



Strategy for Public Health Infection Research

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Strategy for Public Health Infection Research

An integrated national approach to infectious diseases research
that reflects the public health needs of the UK

1. Background

Infectious diseases outbreaks and epidemics can strike quickly with a substantial impact on society, and the political and healthcare landscape. Acute infections are responsible for a significant proportion of the infection related mortality and endemic and chronic infections severely affect people's lives and present a continuing operational and financial burden on the NHS. There have been major successes in controlling some infectious diseases, including many serious childhood infections through vaccination programmes. The UK is a world leader in the field and there is an opportunity to harness the rapid advances in diagnostic methods, genomics, information and communication technologies, to better understand, prevent and manage the public health burden caused by infectious disease.

Public health infections research is one of four priority areas identified under the Office for Strategic Coordination of Health Research (OSCHR) public health work stream. The National Institute for Health Research (NIHR) has been tasked with leadership of the development of a public health infection research strategy and the Medical Research Council (MRC) has worked with NIHR on its development.

The primary aim of the strategy is to deliver a vision for an integrated national approach to infectious diseases research that reflects the public health needs of the UK and the relative strengths of the UK health research community, including research in developing countries with relevance to the UK. The objective is to provide a clear statement of the research needs and opportunities and in the field and to engage funding bodies and policy makers in order to inform funding priorities and policy development.

To achieve this, a three phase review process was used, comprising a scoping exercise and literature review, expert survey, and consultative workshop. The process has engaged with stakeholders in the UK infection research community and gathered views on what the key research questions of the future might be and how they might be tackled. Details on the review process are at [Annex 1](#), the membership of the Scientific Advisory

Group that has overseen the process is at [Annex 2](#) and the list of workshop attendees and the workshop report at [Annex 3 and 4](#).

2. A vision for public health infections research

Vision

To deliver a public health infection research capability which enables effective detection, prediction, prevention and management of infectious disease threats, to secure the health of the population. To promote resilience to infections through identifying and targeting the environmental and socio-economic determinants of infectious disease.

2.1 Guiding principles of the public health infection research strategy

The following guiding principles have been used to shape the aims and objectives of the public health infections strategy:

- To adopt a holistic approach not confined by disease, discipline or healthcare sector boundaries
- To address the 'One-Medicine' agenda by emphasising the need for cooperation between human and veterinary medicine given the importance of zoonoses in the aetiology and the burden of emerging and re-emerging infectious disease
- To fully exploit the opportunities arising from new technologies: molecular diagnostics and epidemiology, genomics, e-health and data linkage
- To ensure the maximum use of fundamental science to stimulate the development and implementation of new detection, prediction prevention and treatment strategies (e.g. vaccines, antimicrobials, linking surveillance and epidemiological studies with molecular biology, immunology, behaviour and health systems research)
- To encourage engagement of the academic research community with a broad range of stakeholders including: policy makers across Government Departments; the Health Protection Agency (HPA) and equivalent bodies in Scotland, Wales, and Northern Ireland; the breadth of healthcare providers from community level (PCTs) to acute NHS Hospital Trusts; the emerging strengths of the Academic Health Sciences Centres, and the National Institute for Health Research Biomedical Research Centres and Units, the pharmaceutical, biotechnology and diagnostics industries
- To take an 'end to end' approach: from detection of infections in individuals and at a population level, along the pathway of strategies for treatment and prevention, to the analysis of health, social and economic outcomes of infections
- To focus on society's needs, in particular the burden of infectious disease(s) on vulnerable groups: the young; elderly; disadvantaged and migrant populations

- To take a life course approach. How are infections acquired through the life course? What is their role in immune maturation and adult disease outcomes?

Many of these guiding principles are aligned with challenges set out in the vision of the Academy of Medical Sciences to reap the rewards of public sector investment in world class medical research¹.

¹ Reaping the rewards: a vision for UK medical science, The Academy of Medical Sciences (2010), <http://www.acmedsci.ac.uk/index.php?pid=99&puid=172>

2.2 Strategic aims

With an ever changing physical and natural environment the human population is constantly under threat from new, emerging and re-emerging infections. This strategy sets out to target the major perceived and potential infectious disease threats and to put in place a research agenda and measures to safeguard the health of the UK population. This will be achieved through four strategic aims:

1. Action against emerging dangers

To capture, characterise and contain – a robust science-led preparedness paradigm and rapid response capability and capacity for outbreaks and epidemics of new or re-emerging infections; refreshing the approach to antimicrobial resistance.

