

A close-up, monochromatic photograph of a laboratory setting. A pipette is shown in the upper right, dispensing a small amount of liquid into one of the wells of a multi-well plate. The plate is filled with many other wells, some containing liquid. The background is blurred, focusing attention on the pipette and the well it is filling.

Precision Medicine and Scotland's Opportunity

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What is Precision Medicine?

Precision Medicine refers to the tailoring of medical treatment to the individual characteristics of each patient. Just as people receive the right type of blood when they need a transfusion, PM envisages a future in which drugs or therapeutic treatment are prescribed to patients based on their own personal data– such as their weight, their age, their diet and especially their genetic make-up. The European Commission's Horizon 2020 Advisory group defined it as:

“a medical model using characterisation of individuals’ phenotypes and genotypes (eg: molecular profiling, medical imaging, lifestyle data) for tailoring the right person at the right time, and/or to determine the predisposition to disease and/or to deliver timely and targeted prevention”.



Practical use

PM is already used widely in the field of Oncology: cancer patients routinely undergo molecular testing so they can get specialised drugs and treatment therapies that will work for them. However, PM could soon apply far more widely. The completion of the Human Genome Project in 2003 means medics can predict disease risk in individual patients. More recent advances in technology also mean that more medical data can be kept, shared, and analysed to help healthcare systems deliver more personalised treatment. The possibilities are boundless. For example, in mental health, PM would examine the risk and resilience factors in individual's lives to help prescribe more accurate care.¹ As discussed above, the use of PM also permits more successful preventative approach to treatment: for example, with access to a patient's data, medical history and genome, medics can build up an accurate picture of an individual's health risks and ensure they avoid diseases they may be particularly susceptible towards.

The benefits go beyond those that support individual patients. PM may also help healthcare providers deal with escalating costs, both by improving preventative care and by ending 'all-population' approaches. For example, it is estimated that 30% of hospital admissions are currently caused by 'imprecise' medicine.² Accurate tailoring of treatment may help patients to remain out of hospital, saving the NHS millions.

1 Precision medicine and global mental health - The Lancet Global Health

2 Infosys Knowledge Institute | Precision Medicine - Technology and Future Potential





PM's development

The potential for PM to transform healthcare over coming decades has been well identified. In 2015, President Barack Obama set up the Precise Medicine Initiative in the USA to support research into the field. A year later, the European Commission set up the International Consortium for Personalised Medicine.³ National and multinational actors are therefore competing to establish themselves as global leaders in PM, by providing an evidence base and through research programmes. Huge growth in the sector is expected: the global value of PM is expected to grow from \$43bn in 2016 to around \$134bn by 2025.

³ Official launch of the International Consortium for Personalised Medicine, ICPeMed (idw-online.de)

PM in Scotland

In 2015, the UK Government announced regional Science and Innovation Audits across the country to catalyse a new approach to regional economic development. These regional audits were designed to examine local areas of strength and assess how best to realise potential areas of strength. In Scotland, the SIA decided to focus on the area of Precision Medicine.

Scotland has long been recognised as a global leader in PM. The SIA identified key strengths

- Home of the Precision Medicine Scotland Innovation Centre (PMS-IC) at the Queen Elizabeth University Hospital which brings together leading experts from industry, the NHS and academia to develop PM SMS-IC (Stratified Medicine Scotland Innovation Centre) | Innovation Centres. It is the only clinical-industry-research centre in the world designed around the clinical implementation of PM.
- Two of the six Medical Research Council Molecular Pathology “nodes” are based in Scotland (Glasgow and Edinburgh). Glasgow University’s centre is the largest of its kind in the UK and helps to deliver PM across a number of diseases.
- NHS clinical research facilities in Dundee, Edinburgh, Glasgow and Aberdeen which bring together University and NHS expertise
- NHS Research Scotland which brings researchers to live and work here
- A network of biorepositories for tissue samples and health data.
- Home to the Imaging Centre of Excellence (ICE) at the QUEH which hosts the UK’s first ultra-high MRI scanners capable of developing next generation imaging
- High quality information and electronic data which is managed by one organisation, NHS Scotland
- Strong private sector support with as many as 230 companies in Scotland already involved in PM
- Excellent University expertise
- A growing life science sector, employing 37,000 people across 700 organisations, which contributes £2bn in Gross Value Added for the Scottish economy
- Access to a population base of just over 5 million which is large enough for meaningful analysis and also stable and traceable by international standards.



