Recommendations for surveillance priorities for healthcare-associated infections and criteria for their conduct

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Surveillance and feedback of results to clinical teams is central to performance improvement in managing healthcare-acquired infections. A major role of the Advisory Committee on Antimicrobial Resistance and Healthcare-Associated Infections (ARHAI) is to advise on surveillance priorities. A sub-committee was set up to systematically review existing UK surveillance schemes. The following three systems were examined in detail: mandatory reporting of methicillin-resistant Staphylococcus aureus (MRSA) bacteraemia and Clostridium difficile infection to the HPA; surveillance of surgical site infection undertaken by the HPA; and surgical site infection surveillance undertaken at University College London Hospital. Recommendations included the extension of mandatory reporting to include bacteraemia due to Escherichia coli and methicillin-susceptible S. aureus, post-discharge surveillance of surgical site infection, the need for validation of surveillance systems and mandatory reporting of Caesarean section wound infections. Mandatory reporting of bacteraemia due to E. coli and MSSA were introduced during 2011 and further extension of surveillance is likely.

Keywords: Staphylococcus aureus, Clostridium difficile, Escherichia coli

Introduction

Surveillance of healthcare-acquired infection and feedback of the results to clinicians is central to efforts to improve performance. Numerous studies have demonstrated the effectiveness of the policy, particularly for surgical wound infections.1 When the Department of Health was faced with the need to reduce methicillin-resistant Staphylococcus aureus (MRSA) bacteraemia in England in 2001, the immediate plan was to make notification of cases to the Public Health Laboratory Service (later the HPA) mandatory, such that tables of performance could be compiled for the purposes of feedback.1 Hospitals with high rates of bacteraemia were publicly identified, with the result that resources within those hospitals were made available to improve performance and ensure ‘ownership’ of the problem. Individual cases were subjected to root cause analysis to determine ways to prevent repetition. The resulting decline in MRSA bacteraemia rates exceeded expectations and the same policy was then extended to Clostridium difficile infections.

Surveillance data must be accurate and consistent for effective monitoring of trends and outbreaks. Only then can appropriate action be taken. The costs of collecting such information can be considerable and have to be offset against the likely improvement in infection rates and patient quality of life. Therefore, surveillance priorities must be carefully considered. When the Advisory Committee on Antimicrobial Resistance and Healthcare-Associated Infections (ARHAI) was set up in 2007, the importance of surveillance to its remit was recognized in the appointment of Dr Ed Smyth to the membership. He had been responsible for setting up and developing surgical wound surveillance in Northern Ireland, including the use of a web site for feedback of data to the surgeons. In 2009 he was asked to set up a sub-committee to make recommendations for ministers as to future targets for mandatory and voluntary surveillance in England. The sub-committee included microbiologists, infection control nurses, surgeons and Department of Health representatives, all with an interest in surveillance. Members were recruited from organizations in the UK and Ireland, but did not represent specific bodies.

The brief

The sub-committee was charged with reviewing existing surveillance schemes in the UK and to make recommendations on how to improve and develop national surveillance. Systems were judged on their level of success in terms of patient outcome and management, information provided to hospital administrations, cost and savings.

The process

The process started with hearing evidence from managers of existing surveillance systems and how they had responded to
gaps in surveillance identified by the National Audit Office.\textsuperscript{3} Systems were chosen on the basis of success in fulfilling their defined outcomes. A detailed scoring proforma with which to score existing surveillance systems was then discussed and drawn up. The criteria used in evaluating existing surveillance systems are shown in Figure 1.

The review included existing mandatory and voluntary surveillance undertaken by the HPA, the National Vascular Database, local well-established hospital systems, including ASEPSIS (a widely used and published wound scoring method), and intensive care clinical network systems. Infections that were the subject of surveillance included those caused by MRSA and \textit{C. difficile}, skin and soft tissue, other bloodstream infections, urinary infection and those caused by norovirus, glycopeptide-resistant enterococci (GRE), multiresistant Gram-negative bacteria and \textit{Acinetobacter} spp. The effects of voluntary versus mandatory reporting were also examined, as was the inclusion of post-discharge surveillance as a means of increasing the number of surgical site infections detected. Three systems were examined in detail, namely mandatory surveillance of MRSA bacteraemia and \textit{C. difficile} infection undertaken by the HPA, mandatory surgical site infection surveillance (also undertaken by the HPA) and surgical site infection surveillance undertaken by University College London Hospital (UCLH) as it was the most comprehensive local surveillance system in operation.

