Statement of Intent – Genomics and precision medicine in Wales

Purpose

The fields of genetics and genomics are rapidly evolving, with new technologies driving down the costs and increasing the speed of DNA and RNA sequencing. This is already revolutionising medicine and public health by providing more accurate, rapid and cost-effective tests.

Wales is well positioned to take advantage of these developments with a single provider of NHS laboratory and clinical genetics services, a universal and health informatics capability and strong links with internationally renowned genetics and genomics research at Welsh universities. Bringing all these components together into a broader, cohesive strategy for genomics, microbiology and precision medicine will enable Wales to build on this solid foundation.

This statement indicates the key priorities and work that will be undertaken to develop the strategy, which will lead primarily on the platforms and advances needed in genomics and related bioinformatics to underpin precision medicine. It will signal our intention to create a co-ordinated, internationally competitive environment for genomics, microbiology and precision medicine – building on existing relationships and forging new partnerships in and beyond Wales to maximise the potential arising from collaborative working between the NHS, public health in Wales, academia, industry and the citizens of Wales. It will lay out immediate and longer-term plans to develop Welsh genetics and genomics services to ensure that people in Wales have access to excellent services for public health and the prediction, accurate diagnosis and optimal treatment selection for disease. It will also fully recognise the importance of integrating research and innovation within these services – building the knowledge base, expanding opportunities for patients to take part in high quality clinical research and trials and underpinning first-class services.

Where are we now?

Traditional laboratory genetic tests apply sequencing methods that analyse a single gene or part of a gene to identify DNA changes that cause illnesses. However, the recent emergence of newer, next-generation sequencing (NGS) techniques has enabled the study of tens, hundreds or thousands of genes or even the whole of a person's DNA (or 'genome') at the same time. As the cost of NGS continues to fall, these techniques are being applied to support more accurate, rapid tests and diagnoses.

Both genetic and genomic tests play an important role in clinical medicine, supporting prediction, diagnosis and treatment selection for a wide range of diseases, including rare diseases, cancer, cardiac and neurological diseases. Their application alongside other diagnostic tests, molecular studies, data analytics and real-time monitoring of illnesses, allows a more precise understanding of a patient's disease(s) to inform the selection of the most appropriate treatment(s). This is known as precision medicine – developing targeted diagnostics and treatments for individuals rather than the population as a whole.

In public health, genomic technologies are beginning to transform our ability to detect, identify and discriminate between pathogens, allowing outbreaks to be resolved or ruled out more quickly and with more confidence than conventional microbiology techniques. When linked to clinical and epidemiological information pathogen genomics can be particularly powerful. It has the potential to underpin more precise, rapid treatment by supporting the molecular identification of pathogens and a better understanding of individuals' responses to infection, treatment and onward transmission.

NHS Wales has shown it is agile and keen to quickly adopt innovative ways of working. It has integrated Health and Social Care systems, a single NHS working to all-Wales standards and has recently adopted an opt-out system for organ donation. Furthermore, medical genetics and microbiology services are provided on an all-Wales basis. As a highly respected UK laboratory, the All Wales Genetic Laboratory (AWGL) provides UK, and often worldwide, genetic testing services for rare and common diseases, with the all All-Wales Medical Genetics Service. The AWGL works closely with Cardiff University, the Wales Gene Park and the Wales Cancer Research Centre – links that have

supported service development, the adoption of new technologies, internationally-renowned clinical trials and precision medicine research. The microbiology service is provided by a network of laboratories across Wales, and these work closely with all major Welsh academic institutions to translate methods and knowledge from academia to diagnostic and specialist microbiology services.

Laboratory medicine services in Wales are developing a national approach to delivery of pathology services with a single Laboratory Information Management system in place which has driven standardisation of protocols. In addition, recent Welsh Government investment in an All-Wales digital pathology system will drive further collaboration and efficiencies. Screening services and Welsh Blood laboratory services are being organised as All-Wales services and work as partners within the Wales Pathology Collaborative.

