difficult. The easy part is identifying staff specially delegated to do the work, the laboratory testing regimes and the prophylaxis used and special protective clothing and cleaning measures that are consumed to deal with the infection. Difficulties arise when one looks at the application of good practice procedures that are under taken in the hospital as these are often diffuse and difficult to separate from other activities. This because they often produce a number of products at the same time there is

'joint production'. For example staff may be undertaking clinical surveillance, providing infection control advice and advising on the administration of drugs etc. Indeed good practice is increasing this trend by embedding practices in this way (e.g. the use of IC link nurses or other clinical staff). In addition, the actions taken to deal with one infection may at the same time have an impact on other infections. Deep cleaning primarily for *C.difficile* may also reduce the load of other organisms e.g. Gram negative rods, *enterococci* and so, on balance, may reduce other infections.

Once resources used are identified they have to be measured and costed. This should be progressed in such a way that other researchers could if necessary readily replicate the study, allowing greater scope for comparability between units, hospitals and countries. This is best done if physical resources are described and then the cost vectors given with due allowance to any economies or diseconomies of scale.

2.12.9 Resources

In the country reports some reference is made to resources that were made available. These were in no way comprehensive and given the multiplicity of sources of resources it would be difficult at assess the contributions made in the various countries to developing the infection control capability of supporting antimicrobial stewardship. A different method would be needed which contacted individual countries for estimated resource allocations.

2.12.10 Governance and accountability

Another significant change over the period since the last NAO report have been the improvement in Clinical and Corporate Governance structures. In the UK England and Northern Ireland place responsibility directly on the CEO for the implementation of infection prevention and control and antimicrobial stewardship, most countries place accountability for IC and AMR on the Board of the hospital. The dual arms of AMR and IC both have their place in the governance structures and reports to the Board or committees. There is increasing pressure for hospitals to produce and file plans of future control activities with the health authorities. There is also an increasing tendency for both hospitals and boards to be subject to audit. In Northern Ireland and Wales an audit system is in place and in Denmark there is a continuous loop between practice and assessment and adjustment in procedures and a root and branch analysis of cases on MRSA. There is as yet little pressure on community PCTs to apply HCAI standards to all the many providers who now offer health care services but for whom HCAI is not being considered. This area needs addressing as the number of suppliers of health care expands.

In the USA the enforcement is via the accreditation scheme and the newly introduced reimbursement schemes for CMS patients – fees will no longer be paid for infections deemed to be avoidable by good practice. This is implemented under

the Deficit Funding Act. There is specific statutory responsibility on each trust's Chief Executive of hospitals in England to see that the Code of Practice for reducing rates of infection are being implemented and that there is an AMR policy in place. Primary Care Trust's (PCT) commissioning services will be able to withhold 2% of the contract price if there is none compliance with these policies and the new 'Modern Matrons' can withhold payment from cleaning contractors if standards are not adhered to.

- **The strong accountability structure in hospital trusts in England is not in place in many other countries.**

  Structural accountability is a good foundation but stronger accountability is needed within hospitals. Problems have been identified during investigations of outbreaks of *C.difficile* in many countries and by the recently introduced inspectorates. Problems identified include reports of poor physical stock, lack of isolation rooms, inadequate cleaning, poor housekeeping - that mixed clean and dirty laundry, – patients being nursed on large nightingale wards during an outbreak of *C.difficile* in a Canada, staff cutting corners and omitting to perform IC consistently. There is still need to strengthen governance and accountability at this level. Whilst care-bundles and bench marking do add some discipline into the system it is the incidents that go unheeded that present the on going challenge for infection control.

Care should be taken to ensure that governance at all levels within hospitals do not undermine the strong structural governance that is being put in place.

We have the advantage at this time of having access the that EU study which, though anonymous, provides a unique overview of trends in Europe. A summary of this finding is reported in the next chapter.

Chapter Three Improving Patient Safety in Europe

3. Improving Patient Safety in Europe (IPSE) project

3.1 The European Union decision 2119/98/EC in 1998 established the principle of developing a network of epidemiological surveillance and control of communicable disea***se***

http://eur-lex.europa.eu/pri/en/oj/dat/1998/l_268/l_26819981003en00010006.pdf

The Hospital in Europe Link for Infection Control through Surveillance (HELICS). was created '…to set up a network at Community level to promote co-operation and co-ordination between member states … for epidemiological surveillance… early warning and response system for the prevention and control of … communicable diseases ' and '…by bringing into permanent communication with one another…the commission and those structures…which are competent ...and are charged with collecting information… and by establishing procedures for the dissemination of the relevant surveillance data…', '…by bringing (together) …the commission and the competent public health authorities…for determining the (required) measures...' http://www.ecdc.europa.eu/IPSE/helicshome.htm

Thus Communicable diseases were subjected to a co-ordinated European surveillance scheme. Diseases comprised those preventable by vaccination, sexually transmitted disease, viral hepatitis, food-borne diseases, water-borne diseases, diseases covered by the international health regulations, some others and HCAI infections.

Over the last ten years the Directorate General SANCO funded HELICS network of network**s** that have established surveillance databases for SSI and intensive care unit (ICU) infections. 27 national/regional networks were identified in 17 of the 26 Member States (MS) plus Norway. Six countries or regions have targeted SSI only, one ICU only and 10 both SSI and infections in ICU patients. There were 18 networks in 14 countries which have adopted a HELICS-compatible protocol (sometimes by adaptation of a previous protocol) and they contributed to the HELICS European database in 2000-2003. England has contributed significantly to the SSI database and the issues relating to comparison of rates are well covered at http://ipse.univ-lyon1.fr/ . The ICU database has patient-based data from 77915 patients from 318 ICUs in seven countries, and the SSI database for 2004 has over 111,000 surgical procedures from the six designated HELICS operation categories from over 600 hospitals in 11 countries and 14 networks.

In 2004, in recognition of the importance of the patient safety related issues of HCAI WHO (2006), DG SANCO released a public consultation on strategies for improving patient safety by prevention and control of HCAI and improved standards of antimicrobial stewardship (DG SANCO Public Consultation, 2008).

For references see 'Public consultation on strategies for improving patient safety by prevention and control of healthcare associated infections': http://ec.europa.eu/health/ph_threats/com/cons01_txt_en.pdf

In addition they required that a consensus be developed for HCAI prevention and control standards and related performance indicators (SPIs) for monitoring the prevention and control of HCAI and Antimicrobial Resistance (AMR), as part of the Improving Patient Safety in Europe (IPSE) project (http://ipse.univ-lyon1.fr/) which they had funded. The HELICS surveillance databases are within this new project which has also established; a consensus on IC competencies for IC professionals, reviewed IC and antimicrobial stewardship arrangements in European long term care facilities, established a rapid alert mechanism ("IBIS") and conducted two pilot ICU projects on HCAI and AMR surveillance and typing of organisms.

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3.2 European Survey

A European survey was performed in 2006 and presented at the 18th European Congress of Clinical Microbiology and Infectious Diseases Barcelona, Spain, 19–22 April 2008 (Poster 1129).

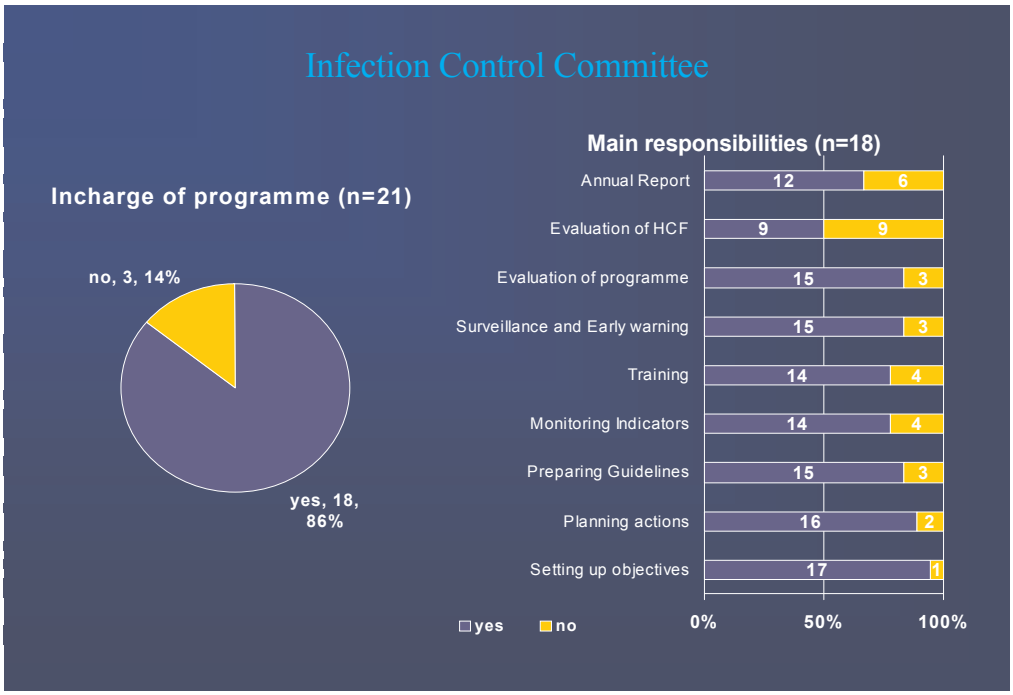
3.2.2 Governance and organisation of control strategies

From a Governance point of view HCAI is, in the HELICS network of networks, being orchestrated by national infection control committees. These committees have a number of functions but the range throughout the responding countries is remarkably similar. !7 out of 18 are responsible for setting objectives, 16 are involved with planning actions, 15 were responsible for surveillance, preparing guidelines, and evaluation of programmes, 14 were involved in training and monitoring indicators, 12 had responsibility for writing the annual review and 9 were responsible for evaluating healthcare facilities. It is not clear where the lines of accountability fall, whether it is on the committee or on the officers.

We cannot specify which countries responded or the nature of their responses, because to ensure a high response rate in what was at that time considered to be a "sensitive" area, anonymity was regarded as important.. We found that national programmes of HCAI existed in 21 of the 29 respondents (33 European countries had been contacted within and without the EU); interestingly these had been established between 1976 and 2003 (median: 1998). National programmes of AMR existed in 18 of the 29 respondents, and these had been established between 1970 and 2003 (median: 1999). National laws had been passed relating to prevention and control of HCAI in 16 countries and for AMR in nine. National objectives to reduce HCAI were included in these programmes in 18 countries for HCAI and 17 for AMR. The figure 3.1 shows the activities of the 18 national Infection Control

Committees in charge of these national programmes. As can be seen there are wide variations in the responsibilities listed.

Figure 3.1 Infection control committees in European countries surveyed by the IPSE Project.



