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The future of public health
A horizon scan

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Summary

This report is the synthesis of the findings of a horizon scanning study on the future of public health and its related scientific and laboratory capabilities and services. The work was intended to help inform thinking at the strategic level within Public Health England (PHE), firstly in relation to the wider vision of the Agency (which was only established in April 2013) and, secondly, in relation to the proposals for the creation of an integrated public health science hub within a network of facilities across the country. PHE is responsible for a broad range of health improvement, protection and surveillance activities. Research and science are core to the organisation’s function and success. As the organisation evolves, the capabilities it needs to address future public health science will also evolve. This report contributes to that endeavour and sheds some light on the extent to which an integrated science hub and network of facilities could serve PHE in the future.

The concept of a public health science hub had been under consideration by the Health Protection Agency (HPA) before it became part of PHE earlier this year. HPA’s Chrysalis Programme had considered the possible co-location of many of the existing microbiological services on a new site and PHE has inherited this programme of work and continues to explore further the possible benefits and challenges associated with the hub and network concept. The study was commissioned by PHE and carried out by RAND Europe in a short timeframe during July-August 2013. It involved a contextual overview including a review of international public health models and co-location literature, a series of key informant interviews, a structured literature review, and a brief Delphi exercise using the ExpertLens platform. Each activity and its main findings are discussed in turn.

Contextual overview

We reviewed organisational and management structures for international health models in Canada, France, Germany, the Netherlands, Sweden and the United States and highlighted national-level agencies which appear to be most relevant as comparators for the future PHE. We found that many of the comparator countries have a central agency or department to undertake data collection and surveillance, but that the agency’s responsibility for wider public health functions varied. In addition, there are a range of organisational models for public health systems, and, moreover, for the role of a national public health agency within these systems. In particular, the national public health agency of any country is usually part of a wider infrastructure that includes other national and sub-national organisations. In many cases, whether under a centralised or decentralised public health system, a central institute works to collect surveillance information, conduct research and provide resources to national and local government.
The countries reviewed benefit from centralising their public health efforts and expertise within a single organisation or network of collaborating institutions in order to provide effective, coordinated leadership of public health. However, there is little precedent for a fully integrated national public health agency. Where they do exist, the institutes have limited capacities and capabilities relative to need across all areas of public health responsibility. Regardless of the specific model, the international examples suggest a consensus for a national level institute or agency to deliver population health surveillance functions and coordination of research evidence for health improvement activities.

The literature on co-location and clustering of different scientific and technological capabilities was reviewed and we summarise the benefits, challenges and opportunities of co-location and clustering policies. The benefits of co-location include: enabling the exchange of tacit knowledge; helping to build trust and social capital; creation of a ‘local buzz’ and an atmosphere of collegiality and collaboration; outcomes of localised learning; the potential for economic externalities and knowledge spillovers to occur; and enhanced absorptive capacity.

However, all of these benefits are contingent upon appropriate policies and conditions for clustering, both nationally and organisationally. The conditions which must be considered include: the presence of factor conditions (human, physical, knowledge, capital and infrastructure resources); the need for demand conditions in the public health research ‘market’; the presence of supporting industries; the role of a clear strategy and structure; and the importance of chance events. The interplay between these conditions is not always straightforward to determine, which has led to a backlash against clustering and engineered co-location in recent years. Clearly, careful consideration is needed in order to maximise the opportunities and benefits co-location can provide.

**Insights from stakeholder interview and workshops**

We conducted interviews with 26 stakeholders both internal and external to PHE, and facilitated a session at an internal PHE workshop in order to determine what the collective views of experts in the field were about future public health science needs and trends. The discussions covered: technological and research trends; the challenges facing public health; important capabilities for the future; the role of PHE in the future; the characteristics of a hub; and uncertainties about the future.

On the question of those technological and research trends that would be influential in future public health, genomics featured prominently, as did informatics and ‘big data’. Challenges facing public health discussed included the involvement and regulation of the private sector’s activities within this traditionally public sector-dominated field. Also considered challenging were various organisational issues pertaining, in particular, to internal integration and continuity issues within PHE itself.

The capabilities that were regarded as being important for future public health needs spanned wet lab disciplines (epidemiology, microbiology, virology, genetics, etc) and ‘dry lab’ capabilities (including statistics, economics, mathematics, behavioural science and bioinformatics and other IT-related disciplines). These were perceived by interviewees as important to allow PHE to deliver on its role, which they considered to involve: integration and co-ordination (nationally and internationally); the exercise of leadership in the public health field; surveillance and response; provision of advice to effect demonstrable positive outcomes for the health of the public; and making the transition from a primarily ‘responsive’ stance to a primarily ‘preventive’ posture.
The greatest diversity of views emerged, perhaps unsurprisingly, in relation to the issue of the possible creation of a hub and how it would work with a range of other facilities within and outside PHE. There was broad consensus on the strategic-level prerequisites for the establishment of a hub (eg robust leadership, common narrative, careful design and so on). Equally, the possible advantages offered by standardisation, cross-fertilisation and economies of scale were also widely recognised. The greatest disparity of views was in relation to the question of whether the establishment of a physical hub would be necessary or beneficial or whether a virtual hub could be just as effective. The question of 'where' (as well as 'whether') was particularly prominent as many respondents could see the merits of physical location, but only providing that the geographical location was appropriate (ie collocated with other relevant bodies and with easy access to other organisations and governmental partners).

