



Infection control: beyond the horizon

J. Gray*

Birmingham Children's Hospital, Steelhouse Lane, Birmingham B4 6NH, UK

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SUMMARY

This article will consider possible future directions for innovation and research in infection prevention and control, and will make the case for the importance of including clinical and cost-effectiveness evaluation in such research. Opportunities for studies in a number of broad subject areas will be considered, including prevention and control of existing and emerging infection hazards, the challenges posed by changes in the way that medical care is being delivered, technological developments that could be harnessed for infection prevention and control, how new laboratory diagnostic technologies might benefit infection prevention and control, cleaning and decontamination, and the infection control aspects of hospital design. The need for robust economic data to support the wide and timely implementation of evidence-based practice is emphasized.

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Introduction

The past decade has seen important improvements in hospital infection prevention and control globally. However, these have been largely based on getting back to basics, with measures such as the renaissance of hand hygiene, improved environmental cleaning, use of care bundles, and wider use of culture-based screening. Whereas opportunities remain for further research in some of these areas, the next decade offers many new opportunities for research, both to harness new technologies and to respond to existing and emerging infection hazards. The aim of this article is to consider future directions for innovation and research in infection prevention and control in healthcare. The article speculates on where research in infection prevention and control may go in the next decade and beyond under a number of broad subject headings. It also makes a case for the need for stronger health economic

analysis in an era when competition for limited healthcare resources is likely to become even fiercer.

Existing and emerging infection hazards

Types of infection

Point-prevalence studies of healthcare-associated infections (HCAIs) have been undertaken in many countries, and show that the same types of infections predominate worldwide.¹ The most prevalent HCAIs are urinary tract infections, surgical site infections (SSIs), pneumonia, gastrointestinal infections, and bloodstream infections. Progress made so far in preventing each of these types of infection has been unequal. In particular, relatively little progress has been made in reducing the incidence of SSIs. This is despite the importance of SSIs as a cause of mortality, morbidity, excess hospital stay, and economic loss. Reasons for this may include the lack of accurate data on rates of SSI, and the lack of good evidence on which to base a comprehensive prevention strategy. Further

* Tel.: +44 (0)121 333 9815.

E-mail address: Jim.gray@bch.nhs.uk.

studies to investigate the optimal pre-, intra- and post-operative care of patients undergoing surgery are required. In the UK, a sharp fall in the incidence of bloodstream infections with meticillin-resistant *Staphylococcus aureus* (MRSA) occurred following a multi-faceted national campaign; this experience suggests that there may be scope to reduce substantially the incidence of other healthcare-associated bloodstream infections.²

Antimicrobial resistance

The threats posed by antibiotic resistance are now recognized at governmental level across the world. However, even the most optimistic commentator would have to agree that the best that can currently be hoped for is that the emergence and spread of pandrug-resistant bacteria will slow down; these bacteria will be part of our lives for the foreseeable future. Consequently, increasing numbers of patients admitted to hospital are likely to be colonized with antimicrobial-resistant (AMR) bacteria. Early detection of carriers of these bacteria is undoubtedly important, and in England guidance has recently been published on screening for carbapenemase-producing Enterobacteriaceae.³ However, it is likely that the sheer number of patients who are colonized with AMR bacteria will overwhelm the capacity of many hospitals to isolate cases in single rooms. It is unlikely that all patients colonized with AMR bacteria present the same infection control threat. Studies that would help in stratifying infection control risks according to patient and organism factors would be useful in determining whether some patients could be safely nursed without isolation, whether patients with different AMR bacteria can feasibly be cohort-isolated, and whether there would be any benefit from the establishment of cohort wards, as have been used for other types of infection such as MRSA and *Clostridium difficile*.

Changes in medical care

Demographic changes

The world is facing major demographic changes that will have important implications for infection prevention and control.

In 2005 it was estimated that there were 937 million overweight [body mass index (BMI) ≥ 25 kg/m²] and 396 million obese (BMI ≥ 30 kg/m²) adults in the world. By 2030, the respective numbers are projected to be 2.16 billion overweight and 1.12 billion obese.⁴ Obesity is a direct risk factor for several types of infection; many of the consequences of obesity such as diabetes mellitus and immobility further add to the risks of infection.⁵ SSIs in obese patients are a major problem. Not only are these infections more prevalent, but the consequences of infection are more severe: patients are more likely to require reoperation and prolonged hospitalization, and to experience long-term morbidity. Although there have been some, mostly small, studies reporting different strategies to prevent infections after specific types of surgery in obese patients, such as local infusion of antibiotics into tissues at the time of wound closure, extended duration of antibiotic prophylaxis, there is no consensus on the best way of managing this group of patients.⁵

Life expectancy is rising by at least two years per decade. In the UK it is projected that by 2037 cohort life expectancy at birth will be 94.3 years for males and 97.3 years for females.⁶ The

elderly are at increased risk of infection for physiological reasons (impaired immune function, anatomic and functional changes); for social reasons (in many countries the elderly will be spending time in close proximity to many other elderly people for part or all of the day, rather than staying in their own homes); and for medical reasons (different types of medical care such as use of urinary catheters). Many outbreaks of infection have been described in elderly care facilities, but there has been far less research into the prevention of infection in this setting.

Changes in the way that hospital care is provided

A growing amount of hospital care involves intensive or high-dependency care. Intensive care and high-dependency units are getting bigger. Designs are often based around patient safety and staff working conditions, priorities that may sit uncomfortably with infection prevention and control. Research is needed to establish whether there are optimal designs and operations for intensive and high-dependency care units to minimize the risks of direct and indirect transmission of infection between patients.

At the other extreme of hospital care, there is a major trend towards managing people who would once have been hospitalized at home under hospital-at-home schemes. From an infection prevention and control point of view, this seems to offer benefits by minimizing the amount of time during which patients are exposed to nosocomial pathogens in hospitals. However, there may also be important infection-related risks to patients receiving care outside hospitals. For example, the home environment may be less hygienic, and healthcare workers visiting patients' homes may be less inclined to follow good infection control practices; certainly independent audits of compliance with good infection control practice are not possible. There are also risks of delays in the recognition of, or medical response to, early signs of infection, meaning that serious infections may develop before antibiotic treatment can be commenced. Further research is required before evidence-based approaches to infection prevention and control in the hospital-at-home setting can be established.

Technological developments

Many aspects of our everyday lives are now heavily influenced by technology. In the past decade, smartphones have changed the way that we communicate, shop, and bank, and now a new generation of wearable devices is emerging. So far, however, adoption of new IT systems in healthcare has been painfully slow, and in infection prevention and control-related activities we continue to use systems based on very old software. Sun Microsystems' co-founder, Vinod Khosla, is on record as saying that: 'In the next 10 years, data science and software will do more for medicine than all of the biological sciences together.' We may all have our own ideas about where IT developments might be of most value, but the following paragraphs consider how the digital revolution in healthcare could transform infection prevention and control.

Electronic health records

Electronic health records will make it feasible to undertake large national or international epidemiological studies with the

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