Reducing harm to patients from health care associated infection: the role of surveillance

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Abbreviations and acronyms

ACHS	Australian Council on Healthcare Standards
ACSQHC	Australian Commission on Safety and Quality in Health Care
AGAR	Australian Group on Antimicrobial Resistance
AICA	Australian Infection Control Association
AICA-NAB	Australian Infection Control Association National Advisory Board
AIDS	acquired immune deficiency syndrome
AIHW	Australian Institute of Health and Welfare
ANZCOSS	Australia New Zealand Co-operative on Outcomes in Staphylococcal Sepsis
ANZNN	Australian and New Zealand Neonatal Network
ARPAC	Antibiotic Resistance; Prevention and Control
ASA	American Society of Anesthesiologists
ASCTS	Australasian Society of Cardiac and Thoracic Surgeons
ASID	Australasian Society for Infectious Diseases
ATC	anatomical therapeutic chemical
BEACH	Bettering the Evaluation and Care of Health project
BMI	body mass index
BSI	bloodstream infection
CABG	coronary artery bypass graft
CA-MRSA	community-acquired MRSA
CAPTION	Community-Acquired Pneumonia: Towards Improving Outcomes Nationally
CARE-ICU	Controlling Antibiotic Resistance in Intensive Care Units
CCU	critical care unit
CDAD	*Clostridium difficile* associated disease
CDC	Centers for Disease Control and Prevention (United States)
CFU	colony forming units
CHRISP	Centre for Healthcare Related Infection Surveillance and Prevention (Queensland)
CI	confidence interval
CLAB	central line associated bacteriaemia
CNISP	Canadian Nosocomial Infection Surveillance Program
CNS	coagulase-negative staphylococcus
CRAB	carbapenem-resistant *Acinetobacter baumannii*
CR-BSI	catheter related bloodstream infection

CSF	cerebrospinal fluid
CUSUM	cumulative sum
CVC	central venous catheter
DANMAP	Danish Integrated Antimicrobial Resistance Monitoring and Research Program
DDD	defined daily dose
DRG	diagnosis related group
DUE	drug usage evaluation
EAGAR	Expert Advisory Group on Antimicrobial Resistance
EARSS	European Antimicrobial Resistance Surveillance System
eICAT	electronic Infection Control Assessment Technology (software)
EMRSA	endemic methicillin-resistant *Staphylococcus aureus*
EOS	early onset sepsis
EPINet	Exposure Prevention Information Network
ESAC	European Surveillance of Antimicrobial Consumption
ESBL	extended spectrum beta-lactamase
ESCMID	European Society of Clinical Microbiology and Infectious Disease
ESGAP	ESCMID Study Group for Antibiotic Policies
FTE	full-time equivalent
GBS	group B streptococci
GPBTU	Gram Positive Bacteria Typing Unit (Western Australia)
HAI	health care associated infection
HBV	hepatitis B virus
HCA	health-care associated
HCV	hepatitis C virus
HCW	health-care worker
HDU	high-dependency unit
HISS	Hospital Infection Standardised Surveillance (New South Wales)
HISWA	Healthcare Associated Infection Surveillance Western Australia
HIV	human immunodeficiency virus
HSV	herpes simplex virus
ICARE	Intensive Care Antimicrobial Resistance Epidemiology
ICD	International Classification of Diseases
ICP	infection control professional
ICU	intensive care unit
IHI	Institute for Healthcare Improvement (United States)
IMPro	Infection Monitor Pro (software)

INICC	International Infection Control Consortium
IP	inpatient episode
IPSE	Improving Patient Safety in Europe
IV	intravenous
IVDRB	intravascular device-related bacteraemia
JETACAR	Joint Expert Technical Advisory Committee on Antibiotic Resistance
KISS	Krankenhaus Infektions Surveillance System (Nosocomial Infection Surveillance System — Germany)
LCBSI	laboratory confirmed bloodstream infection
LIS	laboratory information system
LRTI	lower respiratory tract infection
MBL	metallo-beta-lactamase
MDR-AB	multidrug-resistant *Acinetobacter baumannii*
MRAB	multiresistant *Acinetobacter baumannii*
MRGN	multiresistant gram negative bacteria
MRO	multiresistant organism
MRPA	multidrug-resistant *Pseudomonas aeruginosa*
MRSA	methicillin-resistant *Staphylococcus aureus*
MSSA	methicillin-sensitive *Staphylococcus aureus*
MYSTIC	Meropenem Yearly Susceptibility Test Information Collection
NARMS	National Antimicrobial Resistance Monitoring System
NaSH	National Surveillance System for Health Care Workers
NAUSP	National Antimicrobial Utilisation Program
NethMap	surveillance program for antimicrobial resistance in the Netherlands
NHMRC	National Health and Medical Research Council
NHS	National Health Service (United Kingdom)
NHSN	National Healthcare Safety Network (United States)
NICHD	National Institute of Child Health and Human Development
NIP	non-inpatient episode
NNIS	National Nosocomial Infections Surveillance System (United States)
NPS	National Prescribing Service
NPV	negative predictive value
OBD	occupied bed day
OPHE	outpatient haemodialysis event
OR	odds ratio
PBAC	Pharmaceutical Benefit Advisory Committee