2. Understanding susceptibility and vulnerability to infectious disease

To quantify disease burden and to identify and target effective prevention and treatment strategies towards the most vulnerable groups in society including the young, elderly, disadvantaged or migrant populations.

3. Demonstrating benefit and future-proofing against infection

To evaluate the impact of research discoveries and intervention strategies and to use this knowledge and next generation technologies to future-proof against infection threats.

4. New look – new paradigms

To foster innovation in detection, treatment, and prevention – moving away from pathogen specific approaches.

2.3 Cross-cutting competencies

A set of core research skills and approaches will be needed to address the strategic aims of the public health infection strategy. These cross-cutting competencies will form the foundation of each aim and will be central to the effective delivery of the strategy, they are:

1. Research capabilities

The need to sustain a strong infection specific research capability:

- a research culture which effectively identifies cases at the point of presentation/care at the community or hospital level
- the development of well-characterised cohorts of infected individuals (short-term cohorts to address emerging issues within a focussed time frame)
- the use of existing population cohorts for the study of infections
- the evaluation of outcomes (including pathogenesis and phenotype/genotype interactions)

2. Research tools and technologies

The development and use of innovative research tools and technologies to understand phenotype-genotype relationships in both microbial and human populations. Specifically:

- diagnostics
- molecular epidemiology
- stratified clinical trials/ experimental medicine
- mathematical modelling
- pathogenesis/immuno-pathogenesis

3. Achieving the strategic aims

3.1 Action against emerging dangers

To capture, characterise and contain – a robust science-led preparedness paradigm and rapid response capability and capacity for outbreaks and epidemics of new or re-emerging infections; refreshing the approach to antimicrobial resistance.

Objectives

Epidemic preparedness/emergency responses

An effective response to outbreaks, epidemics and pandemics requires a public health sector that is able to rapidly identify cases at the point of presentation, to detect and characterise the pathogen and host response, and to predict disease burden. To meet this challenge effective research capability is needed in the following areas:

- 3.1.1** A strengthened capability for real-time clinical and behavioural research, including the capture and analysis of real-time data relating to disease presentation, treatment and outcomes and the impact of infectious disease at the population level
- 3.1.2** The development and use of rapid diagnostics, including point of care diagnostics to identify microbial and host signatures of infection. Preparedness for large scale development, use and rapid deployment of novel technologies.
- 3.1.3** Innovative approaches and novel paradigms for surveillance to determine the spread of infection, predict the changing environment and inform policy development (eg sentinel surveillance, use of new communication technologies, etc)
- 3.1.4** Understanding the drivers of disease transmission (see 3.3.4)
- 3.1.5** Cultural change to join up expertise and activity in the fields of diagnostics, molecular epidemiology, immunology and disease and behavioural surveillance in order to characterise effectively the nature of the disease burden and the ecology of infections
- 3.1.6** The promotion of joined up working across the academic and healthcare sectors together with the HPA (and equivalent bodies) and Government departments so as to link research agendas and emergency planning
- 3.1.7** An emergency response capability/panel of first responders that can be quickly mobilised as and when required. This could take the shape of a network of existing centres of excellence bringing together expertise across the range of disciplines required (microbiology, virology, immunology, molecular diagnostic epidemiology, surveillance and modelling, etc) to draw up contingency plans now for a science-led future emergency response

Emerging antimicrobial resistance

- 3.1.9** Novel approaches to surveillance and better integration of information infrastructure to determine spread of infectious disease (including across species) and disease burden, including antibiotic prescribing activity and patient and health professional behaviour

- 3.1.10** The development and use of rapid diagnostics, including point of care diagnostics to avoid inappropriate treatment and reduce antibiotic misuse
- 3.1.11** Innovation in antimicrobial development and the provision of evidence for novel molecules to be developed into drugs. This may be achieved through: public sector investment to stimulate early stage work and promoting public-private product development partnerships; support of international initiatives to combat antimicrobial resistance and stimulate antimicrobial development; encouragement of prioritisation of anti-infectives in drug screening programmes

3.2 Understanding susceptibility and vulnerability to infectious disease

There is a need to quantify disease burden and to identify and target effective prevention and treatment strategies towards the most vulnerable groups in society including the young, elderly, disadvantaged or migrant populations.