3.2.3. Surveillance

Surveillance of HCAI was performed in 78% of respondents' states, with 59% of these making it compulsory. It is apparent when one considers the participants in the HELICS network, that several states interpreted this as including alert organism surveillance i.e. reporting outbreaks, which has been in place for many years in Eastern European Countries (in the newly independent states of the former soviet union). Responses were even higher for AMR surveillance, with 95% having this in place, and 55% making it compulsory. Many of these states would have been contributing to the European Antimicrobial Resistance Reporting Surveillance (EARSS). Indicators of HCAI and AMR were used in 17 responding countries and comprised: analysis at the hospital level (16 countries), at national/regional level (12), standard precautions (4), hand hygiene (5), human resources devoted to HCAI (9), AMR rates (12), and HCAI rates (12). Although national programmes considered education and training, only 43% (9/21) considered it for HCAI; it was much higher for AMR (71%; 15/21). Only 10 % (2/21) considered any estimate of associated costs for HCAI and AMR.

3.3 Consensus Building

The survey showed that there were many differences in the national IC programmes of European countries, and that there was indeed a need for a consensus on European SPIs. In response to this, an IPSE working group was thus convened led by author BC. Those taking part in the consensus process understood that the findings would be taken into account in the preparation of the final DG SANCO document for submission to the European Council of Health Ministers. The possibility was emphasised that member states would, in due course, be required in their national IC programmes to report progress towards compliance with such proposals. DG SANCO, during the project, invited members of the IPSE SPI group to join their group to finalise their document.

3.4 Standards

1. Standards originally written by BC were informed by the DG SANCO document (DG SANCO Public Consultation, 2008) and standards written previously Cookson et al, (1993). These were then developed further into SPIs using a number of sources, MacKenzie et al, (2005), Borg et al, (2008), Cookson et al, (2006), COM, (2005) There were five categories for the SPIs comprising:organisational aspects,
2. prevention and control policies,
3. surveillance policies,
4. education and training and
5. resources for the control of HCAI and AMR.

A 'Standard and Indicators' section described standards and corresponding indicators to measure and monitor progress for each of these five categories. The second part of the document described 'Recommended Practices' corresponding to the Standards outlined in the document's first part. The IPSE MS national contact points were asked to discuss and reach a consensus with nominated members of IC professional societies and other bodies considered to be appropriate.

3.5 Response

3.5.1 There was a high response rate (88%) with 29 National Contact Points returning comments on the document. Most (21: 72%) had engaged with the lead IC doctor and nursing professional organisations in their countries. Most (90%) felt the approach was practical, although opinion was a little more divided about the level of detail. Here it should be remembered that the remit was to respond to the DG SANCO consultation document DG SANCO Public Consultation, (2008), which itself had a high level of detail. That being said, the majority (59%) responding thought the level of detail was about right, with 38% feeling that it was too detailed. There was a high average level of agreement (80%) for the 144 original SPI statements. Another 11% were able to agree subject to alteration, 2% were neutral and 3% disagreed with or without comments. Three countries accounted for three quarters of the disagreements. There were 138 Recommended

Practices relating to these SPIs. For these there was again a high level of average agreement of 84%, another 6% agreed with alteration, 4% were neutral and 3% disagreed with or without comments. A small number of National Contact Points (ten) accounted for 95% of these disagreements.

3.5.2 Despite the high level of consensus, many points were raised. There were 38 alterations made to the SPIs and 27 to the Recommended Practices. In MS with smaller populations, interactions were often closer to healthcare providers and healthcare workers. Ministries of Health may thus interact directly with IC committees, for example. Many interesting comments prompted for clarification, exposing areas of contention often where there is no consensus between or even within MS. However, on page 16 of the DG SANCO document, DG SANCO Public Consultation, (2008) it was stated that there should be a number of actions at the community level which MS should inform e.g. review of resources required for isolation of patients and IC staffing requirements. This requirement for an EU consensus resonated throughout the many comments.

3 6 Resources

3.6.1 There were also comments about other IC resources. It is assumed that IC resources will become augmented (not replaced) by interactions with link nurse and team practitioners on the wards and with audit and quality improvement departments. Again the determination of the resources required will require a DG SANCO/ECDC review in the light of the above comments.

3.6.2 Many other comments emphasised that IC was no longer just the role of the IC team, but part of every healthcare worker's duty of care. This statement was included in the guidance DG SANCO Public Consultation, (2008) and has since been re-emphasised by DG SANCO in their meetings held to review their public consultation document. More audit proposals, in particular, were suggested and included in the revised guidance document.

3.7 Community infections

Many other comments were received about the community aspects. Although the document from DG SANCO, DG SANCO Public Consultation, (2008) related to healthcare associated infections, it was clarified subsequently by DG SANCO that nursing homes and other forms of long term care facilities in the community were outside the remit of their document and the deliverable expected from our project. DG SANCO has since made clear that community aspects are very important and will be considered in the future.

3.8 Publication

One of the most difficult areas was the publication of hospital specific HCAI infection rates, where there were clearly different views amongst MS. The following scheme, developed in consultation with DG SANCO, may provide a way forward by allowing the possibility of different systems.
These are still at a draft stage and may change:
1. Confidential (within the healthcare institution, not shared with public health authorities); e.g. individual surgical team infection rates.
2. Confidential benchmarking within surveillance networks with publication of anonymised or aggregated results; e.g. surveillance of surgical site infections.
3. Disclosure to public health authorities, e.g.; early warning of notifiable HCAI events.
4. Public reporting of agreed indicators, e.g. composite structure and process indicators or HCAI rates.

3.9 Consultation and Debate

No further comments were received from IPSE contact points and their collaborators after the revised SPIs were returned to them. The essential findings were presented at the final consensus meeting in Lyon in May, 2008, where 17 participants from 16 different countries discussed the IPSE WP2 findings in a workshop. There were then extensive further discussions at the plenary session, where all MS were represented.

Interesting areas from these discussions included the following: perhaps we should develop new ways of looking at ICN/ICD requirements taking into consideration numbers of admissions and ICD10 codings. Whilst there are many other staff now involved in infection control (e.g. link teams, staff employed to perform audit, review patient safety issues or surveillance) it was vital that infection control professional expertise was maintained. A parallel was drawn with the requirement to have professional fire safety staff in hospitals.

There was also some concern about the term "Standards," although this had never been raised previously, or at the DG SANCO meetings or in its own consensus process. It was pointed out that in some MS "Standards" implied a legal framework (in others this was termed a "Code of Practice") or an implication that there was proof for a statement, whereas in others neither of these issues was relevant. The group requested that there should be a continuous validation process for such standards or perhaps these could be termed "proposed practices"? This new term might be confusing at this juncture and was not used in the final SPIs.

3.10 Results for England

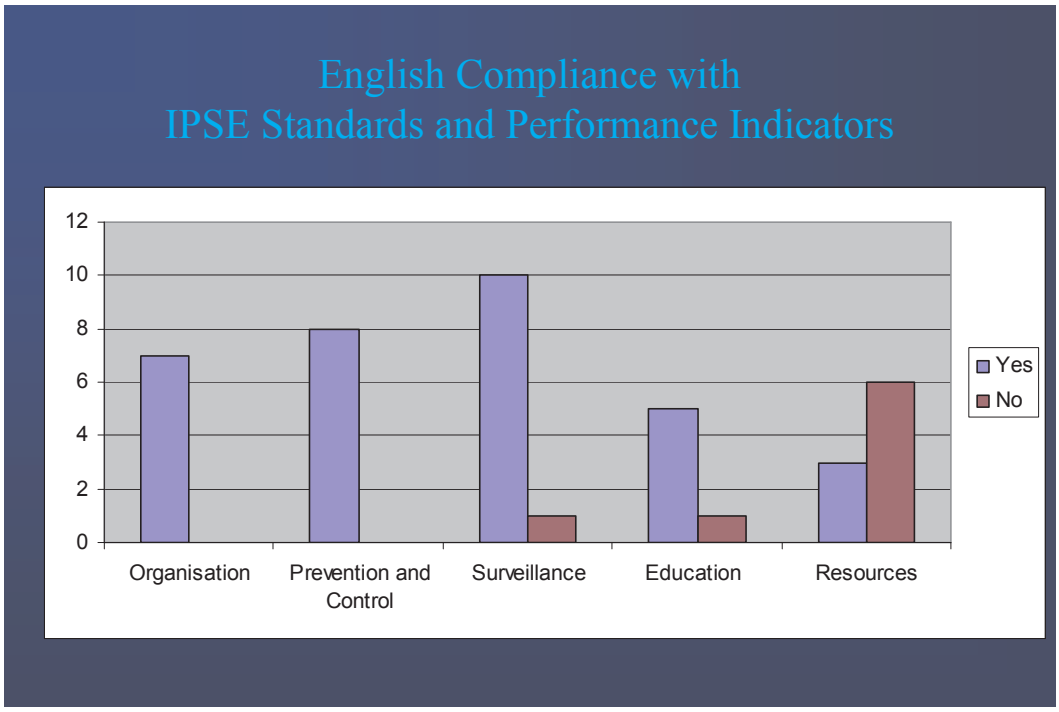
3.10.1 The situation in England in relation to the IPSE SPIs was examined by BC. He is well placed to do this as he sits on the Department of Health AMR and HCAI Advisory Committee. His analysis and comments are included in the Table xx . He

has further analysed these in the Figures 3.1 and 3.2 below . Figure 3.1 shows that England is compliant with all the SPIs for organisation and prevention and control. There were some gaps in the other three areas.

3.10.2 In Surveillance the issues relate to the lack of a continuous surveillance system for monitoring level and trends in antibiotic consumption. England has very good coverage in the community submitting data regularly to ESAC. Agreement has been reached to access these data now and hospital systems are improving too. Connecting for Health are aware of this IT requirement. It is thus anticipated that such a system will be established in the coming years.

3.10.3 Education This suffers from the lack of officially recognised and mandatory educational programmes in HCAI and AMR control to students in medicine, nursing and other health professions. ARHAI has had discussions with the appropriate professional bodies and medical schools are to be approached shortly.

Figure 3.10.1 English compliance with the IPSE Standards and Performance Indicators.

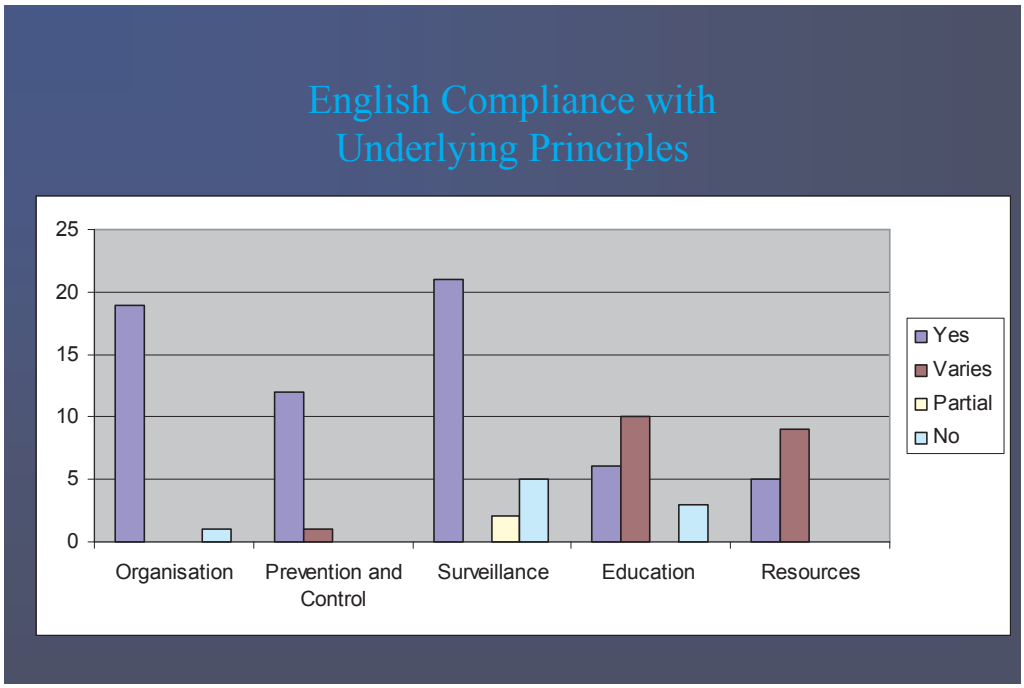


3.10.4 Resources

Here deficiencies are evident. Infection control professional staffing varies and is reviewed by the Healthcare Commission, although the ideal number of such staff is still a matter of some debate. The same can be said for the other listed areas (link staffing, structural resources, single room numbers, audit of hand hygiene facilities and access to accredited microbiological services). All these are inspected by the

Healthcare Commission and improvements expected where there are deficiencies. It is apparent that many MS do not have such a system in place, whilst aspiring to so do (as shown by the consensus SPIs).