Glasgow as a UK hub for PM

Since 2015, Glasgow has continued to expand and further cement its reputation as a PM centre of excellence, backed by UK wide support. After the SIA, a consortium led by the University of Glasgow was formed to focus on Glasgow's strengths in PM. It set out a goal to develop expertise and know-how that could be potentially exported across the world as new technologies, products and services. In 2020, the Living Laboratory for Precision Medicine at the QEUH was one of seven successful bids in wave 1 of the UK Research and Innovation Strength in Places Fund. The £38m provided from UK fund is part of a £90m investment to create the new Lab which is designed to develop new ideas and innovations by industry, academia and healthcare providers. It is hoped these will both deliver savings for the NHS and create fresh commercial opportunities for Glasgow and, especially, the Govan area.⁴ As David Sweeney, executive chair of UKRI says: "The Living Laboratory is an opportunity to capture the health challenges in Glasgow and deploy research expertise to address particular local challenges."

In addition, the Lab is developing a new Health Innovation Hub with 45,000 sq feet of office and lab space to accommodate new PM companies in the hope of expanding the Glasgow cluster. The hub gives firms direct access to world-leading academics and clinical infrastructure, enabling real-world testing of health innovations. This is in addition to the Clinical Innovation Zone which is also accelerating the growth of digital and precision medicine businesses at the QEUH.

The Precision Medicine Scotland Innovation Centre (PMS-IC) in Glasgow is also producing results. For example, one area has already made progress on Fatty Liver Disease which affected around 25% of the Scottish population. As its chief executive Marian McNeil has said: "Death rates from chronic liver disease are 70% higher than the UK average and 60% higher than 30 years ago". A new "Data Commons" called SteatoSITE which holds data from academic and industry sources is now able to look for potential diagnostic

biomarkers for fatty liver disease and identify personalised treatment options. Other diseases being worked on in a similar manner at PMS-IC include ovarian cancer, multiple sclerosis, rheumatoid arthritis and chronic obstructive pulmonary disease. Thanks to Scotland's world leading data set – which enables researchers to track back through family and patient histories – researchers are able to understand the spread of diseases, identify potential warning signs, and prescribe medicines based on individual circumstances.

⁴ How Glasgow University is pioneering a living laboratory at QEUH | The Scotsman University of Glasgow - Colleges - College of Medical, Veterinary & Life Sciences - The Living Laboratory - Our Projects - Health Innovation Hub

Next steps for Scotland

A 2019 Wave 3 report from the Department for Business, Energy and Industrial Strategy identified continuing gaps in the development of PM in Scotland as follows – and the solution to them.

- Limited integration of - and exploitation of potential synergies across - Scotland's expertise in clinical medicine and data science, both in terms of research projects and commercial activities.

SOLUTION: PM offers a major opportunity for closer collaboration between the Universities of Glasgow and Edinburgh, along with NHS Scotland, industry and the major health research charities

- Low levels of entrepreneurship in Scotland, compared to other parts of the UK, and a relatively limited number of start-ups to date targeting the PM opportunity

SOLUTION: Embed a more pervasive culture of enterprise and attract more VC Funds to support the commercialisation effort – we need to promote the PM opportunities for new tech start-ups, celebrate the successes that we have in Scotland, and ensure that growth finance is available (on attractive terms) for investable propositions

- Inconsistent messaging across Scotland about the scale and nature of the business growth opportunities linked to PM for start-ups, existing SMEs, and potential inward investors. This has resulted in a lack of clarity and general awareness amongst the business and investor communities