Objectives

Addressing this aim requires the definition of vulnerable and susceptible groups and an effectively tailored response. This can be achieved through the following means:

- 3.2.1** Using large scale genomics and high throughput 'omics' technologies in well-phenotyped representative samples of infected individuals to understand disease patterns, pathogenesis, immuno-pathogenesis, interaction between microbial and human phenotype and genotype, and the impact of interventions
- 3.2.2** Understanding vulnerability and susceptibility, including the biological and ecological (social, environmental, behavioural) determinants and risk factors and changing vulnerabilities in populations throughout the life course. Of particular importance is a better understanding of why many individuals remain healthy despite community or individual exposure, for instance because of behaviour that prevents exposure, resistance to colonisation, or control of sub-clinical infection, and to use this knowledge to develop better, more targeted treatment and prevention strategies
- 3.2.3** Understanding the interplay between chronic and infectious disease in terms of (i) how chronic disease alters the infection response and (ii) the infectious determinants of chronic disease
- 3.2.4** Continued effort in vaccine development, including public sector investment to stimulate the early stages of vaccine development and facilitation of industry partnerships for further development

3.3. Demonstrating benefit and future-proofing against infection

To evaluate the impact of research discoveries and intervention strategies and to use this knowledge and next generation technologies to future-proof against infection threats.

Objectives

- 3.3.1** To understand the choices people make and to devise effective public communication strategies to communicate risk and encourage healthy behaviour, including better engagement with opinion formers and innovative use of communications technologies
- 3.3.2** To evaluate outcomes at the individual and population level and to measure and model impact in terms of benefits to health, the society and the economy; to harness this knowledge to facilitate the application of novel technologies and approaches into clinical practice and to inform the development of evidence based policies
- 3.3.3** To develop and use innovative methodologies to make maximum use of existing data and to evaluate complex interventions, including social marketing strategies and large scale control activities
- 3.3.4** To understand and target transmission through: (i) predicting potential threats through knowledge of microbial ecology, animal reservoirs, transmission dynamics and modelling, and (ii) protecting the population from existing and potential threats through the design of materials and buildings that minimise the transmission of infectious disease. To bring in relevant expertise (e.g. zoologists, veterinarians, engineers) and stimulate inter-disciplinary research to deliver on these aims
- 3.3.5** To engage the academic community, the healthcare sector (hospital and community settings), Government Agencies and Departments in a coherent national research agenda and to facilitate cross-boundary public health infection research

3.4 New look – new paradigms

Innovation in treatment and prevention – moving away from pathogen specific approaches.

Objectives

- 3.4.1** To understand resilience to infections at the individual and population level throughout the life course; why are some people resistant to infection or don't develop disease following colonisation? How can this knowledge be exploited for public health gain?
- 3.4.2** To explore and develop non-pathogen specific treatment approaches, including stimulation of innate immunity, modulation of inflammatory response, strengthening the natural microflora, advancing the development of adjuvants, etc.
- 3.4.3** To harness novel technologies to understand host-pathogen and genotype-phenotype relationships at the population level ('infectogenomics', 'immunoepidemiology'), including:
 - Large scale 'omics' approaches to determine and link microbe and host signatures (see 3.2.1)

- Innovative methodologies to understand the ecology of infectious disease, including modern mass communication tools (internet search engines, mobile phones) to investigate representative samples at the community level. What are the factors that allow microbes to survive and spread in populations?
- Exploitation of existing large scale cohort studies and data sets for infectious disease research

3.4.4 To harness advances in molecular biology to improve health systems research and surveillance and to facilitate the availability of routine healthcare data for research purposes and data linkage across the health system

4. Implementing the strategy

- Research funders in areas relevant to public health infection research will be encouraged to align their funding priorities with the strategic aims outlined in this document and to apply joint funding mechanisms in cross-disciplinary areas
- The research aims and activities identified in this strategy will serve as a beacon to guide the endeavours of the research community across disciplines and sectors. Investigators seeking support for their activities will be encouraged by health research funders to address specifically in their research proposals the objectives underpinning the strategic aims
- In a time where resource for research is critical, this provides a framework for prioritisation of research opportunities for publicly funded research, building on existing strengths in the infection research community within the UK

5. Measuring success

Monitoring and Evaluation

Through a robust evaluation framework, research in the field of public health infections will be monitored against the aims and objectives set out in this strategy. Evaluations will be made of the level of activity and the investments made in the strategic areas identified for action in this strategy.