Repeated drafts of the report were produced and circulated before recommendations were produced. A draft report was then sent to external referees chosen for their international expertise in this area. Their views were incorporated together with comments from the HPA and Department of Health. After a final teleconference, the report was submitted to ARHAI for discussion. The report was received favourably at ARHAI and a month later was provided to the Health Minister. Final comments were received from the Department of Health during the next month and the report was finally published on the ARHAI web site in March 2010.\textsuperscript{4} The principal recommendations on national surveillance priorities are outlined in Figure 2. The mandatory reporting of methicillin-susceptible \textit{S. aureus} (MSSA) and \textit{Escherichia coli} bacteraemias is now being implemented and information systems are being adjusted.

\begin{itemize}
\item Extension of mandatory MRSA bacteraemia and \textit{Clostridium difficile} surveillance to the independent sector
\item Mandatory surveillance of MSSA bacteraemia
\item Extension of orthopaedic surgical site infection surveillance to the independent sector
\item Mandatory surveillance of Caesarean section surgical site infections
\item Mandatory surveillance of catheter-related bloodstream infections
\item Mandatory surveillance of \textit{Escherichia coli} bacteraemia
\item Withdrawal of surveillance of glycopeptide-resistant enterococci bacteraemia
\end{itemize}

\textbf{Existing surveillance schemes}

\textbf{Mandatory surveillance}

Mandatory enhanced surveillance of MRSA bacteraemia has been in force since October 2005, although a minimum dataset has been collected since 2001. The information is used at local, regional and national level for performance management. There was an appeal system for rare cases in which the infection was arguably caused by a problem that was deemed to be insurmountable, such as a chronically infected aortic graft in an inoperable patient, but this was discontinued in March 2011. Surveillance of GRE bacteraemia has been performed since 2003 but the numbers reported are too low to provide useful information. Reporting of \textit{C. difficile} infection has been mandatory since 2004 and, as for MRSA, the collated data are available on the HPA web site. However, risk factors are reported only for a minority of cases.

Surveillance of orthopaedic surgical site infections is mandatory for NHS units undertaking this form of surgery. A minimum of 3 months each year in at least one category of hip, knee or long bone procedures is required, with the results being fed back to surgical teams. This process contributes to a reduction in rates of infection.\textsuperscript{5} The Surgical Site Infection Surveillance Service is run by the HPA for operations over a range of specialties. Patients are monitored during their stay and on readmission. However, post-discharge infections, which account for at least a third of cases, often went unreported. The HPA has now introduced readmission surveillance and voluntary post-discharge surveillance. Hospital stays are becoming shorter so the importance of post-discharge surveillance is increasing.\textsuperscript{5}

Outbreaks reported as Serious Untoward Incidents are reported locally and ascertainment and root cause analyses vary. National reporting and standardization is not yet in place.

\textbf{Voluntary surveillance}

Voluntary surveillance by the HPA includes laboratory reporting of the isolation of clinically significant pathogens with some relevant antimicrobial susceptibilities included, but more laboratory
participation is needed. Nevertheless, the system is useful in identifying trends in bacteraemia.

For *C. difficile*, a number of schemes are in progress. In addition to the mandatory surveillance scheme, six regional microbiology laboratories form the *C. difficile* Ribotyping Network for England, which provides ribotyping to identify outbreaks. In addition, current surveillance is attempting to link death registrations with laboratory reports of *C. difficile* infection. For *E. coli* bacteraemia, reporting to the HPA has shown a 38% increase since 2004. In particular there have been an increased number of strains producing extended-spectrum β-lactamases (ESBLs). For *Acinetobacter* spp. bacteraemia, reports have increased by only 5.4% since 2003 but isolates are often multi-resistant and affect the critically ill.

Data collection in intensive care was particularly well developed with the Intensive Care National Audit and Research Centre (ICNARC) system. The short-lived National Patient Safety Agency ‘Matching Michigan’ project used rigorous reporting and investigation of infections of central venous catheters in critical care in conjunction with a quality improvement model to reduce infections towards zero, as had been reported previously from Michigan.

The voluntary HPA Surgical Site Infection Surveillance Scheme has a range of categories of surgical operation that can be used for surveillance. Surveillance of Caesarean section is already mandatory in Scotland, Wales and Northern Ireland and has been the subject of a pilot study in England. Voluntary surveillance is often poorly resourced; hence, apart from a few centres with comprehensive surveillance, the infection rates of some procedures are largely unknown and are not reported to most surgeons or patients.

In order to provide an updated estimate of the prevalence of infection in hospitals, the Hospital Infection Society and the Infection Control Nurses Association (now the Healthcare Infection Society and the Infection Prevention Society, respectively) conducted a prevalence survey on behalf of the Department of Health in England in 2006, which was also joined by all of the other countries of the British Isles.