Supporting collaborative working between the NHS and academia is important as it attracts investigator initiated and commercial clinical trials, strengthens clusters of excellence in Welsh universities, enhances local knowledge transfer for NHS adoption of new diagnostics and improves care. Recognising this, the Welsh Government, through Health and Care Research Wales, funds a network of research Centres, Units, Infrastructure Support Groups (ISG), Clinical Trials Units and a support and delivery service. These groups have an All-Wales remit and forge strong partnerships between academic researchers and NHS clinicians and scientists. The Wales Gene Park, an ISG, plays an important role in leading and coordinating genetic and genomic research in rare diseases and cancer, and also supporting world-leading research in other areas such as neuroscience. Another ISG, the Secure Anonymised Information Linkage databank (SAIL) provides a robust, all-Wales approach to linking anonymised, routinely collected, health and social care data and is a key player in the Farr Institute, a UK-wide network for health informatics research.

An attractive infrastructure exists in Wales to support healthcare innovation, clinical trials and biotechnology development. The Life Sciences Hub provides a platform to bring together academic, business, clinical and professional services and funding organisations, and there is strong Welsh Government support for collaborative working between the NHS and industry. The selection of Wales as a site for the Precision Medicine Catapult, with significant investment from Innovate UK, will strengthen Wales' capability in this area. An excellent diagnostics sector exists in Wales with many examples of close, joined-up working between industry, academic and clinical partners in genetics, genomics and precision medicine research and innovation. Furthermore, equitable and quick access to new medicines is supported through the All Wales Medicines Strategy Group, a single body that provides advice and guidance to NHS Wales on the appraisal and adoption of medicines.

'Prudent healthcare' has been embraced by NHS Wales to secure greater value from healthcare systems for patients. Genomics and precision medicine will play an important role in supporting this initiative. Genetic and genomic diagnostics provide evidence to select the most appropriate intervention for individuals, leading to reduced side effects and fewer ineffective, unnecessary and often costly treatments. Additionally, new genomic technologies are already playing an important role in providing information for the public and patients to work with health professionals through 'co-production' to make the best health and lifestyle choices as part of a prudent healthcare system. The adoption of genomics and precision medicine will support NHS Wales in meeting many of the seven well-being goals set out in the Well-being of Future Generations (Wales) Act 2015. It will enable the NHS to demonstrate the value of investing in new technologies to prevent long-term problems through improved, more effective treatments and the faster resolution of infection outbreaks.

Genetic and genomic diagnostics are already part of routine care in areas including oncology, rare diseases and microbiology, but large-scale precision approaches will require a step-change in NHS services. Despite existing excellence, we need to do more. With no rapid and effective route for funding molecular tests in Wales their availability is often variable and demand outstrips commissioning capacity. Furthermore, the potential for a paradigm shift in diagnostics and treatment through the adoption of genomic technologies will be disruptive. The existing workforce will need to be trained to use technologies and the results of tests based upon them and the profile

of the workforce will need to change, with new roles becoming necessary in mathematical biology and bioinformatics. In order to prepare for the future, and capitalise on recent developments in the UK and beyond, it is vital that we now develop a strategy for genomics and precision medicine in Wales.

Four key priorities have been identified as part of the strategy for genomics and precision medicine (summarised in the figure below). The strategy will focus primarily on the platforms and advances needed in genomics to underpin precision medicine, but will also seek to incorporate epigenetics and other 'omics' into research, innovation and services as knowledge and technologies develop. The work programmes underpinning the key priorities will not exist in silos but be fully integrated with each other.

Through the strategy, we aim to create a sustainable, internationally-competitive environment for genomics and precision medicine to support the delivery of prudent healthcare for the population of Wales. This will:

- be based on all-Wales NHS genetics and genomics laboratory and clinical services, working to internationally-recognised standards, as part of an integrated clinical and academic infrastructure for translational genomic medicine
- be flexible and able to adapt to rapid change and new technologies, building on excellent relationships, within and beyond Wales, to capitalise on the potential of collaborative working between the NHS, public health in Wales, academia, industry and the citizens of Wales
- contain plans to develop the NHS workforce to support the delivery of precision medicine
- create a framework to forge new strategic partnerships, to maximise and accelerate health and economic benefits, including inward investment
- outline our ambition to be a major contributor to the UK genomics capacity, working collaboratively across borders to obtain the maximum benefit and value for money from developments in genomic technologies
- capture the potential of genomic data for R&D through supporting Wales' involvement in world-leading clinical research and trials.