Through analysis of publication output, and mapping the development of collaborations within the academic sector, across into public health delivery, and with industry, and the tracking of implementation of new policies and practices it will be possible to evaluate the impact of this strategy.

6. Conclusions

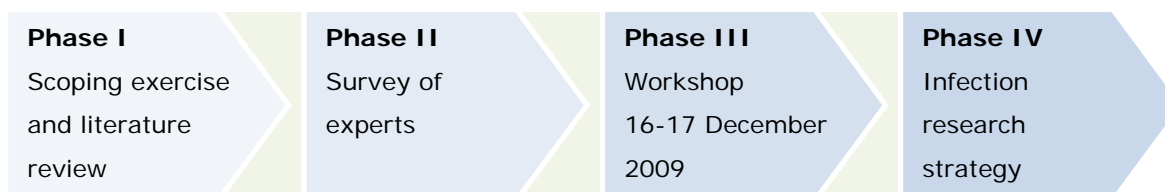
The strategy outlined in the document proposes a research agenda for the coming years in the public health infections research arena. The strategic aims set out clear goals for researchers in this field which will deliver an infection research capability which best meets the need to secure the health of the population.

7. Annexes

Annex 1	Methodology
Annex 2	Advisory Group Membership list
Annex 3	Workshop Attendees list
Annex 4	Workshop report

Methodology

The review process leading to the development of a strategy has involved:



Phase I: scoping exercise and production of a landscaping document analysing the major public health and infectious disease publications which have been produced over the last ten years (Appendix 2 of workshop report).

Phase II: consultation with scientific leaders in infections research to gather views on what the key public health infection priorities are in the UK.

Phase III: a workshop to engage with the infectious disease research community.

Phase IV: development of the final public health infections research strategy and dissemination to all stakeholder groups.

PHASE I LITERATURE REVIEW

The literature review was conducted as a desk-based consultation exercise with the aims of assessing the current state of the UK public health infection research landscape, identifying the major infectious disease problems and categorising them into broad priority areas, and highlighting research priorities described in previous reports. To achieve this, the approach taken was to research, analyse and review all the major public health infection reviews, reports and strategy documents produced over the last ten years (sources of evidence reviewed can be found in the reference section of Annex 4, Appendix 2).

The review document identified five recurrent public health issues and infectious disease priorities:

- Healthcare associated infections
- Antimicrobial resistance
- Emerging and re-emerging infections
- Sexually transmitted infections and HIV
- Respiratory infections

These priority areas were used to design the Phase II questionnaire.

PHASE II SURVEY OF EXPERTS

Infectious disease experts spanning a range of disciplines were identified in discussions with the Scientific Advisory Group and members of MRC and NIHR staff. The survey was initially designed as a two-stage consultation exercise.

The first round questionnaire was structured to gather as broad a range of views as possible as to what the perceived research priorities are likely to be in the UK over the next five to ten years. The first round results were considered by the Scientific Advisory Group and the priority areas were refined into the following five areas:

- Healthcare associated infections
- Antimicrobial resistance
- Emerging and resurgent infections
- Sexually transmitted infections and HIV
- Severe infections: GI, CNS and respiratory infections

The decision was taken not send the questionnaire out for further consultation and to proceed directly to the workshop.

PHASE III WORKSHOP

Aims of the workshop:

- To discuss the needs and opportunities in public health infections research
 - To define key research areas and questions that should form strategic priorities within the OSCHR framework
 - Advise on how the identified research priorities might be taken forward
- For each disease area an expert in the field was identified and invited to give a presentation at the workshop addressing the following main points:
1. The nature of the public health threat/challenge
 2. UK research strengths
 3. UK weaknesses and needs
 4. Possible research priorities

The five target research areas identified and discussed were:

- Healthcare associated infections
- Antimicrobial resistance

- Emerging and resurgent infections
- Sexually transmitted infections and HIV
- Severe infections: GI, CNS and respiratory infections

The report from the workshop is attached as Annex 4.