PBS	Pharmaceutical Benefits Scheme
PCR	polymerase chain reaction
PDA	portable digital assistant
PFGE	pulsed-field gel electrophoresis
PICC	peripherally inserted central catheters
PICU	paediatric intensive care unit
PMC	pseudomembranous colitis
PPV	positive predictive value
PREZIES	Prevention of Nosocomial Infections through Surveillance (Netherlands)
PVL	Panton-Valentine leukocidin
QALY	quality adjusted life year
QHPSS	Queensland Health Pathology and Scientific Services
RPBS	Repatriation Pharmaceutical Benefits Scheme
RR	relative risk
RSV	respiratory syncytial virus
SARI	Surveillance of Antimicrobial Use and Antimicrobial Resistance in Intensive Care Units
SARS	severe acute respiratory syndrome
SD	standard deviation
SENIC	Study on the Efficacy of Nosocomial Infection Control
SHINE	Safer Hospitals Integrated Information Network (software)
SICU	surgical intensive care unit
SIR	standardised infection ratio
SSI	surgical site infection
STRAMA	Swedish Strategic Program for Rational Use of Antibiotics
SWEDRES	Swedish Antibiotic Utilisation and Resistance in Human Medicine report
TB	tuberculosis
TSN	The Surveillance Network (United States)
UTI	urinary tract infection
VAP	ventilator-associated pneumonia
VDHS	Victorian Department of Human Services
VHPSS	Victorian Hospital Pathogen Surveillance System
ViBES	Victorian Blood Exposures Group
VICNISS	Victorian Hospital-Acquired Infection Surveillance
VISA	vancomycin-intermediate *Staphylococcus aureus*
VRE	vancomycin-resistant enterococcus

VRSA	vancomycin-resistant *Staphylococcus aureus*
WHO	World Health Organization

Preface

Australians rightly expect to receive safe, high quality health care. The healthcare system generally fulfils this expectation and provides excellent care. However, some patients acquire infections during their health care and such infections are a leading cause of preventable, and sometimes serious, harm. Healthcare associated infections also have significant resource costs, as they prolong hospital stays and create more work for health care staff.

The Australian Commission on Safety and Quality on Health Care has recognised that a coordinated approach to the prevention and control of healthcare associated infection is essential to improving patient safety. It has a program in place aimed at reducing healthcare association infection, involving systematic, national responses to infection control, hand hygiene and antibiotic stewardship

Preventing healthcare association infections depends on good decision-making – decision-making that is guided by reliable information of the incidence and costs of infections and on the effectiveness of prevention strategies. Surveillance systems play an essential role in providing this information.

This document contains an overview of current healthcare associated infection issues and surveillance initiatives in Australia and reviews of international and Australian surveillance literature. The 51 authors are to be commended for providing such authoritative and compelling analyses. On behalf of the Commission, I extend my thanks to them for their willingness to contribute their expertise and for the substantial efforts required to produce such a comprehensive document.

Preventing health care associated infection is the responsibility of all who care for patients or make decisions about healthcare systems. Many of these people will not read all 18 chapters of this document, but, even so, the overall message is relevant to all of them. That message is that a crucial means to reduce the harm caused by healthcare associated infections is to measure improvement through national and local surveillance systems.

Bill Beerworth
Chair
Australian Commission on Safety and Quality in Health Care

Acknowledgments

This report represents the collaborative effort of many people with a commitment to reducing harm to patients from health care associated infections (HAIs).

In particular, the Australian Commission on Safety and Quality in Health Care would like to thank the contributing authors for their generosity in giving their time and expertise on top of already busy workloads. The commitment of the authors to decreasing infections is evident in the content of this document and in the discussions that ensued as part of the collaborative process of producing it. The group not only provided the rigorous scientific content but also participated in the Delphi survey to identify priority recommendations that will be used to inform ongoing work in the prevention of HAIs.

Special acknowledgement is given to members of the Healthcare Associated Infection Surveillance Expert Working Group who coordinated several chapters each, as well as contributing to their own area of expertise. The expert working group, ably led by Professor Michael Whitby, included Professor Peter Collignon, Dr John Ferguson, Associate Professor Michael Richards, Ms Rachel Thomson and Ms Irene Wilkinson.