SOLUTION: Create PM champions within NHS Scotland, academia and the Scottish Government, to work together and with the enterprise agencies and industry to drive demand/investment and raise the profile and awareness of PM related opportunities. A clearer demand statement from NHS Scotland and the Scottish Government would accelerate the development, adoption and mainstreaming of PM in Scotland. Complementing the previous action area, better PM promotion to the SME base and potential inward investors –

the partners involved in developing this SIA are committed to working with different sectors and investors to articulate the scale and nature of Scotland's offer and the exciting market opportunities associated with PM

- Insufficient promotion of Scotland's existing key PM assets and centres of excellence – there needs to be greater clarity on the PM offer and the major investments in new facilities over recent years. A more coherent, powerful and compelling narrative is needed around the PM ecosystem in Scotland and its key differentiators

SOLUTION: Encourage stronger collaboration between key PM assets and centres of excellence (e.g. the Clinical Innovation Zone at QEUH, BioCity and the Edinburgh BioQuarter etc.), with support from Scottish Enterprise, ensuring a fully integrated offer combining both hard and soft enabling infrastructures

- Lack of clarity on the skill-sets required to grow and develop the PM cluster in Scotland

SOLUTION: Invest more in targeted PM and bioinformatics and AI for Health skills development programmes – the integration of different skill-sets will be key to developing and maximising Scotland's PM opportunity Key ambitions and investment proposals

Recommendations

Some of the 2019 report's recommendations have already been acted upon – for example, the proposal to develop the QEUH as a “living lab”.

However, more needs to be done to boost the amount of venture capital and investment involved in PM and to ensure greater cooperation and collaboration not just within Scotland but across the United Kingdom so that the PM sector in Scotland can become a genuine global superpower in the sector.

We propose that:

In order to promote Glasgow as the key UK PM cluster, the UK Government and Scottish Governments should jointly announce the creation of a new **UK Precision Medicine Academy**, based on President Obama's US model, headquartered at the Queen Elizabeth University Hospital in Glasgow. This would simply bring under one roof many of the existing assets at the QEUH but it would send a clear signal that the Govan site had been identified as the centre of the UK PM cluster. As the 2019 Glasgow University SIA report concluded, there is “insufficient promotion” of Scotland's PM's assets. A clearly branded PM Academy, with the full backing of both the First Minister of Scotland and the Prime Minister of the UK, would make clear the ambition to make Scotland a global PM leader, and would provide a clear statement of intent that Glasgow is now the centre for PM development in Scotland and the UK.

To launch this, the UK and Scottish Governments should jointly hold an **international Precision Medicine** summit, to establish Glasgow as the PM Growth capital of the UK. This should be co-hosted by the Prime Minister and First Minister.

The UK Government should also create a **new UK PM network** to bring together not just Scottish areas of expertise but also to better connect Scottish expertise to the “golden triangle” of London, Oxford and Cambridge. The reality is that more capital is available in the south-east compared to Scotland; the solution for Scotland is not to compete with the south, but to collaborate through joint ventures which bring together researchers and expertise from all the key institutions in Glasgow, Imperial, Edinburgh, UCL and Cambridge.

The new PM Academy and the new PM network should coordinate with existing life science venture capital businesses to source finance for start-ups and scale-ups across the UK. Life sciences have already benefited from the far-sighted investment decisions made by the Strathclyde Pension Authority, the largest of its kind in Britain. PM leaders should make it their priority to begin discussions with the SPA and other sources of finance, such as the British Business Bank, to build a substantial fund capable of financing new companies.



Conclusion

Scotland already has a head start in Precision Medicine thanks to its existing strengths and the pioneering work being led by the University of Glasgow at the QUEH, and by other teams in Edinburgh, Dundee and Aberdeen. However, to become a global leader in this area, the task is to bring expertise together within Scotland, and within the UK as a whole. At the same time, Scotland's life sciences sector also needs to adopt a more entrepreneurial culture. The aim is for Scotland, in time, to take all our strengths, including in Precision Medicine, to build our first globally competitive and home-grown biotech and biopharma company.



Our Scottish Future believes that good government in Scotland and across the United Kingdom has to be based on the values of cooperation, empathy, solidarity and reciprocity.

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