Figure 3.10.2 English compliance with the underlying principles of the IPSE SPIs



3.10.5 In some instances there is variation (in Prevention and Control, Education and Resources) which is reviewed by the Healthcare Commission as already stated in section above**.**

3.10.6 Partial compliance is evident in Surveillance for electronic data collection from available databases (e.g. clinical, laboratory, pharmacy, administrative, occupational health). The Health Protection Agency has made "Connecting to Health" aware of the fields needed and it is anticipated that there will be considerable improvement in the situation in the next five years. England is also deficient in funding external data validation studies. These are not easy to perform but other countries in HELICS (e.g. Belgium and the Netherlands) do perform these. England also does not perform regular reviews of the resources required for the programme and examine the balance between the need for national datasets to provide Public Health information and the local needs of surveillance. A sub-group of the ARHAI Committee has been established and will make recommendations for future surveillance in England. In antimicrobial resisance, we do have some systems in place but these are not comprehensive. It is more than many other MS in the EU. In education the deficiencies are as mentioned above**.**

3.11 Conclusion

From this aggregate data it is clear that countries are moving in concert to put in place structures and resources to deal with the challenges of HCAI. The network provides a platform for exchange of views and experiences that via the consensus mechanism can form the basis for a European approach.

England has been placed in the context of this wider profile. It is shown in figures 3.2 and 3.3 deficiencies are apparent in surveillance, education and resources. These need to be addressed.

3.12 Summary of IPSE

3.12.1 The network established in the EU has matured during the past five years with more countries involved in the HELICS surveillance database, the new project has, as we saw above, also produced a consensus on IC, competencies for IC professionals, and has reviewed IC and antimicrobial stewardship in long term care facilities in Europe, set up a rapid alert mechanism ("IBIS") and conducted two pilot ICU projects on HCAI and AMR surveillance and typing of organisms.

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3.12.2 The governance of HCAI in the MS explored by the IPSE project is conducted through infectious disease committees. This is the pattern that we also found predominant in the country surveys in Chapter 2 above. As in that study, we find a large body of surveillance work in place: it was undertaken in 78% of respondents' countries and was compulsory in 59%. Inspite of patterns emerging between states there were significant differences amongst the national programmes and it was considered that some attempt should be made to establish a consensus.

A consensus group convened by BC was set up to draft policies on which there was agreement. This consensus group concentrated on the five categories that were dominant themes during the past five years in national and international policies: governance, prevention and control, surveillance, education and resources. Ideas around these themes were listed and member countries were asked to describe their individual positions on each of these.

The response was high and it was clear that a defined governance structure was emerging focused around the IC committee, that certain preventive activities and surveillance were in place. Educational resources, training and resources allocated to IC showed most variation. One of the most contentious areas was the publication of results. Because the attitudes to publication of individual countries was strongly felt only aggregate percentage compliance was reported.

3.12.3 Against this average BC has been able to explore the position of England on the various attributes. In England the SPIs for organisation and prevention and control were largely met or made compulsory under the Code of Practice. There were some gaps in the other three areas. Education suffered from a lack of a structured officially recognised programme of competencies; there was little in the curriculum of students in medicine, nursing or professions allied to medicine about

either HCAI or AMR. Approaches to professional bodies about this deficiency are taking place. The General Medical Council will be a vital link in this process. Electronic data collection was also only partially achieved and HPA has made representations to 'Connecting for Health' programme to ensure fields for HCAI and AMR are in place. England, unlike Belgium for example, had not had funds to put in place validation studies.

Chapter Four Survey of the literature.

4.1.Objectives

4.1.1 The objective of this part of the review is to bring attention to articles from the recent literature that indicate factors that have a bearing on the improved management and control of HCAI.

4.1.2 Search strategy

Searches were made in (Medline, Embase, pubMed, Cochrane) databases using key word. First wide searches were undertaken based on HCAI, nosocomial infections, devices, SSIs, antimicrobials, resistance, MRSA, catheters, rates prevalence and incidence, surveillance, screening,costs, economic evaluations Research strategy details see Appendix One

4.1.3 Methods
Abstracts chosen for reviewed were those seen as having a bearing on the potential for future management of HCAI were considered to be of particular interest and examined in more detail, see Appendix 1. This was not a systematic review – rather it was a review geared to finding out what work was being done that had a bearing on managing the control of HCAI infection. Work suggestive of being productive it is hoped could be tested or replicated elsewhere to ascertain its potential.

4.2 Themes
The articles have been grouped around a number of themes*:* risk factors associated with clinical practices, estimates of incidence and prevalence rates, economic evaluation and costings and resources, and organisation and governance. The key points which may be of interest to the NAO were summarised for each area.

4.3 Summary of the Literature

4.3.1 Risks in Clinical Management

Lack of Adequate Hand Hygiene

Inadequate hand hygiene is a major risk factor for transmission of HCAIs. Since the last NAO report much has happened to improve hand hygiene. The Hand Hygiene Liaison Group made great strides to raise the profile of hand hygiene at the political and professional healthcare worker (HCW) levels. Their efforts have been praised by the WHO. The UK launched the world's first national hand hygiene campaign (2004) and the WHO used hand hygiene as the First Global Patient Safety Challenge. England has representatives on the Core Group which has written Guidelines. These are in the advanced draft stage but are now being finalised

WHO guidelines on hand hygiene in health care (advanced draft)
http://whqlibdoc.who.int/hq/2006/WHO_EIP_SPO_QPS_05.2.REV.1_eng.pdf

- In neonatal intensive care units Lam *et al* (2004) found that a multimodal intervention programme (as advocated in the UK), including observed compliance and technique of hand hygiene among HCWs before and after care of a patients, was found to reduce the risk of infections Girou et al, (2006). Creedon (2005) and Taneja (2008) also indicated the effectiveness of hand hygiene.

- Beggs et al (2008), however, cautioned that hand hygiene after a certain point might be subject to diminishing returns estimating from their model that 40% compliance should be enough to prevent outbreaks. Yet this conclusion possibly does not take into account the cultural value of hand hygiene in maintaining compliance. Various modelling groups are exploring these dynamics further (including a DoH funded project).

Device Related Infection

- A DoH funded PHLS study showed in the 1990s that insertion of a central venous line or urinary catheter increased the risks of HCAIs seven-fold on non surgical wards studied. Glynn A, et al (1997) Since this time device related risk factors are increasingly seen to be associated with infection.

- A systematic review by Casey et al (2008) of the use of antimicrobials in central venous catheters (CVCs) found many shortcomings with the literature. However, their findings support the DoH NICE guidelines that they should be considered when the infection rate is high despite full implementation of infection prevention interventions. Two catheters performed better than the rest (first-generation chlorhexidine-silver sulfadiazine and minocycline-rifampicin). In another systematic review by Safdar and Maki (2008), a vancomycin lock solution reduced infection rates in high-risk patient populations (e.g. those with malignancy or low-birthweight neonates) being treated with long-term CVCs. In a third systematic review, Ho and Litton (2006) found that chlorhexidine-impregnated dressing were effective in reducing vascular (and epidural) catheter bacterial colonisation. There was also a trend towards reduction in catheter-related BSIs. Cost-effectiveness needs to be explored in a large trial.

- GBV-C infection following bronchoscopic examination was reported by Vanhems (2003). The connection between UTIs and catheters is well established, now the debate is about which type of catheters reduce risk. Brosnahan et al (2004) in a review concluded that the risk of infection was less when silver alloy indwelling catheters for adults were used for a short time. This finding was also shown in the work of Schumm and Lam (2008), who confirmed the short term effect. Consistent with this finding was the work of Saint et al (2005) who found that it was forgotten catheters that were the problem. Azegami et al (2004) in Japan found a significantly increased risk of infection in patients over 60 years old who had a catheter for over 7 days. Orsi et al (2005) showed the improvement in infection rates when a combined programme of infection control in an ICU in Italy that involved a specialist team in control policies including the use of central venous catheters and antibiotics. It was not possible to disentangle the contributions from the individual changes but it is plausible that the benefit came from concerted action focused on many variables – maybe a care bundle is required. Gilbert and Harden (2008) undertook a systematic review of impregnated central venous catheters and found that heparin-coated or antibiotic-impregnated venous catheters offered the best practice for reducing catheter related blood-stream infections. The possibility of encouraging resistance is ignored in some of the literature. Halton and Graves (2007) undertook a review of economic evaluations of catheter-related bloodstream infections. Large amounts of missing data prevented the development of robust models that could be used for policy programmes.

Transfusion Risks

- Neonates are more prone to infections for many reasons and often need transfusions. Hughes et al, (2003) found that, once other confounding variables had been taken into account, there was no added risk of mortality from infection. Neonatal surveillance is being discussed at ARHAI. A system is in place in some neonatal units which has commercial support.

Surgery

- Surgical site infections (SSIs) are one of the most common HCAI s. A study in Italy by Petrosilla et al (2008) looked at the risk factors for in-hospital and post discharge SSIs in 48 hospitals in general, medicine and gynaecological units. In considering risk factors those of NNIS, pre-operative hospital stay and use of drains (and antibiotic prophylaxis for post discharge cases) were all strongly associated with SSIs. Risk factor analysis has also been used in the HELICS analyses (see elsewhere in this report) and the English SSI surveillance system. Post discharge surveillance is now a crucial area as lengths of stay are so short that many SSIs would otherwise be missed. This paper adds this component to the analyses. England is phasing in post discharge surveillance as a matter of some urgency.

Antimicrobial Stewardship

Antimicrobial stewardship comprises antibiotic policy design, implementation, education and interventions e.g. audit and feed back methods, automatic stop dates, rotating antimiorobials. Many studies have shown the importance of these measures in antimicrobial resistance prevention and control and in the prevention of some HCAIs e.g. *Clostridium difficile*, Ramsay et al, (2003), Davey et al (2005), Cookson, (2007).