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Executive summary

Health care associated infections (HAIs) cause patients pain and suffering, and use up valuable health-care resources. These infections prolong hospital admissions, create more work for clinicians and can cause significant harm to patients, some of whom die as a result. Many of these infections are preventable.

Each year in Australia there are about 200,000 HAIs. Spending on HAI surveillance can be a 'win–win' situation, because patient outcomes improve and health-care resources are made available for other uses.

The purpose of collecting and analysing reliable surveillance data is to improve quality and patient safety within a service or facility. Effective surveillance systems provide the impetus for change and make it possible to evaluate the effectiveness of interventions. An effective surveillance system is one that provides timely information to hospital managers and clinicians to promote action for health. The value of surveillance as part of a hospital infection control program is supported by high-grade international and national evidence. Currently, there is no systematic Australia-wide approach to the measurement of patient harm caused by or associated with HAI.

Prevention of HAI is the responsibility of all who care for patients, and can cost less than treating such infections. Infection has moved from being considered an unpredictable 'complication' to being considered a potentially preventable 'adverse event'.

This report summarises the state of HAI in Australia and makes recommendations for reducing HAI through surveillance and prevention.

Issues with health care associated infection in Australia

Australian efforts in HAI surveillance and prevention are mostly coordinated at a state or regional level. As a result, Australia does not have a systematic approach to HAI issues (such as infection control, hand hygiene and the management of antimicrobials) or to data gathering and analysis. The resources invested in HAI and the scope of surveillance (which infections are monitored and how) also differ across Australia.

The fragmented state of HAI surveillance in Australia means that information is scarce, unreliable and difficult to generalise from. For example, growing antimicrobial resistance contributes to poor patient outcomes and threatens to undermine the great advances in treatment of infectious diseases, but there is no national program to draw together data on the incidence and prevalence of multiresistant organisms in Australia.

Effect of the quality and safety movement

The quality and safety movement provided new and important impetus for action by framing infection control as a problem for patient safety. In 1991, The Harvard Medical Practice study demonstrated the large volume of potentially preventable harm occurring in hospitals. The report was followed by similar findings worldwide, which led to calls for action to make health care safe. In Australia, one of the major policy responses to this situation was the formation of the Australian Council on Safety and Quality in Health Care — the predecessor to the Australian Commission on Safety and Quality in Health Care (ACSQHC).

HAI is the most common complication affecting patients in hospital. Many such infections can be prevented using approaches based on quality and safety theory, such as:

- quality improvement methodologies
- safety culture (ie a system in which individuals feel responsible for helping to increase safety and quality)
- application of systems thinking (ie understanding the 'system factors' that allow individuals to make errors or prevent them from doing so).

Developing a national approach

The ACSQHC focuses on areas of the health system that could benefit from urgent national consideration and action. HAI is one of the commission's priority areas. The commission's HAI program focuses on identifying and addressing systemic problems and gaps, so that nationally coordinated action can be taken on this issue. Growing public awareness of the specific risks and significance of HAI makes the need for action more urgent.

This report includes recommendations, but these do not presume a solution; indeed, there is no single solution to the problem of HAI in Australia. Some recommendations are simple to implement, while others would require further action. No single body has responsibility for HAI, and this may have been a barrier to comprehensive improvement in the past. However, there are groups immediately able to act on some of these recommendations. The case this report makes for new action is compelling.

Issues covered in the report

This document first looks at surveillance as a whole, then at specific sites of infection or populations, specific organisms or types of organism, specific locations in the hospital or community, preventive strategies, and human and economic costs. Each of the chapters includes key points and recommendations, which are also given at the end of this executive summary.

The most important sites of infection are the bloodstream and surgical sites. Infections in such sites, particularly those due to methicillin-resistant *Staphylococcus aureus* (MRSA), cause complications, and one in three patients who develop such infections die. MRSA is now endemic in most Australian hospitals.

The most important preventive strategies to reduce and prevent HAI include hand hygiene, the appropriate use of antibiotics and immunisation of health-care workers (HCWs). Monitoring of process (eg hand washing compliance) and outcome (eg bloodstream infections (BSIs)) can improve hand-hygiene practices. Antibiotic stewardship programs have been shown to reduce resistance rates, morbidity, mortality and cost, but Australia needs better national data on use of antimicrobials. HCWs who are not immunised place patients at risk of acquiring vaccine preventable diseases, and more complete data are needed to help staff and employers to reduce this risk.

Specific populations at risk of HAI include neonates and HCWs. Surveillance results can be used to inform birthing practices and so reduce the risk of some neonatal infections. A national perspective is needed on HCW exposure to infectious agents; for example, through injuries from sharps.

