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Funding healthcare-associated infection research: a systematic analysis of UK research investments, 1997–2010☆

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SUMMARY

Background: Healthcare-associated infections (HCAIs) are a cause of high health and economic burden in the UK. The number of HCAI research studies funded in the UK, and the associated amount of investment, has not previously been analysed.

Aim: To assess the level of research funding awarded to UK institutions for HCAI research and the relationship of funded research to clinical and public health burden of HCAIs.

Methods: Databases and websites were systematically searched for information on how infectious disease research studies were funded for the period 1997–2010. Studies specifically related to HCAI research were identified and categorized in terms of funding by pathogen, disease, and by a research and development value chain describing the type of science.

Findings: The overall dataset included 6165 studies (total investment £2.6 billion) of which £57.7 million was clearly directed towards HCAI research across 297 studies (2.2% of total spend, 2.1% of total studies). Of the HCAI-related projects, 45 studies had a specific focus on MRSA (£10.3 million), 14 towards *Clostridium difficile* (£10.7 million), two towards pneumonia (£0.3 million) and 103 studies related to surgical infections (£14.1 million). Mean and median study funding was £194,129 (standard deviation: £429,723) and £52,684 (interquartile range: £9,168 to £201,658) respectively. Award size ranged from £108 to £50.0 million.

Conclusions: Research investment for HCAIs has gradually increased in the study period, but remains low due to the health, economic, and social burden of HCAI. Research for hospital-acquired pneumonia, behavioural interventions, economic analyses, and research on emerging pathogens exhibiting antimicrobial resistance remain underfunded.

Introduction

Healthcare-associated infections (HCAIs) account for a significant burden of disease in the UK. Meticillin-resistant *Staphylococcus aureus* (MRSA) infections, which were the subject of much media attention, peaked in 2003, but in

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England since 2006 there has been a decline in the rate of MRSA bloodstream infection.[1] Similarly, rates of *Clostridium difficile* infection have been decreasing year on year in the UK since 2008, though they still number almost 15,000 per year, and there are global concerns about antimicrobial resistance; for example, carbapenem-resistant *Acinetobacter baumannii* is increasing in prevalence and is notable in particular for its ability to cause infections in immunocompromised patients.[2–4] Norovirus is a common pathogen in hospitals, often causing outbreaks that require the closures of wards in England and beyond with consequent significant economic burden.[5] Viral hepatitis may be transmitted by multiple routes and in numerous different settings, including within the healthcare setting – one review reported on 33 hepatitis B virus outbreaks that involved 471 patients, with 16 fatal cases.[6] In the UK, there has also been neonatal mortality associated with outbreaks of pseudomonas.[7]

The true economic burden of HCAIs across UK hospitals and other healthcare providers is difficult to establish – the most recent estimate published in 2000 suggested that the annual cost of HCAIs in the UK was approximately £1 billion.[8] Antimicrobial resistance (AMR) has also led to substantial morbidity, mortality and financial impact on hospitals and other healthcare institutions. Globally, infection prevention and control has become a priority for healthcare organizations, and institutional management of HCAIs is recognized as being critical to improving quality of care and patient safety.[9]

In the USA, the total annual costs of HCAIs is thought to be greater than US$9.8 billion, with surgical site infections contributing to a third of these costs, and approximately 50% of the incidence is thought to be preventable.[10] The infection rates for HCAIs vary greatly by country.[11] Globally, there is a high burden of antimicrobial resistance bacteria.[12] Healthcare-associated bloodstream infections and pneumonia have been shown to greatly increase mortality and the length of stay in intensive care units.[13] Modelling studies have typically been limited to studying transmission pathways in the UK, USA and The Netherlands, rather than the health, economic, and societal cost of HCAIs.[14] There are few data on the burden of HCAIs in low-income countries.[15]

Between 1997 and 2010, UK research institutions received around £2.6 billion of public and philanthropic funding for infectious disease research from a variety of national and international funding sources.[16] In this study, we estimate research funding awarded to UK institutions specifically for HCAI research, with temporal trends, and assess the relationship of funded research to clinical and public health burden of HCAIs.

Methods

We analysed all the studies funded in a 14-year period (1997–2010 inclusive) that were clearly relevant to, or had specific mention of, healthcare-associated infectious disease. No private sector (commercial) funding was included in this analysis as few data are publicly available.

The analysis presented here is a subset of a larger study on funding of infectious diseases in the UK, and as such the methods have been described in detail elsewhere, but are discussed here briefly.[16] The overarching dataset was developed following a detailed and systematic search of all the studies for infectious disease research from the major sources of public and charitable funding for infectious disease research studies, including the Wellcome Trust, Medical Research Council, and other research councils, UK government departments, European Commission, the Bill and Melinda Gates Foundation, and other research charities. We developed the dataset by (a) downloading all data from the funder website and manually filtering the infectious disease studies; or (b) searching open access databases on the funder website for infection-related keyword terms; or (c) contacting the funder directly and requesting details of their infection studies. Funders were identified through the authors' knowledge of the research and development landscape and searches of the Internet. M.G.H. performed the majority of data extraction, with support from J.R.F. Each study was assigned to as many primary disease categories as appropriate.[17] Within each category, topic-specific subsections (including specific pathogen or disease) were documented. Studies were also allocated to one of four research and development categories: preclinical; phase I, II, or III; product development; and implementation and operational research (including surveillance, epidemiology and statistical and modelling projects; for definitions and examples see ResIn[18]). Funders were considered either in their own right, or for convenience; some were grouped into categories, such as in-house university funding, research charities, and government departments. In total, 26 funder categories were used. Studies were excluded if: (i) they were not immediately relevant to infection; (ii) they were veterinary infectious disease research studies; (iii) they concerned the use of viral vectors to investigate non-communicable diseases; (iv) they were grants for symposia or meetings; or (v) they included UK researchers, but with the funding awarded to and administered through a non-UK institution. Studies were categorized as HCAI research where there was specific mention of, or a clear implication of relevance to, HCAIs in the title or abstract. Unfunded studies were excluded. Grants awarded in a currency other than pounds sterling were converted to UK pounds using the mean exchange rate in the year of the award. All awards were adjusted for inflation and reported in 2010 UK pounds. Analysis was carried out in Microsoft Excel and Access (versions 2000 and 2007) and Stata (version 11).

Results

We identified 6165 studies funded within the 14-year study period and covering all infectious disease research, representing a total investment of £2.6 billion. There were 297 studies of relevance to HCAI research, comprising in number 2.1% of total infectious disease research projects. These 297 studies were awarded £57.7 million, 2.2% of the total spend, with a median award of £52,684 (interquartile range: £9,168 to 201,658) and mean award of £194,129 (standard deviation: £429,723) (Table I). Award size ranged from £108 to £50.0 million.

Of the 297 HCAI projects (Table I), MRSA was the most-studied pathogen across 45 studies (15.2%), and these received £10.3 million (17.9%) of investment. There were 14 *C. difficile* studies (4.7%), which received investment of £10.7 million (18.5%), whereas acinetobacter investment totalled £0.3 million across four studies, viral hepatitis investment

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