Antimicrobial related risks are targeted in new action oriented indicators introduced by many countries including the USA and France. In England SACAR and now ARHAI are doing much to improve antimicrobial stewardship and there are several aspects of this covered in the Hygiene Code.

- A study of the relationship between use of antimicrobials and MRSA over a five year period found that 78.4% of the variance in the monthly incidence of MRSA was explained by antimicrobial policies and infection control Aldayeb et al, (2008). Studies often do not control for lengths of stay. There are more consistent relationships in the literature between *C difficile*, enterococci and some Gram negative rods than for MRSA Ramsay et al, (2003).

- Several other studies are reviewed. Inappropriate vancomycin use was explored in a Brazilian tertiary referral hospital and subdivided in five categories (Melo et al, 2007): almost all of 132 orders were considered appropriate and "conscientious". However, as in much of the literature, a statistically significant

relationship was observed over time between MRSA incidence and infection control practices. There is a wealth of literature covering the correct timing of prophylactic antibiotics. The pharmacists role in reducing the risk of *C.difficile* was discussed in *Consultant Pharmacists* (2003), which indicates that infection control including pharmacists' advice on antibiotic therapy can contribute to reduction of risk of infection in debilitated elderly patients. Much of this review will be superseded by the English Guideline document that is in press at the time of writing. The English guidelines advocate the role of a team to review all cases of *C. difficile* related disease.

- A comparative study of antibiotic resistance as a global threat was carried out by Zhang, et al (2006) who compared rates of infection in China, Kuwait and USA from 1994 to 2000. This found that the most rapid growth in resistance was in China with 22% growth followed by Kuwait at 17% and USA at 6%. In each country it is suggested that clinical practices pose risks that can be managed better if risk factors were better known.

4.3.2 Environmental, clothing and cleaning issues

The role of the environment in HCAIs is much debated. For some HCAIs there is abundant evidence (eg *C difficile*, some Gram negative rods and enterococci). The literature addresses many areas, including cleaning of the premises and staff protective clothing.

- A study of room cleaning and the impact of a cleaning intervention on the proportion of positive cultures showed a fall from 45% to 27%. The study also pointed out that 'flat surfaces were more likely to be cleaned than were door knobs and sink or toilet handles, suggesting the need for clear direction in cleaning contracts to those areas, Goodman et al, (2008).

- The study by Snyder et al (2008) looked at the transmission on protective clothing -gowns and gloves - of nurses caring for patients with MRSA or GRE with respiratory tract infections or in dwelling catheters. This showed that the organisms were found on 17.5% with a confidence interval 11.6-24.4% of gowns and gloves, suggesting that care should be taken when disposing of the protective clothing and hand washing on treatment completion, a finding that resonates with some of the concerns about clean and soiled linen in reports of the HCC inspectorates.

- Wren et al (2008) suggest that ultramicrofibre-woven cloths function better than traditional clothes and have a roll to play in infection control. A cross over DoH funded English study exploring the use of these cloths is underway.

- A study recorded the impact of changing and refurbishing an intensive neonatal baby unit, Von Dolinger de Brito et al, (2007). When the unit was transferred to

temporary accommodation with lower sinks-to-cot ratio and an admission rise, rates of HAI rose from 12.8% to 18.6% and decreased when the unit moved to the new facility, although the impact may in part have been attributed to change in the use of catheters,

- Scott et al (2008) looked at the presence of organisms within USA household and found high levels of *S. aureus* in 97% of homes of which 24% were MRSA; an important finding given the growth of community acquired infections reaching hospitals in the USA. A positive correlation was indicated for the presence of a cat and the isolation of MRSA from surfaces. Community acquired MRSA has been reviewed by a DoH working party and a report prepared by the PVL sub-group of the Steering Group on Healthcare Associated Infection. Guidance on the diagnosis and management of PVL-associated *Staphylococcus aureus* infections (PVL-SA) in England.
  http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1218699411960

4.3.3 Rates and prevalence

- A recent international survey of HAI has recently been produced by a group of professionals that discusses the present understanding of microbiological aspects of HAI, risk factors, and comparative prevalence rates, antimicrobial resistance and a commentary on international comparisons including discussions of developments in Japan, Poland and Latin America, Marcel et al (2008).

- In Brazil, Dantas and Moretti-Branchini (2003) had the objective of determining the incidence of HAI and the incidence and risk factors of MRO in an extended-care area of an emergency department of a tertiary-care university hospital.. The rate was 32.7 per 1000 patient days. MRO colonised 59 patients (25.4%) The infected cases spent 13.9 days versus 9.8 days in hospital and the mortality rate was significantly higher.

- A period prevalence study was undertaken in the Veneto Region of Italy by Pellizzer et al (2008), to assess the prevalence and risk factors for HCAIs. It found 7.1% of patients were affected, 6.9% of whom had at least one infection. Risk factors were also identified.

- A prospective case-control study in Spain was conducted to find the incidence of nosocomial pneumonia. An incidence rate of 3.35 per 1000 admissions was identified with a mortality rate of 27% Barreiro-Lopez et al (2005).

- Taneja et al (2004) in India looked at the admissions of cases to a burns unit to see if acquiring an infection had an impact on recovery. It was found that infection contributed to 75% of observed mortality.

Studies in Children

- A study by the Perez-Gonzalez et al (2007) reviewed nosocomial infection in children from 1991-2000 found a decrease in rates of infection but not mortality. Incidence of HCAI in neonatal units was studied by van de Zwet et al (2005), in a Medical Centre in the Netherlands. A prospective surveillance was undertaken from 1998-2000. A case definition was adapted from CDC < 1 year old babies. The CDC definition would have picked up 75% of bloodstream infections and 87.5% cases of pneumonia.

Prevalence Studies

- A repeat prevalence study was undertaken in New Zealand between 1996-1999 to predict the cumulative incidence rate, in the absence of incidence studies this method provides useful information, Graves et al (2003). A prevalence rate of 9.5% and an incidence rate of 6.33% were estimated. The timing of surveys was explored in a study in Spain by Rossello-Urgell et al (2004). It found that the number of days taken to undertake the prevalence survey did not affect the results.

Community and HCAIs

- A study in Japan, Aoki et al (2003) looked at severe infections, distinguishing between those acquired in the community and those acquired in the hospital. The most commonly found infections in the community group were UTIs, pneumonia, endocarditis with *E.coli*, viridans streptococci and *Streptococcus pneumoniae*. In the hospital infections occurred in intra-venous catheters and UTIs. This resonates with the UK prevalence studies, see Chapter 2 and Appendix 2.

Modelling

- Hsu et al (2008) used an artificial neural network (ANN) model to predict MRSA colonisation.and found the estimates to be accurate 92.5% of the time. A retrospective surveillance model was used to estimate the positive and negative predictive values of data for estimating SSIs in CABG abbrev cases. There was general concordance, except about the depth of sternal infections.

4.3.4 Economics and Costing studies.

The number of well constructed costing studies and economic evaluations is small. There are many studies that quote costs but the methods of obtaining them are not comparable and the infections included, country and dates are different. Some studies, in countries in which the patient or the insurer pay, quote charge-fees not costs.

- Sheng et al (2005) undertook a case control study of cases in a medical centre and a community hospital and found similar extra costs in the two sites ($5335 and

$5058 respectively). A study by Roberts et al (2003) in the USA found excess costs of $6,767 for cases suspected of having an infection and $15,275 for a case with infection in a model which explained 56% of the variation. Esatoglu et al (2006) quote extra costs, based on length of stay, for cases with infection as $2026. Attribution is difficult even in case control studies.

- In an attempt to refine the costs attributable to infection and disentangle the impact of length of stay on the risk of infection from the length of stay attributable to the infection, Graves et al (2005) found that a 10% reduction of risk brought about a saving of £693.

A number of cost effectiveness studies were undertaken. Some of these were empirical studies and others models based on estimates from the literature when available.

- In studies to evaluate faster testing techniques in a screening process Jeyaratnam et al (2008) and Harbarth et al (2008) found no difference in costs. However, the background rates of infection were low in both cases and the control measures were good. Two other studies on costs of faster testing did find some advantages and attempt to cost the tests and resources used. One was a systematic review report Richie et al (2007), which is not summarised here, and Keshtgar (2008) which costed the tests and the costs of bed days. Graves et al (2006) modelled the impact of 8 interventions to find out which interventions were cost effective.

Other studies attempt to describe the methodology of costing and how it might be used to gain funds and consider strategies

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- Perencevich et al (2007) provided a very good resume on economics of infection control and a template for making a business case. Graves (2004) set out the economic aspects of HCAI.Resources for managing infection control are not clearly delineated. Several studies have addressed the problem.

- Stone et al (2008) show that the number of permanent nursing staff have a roll to play in keeping infection rates low. Brussaferro et al (2003) considered the availability of resources for infection control in Italian hospitals; it was found that 76% had an active programme of infection control, 71% of hospitals had an infectious disease physician and 70% had up dated a guideline in the past two years. A study conducted in England by the Department of Health (2007) Hospital Organisation: specialty mix and MRSA, not summarised in here, found that although there was a strong relationship between bed occupancy, cleanliness and temporary nursing staff in the years 2001-2004, the relationship was weaker in the later period 2004-2006 with bed occupancy and temporary nursing staff no longer having a negative effect on infection rate of MRSA. The statistical time trend is not strong and further work needs to be done in this area that perhaps can encapsulate the difference in emphasis placed on prevention of HCAI in all hospitals in the later years.

The programme of infectious disease control has the task of ordering priorities. Priority setting is a central task for economics and one would expect economists to raise the issue.

- Some economists have raised the question of priorities in infection control particularly in connection with AMR programmes. Miller et al (2008) question the priorities devoted to MRSA in control policies. However, one has to bear in mind that the relationships are not simple but are symbiotic and actions on one affect the viability and potential for resistance of others.

4.3 5 Governance and Organisations

There have been very few inquiries into the organisation or governance of infection control policies, targeted searches for these topics did not generate results. The concepts of uncertainty, agency and opportunism have not been explored in this context. Changes are advocated, guidelines provided, targets are set and monitoring is in process but little attention is given to the way these changes can best be managed. There appears to be a little analysis of the agency problems and the impact that incentives and penalties may have. Lack of attention to these factors possibly represents a significant barrier to implementation of change in areas where no strong institutional culture supporting control is present.

- The establishment of accountability structures and encouraging compliance are central to the control of infection disease. The developments along these lines is gradually being established, as we see from the IPSE analysis. It will become apparent from the NAO survey how much progress has been made on these matters in England. A further development along these lines may well be the application more generally of incentives and penalties.

Agency theory sometimes appears to seek out negative behaviour in so far as agents when unobserved will choose easy options or focus on other targets such as financial games. But work has also shown commitment on wider issues.

- Love et al (2008) indicated that executive officers bore in mind wider aspects of quality than the performance indicators or financial constraints when considering infection control. A similar finding was reported by Saint et al (2008).

- Team work is very important in control policies. Recognition that all members of the team should be brought into the surveillance process is acknowledged by Hogg et al (2005). Allen et al (2003) reported on a survey of infection control professionals in England that found little involvement of the hospital executives and hospital boards with infection control and a distancing of infection control professionals from decisions on matters of relevance to prevention of infection.