Specific organisms, especially those that are multiresistant, increase the morbidity and mortality associated with HAI. They also increase costs; for example, because patients stay longer in hospital if they acquire an HAI. The multiresistant organism *Clostridium difficile* is a major

problem overseas but not yet in Australia. The analysis and recommendations contained in this document provide an opportunity to put into place early warning and response capabilities that incorporate guidelines for the prevention, control and outbreak management of *C. difficile*. Respiratory syncytial virus and rotavirus are two microorganisms that can spread rapidly within hospitalised paediatric patients, increasing length of stay and sometimes causing serious morbidity and mortality, especially in immunocompromised children and premature babies.

Some hospital environments, such as intensive care units (ICUs), provide an ideal setting for the development and spread of antimicrobial-resistant pathogens. Infection in ICUs can be greatly reduced by strategies monitored by effective surveillance. These strategies include the use of 'bundled' sets of practices (a number of evidence-based strategies used together) that improve outcomes when performed consistently. Neonatal ICUs have special surveillance needs. Two particular locations that require alternative surveillance approaches are smaller hospitals and residential-care facilities (which have particular infection issues and need to focus on simple surveillance and preventive strategies).

A patient with an HAI will probably stay longer in hospital, and will also be diagnosed and treated during this time, using up valuable health-care resources. Such patients will also lose some quality of life and be at greater risk of dying from infection. High-quality models are needed to determine the cost-effectiveness of programs that mitigate the risk of HAI.

Key points and recommendations

Chapter 1 Surveillance and quality improvement

Key points

- Reliable surveillance data underpin all quality-improvement processes.
- Collection, analysis and reporting of surveillance data on HAIs is associated with a reduction in infection rates, morbidity and mortality.
- Process measurements are usually easier to measure, less ambiguous and more widely applicable than outcome indicators.
- Some outcome measurements are not appropriate for all agencies, due to the effect of confounders that are not associated with or controlled by patient safety activities, and the inability to risk adjust for these effects.
- Other outcome measures — for example, the incidence of health care associated MRSA bacteraemia — appear to be reliable and have driven practice change, leading to significant improvements in patient safety.
- Effective methods of feedback are needed.
- There is insufficient evidence to determine the value of public reporting of HAI in assisting in a reduction in HAI in health-care facilities.

Recommendation on surveillance and quality improvement

1. All health facilities require HAI surveillance systems because these are proven to reduce infection rates when local data collection results in timely feedback.

Chapter 2 Bloodstream infection

Key points

- BSIs are common, and cause significant illness and death; more than half of these infections are associated with health-care procedures.
- Each year in Australia, there are likely to be more than 12,000 BSIs associated with health care.
- Studies in Australia document that 17–29% of patients with hospital-acquired BSIs die while still in hospital. Patients who develop BSIs are also more likely to suffer complications during their hospital stay that result in a longer hospital stay and an increased cost of hospitalisation.
- *Staphylococcus aureus* is the most common cause of health care associated BSIs. In Australia, there are about 7000 *S. aureus* BSI episodes per year, most of which are associated with health-care procedures and are thus potentially preventable.
- The use of intravascular catheters is the most common medical procedure associated with health care associated BSIs. These catheters are associated with more than 3500 BSIs per year in Australia.
- People who are immunocompromised, on haemodialysis or in ICUs are more likely to develop health care associated BSIs and require special preventive measures to be taken.
- Quality-improvement programs in Australia and overseas that have involved surveillance and then implementation of improved policies and procedures have resulted in sustained falls in the incidence of health care associated BSIs. For example, over three years the incidence of MRSA in the United Kingdom and of intravenous (IV) sepsis at the Canberra Hospital has fallen by 50%.

Recommendations on bloodstream infection

1. A mandatory continuous national surveillance system is required to collect and report an agreed minimum dataset for:

- *S. aureus* bacteraemia, including MRSA
- central line associated BSI in all ICUs
- haemodialysis access associated BSI.

2. Australian expert consensus is required to agree on national definitions for IV device-associated BSIs and methods for calculation of infection rates.

3. All health-care settings should take action to monitor and reduce the incidence of IV device-associated BSIs.

Chapter 3 Surgical site infection

Key points

- Surgical site infections (SSIs) are associated with substantial morbidity, mortality and costs.
- Surveillance of SSIs, coupled with prompt feedback of data from the infection prevention team to treating clinicians, can achieve major reductions in SSI rates.
- Reporting of risk-adjusted, procedure-specific SSI rates is a measure of quality of surgical care.
- Surveillance methods based on the United States National Healthcare Safety Network (NHSN) (formerly the National Nosocomial Infections Surveillance System (NNIS)) have

been widely used internationally. Australian state surveillance programs use the NHSN/NNIS definitions.