Benefits for patients, families and the population of Wales include:

- a more efficient and prudent healthcare service, directing resources to where they are most effective and needed
- earlier, more accurate diagnosis, supporting early intervention and better targeted treatments, resulting in better responses to treatment, fewer side effects and quicker recovery from illness
- better infection prevention and control strategies and more effective management of infectious diseases in healthcare settings and the community
- patients will be empowered through more detailed information, appropriately communicated, allowing them to have a greater understanding of, and take greater responsibility for, their own health
- patients will have greater opportunities to take part in clinical trials and other innovative research studies and contribute to future discoveries that will improve health and healthcare.

Key priorities

Genomics and precision medicine in Wales			
Clinical and laboratory genetics services	**Research / Innovation**	**Strategic partnerships**	**Workforce**
• Excellent clinical genetics services • Rapidly responsive, integrated, all-Wales laboratory genetics services • All-Wales infectious diseases genomics service • Optimal commissioning / hosting	• All-Wales leadership and co-ordination • Integrated and collaborative working between NHS and HEIs • Welsh resource of securely-held genetic and genomic data • Innovation in diagnostics	• Collaborative agreements with Higher Education Institutions and charity funders • Collaboration with UK and international research projects, including Genomics England • Strong framework to support collaboration with industry, including the Precision Medicine Catapult	• Critical mass in bioinformatics in Wales • Integrated genomics education for NHS healthcare professionals • Strong clinical and scientific skills base in NHS Wales in genetics and genomics

1. Clinical and laboratory services

Genomic technologies are moving from specialised services to standard care and although the NHS is quickly adapting many challenges still remain. With the ability to probe deeper into DNA, the likelihood of identifying variation of unknown significance increases. Understanding the potential clinical significance of such variants is increasingly a global endeavour and we must ensure that our genetics and genomics services are able to fully participate within global networks. Furthermore, as genetic and genomic information becomes ever more complicated there is a need to educate the NHS workforce and public so that patients and families can receive accurate and appropriate information and confidently understand the significance of the tests they undergo and the results they receive.

The genomics and precision medicine strategy will lay out plans to develop internationally competitive genetics and genomics services. In clinical genetics, the strategy will address areas such as data management, ethics, consent and the communication of results. It will also outline plans to empower patients, families and the public to understand genetic and genomic tests so that they can make the best treatment and lifestyle choices through co-production with NHS staff.

The strategy for genomics and precision medicine in Wales will outline our plans to continue to support, and build on, a single All-Wales Genetics Laboratory and an All-Wales Microbiology Service, so that they meet recognised standards and national/international accreditation and remain competitive providers of UK specialist genetic services. The work programme for clinical and laboratory services will:

- develop plans for a new, world class laboratory for NHS genomic services and research, building on strong synergistic working between medical and microbiology genomics services and the NHS and academia in Wales
- identify investments needed in sample collection/handling (robotics), IT and bioinformatics and sequencing technologies to ensure that the AWGL and microbiology laboratories can adopt new genetic and genomic technologies to underpin truly excellent services

- show how both the AWGL and microbiology laboratories will act in the short-term to deliver new genetic and genomic services where there is already robust evidence of clinical utility and demand
- describe the longer-term plans to develop and expand genetics and genomics services so that they can rapidly and flexibly adopt new tests to meet future demand, and new technologies where they have the potential to improve care
- identify and support the resources and technologies needed to share and integrate genetic and genomic data with clinical and epidemiological information and local and worldwide data resources - to underpin the clinical interpretation of genomic data and research
- Identify and support the resources required to develop the clinical All Wales Medical Genetics Service and the Wales Gene Park to lead health care workforce and citizen education in genetics and genomics.

As genetic and genomic diagnostics become more mainstream, the relationship between laboratory genetics and clinical genetics is changing. Added to this, genetic and genomic technologies are having an increasing impact on all pathology disciplines, including microbiology, histology, and immunology services, and over an increasing range of clinical services, such as cardiology, diabetes, oncology, paediatrics, mental health and neurology. The strategy will identify the optimal commissioning and hosting arrangements for genetic/genomic services in Wales. It will also propose a plan of engagement with the pathology modernisation programme to ensure seamless linking and closer working across pathology specialities.

