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Genomics for infection control: meeting local and national needs

Genomic technology is likely to play a significant role in infection control, although hospitals and other health providers will need to make individual decisions about which pathogens they sequence and when sequencing is needed. While sequencing is already being used in many contexts to uncover the source and transmission patterns of outbreaks, the technology has yet to be implemented consistently on a nationwide scale. In order to ensure that genomics services are available to meet the health system's demands, both at a local and national level, equitable provision of services needs to be considered, as well as the coordination of priorities for sequencing.

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Genomics has the potential to influence every step of the infectious disease pathway. Infection control is the principal area where next generation sequencing (NGS) technologies could be used now for infectious disease management and surveillance, complemented by established techniques. The detailed and high-resolution information obtained by sequencing a pathogen from a patient can be used to make a diagnosis and inform treatment, but is also important in a public health context for understanding how diseases spread in the community.

Genomic information is therefore of interest to the full range of organisations involved in the delivery and use of microbiology services. As each organisation has its own priorities, which influence how they use microbiology services, a coordinated approach and open communication between stakeholders is required to ensure that genomic services meet the needs of all. Without this, uneven provision, knowledge gaps, and missed opportunities to understand outbreaks could result.

How will microbiology service providers use genomics?



Microbiology services in England - who is involved?

Microbiology services in England are provided by the National Health Service (NHS) and Public Health England (PHE) in a mixed model, with some private provision:

- **Public health microbiology services**

Provided by PHE through a network of specialist microbiology laboratories embedded in NHS hospital trusts. There are also a number of national PHE reference laboratories. Service functions cover: diagnosis and monitoring of pathogens of public health importance in community and healthcare settings including novel or re-emerging threats; monitoring antibiotic resistance and vaccine uptake and advising government on infectious disease policy.

- **NHS clinical microbiology services**

Provided through hospital-based laboratories, these services offer identification of a range of common pathogens and support clinical management of patients. They also play a crucial role in hospital infection control efforts by identifying common pathogens and providing drug susceptibility information. More complex cases are sent to PHE-led specialist or reference laboratories. NHS services also play a significant role in contributing to public health microbiology practice; they may test samples as part of a PHE-led outbreak investigation, and are required by law to report on certain 'notifiable' pathogens of public health significance, including measles, tuberculosis, and foodborne infections.

- **Private providers**

Joint ventures exist with providers, such as The Doctors Laboratory, Serco and Spire Health. Services are the same as those provided by NHS laboratories themselves.

The funding and commissioning of microbiology services reflects the dynamics of their organisation. The current payment structure will be challenging to apply in a situation where genomics is used, since the information is useful in both a primary care and public health context. Effective stakeholder communication is key to resolving this challenge.

How will service providers use genomics for surveillance and infection control?

- **Hospital clinical microbiology laboratories (NHS and private) – control of infection**

At a local level, the advantages to hospitals of using genomics for infection control efforts include targeted and swifter resolution of outbreaks and optimal use of control measures¹.

- **PHE reference laboratory – national surveillance**

The use of genomic information can also benefit national surveillance, a core function of PHE, for example by demonstrating or refuting connections between outbreaks in different geographical areas. The higher resolution of whole genome sequencing means that accurate transmission networks can be determined, and if applicable the source can be dealt with¹.

Where will genomics fit into the evolving microbiology landscape?

Microbiology services are undergoing a process of consolidation which will reduce the number of hospital laboratories. Those that remain will be larger and able to carry out more specialist tests. They will benefit from economies of scale, which will have implications for how services are provided in the future. This consolidation will affect how genomics is implemented into health services - different business models and needs will have to be taken into account.

Genomic based services are already operational or in development by PHE. The central PHE reference laboratory has set up a sequencing service to investigate organisms of public health importance such as *Salmonella* spp. and *Staphylococcus aureus* with the aim of ensuring a resilient and self-sufficient NGS capability to meet national needs. Other PHE centres are developing sequence-based approaches for the management of specific pathogens, including HIV and tuberculosis. Moreover, the infectious diseases component of the 100,000 Genomes Project is being fulfilled in collaboration with PHE. However, widespread national implementation of pathogen genomics has yet to occur.

For genomics to be effective within the health system as a whole, it should be implemented in a way that serves both the local and national needs of the different organisations involved in the delivery of services.

Policy issues and actions

The following issues should be considered in parallel to ensure that genomics services are optimised by all users and that provision is equitable:

Considerations for establishing genomics services

- **Assessment of users' needs.** The implementation of genomics will vary depending on the laboratory set-up at each location and on the needs of the users. Assessments of which type of service is likely to best fit these needs should be undertaken, to provide a solid knowledge base that will enable implementation to occur quickly and efficiently.

For the implementation of genomics to be effective for the health system as a whole, it should be delivered in a way that serves both the local and national needs of the different organisations involved in the delivery of services.

Establishing genomic services



Assessment of users' needs



Availability of expertise



Infrastructure



Resource provision

Bridging local and national needs



Coordination and collaboration



Alignment of priorities



Funding of sequencing



Sharing of information

- **Availability of expertise.** The implementation of sequencing requires access to expert laboratory staff who can prepare samples, analyse data, interpret the results and act on them appropriately. Consideration is needed on whether to establish this expertise locally or to have access remotely.
- **Infrastructure.** The initial implementation of pathogen genomics services should focus on laboratories providing consolidated microbiology services, as these are best placed to realise essential economies of scale and to achieve the required concentrations of expertise and efficient data management².
- **Resource provision.** The provision of resources such as sequencing equipment, laboratory space, storage for samples and for data, and how they should be paid for and distributed.

Bridging local and national needs

- **Coordination and collaboration.** PHE will need to work with all microbiology service providers, both public and private sector, to ensure that they participate fully in meeting requirements to contribute to national infectious disease surveillance, through appropriate contributions to the implementation and development of pathogen genomics services².
- **Alignment of priorities between PHE and frontline health services.** Hospitals should be consulted about which pathogens are most problematic in terms of patient care, and a compromise should be reached so that the needs of the hospitals and priorities of national surveillance are met.
- **Funding of sequencing.** Agreement needs to be reached between PHE and NHSE with regard to funding for service development and delivery where genomics services have a dual clinical and public health benefit².
- **Sharing information between NHS and PHE.** If an outbreak of a notifiable pathogen is investigated at a local level using genomics, it should be decided how this information can be shared to allow PHE to maintain their national surveillance responsibilities.

References

1. Blackburn L. Protecting patients from healthcare associated infections: a role for genomics. PHG Foundation (2015).
2. Luheshi L. *et al.* Pathogen Genomics Into Practice (2015).

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