- Australian states and territories differ in the extent of SSI surveillance, the resources available, and the approaches to mandatory reporting of data and to risk adjustment of infection rates.
- An Australian national surveillance database of SSI rates would primarily be of value if it was timely and allowed valid comparisons of infection rates between hospitals. An agreed national approach to risk adjustment is required before a useful national database can be established. Ongoing local support is needed to promote data quality and ensure that programs are responsive to local needs.
- Benefits of such a database would be:
  - a greater understanding of the nature and extent of SSIs after many types of surgery
  - efficiencies and economies in educational activities and support
  - development of improved surveillance methods.
- Validation studies are essential to develop confidence in data, but have only recently been undertaken for SSI surveillance data.
- There is no widely accepted method of post-discharge surveillance.
- Surveillance of surgical antibiotic prophylaxis and feedback of hospital performance with respect to national guidelines has led to some improvements in clinical practice.

Recommendations on surgical site infection

1. Local surveillance of SSI and infecting pathogens should be undertaken.
   - Surveillance should include all coronary artery bypass graft surgery, major joint prosthesis insertion, and other important surgeries (in terms of surgical frequency, or SSI morbidity; for example, lower segment caesarean section) and procedures locally noted to have higher than expected SSI rates.
   - Standard NHSN/NNIS surveillance methodology (ie definitions of infection and detection methodologies) should be used.
   - Staff need to be trained in data collection, audit and surveillance.
   - Post-discharge surveillance data requires the development of a validated, cost-effective method.
2. Risk-adjustment methodologies for SSI surveillance to facilitate national benchmarking are required.
3. Surgical antibiotic prophylaxis should be used as a key national hospital quality-of-care measure.

Chapter 4 Neonatal infection — early onset

Key points

- Sepsis occurring in the first week of life (early onset sepsis (EOS)) can be a devastating problem; it has an incidence of about 1–2 per 1000 live births and case mortality rates of 8–10%.
- Group B streptococci and Enterobacteriaceae (eg coliform bacteria such as *Escherichia coli*) are the main causes of EOS in more developed countries.
- Intrapartum antimicrobial prophylaxis has lowered the incidence of early onset group B streptococci sepsis by 50–80%.

- Surveillance of EOS is important to demonstrate the effectiveness of preventive efforts and to detect significant changes in incidence or emergence of antibiotic resistance.

Recommendation on neonatal infection — early onset

1. All birthing services should measure and report the incidence of and mortality from early onset bacterial sepsis (including meningitis).

Chapter 5 Health-care worker bloodborne virus exposure

Key points

- There is international agreement that occupational exposure causes a substantial burden and cost to both health-care systems and individuals.
- International experience shows that occupational exposure surveillance can:
  - demonstrate trends in injury and exposure
  - enable early recognition of specific problems
  - be used to direct prevention efforts and risk management
  - permit ready assessment of the impact of prevention efforts.
- Australian health care and HCWs will benefit from the establishment of an ongoing, standardised, aggregated national system for occupational exposure data.

Recommendation on health-care worker bloodborne virus exposure

1. A national surveillance system for monitoring trends in occupational exposure to bloodborne pathogens should be developed.

Chapter 6 Multiresistant organisms

Key points

- Antimicrobial resistance contributes to poor patient outcomes and threatens to undermine the great advances in treatment of infectious diseases that have occurred over the past 40 years.
- The relationship between antibiotics and antibiotic resistance is complex, and encompasses selection and dissemination of resistance determinants between human and bacterial hosts. Antibiotic resistance in the community is emerging as a significant problem worldwide, but Australia has few ways of measuring this nationally at present.
- Surveillance systems for multiresistant organisms have traditionally been laboratory based, with percentage resistance among laboratory isolates being the most frequently used summary measure. However, laboratory surveillance alone does not give a measure of the burden of disease caused by multiresistant organisms. Active prospective surveillance is required to:
  - measure the incidence of new antibiotic resistance in microorganisms
  - detect emerging resistance and outbreaks of cross-infection within an institution
  - monitor the success or otherwise of interventions designed to reduce the acquisition of multiresistant organisms.
- Standardised protocols for screening multiresistant organisms and definitions for surveillance indicators have been developed for Australia, and many hospitals have adopted these. Some states have established centres for data aggregation for at least some organisms, such as

MRSA and vancomycin-resistant enterococci (VRE), but only one state has expanded this to include other types of multiresistant organisms. MRSA is the most commonly reported multiresistant organism and is responsible for the greatest burden of disease.

- Antibiotic usage monitoring and analysis is necessary to improve antibiotic-prescribing patterns and reduce the main driver of resistance. This is particularly important in Australia, where the overall usage in tertiary referral hospitals is high compared to international benchmarks, such as the Scandinavian countries or the Netherlands.

Recommendations on multiresistant organisms

1. A feasibility study on reporting all health care associated MRSA infections, using the established Australian Infection Control Association (AICA) definitions for multiresistant organism indicators, should be undertaken.