Brusaferro et al (2003) found that a regional policy, an annual plan and a team were associated with improvements in infection control. This approach has led to the development of strategies based on care-bundles.

Guidelines to Bundles - One of the clearest explanations of why bundles might be of use in managing infection is given by Goldman (2007) who taking as an example the rates of HAI in European countries for three years 1999 -2002 he asks what can be the reason for the variability displayed. He discovers that although the compliance with certain procedures was between 63% and 83% compliance with all the components of care of medicare patients with pneumonia was only 26%. Although team working experiments were an improvement on individual compliance with guidelines the discipline they offered did not yield the improvements in compliance with essential processes sufficiently nor did they provide a reliable monitoring or auditing device. Emphasis on individual responsibility was clearly not working; a systemic approach was proposed as an alternative that drew on the Guidelines extracting a few key actionable interventions could be brought together as a 'bundle' that could be used to manage infection control more decisively. Drawing on the behavioural change literature he concluded that multifaceted approaches may be more affective. In terms of the aspects of infection control that we raised in chapter one, above, the 'bundle' deals deal directly with the issues of agency and invisibility, discussed above Chapter One, which make monitoring difficult. Management approach using a 'bundle' has the advantage of identifying the necessary procedure for each patient and identifying the person responsible for carrying it out. They thus provide an audit of individual clinical care and a general audit of processes for the unit or procedure. Extensive use of bundles has been established in each of the UK countries and other European countries and in the USA. Care bundles, like guidelines need constant up dating if they are to be useful.

One of the significant introductions into day to day management of clinical risk is the 'care bundle' that at once provides a check list of what needs to be done and an audit trail to see that it has been done.

Whereas care bundle address the treatment of individual cases and allow for monitoring and audit of practice other matters affect the performance of infection control. The infrastructure of the facility and the use made of the resources that are available is very important. Bed occupancy is increasingly seen as a factor affecting HCAI. Kroneman and Siegers (2004) showed that reduction in acute beds had been one of the ways that had been used to contain hospital expenditure. The found statistically significant effects of 'occupancy rates' and admission rates. Ornedi (2008) found that hospital-bed occupancy, and MRSA were associated. UK has a higher proportion of bed occupancy than the European average of 75%. Clements et al (2008) drew attention to the many aspects of management of clinical care in acute services that may impact on infection rates including staffing and ward

practices. It may well be that it is the area of day to day management that is still left unchecked inspite of strong structural governance that needs to be tackled to sustain the progress towards reducing HCAI.
www.hanming.com.tw/education/950912The%20evolution%20of%20**hospital**%20systems.pps

Internal issues are not the only factors that shape policy. External perceptions and pressures also shape policy. Edmond M, Eickhoff TC. (2008) draws attention to media pressures in shaping policy. The actual perception of HCAI is the policy driver and this does not necessarily reflect the trends of HCAI that are recorded. Nevertheless politician react to the anxiety and are keen to be seen to be taking action in an attempt to calm fears as well as reduce rates.

4.4 International Review

This review concentrates on research on the hospital sector and the factors that act to motivate agents and provide guidance within that sector. Increasingly however infection in the community either because of new pathogens or early discharge is crucial to the overall containment of HCAI. These trends and the growing tendency for health care systems to rely on non-traditional providers to provide services call for more general vigilance both inside and outside the hospital and an awareness of infection in the contracting out of services. In England most of the contracts are between PCTs and the new providers and it would appear that little is being done to ensure HCAI issues are specified in these new contracts. The new governance systems in hospitals may have fractured the link between infection control and public health. Although searches have taken place it seems that little is written about these matters and little advice is being given to PCTs about writing aspects of contracts which may have HCAI issues. This is a matter of some concern and needs monitoring.

Chapter Five Conclusions

5.1 Introduction

5.1.1 This international review was undertaken from three perspectives: a country review comparing England with a selected group of other countries; an analysis of aggregative European data from the IPSE project with consensus standards and performance indicators (SPIs) and an informed analysis of England against these SPIs; finally, an analysis of selected research papers particularly relevant to infection prevention and control and antimicrobial stewardship. Whilst the review was extensive it was difficult to obtain data on strategies and policies that were imbedded in the national data bases so it was difficult to ensure the review included all significant factors. A more targeted survey study, such as that carried out by Pratt et al (2004), would have provided standard responses to certain strategic, structural and factual questions, but would not have captured some of the difficulties and processes involved in their implementation. These are issues of concern to the NAO.

The international review focussed on governance and organisational arrangements, surveillance strategies, prevalence and incidence rates, resources, costs and economic evaluation, and barriers to progress.

The central questions addressed were: have the measures adopted in England since the last NAO review been used elsewhere, if so to what effect; and could any lessons be learnt from practices adopted in other countries? In this chapter we will bring together the three strands of the study and indicate the important findings.

5.2 Governance

5.2.1 In England the CEO was made responsible for the implementation of infection prevention and control policies and antimicrobial stewardship. S/he works with the Hospital Trust Board. A Director of Infection Prevention and Control (DIPC) who is to report directly to the Hospital Trust Board was appointed in each Trust. An ICC had to be set up in each hospital and it had to include one expert in IC and one in antimicrobial stewardship. Previously the focus of CEOs and Trust Boards had been on financial and waiting list targets, they probably had not given enough attention to IC or antimicrobial stewardship, so this was a fundamental change in governance. Responsibility assigned in this way empowers the CEO, who now has to ensure that the good practice guidelines for which s/he was responsible are upheld. These arrangements are similar in each UK country; in some countries the CEO is responsible together with the board and in Wales there is a executive officer to oversee cleanliness. This is a novel development that has made a contribution to ICC policy. The IPSE study of 27 EU countries found that many MS are implementing stronger governance structures: most had national ICC s in place which include infection control experts. The country surveys did note that individual CEO responsibility was uncommon.

As we observed before (see Chapter Two) the governance role was strengthened further in England by empowering PCTs, the purchasing authorities, to withhold funds (up to 2%) if hospitals did not fulfil obligations and for Modern Matrons, to withhold fees from cleaning contractors who failed to meet their obligations. These are powerful instrument that provide strong incentives but which can have perverse effects as described elsewhere, see Walker et al, (2008) and Graves, (2008).

The next most forceful exercise in control and governance, introduced in the USA in October 2008, allowed the withholding of payments for CMS patients' healthcare costs, if they arose from certain avoidable infections. This is a strong incentive to improve IC, as the costs of infected and uninfected cases differ substantially. The system is to be extended to include other preventable infections in 2009.

Most insurance based systems rely on withdrawal of accreditation or legal remedies to obtain redress for poor quality care that has arguably led to the infection. Some countries have made it easier for litigation to take place, for example, in France litigants are now able to assume that certain infections were hospital acquired, see para 2.10.1 above.

Codes of practice provide a framework for good practice standards that can be used for accreditation and as evidence supporting claims of negligence. However, codes of practice need to be updated continually to take on board new findings and take on board non-traditional providers lest they lose credibility.

Although governance structures have been strengthened internationally the governance structures imposed in England, and in modified forms in the rest of the UK, are some of the strongest of any country reviewed.

The recent introduction of penalties and fines, however, open up the possibilities of gaming and other strategies to circumvent the system. **England and the USA will need to review and reflect on this new situation.**

5.2.2 Governance is of crucial importance in the organisation of IC and antibiotic stewardship, but there is very little literature exploring different forms of governance. Trawls that focussed on a number of different words and phrases relating to governance of HCAI were undertaken, but revealed little work in this area. It is an important area that needs further study. Input from economists familiar with organisational and institutional aspects of team working, networks agency and transaction costs is needed. These issues cannot be addressed properly by standard economic evaluations.

More research work on governance structures appropriate for HCAI is needed.

5.2.3 Audit is a feature that has emerged over the past five years of governance of IC and antimicrobial stewardship. It provides a framework for enforcing existing standards and indicates others that might be needed. For example, an audit in Northern Ireland found that clean and dirty linen were on the same trolley: this is worrying especially in light of the work reported in the literature review, Snyder et al (2008), that found high levels of contamination in clothing used to treat MRSA cases in isolation rooms. A very detailed audit trail is set out for Scotland which covers all parts of the delivery system, but raises questions of time needed to undertake the audit, see para 2.6.1.

Regular audit can play a role similar to the cyclical management process adopted in e.g Denmark, France and Chile, that constantly brings improvements into the cycle to ensure developments are kept up to date. Regular audits can identify weaknesses and opportunities for improvements that can be added into good practice procedures and guidance.

Audits at local and national levels should be used to update procedures and processes to ensure best practices are adopted into the system of IC and antimicrobial stewardship.

5.3 Surveillance

5.3.1 Prevalence studies are cheaper to perform than prospective studies of incidence surveillance. As we discussed in Chapter Two, prevalence studies have drawbacks. They produce higher rates than incidence studies, largely because cases with infection tend to stay longer in hospital and are more likely to be included. When lengths of stay are reduced prevalence and incidence data will tend to converge, but both will miss those patients discharged into the community who then present with HCAIs. Attempts have been made to derive estimates of incidence from prevalence rates, in Scotland and in New Zealand; see NHS Scotland, (2007) and Graves et al (2003). The second weakness for comparability purposes arises because prevalence studies may have different definitions, be collected differently and include different mixes of hospitals or patient conditions. For this reason they are more useful for tracking developments within countries over time than for comparing countries. France and Denmark have regular prevalence studies every three and five years respectively. Comparisons even when methodological issues are dealt with have to be handled with care as the difference in rates may represent different phases in the spread or occurrence of the disease.

5.3.2 A prevalence study was recently conducted in England, Wales, Northern Ireland and EIRE, a separate but parallel study was in place in Scotland Table 2.1. Appendix 2. The methods were used to collect data from each country were the same but there were important differences as some countries allowed voluntary participation and others did not and some sampling differences to accommodate different sizes of units but these too could lead to bias, see Wilson et al (2008). The differences that were apparent from the studies, ie England had higher rates than

Wales, Northern Ireland and Eire, whilst Scotland had the highest rates should be interpreted with care until further analysis is made of the impact of the procedural differences. Studies of the prevalence of specific infections were also part of the prevalence studies, see Tables 2.3 – 2-6 Appendix 2.

In spite of the methodological difficulties there is support for prevalence studies and pressure for their publication. The ECDC intends to undertake some prevalence studies in the future; a Long Term Care Facility prevalence study will also be carried out in 2009, these will use the same methodology, making it easier to make comparisons.

Well designed prevalence studies may have a role to play in the management of HCAI in England.

5.3.3 Incidence rates, especially those that use the same methodological approach and definitions, are probably more useful for comparative purposes. The adoption of similar methodology does not always occur. As we saw from the country surveys the NNIS methods have been questioned as not being suitable in some Australian provinces and in Scotland. In England they have been adapted for SSIs following consultations with the relevant healthcare workers. The HELICS surveillance network, now transferred to ECDC, requires more validation work so that infection rates are more comparable between countries. Such validation work is expensive. However, it should be progressed so that the monitoring of infection rates can be more consistent and comparable and can be better used for research, a basis for an evaluative exercise, or target setting and applying penalties or incentives.