The final discussion area related to uncertainties and those issues that were considered core areas of concern by interviewees. These included: the emergence of new pathogens; the continuing rise of antimicrobial resistance; organisational challenges; the influence of short-termist policies and the vulnerability of PHE to changeability in national politics; health inequalities; and economic constraints.

**Horizon scanning the literature for future scientific and technology trends**

The literature review allows us to understand the wider empirical and conceptual developments in the field that will impact upon the co-location of laboratory and other public health services. We derived a number of areas from an initial rapid search and early-stage interviews which resulted in eight 'deep dive' areas presented in this chapter. These cover both broad areas of scientific and technological capability, and public health challenges in which those capabilities would be utilised. Due to limitations of resource and time, we do not claim these are fully representative of all areas, but they do provide insight in several capabilities which are likely to be needed in some way in the future.

A number of implications for PHE and a series of themes emerge across these areas. The challenges for public health over the next 20 years will be multi-faceted and affect the population at many levels. Integration of data will play a significant role. The future will be dominated by many different kinds of data and these will all need to be collected, mined, fused, integrated and managed in order to maximise positive outcomes for public health. Finally, there is no single technology or capability that dominates the field. Multiple platforms will be required, and need to be brought together across both wet and dry laboratory spaces in order to make the most of the data and knowledge that emerge from each space. Each 'deep dive' area is summarised in turn below.

**Behavioural science** is important to the future of public health science because the most prominent contributors to death and disease in the UK and globally are related to behavioural factors and non-communicable diseases, particularly tobacco use, diet and activity patterns, alcohol consumption and sexual behaviour. In synthesising the diverse literature, the following future trends stand out: policy planning and design; behavioural nudging; design of intervention trials; ecological modelling; populomics; and data collection, mining and management. The key challenge in mobilising behavioural sciences for PHE rests on the use of inter-disciplinary, locally sensitive and multi-level approaches to solve clinical, high-risk and population-based public health problems.

**Public health informatics** is the systematic application of information and computer science and technology to public health practice, research, and learning. Some of the future trends which will feature include:
bioinformatics and biomedical informatics; privacy and data management; user-led information networking and sharing; and the management of electronic health records. There are two main reasons for the importance of informatics to public health: the availability of new kinds of data and the potential new ways to use the data. In the future not only will scientific data drive public health, but so will patient, clinical and social data. PHE must be able to utilise this in so-called dry lab facilities, which will draw on more traditional wet lab data as well as various other kinds, and there will be corresponding requirements for supporting IT infrastructures.

Simulation and modelling provide public health science with means for testing and experimenting with potential improvements and future scenarios. Several types of models might be used in the future, including: models for accountability and management; population effects models; prevalence models; and systems dynamics models. Public health agencies will look to modelling and simulation techniques to understand the ‘future state’ of public health conditions under alternative demographic, economic and technological assumptions.

Genomics and genetic technologies can further our understanding of disease risk in the future, support diagnosis and prognosis, enable prioritising preventative or therapeutic options, and develop targeted vaccines or antimicrobials. Genomics can help support the shift to a more predictive and preventive paradigm in public health. The following areas will help to drive the field: stratified medicine and preventative medicine; pathogen genomics, as it continues to track and identify infectious disease; and enhanced technological tools and capacity. The effective application of genetic technologies to public health involves disciplines will range from computer to wet lab scientists, social scientists and public health practitioners.

Infectious disease coupled with the rise of antimicrobial resistance (AMR) has been identified as a key public health concern for the UK by the Chief Medical Officer. In order for infectious disease surveillance programmes to be successful, they will need to be comprehensive, integrating data from a wide range of heterogeneous sources and employing advanced technological developments including: improved diagnostic tests; intelligent sensor networks; data mining and fusion; and biosensors and biomarkers. Interventions in the healthcare setting will be important in responding to AMR, such as antimicrobial stewardship, rapid diagnostic tests and aggressive infection control.

Health improvement will become an increasingly important area of focus for public health agencies as there are growing health inequalities in England, both in terms of life expectancy and quality of life. Tackling these challenges will require cross-disciplinary methodologies (eg behavioural sciences, informatics, genetic technologies) and a holistic view of how to promote healthy environments and wellbeing.

Public health emergency preparedness (PHEP) focuses on ensuring that public health agencies anticipate, assess, prevent and prepare for any major event that has the potential to overwhelm routine capabilities. It is thus both a capability and a future public health challenge that PHE will need to address. The following capabilities will be needed: surveillance; epidemiological and microbiological capabilities; data monitoring using geographical information systems; and risk awareness. PHEP is a holistic capability that cuts across a number of the literature reviews identified above including behavioural science, informatics, modelling and simulation, infectious diseases and AMR.
The ExpertLens

ExpertLens is an online variant of the Delphi approach to stakeholder engagement. The purpose of the ExpertLens was to understand the perspective of a diverse group of stakeholders regarding the relative importance of different public health scientific and laboratory capabilities which might be required in the future.