2. A comprehensive laboratory-based surveillance program for antibiotic resistance as recommended by the National Health and Medical Research Council (NHMRC) is required.

3. A national surveillance program in high-risk patient groups (eg ICU) for infections caused by gram-negative bacilli harbouring key resistances, including extended spectrum beta-lactamases, plasmid-mediated AmpC and metallo-beta-lactamases, is required.

4. Training programs for Australian laboratories to promulgate best practice methodologies for detecting and reporting resistance in organisms responsible for HAIs — MRSA, vancomycin-intermediate or vancomycin-resistant strains of *S. aureus*, VRE and multiresistant gram negative bacteria — are required.

Chapter 7 *Clostridium difficile* associated disease

Key points

- *C. difficile* is a common HAI that causes significant patient morbidity and mortality, as well as adds to health-care costs. Almost all cases follow the use of antibiotics, and the major reservoir of infection is infected patients in hospitals or long-term care facilities.
- The emergence of a novel strain of *C. difficile* (NAP1/027(B1/NAP1)) in North America and Europe has been associated with increased frequency, severity and relapse of *C. difficile* disease.
- Principles of *C. difficile* prevention include antibiotic stewardship, monitoring of incidence and outbreaks, appropriate use of contact precautions, accurate identification of infected patients, consistent hand hygiene and improved environmental cleaning.
- A variety of surveillance systems and definitions have been used to monitor infection rates. Recently published international recommendations and definitions support implementation of an appropriate surveillance program in Australia.

Recommendations on *Clostridium difficile* associated disease

1. Early warning and response capabilities for *C. difficile* associated disease (CDAD) should be developed to include:

- reporting of severe cases to jurisdictions and nationally
- ensuring culture for *C. difficile* occurs across a wider spectrum of laboratories.

2. Strain typing and surveillance for *C. difficile* is required nationally, including testing for the presence of the emerging, highly virulent NAP1/027 strain.

3. *C. difficile* surveillance results should be linked with antibiotic use data from each facility to highlight specific drivers of local *C. difficile* incidence.

4. National guidelines for prevention, control and outbreak management of CDAD (including isolation) should be accessible and current.

Chapter 8 Respiratory syncytial virus infection

Key points

- Respiratory syncytial virus (RSV) is the leading cause of paediatric lower respiratory tract infections and related hospitalisations and of HAIs in infants and young children.
- The burden of severe RSV disease falls particularly on premature infants, immunosuppressed patients, and children and adults with chronic respiratory and cardiac disease.
- Mortality rates are low in developed countries but infections have a significant impact on the health-care system.
- Targeted infection control programs that control the spread of RSV within paediatric hospitals are highly cost-effective.
- Effective surveillance systems are required to detect the onset of the annual community-acquired RSV season and to measure the effectiveness of facility infection control programs for health-care acquired cases.

Recommendation on respiratory syncytial virus infection

1. Monitoring and prevention of hospital-acquired paediatric cases of RSV should be based on laboratory-confirmed RSV results.

Chapter 9 Rotavirus infection

Key points

- Rotavirus is the major agent of paediatric hospital-acquired diarrhoea across the world; it particularly affects younger infants, including neonates.
- Mortality rates are low in developed countries; however, the impact on the health-care system is significant.
- Controlling the spread of rotavirus within paediatric hospitals through targeted infection control programs is cost-effective.
- Effective surveillance systems are required for community-acquired cases (to identify the onset of the annual rotavirus season) and for hospital-acquired cases (to measure the effectiveness of facility infection control).
- The recent availability of a rotavirus vaccination makes more effective prevention a prospect.

Recommendation on rotavirus infection

1. Monitoring and prevention of hospital-acquired paediatric cases of rotavirus should be based on laboratory-confirmed rotavirus results.

Chapter 10 Adult intensive care unit acquired infection

Key points

- Patients in ICUs are at high risk of HAIs that often have severe adverse outcomes.
- The most important HAI types are central line associated BSIs and ventilator-associated pneumonia.
- Many international ICU-acquired HAI surveillance programs base their methods on the United States NHSN/NNIS program.
- Several Australian states undertake ICU surveillance — particularly of BSIs — using either NHSN/NNIS definitions or those of AICA.
- The NHSN/NNIS definitions for BSIs have recently changed, and this should prompt a review of the Australian definitions.
- In the United States, recent comprehensive prevention programs that 'bundle' a group of three to five evidence-based HAI strategies have significantly reduced ICU-acquired infections.
- ICUs provide an ideal environment for the development and spread of antimicrobial-resistant pathogens and are the setting for considerable broad-spectrum antimicrobial use. Antimicrobial resistance is expected to increase.
- Optimal antibiotic use, guided by a local knowledge of likely pathogens and their antibiotic resistance, is a key factor in controlling the development of antibiotic resistance.
- No integrated national surveillance system exists to monitor ICU infections, antimicrobial resistance or antibiotic use. Standardised monitoring of antibiotic use has recently been established in some Australian ICUs.