2. Research and Innovation

Wales has recognised strengths in several areas of genomic medicine, such as rare disorders, oncology, infectious diseases and neuropsychiatric disorders; however, to date much of this work has existed in isolation. The strategy will develop an 'All-Wales' plan for effective leadership and co-ordination in genomics research, fully integrated with NHS clinical and laboratory genetics services. It will build on areas of existing research strength whilst seeking to incorporate strategic emerging areas such as plant and animal genomics where opportunities occur.

A key aim of the strategy will be to develop a research resource capturing appropriately consented and secure genetic/genomic data from NHS patients and research participants across Wales. The work programme underpinning this will outline plans to:

- develop IT, bioinformatics and workforce/training needed for the robust collection, management and storage of genetic/genomic and accompanying clinical data
- securely link genetic, genomic and other data collected from the AWGL, Public Health Wales microbiology laboratories, NHS Wales laboratory services, such as blood sciences, cellular pathology and other microbiology laboratories and Health and Care Research Wales infrastructure groups
- build on the unique strengths of the SAIL databank and HealthWise Wales to link genetic/genomic, epigenetic and other 'omics' data to health, social care, and lifestyle information and support the development of a richly-described Welsh cohort for research
- become key contributors to global research initiatives most likely to make future transformative research discoveries.

The resource will stimulate high quality research to inform our understanding of the causes and progression of disease and transform our ability to deliver clinical trials for precision medicine in Wales. It will be a platform enabling phase III trials which rely on large-scale recruitment of patients with molecularly-defined disease, and consequently be an attractive resource for the pharmaceutical and life sciences industries. It will also support improvements in public health arising from a better understanding of the genetics/genomics of micro-organisms and hosts. Patients and families will be actively encouraged to develop, engage with, and take part in innovative research and will benefit from early access to novel therapies.

The development of the 'companion' genetic/genomic diagnostic tests required for precision medicine will depend on close working between the NHS, academia and industry. A co-ordinated environment for genetics/genomics will provide an excellent basis for partnership and innovation with the strong diagnostics sector in Wales and support the translation of genomic technologies into mainstream medicine. The work programme will build on previous technology infrastructure investments (for example Health Technology Exemplars, Efficiency Through Technology Fund and Health Technology and Telehealth Fund programmes) to accelerate the demonstration and evaluation of new precision medicine approaches, particularly through applied research and partnering with industry.

3. Strategic partnerships

In order to fully exploit its potential to be a major international force in genomics and precision medicine, Wales needs to establish strong strategic partnerships within the United Kingdom and across the world. "Team Science" through large international consortia is likely to be central to discoveries that will lead to transformational changes in the delivery and effectiveness of healthcare. Welsh researchers have, and will continue to, play an active role in such consortia (for example, the Psychiatric Genetics Consortium).

Wales will prospectively seek out opportunities and develop strategic partnerships with those organisations/individuals best placed to complement Wales' strengths. This will include higher education institutions, UK and European Union funding bodies, international research consortia, industry partners and the third sector, building on partnerships which are already well-established and creating new partnerships where this will add value. Developing and established partnerships include those with Genomics England Limited and The Precision Medicine Catapult.

The 100,000 genomes project was established in 2013 by Genomics England Limited, with the aim of enabling new medical research and creating a new genomic medicine service for the NHS. The project will sequence 100,000 genomes from around 70,000 NHS patients and their families to improve the understanding of the link between DNA changes and disease and provide accurate diagnosis and better treatment selection for patients with rare diseases and cancer. NHS Genomic Medicine Centres have been established to recruit participants and transform services to meet the high quality standards required by the project.

The strategy will outline investments that would support our clinical and laboratory genetics services to meet internationally-competitive standards, enabling them to provide optimal services for patients and families in Wales and to participate in UK and international genomics projects. For example, joining the 100,000 genomes project would enable Welsh patients to take part in a UK-wide research programme, and strengthen NHS Wales and Welsh researchers' ability to capture external funding to support research and further development of genetics/genomics services. It also has the potential to provide better diagnosis of rare diseases and support treatment selection in oncology for those who take part.