The central role of integrating different types of knowledge in any future configuration of public health services is clear. Underpinning this knowledge is the different kinds of data that future public health scientists will need to grapple with. Putting in place effective mechanisms for collecting, managing, mining, integrating and translating data into new knowledge will be of central importance. Participants in the ExpertLens confirmed this in their repeated stress on the need to focus not only on centralisation in a physical way, but more crucially, on integration of different kinds of capabilities and knowledge going forward.

Interestingly, given its focal role in the literature review and, to a certain extent in the interviews, there were mixed views on the role of genetic sequencing across different areas of public health. In particular, there was less certainty about its potential importance in relation to health improvement. This sits in contrast to some of the insights from the literature review, which pointed to the role, in some cases the central role, of genetic technologies in the future across many areas.

The exercise also allowed for a set of issues around the hub itself to emerge. In the discussions these issues were less related to the nature of the capabilities a hub might enable, and more about the characteristics which would enable success. Here, participants highlighted the need for a strong vision for PHE, which in turn would inform the nature of the hub, as well as the importance of continued discussions about how a hub would be implemented. Participants felt that one should not precede the other, but rather the two must go forward hand-in-hand.

Cross-cutting themes and findings

During the course of the study it became clear that there are a series of both strategic enablers and operational platforms which will allow for PHE to deliver across the three domains of public health: health protection, health improvement and health services. The strategic enablers which emerged comprise different, often overlapping component parts, and may be loosely defined as follows:

- **Integrated knowledge flows.** This relates to the flow of information, skills and best practice between individuals and groups, underpinned by various different types of data, its storage, integration, interrogation, analysis and sharing.

- **Leadership and management.** This relates to the provision of strong, committed direction which embodies the corporate mission, motivates and guides PHE’s people, and makes and delivers on long-term strategy to meet emerging needs.

- **Scientific capabilities.** This relates to the various disciplines and domains that allow the Agency to prosecute its mission and to their integration in a multi-disciplinary, collegiate context.

For PHE to be successful, all three strategic enablers will be required, to a greater or lesser extent, at all times. Under differing circumstances, though, the various elements will, naturally, assume greater or lesser
importance, or may require particular attention or enhancement. In any case, the relative extent of each enabler is less important than the interplay between them.

In reality the balance may shift in a dynamic way in relation to a broader set of contextual conditions in which PHE operates. To this end, a set of operational platforms are also required which can be called upon and utilised in various ways depending on the demands placed upon PHE and the public health infrastructure in the future. These operational platforms will provide the capabilities, capacity, methodologies/techniques, technologies and resources for this task. These capabilities and supporting elements are drawn from across all the activities of this horizon scan and are summarised in full in the final chapter of this report.

The three strategic enablers, the operational platforms and the elements which support all of it are critical factors in the successful establishment of a hub. The interplay between these three areas will represent the core constituents of PHE’s future success, as shown in the figure here.

However, one of the most important takeaway messages of our study relates to the question of a hub: interdisciplinary efforts will drive the future, and just as these interdisciplinary efforts will manifest in different ways, so too will the concept of co-location. Co-location is itself multi-faceted. It can be virtual, networked or physical; centralised, decentralised or interconnected. Each one of these facets will be important in some way for PHE to consider. Integrated knowledge flows, the ability to draw on the supporting scientific capabilities and the constant, guiding role of strategic leadership and operational management will be crucial, whatever kind of co-location is sought.

In this sense, co-location is not about physical centralisation of capabilities so much as it is about the integration of all of PHE’s collective resources. PHE will need to consider the need to conduct and provide public health science activities itself, alongside its role in enabling others to conduct public health science activities and helping to shape the future. It must, crucially, integrate both aspects together. These considerations and the balance between them will drive many of the future decisions which are necessary.

This also suggests that there is a wider role public health science alongside PHE in the future. Not only will PHE have to consider the right balance of its activities, but the field as a whole could collectively consider where capabilities are overlapping, mutually supporting, complementary, or duplicative. To this end, a wider system mapping might be beneficial in order to understand where expertise, capacity and capability already exist, and therefore where synergies might be maximised and duplicative efforts removed.

Protecting and improving the public’s health and wellbeing are substantial, multifaceted tasks, and ones which require not only national, but international perspectives and cooperation. PHE must balance its
role in enabling, doing and integrating public health science. It must consider where it makes sense to act on its own versus leading a more networked approach. The individual scientific capabilities, techniques, tools and associated elements identified in this report can help to enable this. They will cut across each other and intersect in various ways and their overlap and interplay will vary depending on the type of public health challenges faced. All capabilities will support different operational platforms, which will require strategic integration of knowledge flows in order to optimise the efforts. Strong leadership must guide the efforts. The subtle interplay of all of this should be considered together in any future decisions.