Recommendations on adult intensive care unit acquired infection

1. A mandatory continuous national surveillance system to collect and report on an agreed minimum dataset for central line associated BSIs in all ICUs is required.

2. Australian expert consensus is required to agree on national definitions for central line associated BSIs and ventilator-associated pneumonia, and methods for calculation of infection rates.

3. Evidence-based strategies for HAIs should be used to target central line associated BSIs and ventilator-associated pneumonia. These will include standardised application and auditing of compliance.

4. Monitoring of national antibiotic usage and resistance surveillance data, resistance management, and intervention strategies requires a comprehensive integrated surveillance program.

5. Expansion of the national antibiotic utilisation data obtained from hospital pharmacies to include data from all ICUs.

Chapter 11 Neonatal intensive care unit acquired infection

Key points

- Late onset (intensive care associated) sepsis is a major cause of mortality and morbidity in neonates who require intensive care management. Infection is associated with adverse neurodevelopmental outcomes.
- Best practice is likely to protect most neonates from developing intensive care associated infections.
- Systematic surveillance of infection and antibiotic resistance is required to improve quality and provide meaningful benchmarks.

Recommendations on neonatal intensive care unit acquired infection

1. The late onset neonatal sepsis indicators (BSI and meningitis) developed by the Australian Council on Healthcare Standards (ACHS) and the Australian and New Zealand Neonatal Network (ANZNN) in 2003 require revision.

2. Standardised indications and methods for collection of blood and cerebrospinal fluid cultures from neonates are required.

3. Benchmarking of neonatal intensive care surveillance data is required. Neonatal ICUs should measure and report antibiotic resistance and usage. The development and updating of prescribing guidelines and other aspects of antibiotic stewardship should be based on analysis of antibiotic resistance and usage.

Chapter 12 Smaller hospitals

Key points

- There is limited published literature on HAIs and surveillance programs in smaller hospitals (<100 acute-care beds) because most frequently referenced studies have taken place in larger hospitals.

Recommendations on smaller hospitals

1. A surveillance program for smaller hospitals (<100 acute-care beds) based on the signal event surveillance program and relevant process indicator measures is required.

2. Smaller hospitals require mechanisms to support staff involved in infection prevention and control; for example, through external support networks and alignment of services with infection prevention and control teams from larger hospitals, or with regional, state and territory groups.

Chapter 13 Residential aged-care facilities

Key points

- As Australia's population ages, the number of elderly people living in residential aged-care facilities is expected to increase substantially.
- Residents of residential aged-care facilities are at high risk from community infections and HAIs. They live in a home-like environment, have close contact with potentially infected or colonised residents and staff, have increased antibiotic exposure and exposure to hospital stays, and are often immunocompromised.
- Residents of residential aged-care facilities may become colonised with multiresistant organisms, which are transmitted to other patients when residents are hospitalised.

- Infection surveillance systems in residential aged-care facilities are needed to detect disease outbreaks. Routine detection of sporadic infections is error prone, given the variability in current infection definitions and surveillance methods, and the lack of trained staff.
- Optimal infectious disease control in residential aged-care facilities focuses on preventive strategies (eg immunisation of staff and residents) and compliance with process measures (eg hand hygiene and other standard infection control requirements).

Recommendations on residential aged-care facilities

1. Long-term facilities require a standardised system of local surveillance focusing on processes such as standard infection control precautions, including hand-hygiene compliance and device-related care.

2. Immunisation status among residents and staff should be monitored, with particular reference to influenza, hepatitis B and hepatitis A.

3. The development of validated Australian definitions for infection surveillance in residential aged-care facilities is required.

4. The development of strategies to evaluate and improve antibiotic prescribing in residential aged-care facilities is required.

Chapter 14 Hand hygiene

Key points

- Transfer of microbial pathogens on the hands of HCWs is a key driver of HAI.
- Alcohol-based hand-hygiene programs have been shown to improve hand-hygiene compliance and reduce HAIs in observational studies in Geneva and Melbourne.
- In the United States, the Centers for Disease Control and Prevention (CDC) now recommends that health-care facilities introduce and maintain alcohol-based hand-hygiene programs for HCWs.
- The World Health Organization (WHO) similarly recommends the worldwide introduction of alcohol-based HCW hand-hygiene programs based on their 'five moments for hand hygiene' initiative.