NHS collaboration with industry partners supports applied research and knowledge transfer and the appraisal and adoption of new technologies. This leads to better healthcare services and brings economic and health benefits. For genomics and precision medicine, partnering with industry will provide vital investment and knowledge to support faster NHS adoption of precision medicine, for example through redesigned services, which link digital platforms, data analysis, clinical decision support systems and tools for managing and monitoring health and wellbeing outcomes.

Our intention is to encourage and support industry engagement with NHS genetics/genomics services, on an all-Wales basis. The strategy will develop a framework setting out the key principles which will underpin such collaborative working. This will complement the prioritisation of life sciences and health as a key sector in Welsh Government research, innovation and economic development strategies. For example building on local strengths in diagnostics, data and digital health to provide a platform for the development of new point of care and companion diagnostic

tests, which will support earlier diagnosis and better management of conditions, using precision medicine approaches.

4. Workforce

A step-change in workforce education and development will be needed for the NHS to fully capitalise on the advantages that genomic technologies can bring for healthcare. As genetic and genomic technologies become more mainstream, this need extends beyond genetics and genomics services into related areas, such as pathology and general medicine. There will also be a need to support and develop dedicated bioinformatics expertise to support data handling, analysis and interpretation as the amount and complexity of genetic and genomic data grows.

The genomics and precision medicine strategy will outline plans to build and consolidate the clinical and scientific skills base in NHS Wales genetics services, including investing in training for molecular pathology, medical and microbiology laboratory genetics/genomics and genetic counselling. This work has already begun, with the recent announcement of additional training for consultant scientists in genomics and molecular pathology and scientist training in bioinformatics, genetic counselling and genomics. Recognising the critical importance of developing bioinformatics skills, the work programme will highlight plans to support and develop a critical mass of bioinformatics expertise in Wales, with genetics services building on links with bioinformatics at the Wales Gene Park at Cardiff University and the MRC Cloud Infrastructure for Microbial Bioinformatics Centre at Swansea University.

The strategy will also lay out plans to integrate genetics and genomics training across NHS Wales, supporting higher-level non-specialist skills to develop a workforce with the knowledge and skills needed to deliver innovative precision medicine and public health services for patients. It will also signal our intention to work to ensure that the NHS Wales workforce has access to excellent education programmes for enhanced knowledge and understanding of genetics and genomics, underpinning better services for patients.

The next year

The longer term strategy described above is vital to ensure we are equipped to provide the healthcare of the future. However, there is also a real need to invest now in areas where there is evidence of clinical utility for NGS techniques, to develop a tighter focus and faster pace of change. Earlier this year, the Welsh Government committed in 2015-2016 over £1M to support genetics, genomics and precision medicine – investing in new NGS equipment and technologies, IT infrastructure, equipment and consumables to support the delivery of new genetics/genomics services. We have also committed to new workforce posts in bioinformatics, genetic science, microbiology, genetic counselling and molecular pathology. For example, this funding will enable the All Wales Medical Genetics Service to start to develop services for clinical exome sequencing for rare diseases and NIPT analysis for women at risk of fetal abnormalities. It will also support Public Health Wales Microbiology services to develop pathogen genomic services, with a particular focus on gastrointestinal and respiratory infections.

Over the next year we will continue to provide support where there is already evidence that NGS can provide more accurate, rapid and cost-effective approaches, and a £1M Welsh Government capital investment has been earmarked to support genomics activities in 2016-2017. This will allow the development of NGS capacity, informatics and IT and laboratory automation, supporting services to continue to meet UK and worldwide accreditation standards. We will continue to work closely with the NHS in Wales to deliver further developments in genomics within genetics services.

Next steps

A genomics taskforce has been established to support the development of the full strategy. The taskforce will be chaired by Dr Andrew Goodall, Chief Executive NHS Wales and it is proposed that a

programme manager will be appointed to assist with the development and implementation of a collaborative work programme to underpin the strategy. The taskforce will engage with stakeholders and report back to Ministers on achieved deliverables in September 2016. The Strategy will be delivered together with the NHS in Wales, who have endorsed this Statement of Intent.