A number of other surveillance activities were also considered. These include the introduction of laboratory reporting of norovirus infection in order to provide some intelligence on the levels of norovirus activity and assist with planning and decision making. In addition, the National Vascular Database collects information on four operations that have high rates of infection, with surgeons having online access to their own data (both at hospital and individual surgeon level), which enables them to compare their local rates with national rates.

Other surveillance networks that have the potential for development include several with a focus on infection and antimicrobial resistance in children. The Children’s Infection Linkage Project, run by a multi-disciplinary research consortium, has found rising rates of *S. aureus* bacteraemia in children and multiresistant Gram-negative bacteraemia in neonates, and seeks to link microbiological, clinical and prescribing datasets. The Paediatric Intensive Care Audit Network and the Neonatal Data Analysis Units also hold information on infections.

Urinary tract infections are the most common healthcare-acquired infections and can cause bacteraemia, particularly due to ESBL-producing enterobacteria. However, systematic surveillance is lacking. The reasons for this increase are unclear, although it is possible that overuse of urinary catheterization may be a driver for the increasing reports of *E. coli* bacteraemia. ARHA1 recommended that some time-limited surveillance be conducted in order to enhance the epidemiology behind the increase.

**Possible future developments**

In critical care, lower respiratory tract, wound, urine and catheter-associated infections predominate and mortality is high. ICNARC receives data on patients from 75% of UK units, and although these data cannot currently be used to provide rates of healthcare-acquired infection in intensive care units (ICUs), they may be suitable for future development. Ventilator-associated pneumonia is a clinical problem that clearly warrants surveillance, but there are problems with which case definition to use.

**Conclusions**

To ensure best use of current resources, set standards for surveillance need to be developed to facilitate integration of the widely varying national and local systems. The sub-committee developed a set of surveillance criteria and used them to review existing systems. Surveillance should concentrate on issues of local importance to improve policy and practice. Mandatory surveillance of all infections would not be justified. If surveillance data are to be used for performance management, risk stratification is essential. A national register of surveillance schemes would ensure effective use of data and help hospitals to find expert advice. Epidemiology services available to Trusts should be reviewed to provide more appropriate information and help reduce the risks of healthcare-acquired infections. Feedback of results must be rapid, accurate and easily understood to allow clinicians to take appropriate action, take ownership and improve patient care. Named surgeon rates are essential at least every quarter.

Investment in surveillance is offset by reductions in infections and improvement in lengths of stay, readmissions and social benefits. Surveillance is best accomplished by trained healthcare staff and healthcare assistants can perform well if they are given clear criteria. The HPA is the host of England’s epidemiological expertise and should provide specialized surveillance support. The National Audit Office report (2009) recommended that commissioners state expectations of quality and provide the support for data collection. Local definitions of infection should be unequivocal and in line with those agreed nationally. As patients move frequently between hospitals and the community, surveillance in primary care could be cost neutral. Surveillance systems should be validated to ensure data collection is robust. Pathology information technology systems should provide the ability for data extraction or interfacing with computerized surveillance systems to reduce the need for manual data entry. Existing surveillance systems used by clinical networks such as the ICNARC should share in the development of healthcare-associated infection (HCAI) surveillance. Antibiotic stewardship will benefit from the
introduction of electronic patient records, which should be introduced as soon as possible.

Mandatory surveillance has been successful in driving down MRSA bacteraemia rates and in building public confidence in the compliance of Trusts with national recommendations for infection control. However, mandatory national surveillance is limited to particular areas, such as C. difficile infection or orthopaedic infection, whereas urinary infection may be more important locally. Voluntary schemes are often only maintained by the enthusiasm of local staff but could be expanded nationally. Revalidation for medical practitioners requires doctors to gather results for their own portfolio and individualized results coming from surveillance data could be part of this process in supporting reflective practice and enhancing quality measurement. However, the same surveillance methodology and definitions of infection must be used to allow comparison. Relevant professional groups must be engaged at an early stage in any expansion.

Although enhanced MRSA reporting allowed reporting of MSSA bacteraemias, the provision of epidemiological data for the latter was voluntary. The same data were also reported via CoSurv, another voluntary reporting system. Falls in MRSA bacteraemia often were not accompanied by falls in MSSA bacteraemia, hence the causes of the latter require investigation. MRSA mandatory reporting should be continued and extended to the independent sector. MSSA bacteraemia should be mandatorily reported in the same way, especially for certain patient groups (e.g. renal dialysis patients) in order that an understanding of the lack of reduction in cases can be gained.

Mandatory reporting of C. difficile duplicates some data reported through CoSurv. Toxin tests alone have poor positive and negative predictive values, which affects the quality of data used for surveillance. Hence, testing needs to follow best practice. The sub-committee recommended the scheme should be extended to the independent sector.