More work to achieve consistent and comparable surveillance measures of incidence so that they can be used in the IC strategies nationally and internationally.

A recent paper by Suetens et al (2008) from the HELICS data analysis has brought together European data on prevalence data from various studies since 1997. A prevalence of 7% and an incidence rate of 5% has been estimated based on 2001 figures. This represents 5m infections per year from acute hospitals in Europe. He estimates that this will be associated with 1% direct mortality and 2.7% contributory mortality. The cases stayed in hospital on average for four extra days.

5.3.4 Mandatory surveillance is being used increasingly in the EU and elsewhere. The mandatory laboratory reports are probably the most consistent rates and are easier for the public to interpret. These can be monitored and used very effectively for control and research purposes. The introduction of English mandatory surveillance provided a basis for the novel introduction of targets: a 50% reduction by 2008 was set and met. Targets for *C difficile* infections in England are now the subject of a targeted reduction of 30% by 2011.

Reporting of infections related to AMR, such as MRSA, were mandatory not only in the UK but widely in the developed world. In USA the requirement was incorporated into law in many States and, although some gave it little importance, others laid down detailed procedures to be followed, for example, isolation, decontamination and antibiotic prophylaxis. However, the requirements were unevenly enforced and some states were not as rigorous as others, see Chapter 2, para 2.2. Some European states have adopted a "search and destroy" policy for MRSA. In these countries anyone found to be colonised or infected with MRSA is isolated and contacts in hospital and in the community are tested and eradication treatment implemented. Search and destroy policy is probably best suited to countries that have low rates, as it requires a robust infection control facility. The low rates of MRSA in The Netherlands and Denmark is attributed to this search and destroy approach. England has developed a typing network approach and is tracking the spread of different *C. difficile* strains.

Countries with search and destroy policies, similar to those in England in the 1980s, these should be observed closely to see how far the methods could again be adopted in England

5.3.5 Although MRSA continues to be of major concern, *C.difficile* is now the HCAI that is attracting most attention. This is very contagious and has significant mortality and relapse rates. It is particularly a problem amongst vulnerable elderly people in hospital. Control measures need to be put in place quickly and cleaning must be very thorough to remove the spores. One of the universally accepted evidence based pieces of advice is to use soap and water for hand washing, as the alcoholic hand rubs do not destroy the spores. The mandatory reporting of *C.difficili* has been in place in England since 2004 and targets for reduction have been imposed. A 30% reduction by 2011 is now proposed.

In Northern Ireland and in France large outbreaks were attributed to slow recognition of the problem. Epidemiological skills were over stretched. The simultaneous occurrence in adjacent hospitals was not picked up until the typing information was made available and ribotype 027 identified. Scotland has instituted extra IC controls for any case of *C.difficile* whilst waiting for the typing result. Typing seems to be a useful step in identifying outbreaks. Northern Ireland has recommended that a 'root cause analysis' should be carried out when any case of *C.difficile* had been entered as the main cause of death on Part 1 of the death certificate and in a sample of those where it is mentioned as a contributory cause in Part 2. The English *C.difficile* guidelines are in press as this is written, will emphasise the seriousness of the condition and recommend that each case should be assessed by an expert team. England is in line with other countries undertaking mandatory surveillance for *C.difficile,* but some other countries may focus on tracking individual cases, undertaking typing and following up cases where death is attributed to the infection as mentioned above.

England should monitor countries that also employ typing or root cause analysis to explore the contribution of these methods compared to its own strategies.

5.3.6
Surveillance is used extensively for research in many countries, and is the focus of much research at the Statens Serum Institut in Denmark. In USA some research work is delegated to special networks in various collaborating states, eg the Keystone study, In Scotland observed patterns led to the modification of practice and a substantial reduction in transmission in ICUs. This Lothian method is presently on trial and has been recognised by the EU HELICS surveillance programme.

The management of surveillance is developing rapidly as the new technologies are being brought to bear on it. The use in England of a web-based data entry is a much needed advance and one that has also been progressed elsewhere e.g. USA and Bulgaria. Inter Agency working on English surveillance data is apparent but should be strengthened.

Research capacity to analyse surveillance data should be assured.

5.4 Intervention

5.4.1 Many studies of interventions or potential interventions have taken place in the past five years. Not all studies meet the standards described in ORION guidance Stone et al, (2007) and many report retrospective findings drawn from interventions or outbreak studies some of these have been included because of the insights they offer, but would need further work to ascertain whether the findings are valid and reproducible.

5.4.2 Screening is an intervention strategy that has to be considered carefully, because most hospital pathogens are opportunists, infect a minority of patients and are not detected in clinical specimens. This is made worse by the shortening of lengths of stay with infections presenting outside the hospital. Spread can occur from the colonised patients to others leading to HCAIs. Screening is thus vital to many HCAI prevention and control programmes, particularly for MRSA and *C.difficile*. The European countries that adopt a 'search and destroy' policy for MRSA utilise aggressive screening techniques and waste no time in isolating suspects, tracing contacts and decontaminating those colonised/infected.

In other systems, patients who may or may not be infected or colonised stay in wards until tests results arrive which, until a year or so ago, could take from 3-7 days. Now with the introduction of faster testing, it is possible to obtain a result before an operation even for some trauma cases, as a test can be administered on site for MRSA and a result obtained in 2-3hrs, that is in time to prepare the patient and inform the operating team of the problem and take action. These faster tests

have also opened up new possibilities for other cases, as most give a definitive result in 18-48 hrs and can be used for bed management and prevention measures. Recently models have been constructed to test the cost effectiveness of such faster tests - Richie et al (2007) and Roberts et al (2008); trials have taken place of the use of the tests, Jeyaratnam et al, (2008), Harbarth et al, (2008)., Keshtgar et al (2008) and other papers are in press.

It would appear that schedules and patterns of admission could be revised to take into account of this new technology. An important finding emerging from some of the early work, is that money may be better spent in more rapid and effective infection control than in rapid molecular MRSA testing Harbarth *et al*, (2008), Jeyaratnam *et al*, (2008). However, these trials were in hospitals with low rates of infection and high standards of IC. Trials of near-patient DNA testing systems are underway, and may change the configuration of admission and preoperative procedures.

New faster testing technologies have a contribution to make to IC and may change the configuration of some services.

5.4.3 As more is learnt about infection prevention and control and the interaction between antibiotics and the selection of antimicrobial resistance, many innovative intervention studies have been undertaken. Quite a number of these concern the effectiveness and sustainability of hand hygiene – the most commonly advocated intervention in all countries surveyed. Evaluative studies of hand hygiene generally show dramatic reductions in infection rates, see Chapter 4 above. Other studies proliferate in connection with the use of catheters and ventilation in ICUs. The evidence on these matters is so clear that there is a strong presumption of failure in these areas if infection arises and hence to the adoption of indicators of compliance being built into accreditation procedures and contracts.

5.4.4 There has been much debate on developing systems (root-cause analysis and care bundles) which ensure that the need for venous catheterisation is reviewed constantly. Indwelling urinary catheters are audited to ensure they are in place for as short a time as possible and not forgotten. Another key question is whether or when antimicrobial-containing catheters should be used. Antibiotic coated catheters, silver alloy coated catheters and even heparin coated catheters have been explored. Their use should be considered where infection rates are high. An interesting observation was the finding that there were excess infection rates amongst those who had recently had an endoscopic examination. This has led to a more circumspect use of this and other invasive scanning techniques.

England IC professionals should remain alert to invasive devices that may be vehicles for infection.

5.5 Antibiotic stewardship

5.5.1 Antimicrobial policies have been increasingly scrutinised and attempts have been successfully launched in England to deal with inappropriate prescribing in the community; the use of antibiotics in the hospital environment is not so well controlled. Guidelines exist about prophylaxis: optimal time of administration, of the appropriate drug, dose, duration. This has not always been followed. Therapeutic use of drugs is still a matter for some debate and an English systematic review was only able to establish an evidence base in certain areas.

Evaluation of one drug at a time is not considered appropriate, as the interaction amongst drugs used, and the purpose for which they are used, are all vital components of good stewardship. Greater care is being given to these matters, including emphasising the importance of sending specimens for culture and testing for antibiotic susceptibilities. Monitoring for the development of MRSA, ESBL Gram negative rods and GRE is being orchestrated as improved antimicrobial stewardship and IC attempt to preserve antimicrobials as viable treatment options. The situation is further confounded by the role inadequate IC plays in spreading AMR organisms. Methods, including modelling approaches which explore these dynamics, are still being developed.

- **Monitoring of the various aspects of antimicrobial stewardship should continue to be a high priority.**
- **Data from AMR surveillance needs to interpreted in relation to antimicrobial stewardship and usage data**
- **Such analyses will also need to consider ways in which standards/performance indicators of IC can be we can factored in.**

5.6 Environmental factors

5.6.1 Cleaning *per se* gets particular attention in the literature of the UK, where it is monitored and audited in England, Wales, Scotland and Northern Ireland. The literature has shown that the environment is important for many HCAIs e.g. *C.difficile*, GRE and some Gram negative rods, although for MRSA there is more debate. It is also referred to in Canada, where experts comment unfavourably on their cleaning contracts and consider that they embodied some of the less favourable factors seen in the early days of contracting in Britain. Lack of cleaning guidelines is a criticism in the USA, where the requirement for surface cleaning and monitoring was modified. Cleaning has been monitored in special studies or in audit reports indicating where there are poor results. Cleaning is seen to address mainly flat easy to clean surfaces neglecting heavily used items such as switches and monitors, key boards, telephones etc. These need to be considered. Some new cleaning materials have been evaluated and merit further examination - Wren et al (2008) suggest that ultramicrofibre-woven cloths seem to be able to clean to standards rarely accomplished with water and detergent.

Presence of MROs in the community, where these have been monitored, can be high. Pets, such as cats and dogs, can be innocent bystanders for HCAI and may

be important in continuing transmission in the home. Norovirus and *C difficile* in particular can occur in the community and be introduced into the hospital and then spread further.

- **The contracts for cleaning must be specific about areas that need to be cleaned.**
- **Shortening lengths of stay is resulting in HCAIs presenting in the community, infections are also arising there and greater attention should be given to these processes**

5.7 Training and Education

Most countries have in place some good training programmes at the level of attracting the attention of staff to the problem of infection. In most countries higher degree courses are available in infectious disease related topics. Chile, for example, has a masters degree programme for young professionals. This capacity has also been reviewed by IPSE in Europe. The Diploma in Hospital Infection Control renamed as the Diploma in Healthcare Associated Infection Control in the UK is targeted at infection control professionals and has been referred to by the Healthcare Commission in questionnaires as a bench mark for IC professional education. Although the potential is great for exploration of surveillance data, there is an epidemiological constraint because of lack of trained personnel. This has been recognised in Northern Ireland, where it was considered that *C.difficile* outbreaks would have been identified more quickly if more epidemiologist time had been available to interpret the data. Clearly attention to training and employing epidemiologists and increasing the competencies of IC professionals in this area must be addressed.