Recommendations on hand hygiene

1. Repeated monitoring of hand-hygiene programs through process measures (eg monitoring compliance with WHO's 'five moments for hand hygiene') and outcome measures (eg rates of nosocomial sepsis, using an indicator organism such as MRSA) should be conducted in all health-care facilities.

2. Alcohol-based products used for hand hygiene must conform with international testing standard EN 1500.

3. All hand-hygiene clinical competency assessments should be assessed against WHO's 'five moments for hand hygiene' guidelines.

Chapter 15 Antimicrobial usage: monitoring and analysis

Key points

- Monitoring and analysis of antimicrobial usage is critical to understanding antibiotic resistance and to monitoring effects of containment strategies.
- Methods of antimicrobial data collection differ, but most institutions provide population surveillance data obtained from computerised pharmacy records.

- Surveillance data can be used to identify changes in usage that may be linked to development of resistance and to measure the impact of antimicrobial stewardship programs.
- Antimicrobial stewardship programs have been shown to reduce resistance rates, morbidity, mortality and cost.
- Comprehensive, integrated surveillance programs operate in the United States and Europe, where programs include the European Surveillance of Antimicrobial Consumption, the Danish Integrated Antimicrobial Resistance Monitoring and Research Program, a surveillance program for antimicrobial consumption and resistance in the Netherlands, and the Swedish *Antimicrobial Utilisation and Resistance in Human Medicine* report. In Europe, reports on antimicrobial consumption and resistance are published annually.
- In Australia, the National Antimicrobial Usage Surveillance Program provides monthly reports on hospital inpatient antibiotic usage to contributing hospitals and bi-monthly reports to the Australian Department of Health and Ageing. Data are contributed by 50% of principal referral hospitals from six states.
- Comparison with international data shows that Australian usage rates in hospitals are high for some antimicrobial classes. The total use of antibiotics in the Australian community falls in the middle of the range recorded in European countries.
- The Drug Usage Subcommittee of the Pharmaceutical Benefits Advisory Committee reports on antibiotic use in the community sector to the Expert Advisory Group on Antimicrobial Resistance, the Australian Institute of Health and Welfare and the WHO International Committee on Drug Statistics Methodology. Antibiotic usage data are also published in The Australian Statistics on Medicines. The data are used by the National Prescribing Service to inform program planning.
- Australian antimicrobial usage data are incomplete and not linked with resistance surveillance data, which limits their potential use.

Recommendations on antimicrobial usage: monitoring and analysis

1. Monitoring of national antibiotic usage and resistance surveillance data, resistance management, and intervention strategies requires a comprehensive integrated surveillance program.

2. National antibiotic stewardship guidelines are required for all health-care settings; surveillance data should guide the development and updating of prescribing guidelines, decision support systems (including computerised approval systems), clinical guidelines and education.

3. Antibiotic resistance and usage data should be made available at clinical service, hospital and national levels.

Chapter 16 Health-care worker immunisation

Key points

- Immunising HCWs can prevent infection associated with health care.
- HCW immunisation currently occurs at the level of individual health-care units for the protection of individual HCWs. State and territory governments have begun to consider or initiate systematic programs aimed at disease prevention for the whole health-care population, but Victoria is the only jurisdiction to have established a limited surveillance program. The international situation seems similar.
- In Australia, national recommendations for HCW immunisation were republished in 2003. A national program is warranted, given the existence of the national recommendations, the

mobility of the Australian health-care workforce, inconsistencies between states and territories, and duplications of effort.

- HCW immunisation should be an integral part of national disease control programs. An effective national program would need to be underpinned by national surveillance, with standards comparable to those already in place for the National Immunisation Program.

Recommendations on health-care worker immunisation

1. All Australian HCWs should be immunised in accord with the NHMRC *Australian Immunisation Handbook* to protect HCWs and patients from vaccine-preventable diseases, including influenza.

2. National surveillance of vaccine-preventable infections should include data on employment status as an HCW (ie when a person is vaccinated, information should be collected as to whether the person is an HCW).

3. Standardised recording of HCW immunity and immunisation status is required.

Chapter 17 Costs of health care associated infection

Key points

- The costs of HAIs are difficult to measure and value.
- The costs are an important consideration for any decision to increase investment in infection control programs.
- The greatest cost is the bed days lost to infection within the hospital sector.
- The value of these bed days depends on the need of the general population to access hospital services and the willingness of decision makers to pay for these services.
- Based on the available data and a number of assumptions, it is estimated that almost two million bed days are lost to infection per year in Australia.
- The data must be interpreted carefully because not all infections can be prevented.
- There are also many private and difficult-to-value costs associated with infection: these include pain and suffering for patients and their families.

Recommendation on costs of health care associated infection

1. The process of attributing cost to HAI should be expressed in terms of the number of bed days that are released by effective infection control programs as well as any savings in variable costs.