Surgical site surveillance has been increasingly taken up by English hospitals, with reduction in infection rates. Feedback may result in improvements in operative practice. However, many hospitals do not provide resource for non-mandatory elements of surveillance, so the majority of procedures nationally are not recorded. Recommendations have been made for hospitals to have a rolling 3–6 month programme in a range of procedures, including post-discharge surveillance.

The economic burden of surgical site infections is considerable. Only surveillance of orthopaedic infections is mandatory and includes NHS inpatient admissions and readmissions only. It is intermittent and surgeon-specific rates are needed. However, continuous surveillance is more beneficial to surgeon appraisal.

Post-discharge surveillance requires resources but becomes more important as length of stay is reduced. Two postal surveys following discharge were successful in achieving 85% coverage at University College Hospital. Orthopaedic surveillance should be extended and the independent sector included. Surveillance should be continuous. The sub-committee believed that, following on from the HPA pilot, Caesarean section surgical site surveillance should be made mandatory. Where undertaken, surveillance of high-risk procedures, such as vascular, breast and colonic surgery, should be continuous. A national methodology should be agreed for post-discharge surveillance to ensure data are consistent.

The HPA had previously recommended in 2007 that ICUs should be the subject of surveillance, particularly for pneumonia and bacteraemia. To facilitate this, the existing HELICS (Hospital Link for Infection Control through Surveillance) definitions from the European Centre for Disease Control (ECDC) and ICNARC database could be used. The Matching Michigan project was voluntary and temporary, having closed in March 2011, and no data have been published to date. The sub-committee recommended that surveillance of central venous catheter-related bloodstream infections should be mandatory once Matching Michigan is completed. Although there is little surveillance on neonatal ICUs, databases already exist with the Neonatal Infection Network, amongst others, indicating the potential for the development of electronic systems. Surveillance in renal units is limited to MRSA bacteraemia, but this may be extended to all bacteraemias.

The increasing prevalence of Gram-negative bloodstream infections and the lack of new antimicrobial agents led to the HPA Steering Group recommending that ESBL-producing, quinolone-resistant E. coli bloodstream infections should be the highest priority for mandatory surveillance. Hence a time-limited national investigation of E. coli bacteraemias is recommended. Many may be linked to urinary catheterization but information is needed. Urinary tract infections are not subject to national surveillance due to the workload involved in collecting robust data, but the use of catheters should be examined to minimize their use. In contrast, the number of GRE bacteremia cases was so low that it was felt that surveillance could be referred to the local level where appropriate. Acinetobacter bacteraemia surveillance would depend on local priorities, and is not prioritized nationally.

Norovirus is subject to a voluntary surveillance scheme. However, many outbreaks are not reported. The economic cost of outbreaks to healthcare providers is large, particularly when affected wards are closed and affected staff are excluded for at least 48 h. The group felt that, in order to achieve optimal results and increase vital information dissemination, norovirus surveillance should be extended to the community, including nursing homes and schools.

National prevalence surveys of HCAI are planned in the European Union and USA and should be useful in identifying current deficiencies. The 2006 national survey should be repeated, and some data collection will be undertaken in 2011 as part of a European initiative. For local surveys, Trusts should use nationally agreed definitions. Local health protection units should support local surveillance. Serious untoward incidents and outbreaks should be reported to a central database as a resource to all hospitals.

The sub-committee recommended that surveillance should include ESBL-producing enterobacteria, particularly when isolated from blood, CSF and ascitic fluid. Such surveillance should distinguish healthcare- and non-healthcare-acquired infections.

The outcome

The principal recommendations on national surveillance priorities are listed in Figure 2. The Health Minister approved the introduction of mandatory surveillance of MSSA bacteraemia from January 2011 and E. coli bacteraemia from June 2011. HPA
computer entry forms were set up to allow this additional mandatory reporting. It was important to emphasize, however, that these were data-gathering exercises being carried out in order to gain public health intelligence. Hence, the tendency of some commissioners to perform management these bacteraemias was premature. The HPA is considering the introduction of surveillance of Caesarean section wounds.

Future remit of ARHAI in surveillance

Given the remarkable performance of MRSA bacteraemia surveillance in reducing incidence, there is every indication that mandatory surveillance will continue and be extended. ARHAI will be able to provide leadership in directing these efforts to ensure that future surveillance has robust objectives and that outcomes are likely to be useful. The committee has the expertise to rapidly assess the available scientific data and determine which areas are likely to be cost effective and improve patient quality of life. However, current economic conditions have greatly restricted work in advising the government. The composition of the group may therefore need to include a health economist to ensure the work and recommendations remain practical and cost effective.

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References