There is also a lack of nurses in infection control, with many countries recognising that they have still not achieved the ratios recommended by Haley and his colleagues in the 1970s and 80s. Good written material, which provide guidance and explains the reasoning behind the precautions is made available to staff in most countries. These, like those available in UK, are either evidence based or based on expert opinion. Some work has been directed towards establishing a viable infection control team, Vass (2007). However, in meeting targets of staffing norms England and the rest of the UK, as for many EU MS, is low.

There is a lack of epidemiological expertise and infection control practitioners in many countries.

5.8 Resources

As we have just discussed the way in which resources are allocated to infection control varies particularly in terms of the numbers and grades of staff involved. Some work has been directed towards establishing a viable infection control team, van den Broek et al, (2007) Voss et al, (2007). However, in meeting targets or

staffing norms England and the rest of the UK are low, although substantial extra funding for HCAI have been made available in recent years. In the review we came across examples where states or countries had made funds for extra staff or buildings available for IC e.g. Canada and Australia; see 2.3 and 2.4 above. The source of funding between countries differs because of the underlying differences in health care systems; systems that deliver care that are funded by the insurance schemes or privately have to incorporate and support extra funding with a business plan, see Perenchevich (2007). Other countries may receive funds in the form of grants. It would be necessary to carry out substantial studies to disentangle the sources of funds for HCAI internationally.

Most countries have a strongly based research programme. In England this has been supported by investment by the Department of Health, the UKCRC, MRC and the Health Technology Assessment panel and funds have also been made available in other UK countries. Funds for research have also been forthcoming from national sources elsewhere, see, for example, work undertaken under the auspices of the CDC or the work of Statens Serum Institut in Denmark. This work has strengthened the evidence base and provided a platform for other research and experimentation. Much research is undertaken in Universities and large teaching hospitals funded from various sources. Because of the multiplicity of sources for research funds it is not possible to derive adequate comparative profiles for the various countries. Further details would require a postal questionnaire to the various countries of interest if more specific details are required even such surveys may not capture all sources of funding. In England the DH have commissioned an information gathering exercise of HCAI and antimicrobial stewardship research and a priority-setting exercise.

A separate survey would be required to gather comparative data about funds available for research and expenditure on IC nationally and internationally .

5.9 Cost effectiveness or costing studies

Given the enormous problem of HCAI, there are few studies on economic evaluation. The costing study carried out in England by Plowman et al (1999) stands out internationally as one of the most comprehensive studies of costs. Other estimates derive costs by using length of stay data often without addressing the attribution problem. The formulae derived from the Burden of HAI study Plowman et al, (1999) by the DOH is probably the most useful tool for establishing rough estimates of costs internationally.

Some studies of costs have looked at specific interventions or programmes. These include studies on catheters, nursing resources, length of stay and faster testing. There are a number of studies advocating an economic approach to HCAI. Some of these are illuminating, but some seem flawed, as the essential characteristics of infection are not taken into account. Because there is a dearth of data, several models have been constructed to assess the implications of change they are less

costly to develop and can be refined and populated with data as this becomes available.

Recent estimates by Suetens et al (2008) for ECDC suggest costs of HCAI in Europe to be between €13-24 b per year, these estimates are for attributable costs and are supposed to include direct and indirect costs. However, the full methodology of the estimates is not given.

- **Basic costing studies and economic evaluations of interventions to control infections or improve antimicrobial stewardship are needed.**
- **More investment is needed to do this.**

5.10 Barriers and Potential

Barriers to progress have been derived from considering the strategies that have been adopted and the constraints of funding or organisational arrangements that make change difficult to achieve. The establishment of the IPSE project's European consensus in SPIs enabled us to review the current state of play in England in the context of the 27 states reporting. We observed a concerted drive in all countries reviewed to get a grip on the control of infection and the development of antimicrobial resistance.

Achievements over the period:

Improved governance - CEO being made personally responsible for IC and antimicrobial policy, with the Hygiene Code to provide the standards.

Improvement brought about by the compliance with the provisions of the Hygiene Code and the launch of the Clean**your**hands campaign although **improvements in education and training is still needed especially among undergraduates**

Improvement brought about by targets where England has taken the lead internationally but other countries have held back because of concerns about "naming and shaming".

England and needs to consider a national benchmarking system based on process surveillance as in France.

Barriers to further change:

Cultural values that do not regard HCAI as an important risk factor

Gaming which may become a threat as more penalties are introduced into the English system

Lack of professional involvement at all levels

The adequacy of the hospital infrastructure and trained personnel

Neglect of community HCAIs and those arising in the community de novo may rebound on hospitals

Lack of information about the long term burden of disease may distort investment decisions

Lack of costing data at all levels and dearth of economic evaluative studies

Little apparent appreciation of the need for infection control to be taken into account in contracts with the multiplicity of providers in the reformed NHS.

Apparent lack of involvement of Public Health and Infectious disease specialists in PCT contracting; which is a potential danger especially if community infections becomes more prominent.

Possibilities for further developments

The review of the national surveillance programme to consider how best to augment current activities (e.g. ICUs, UTIs, post discharge work and repeated prevalence studies).

Foster a better balance between surveillance for national and local needs, ensuring that Trusts have access to modules that enable them to pursue local surveillance objectives.

Use guidelines to monitored compliance as in Chile

Consider the differences between current policies and 'search and destroy' approaches

Involve patients and their carers in policies to control infection

Improve access to routine statistical data for researchers and public - currently web pages of major stake holders are neither user friendly nor consistent.

JAR and BDC

January 2009

Glossary

Accountable:	It implies that there is a person to whom the subject is held to account.
Alert organisms:	This is a daily list of organisms produced by the microbiology laboratory from specimens received that need to be drawn to the attention of the infection control team e.g. virulent organisms (*Streptococcus pyogenes*), antimicrobial resistant organisms e.g. MRSA.
Alert conditions:	Is the same as above listing infections e.g. cellulitis.
Antibiotic Stewardship:	This comprises antibiotic policy, prescribing interventions and educational activities
Appropriate:	A suitable action or approach that meets the requirements of the programme or procedure being undertaken eg. fitting the objectives of a hospital/healthcare organisation
Audit:	Audit is a process that traces administrative decisions or funds within an organisation over time. It can be used to assess probity in accounts or trace actions taken. It can be used to evaluate and compare practice with known policy goals. The results of an audit can be reflected upon and the policies or practices altered where this is appropriate; for example by re-training or removing opportunities to deviate from practice e.g. restricting antibiotics.
Benchmarking	Establishing standards that should be complied with and for monitoring progress towards achieving goals.
Care Bundle	A group of evidenced based interventions that should all be completed to ensure best practice is observed. These bundles can monitor care given to individual and provide a monitoring or audit tool for the IC team.
Clinical governance	This is a framework through which NHS organisations are accountable for continuously improving the quality of their services and safeguarding high standards of patient

	care, by creating an environment in which excellence in clinical care will flourish and which allocates responsibility for action clearly within clinical teams. Reference: Onion CWR. Principles of Clinical Governance, Journal of Evaluation in Clinical Practice. 2000:6;405-412.
Duty of care	This is defined as an obligation that a sensible person would use in the circumstances when acting towards others and the public. If the actions of a person are not made with watchfulness, attention, caution, and prudence, their actions are considered negligent. Consequently, the resulting damages may be claimed as negligence in a lawsuit. Reference: http://www.legal-explanations.com/definitions/duty-of-care.htm
Equivalent system	This is one that is comparable and would produce the same results.
Evaluation	The process of assessing the effectiveness of action or processes or structures.
Economic Evaluation	A way of assessing a scheme, project or intervention that includes costs and benefits when ever and where ever they occur are included in that analysis, may include cost benefit analysis, cost-effectiveness and costing studies.
Formulary:	This is a list of preferred, commonly prescribed prescription drugs. These drugs are chosen by a team of doctors and pharmacists because of their clinical superiority, safety, ease of use and cost. Reference: http://www.emonetwork.org/terms.asp#formulary
Governance	The decision making and accountability structure that ensures that roles and responsibilities for the delivery of service are clear and effective. In institutional economics this can be achieved using authority chains or via market processes. If governance fails in its scope or reach organisational problems are likely to occur
Good/Best practice	The adoption of safe working to control existing healthcare associated infections and to prevent the acquisition of infections within the healthcare setting. The Health and Safety Executive (HSE) defines it as those

	standards for controlling risk which have been judged and recognised by the HSE as satisfying the law when applied to a particular relevant case in an appropriate manner. The term is often used in EU documents in our field. e.g. "EU-wide exchange of best practice of all relevant issues should be promoted. Examples of good practice concerning antimicrobial resistance, vaccination campaigns and hygiene/infection control should be discussed and exchanged between Member States. Reference: *http://ec.europa.eu/health/ph_threats/com/mic_res/com684_en.pdf*
Incidence	Any measure of the number of events occurring in a particular period of time. Can be expressed as number of event per case.
National Audit	This is a country wide review which is generally carried out by nominated independent organisations and is fed back to the national body for scrutiny. They in turn may release it into the public domain. It may also be included in annual reports showing hospital performance against specific targets.
National Health Authority	This term describes a health system that is responsible for regulation or providing health services across the nation. It may have administrative power to enforce compliance with legislation.
Officially recognised Programmes	These are programmes that are established or sanctioned by a government (national or regional) with authority to impose them.
Prevalence	The number of cases or incidents that occur at a given point or period of time. Normally higher than incidence for HCAI as cases stay in hospital longer and more will be picked up in a prevalence study.
Programme	A broad framework for action towards applying policies in a certain domain. It may set goals, dictate procedures and incorporate monitoring and outcomes. A specific example could be the IC programme which could be seen as an agreed statement of objectives between chief

	executive/manager of the healthcare organisation, the infection control programme director, and the senior management group, for example clinicians to whom the programme director reports.
Screening Strategy	A long term plan of action or a specific approach designed to achieve a particular goal within a screening programme.
Structural measures	Structural measures are those that relate to the framework in which procedures take place. They may refer to any physical construction or organisational arrangements within which individual processes and procedures take place. Some times inadequate structures impose constraints on the ability of staff, to carry out a procedure effectively or reduce possible hazards such as HCAI. Reference: http://www.unisdr.org/eng/library/lib-terminology-eng%20home.htm
Suitable system	A suitable system is one that fits the purpose of the organisation or hospital and which is recognised as such by those working in it such as a representative body of clinicians
Surveillance	Measures to monitor activity or outcomes and any changes that occur over time. Mandatory surveillance is surveillance which has to be undertaken to fulfil the regulatory responsibility to track the changes in the pattern of organisms such as MRSA and *C.difficil.*
Validity	Measures that provide a true reflection of the underlying process being measured. Validity is derived from the underlying logical frameworks. A valid result will not be biased by processes of collection or analysis. Validity can relate to the compatibility with the context which is being explored – context or face validity – or statistical validity which avoids bias in the statistical inferences drawn from the analysis.