Advisory Group Membership list

Name	Affiliation
Professor Dwaler Ala'Aldeen	University of Nottingham
Professor Janet Allen	Biotechnology and Biological Sciences Research Council
Professor David Armstrong	King's College London
Professor Janet Darbyshire	MRC Clinical Trials Unit
Professor Lindsay Davies	Department of Health
Professor David Dockrell	University of Sheffield
Professor Brian Duerden	Department of Health
Dr Wendy Ewart	Medical Research Council
Professor Neil Ferguson	Imperial College London
Professor Jonathan Friedland (Chair)	Imperial College London
Dr Russell Hamilton	National Institute for Health Research
Professor Peter Hawkey	Department of Health
Professor Anne Johnson	University College London
Professor Paul Little	University of Southampton
Professor Sir Andrew McMichael	University of Oxford
Professor Ivan Morrison	University of Edinburgh
Professor Deborah Smith	University of York
Dr Wendy Snowden	GlaxoSmithKline
Dr Glenn Wells	Department of Health
Professor Chris Whitty	Department of International Development
Professor Maria Zambon	Health Protection Agency

Public Health Infections Workshop

Attendees list

Name	Affiliation
Professor Janet Allen	Biotechnology and Biological Sciences Research Council
Professor Jeff Almond	Sanofi Pasteur
Professor Daniel Altmann	Imperial College London
Professor David Armstrong	King's College London
Sir Leszek Borysiewicz	Medical Research Council
Dr Meredith Bradbury	Technology Strategy Board
Professor William Carman	University of Glasgow
Professor Mary Collins	University College London
Dr Lloyd Czaplewski	Biota Europe Ltd
Professor David Dockrell	University of Sheffield
Professor Gordon Dougan	Sanger Institute
Professor Brian Duerden	Department of Health
Professor Tom Evans	University of Glasgow
Dr Wendy Ewart	Medical Research Council
Professor Neil Ferguson	Imperial College London
Professor Roger Finch	University of Nottingham
Professor John Frank	University of Edinburgh
Professor Jonathan Friedland	Imperial College London
Professor Noel Gill	Health Protection Agency
Dr Pat Goodwin	Wellcome Trust
Professor George Griffin	St Georges University
Professor Andy Hall	London School of Hygiene and Tropical Medicine
Dr Russell Hamilton	National Institute for Health Research
Professor Graham Hart	University College London
Dr Alan Hay	National Institute for Medical Research
Professor Richard Hayes	London School of Hygiene and Tropical Medicine
Professor Andrew Hayward	University College London

Professor Adrian Hill	University of Oxford
Dr Rebecca Hodges	Medical Research Council
Professor Alison Holmes	Imperial College London
Dr Susan Howard	Consultant
Professor William Irving	University of Nottingham
Professor Anne Johnson	University College London
Professor Ian Jones	University of Reading
Professor Mike Levin	Imperial College London
Professor Paul Little	University of Southampton
Professor Michael Malim	King's College London
Professor Jane McKeating	Birmingham University
Professor Sir Andrew McMichael	University of Oxford
Professor Ivan Morrison	University of Edinburgh
Professor Marie Louise Newell	University College London
Professor Sarah O'Brien	University of Manchester
Professor Tim Peto	University of Oxford
Professor Deenan Pillay	University College London
Professor Caroline Sabin	University College London
Professor Gavin Screaton	Imperial College London
Dr Mike Sharland	St Georges University
Professor Geoffrey L Smith	Imperial College London
Professor Peter Smith	London School of Hygiene and Tropical Medicine
Dr Wendy Snowden	GlaxoSmithKline
Dr John Stephenson	Health Protection Agency
Dr Philip Stevenson	University of Cambridge
Dr Janet Valentine	Medical Research Council
Dr Heike Weber	Medical Research Council
Professor Jonathan Weber	Imperial College London
Professor Robin Weiss	University College London
Professor Chris Whitty	Department of International Development
Professor Paul Williams	University of Nottingham
Dr Penny Wilson	Technology Strategy Board
Professor Douglas Young	Imperial College London