Abbreviations

A&E	Accident & Emergency Department
ARHAI	Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infections
ACSQHC	Australian Commission on Safety and Quality in Healthcare
AICA	Australian Infectious Control Association
AMR	Antimicrobial Resistance
AUR	Antimicrobial Use and Resistance
BSAC	British Society for Antimicrobial Chemotherapy
BSIs	Bloodstream infections
CABG	Coronary-artery by-pass graft
CA-MRSA	Community-associated meticillin-resistant *Staphylococcus aureus*
CAUTI	Catheter-Associated Urinary Tract Infection
CDAD	*Clostridium difficile* associated diarrhoea
CDC	Centers for Disease Control and Prevention
CDHA	Commonwealth Dept of Health and Aged Care
CEO	Chief Executive Officer
CHRISP	Centre of Healthcare Related Infection Surveillance and Prevention
CHSRF	Canadian Health Services Research Foundation
CLIN	Centers of HAI Control Committee (France)
C.CLIN	Co-ordinating Centers of HAI Control Committee (France)
CMS	Centers for Medicare & Medicaid Services (USA)
CPSI	Canadian Patient Safety Institute
CRI	Catheter Related Infections
CTIN	Committee Technical at the national level (France)
CUPE	Canadian Union of Public Employees
CVC	Central Vascular Catheter
DHQP	Division of Healthcare Quality Promotion
DHSSPS	Department of Health, Social Services and Public Safety (Northern Ireland)
DIPC	Director of Infection Prevention and Control
DSN	Dialysis Surveillance Network
EARSS	European Antimicrobial Resistance Surveillance System
ECDC	European Centre for Disease Prevention and Control
EMRSA	Epidemic Meticillin resistant *Staphylococcus aureus*
EPIC	European Prevalence of Infection in Intensive Care
ESAC	European Surveillance of Antimicrobial Consumption
ESBL	Extended spectrum β-lactamase
EU	European Union
GP	General Practitioner
HAI	Hospital Acquired Infection
HCAI	Healthcare associated infection

HCS	Healthcare Settings
HCW	Healthcare worker
HEAT	Health improvement, Efficiency, Access and Treatment
HELICS	Hospital in Europe Link for Infection Control through Surveillance
HHS	Health and Human Services
HICPAC	Healthcare Infection Control Practices Advisory Committee
HIS	Hospital Infection Society
HICWA	Healthcare Associated Infection Council of Western Australia
HISC	Healthcare Associated Infection Surveillance Centre, Belfast,
HPA	Health Protection Agency
HPS	Health Protection Scotland
IC	Infection Prevention and Control
ICALIN IC	A composite index used in France for benchmarking
ICP	Infection Control Professional
ICS	Infection Control Service (Southern Australia).
ICU	Intensive Care Unit
IHI	Institutes for Healthy Improvement
IPSE	Improving Patient Safety in Europe
IT	Information Technology
InVS	Instutit de Veille Sanitaire
LHCAI	Laboratory of Healthcare Associated Infection
LTCF	Long Term Care Facility
MRE	(2.8.2)
MREA	Multi-Resistant *Enterobacter aerogenes*
MRO	Multi-Resistant Organisms
MRSA	Meticillin Resistant Staphylococcus aureus
MSSA	Meticillin-sensitive *Staphylococcus aureus*
NAO	National Audit Office
NaSH	National Surveillance System for Healthcare workers
NH	Nursing Homes
NHMRC	Australia >
NHSN	National Healthcare Safety Network
NINSS	Nosocomial Infection National Surveillance Scheme (England)
NNIS	National Nosocomial Infection Surveillance (USA)
NPSA	National Patient Safety Agency
NSHI	National Surveillance of Healthcare Associated Infections
PCR	Polymerase Chain Reaction
PCTs	Primary Care Trusts
PVL	Panton-Valentine Leukocidin
QALYs	Quality of Life added Years
QIEP	Quality Improvement and Enhancement Programme
REISS	Research, Exchange, and Impact for System Support
RIE	Royal Infirmary of Edinburgh
RQIA	Regulation and Quality Improvement Authority
SA	*Staphylococcus aureus*

SACAR	Specialist Advisory Committee on Antimicrobials
SAI	Serious Adverse Incidents
SANIT	South Australian Noscomial Taskforce
SEHD	Scottish Executive Health Department
SENIC	Study of Efficacy of Nosocomial Infection Control
SHEA	Society for Healthcare Epidemiology of America
SICSAG	Scottish Intensive Care Society Audit Group
SMRSARL	Scottish MRSA Reference Laboratory
SSHAIP	Scottish Surveillance of HealthCare Associated Infection Programme, Glasgow
SOP	Standard Operating Procedure
SSI	Surgical Site Infection
UTI	Urinary Tract Infection
VAP	Ventilatory Acquired Pneumonia
VRE	Vancomycin-resistant enterococci
WA	Western Australia
WHAIP	Welsh Healthcare Associated Infection Programme
WHAISG	Welsh Healthcare Associated Infection sub-group
WHO	World Health Organisation

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Appendix One

Survey of International Literature

Publications from 1st Jenauary 2003 to 30th September 2008

Medline©, Embase©, Pubmed© and the Cochrane database.

Words cited: hospital acquired infection, healthcare associated infection, nosocomial infection.

Filtered by surveillance, prevention, antimicrobial resistance, multidrug resistance, MRSA and *C.difficile,* costs of HCAI and cost-effectiveness'..

Extended by guidelines, audit, faster tests, care bundles, venous line infections, urinary tract infections and ventilator associated pneumonia.

Medline 64326 - 17843 - 670 – 167 -

Pub Med 56902 - 14390 - 720 - 185 -

Embase 14390 - 6982 - 297 - 163 -

Cochrane 5416 - 14 - 1

Abstracts considered 316

Papers reviewed included 73

Abstracts of all articles considered to have made a significant contribution to the management of HCAI were reviewed by both consultants and grouped the following themes: *risk factors associated with clinical practices, estimates of incidence and prevalence rates, economic evaluation of interventions and costings, and governance and organisation.*

APPENDIX TWO

International Review of Papers on Healthcare associated infections HCAI

Table 2.1 Rates of infection - prevalence by country specialty and type

Country	source	date of collection	% rate total acute hospitals	
Prevalence rate estimated for				
England	1	2006	8.2	
Wales	1	2006	6.35	(95% CI 5.75-7.01)
Northern Ireland	1	2006	5.5	
0Scotland	2	2005/6	9.5	(95% CI 8.8-10.2)

Source:
1 The Third Prevalence Study of Healthcare Associated Infections in Acute Hospitals 2006 England Wales Northern Ireland 2007
2 NHS Scotland National HAI Prevalence Study 2007

Table 2.2 **Prevalence Rates in Earlier Studies**

	source	Year	Rate
United Kingdom	6	1980	9.2
United Kingdom	7	1993/4	9.0
UK (less Scotland) + Ireland	1	2006	7.6
England	1	2006	8.2
Wales	1	2006	6.4
Northern Ireland	1	2006	5.5
Scotland	2	2005/6	9.5
EU	3	2007	7.6
Belgium	5		8.0
Denmark	8	2003	8.7
France	8	1996/01	6.6
Greece	8	2000	9.3
Italy	8	2002	7.5
Netherlands	8	2007	6.9
Portugal	8	2003	8.7
Sweden	8	2004/6	9.5
Switzerland	8	1996	11.6
USA	4	2006	5-10%
Australia	5	1993	10.5
Canada	8	2002	10.5

Table 2.3 **Prevalence by specialty - specialties with highest rates - 2006**

	England	N Ireland	Wales	Scotland
Care of the elderly	10	9.47	7.75	11.9
Clinical Haemotology	14.6	9.8	11.11	6.7
General Medicine	7.7	5.19	4.45	9.6
General Surgery	8.1	3.69	7.49	11.2
Trauma and Orthopaedics	8.7	7.19	7.48	9.2

Source

1 The Third Prevalence Study of Healthcare Associated Infections in Acute Hospitals 2006 England Wales Northern Ireland 2007

2 NHS Scotland National HAI Prevalence Study 2007

Table 2.4 Prevalence rates selected organisms as at 2006

	England	N Ireland	Wales	Scotland
MRSA	1.28	0.85	0.87	0.68
Clostridium Difficile	1.98	1.13	1.1	0.69
Norovirus	0.74	0.44	0.99	-

Source

1 The Third Prevalence Study of Healthcare Associated Infections in Acute Hospitals 2006 England Wales Northern Ireland 2007

2 NHS Scotland National HAI Prevalence Study 2007

Table 2.5 **Prevalence by type of infection - proportion of infection of common type 2006**

	England	N Ireland	Wales	Scotland
Gastro intestinal infection	22	13.2	15.5	15.4
Pneumonia	13.9	10.20	9.8	11.2*
skin and soft tissue	10.5	10.2	12.5	11
surgical site	13.8	14.8	18	15.9
urinary tract	19.7	16.4	15.5	17.9
	79.9	64.8	71.3	60.2

*** This is lower respiratory tract not pneumonia**

1 The Third Prevalence Study of Healthcare Associated Infections in Acute Hospitals 2006 England Wales Northern Ireland 2007

2 NHS Scotland National HAI Prevalence Study 2007

Table 2.6 **Prevalence by type of infection - by patient surveyed-1**

		England	N Ireland	Wales	Scotland
Gastro intestinal infection		2.02	1.7	1.08	
Pneumonia		1.27	1.2	0.68	
Skin and soft tissue		0.96		0.87	
Surgical site	All admissions	1.27		1.26	
Surgical site	Admissions operation	4.65	4.2	5.35	
Urinary tract		1.8		1.08	

1 The Third Prevalsence Study of Healthcare Associated Infections in Acute Hospitals 2006 England Wales Northern Ireland 2007

Table 2.7 Helics surveillance IAP and CABs for network and EU

Countries	VAPs (1000/intubated days)*	CABS (1000 CVC days)
Austria	22	2.2
Belgium	20.3	2.5
Estonia	18.1	4.5
France	13	3
Luxemburg	4	3.6
Netherlands	17.8	6
PT	15.1	2.9
European Union	15.3	3

Source Helics p56

Table 2.8 Helics surveillance VAP, C-BSI and UTI for Network countries and USA

Net work surveillance Patients included		VAP 1000 admissions	VAP 1000 ventilation days
Belgium	>48 hrs ICU	5.10%	20
France	>48 hrs ICU	9.10%	14.8
Netherlands	>48 hrs ICU	14.00%	24.5
Spain	>24 hrs ICU	6.50%	17.7
Germany	All	1.60%	9.9
US	All	na	10

Source: Helics

Net work surveillance Patients included		C-BSI /100 admissions	C-BSI/1000 central line day
Belgium	>48 hrs ICU	1.30%	2.7
France	>48 hrs ICU	0.80%	1
Netherlands	>48 hrs ICU	2.20%	3.5
Spain	>24 hrs ICU	1.10%	1.3
Germany	All	0.50%	1.8
US	All	NA	5.1

Source: Helics

Patients included		UTI.100 admissions	UTI per catheter days
Belgium	>48 hrs ICU	NA	NA
France	>48 hrs ICU	8.60%	10.5
Netherlands	>48 hrs ICU	6.70%	8.2
Spain	>24 hrs ICU	3.10%	5.9
Germany	All	1.10%	3.7
US	All	NA	6.6

Source: Helics