Scottish Science Advisory Council

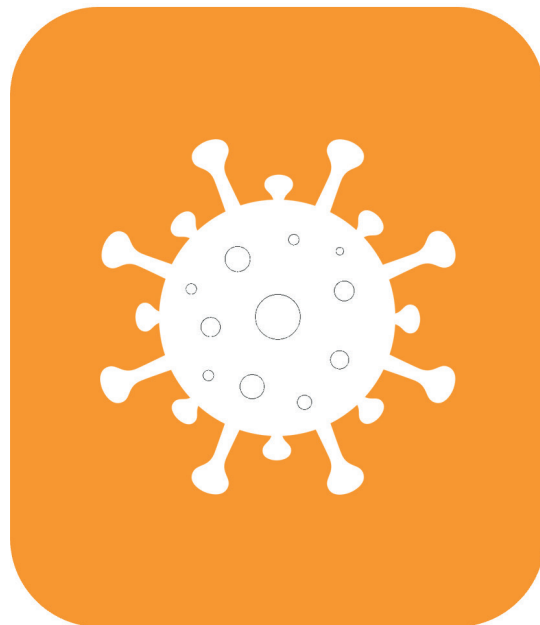# Building on the Science Legacy of COVID-19 in Scotland

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"Before anything else, preparation is the key to success"

Alexander Graham Bell

Executive Summary

Scotland has a history of great scientists who have contributed significantly to shaping the world we live in. During the COVID-19 pandemic, the contribution of science to managing national and international responses was vital. We have a strong reputation in life sciences from world-leading research through to its application in the development of therapeutics[1]. This platform of skills has been nurtured by a number of innovative funding mechanisms to support collaboration between organisations and sectors.

During the pandemic, the degree of collaboration across boundaries (disciplines, sectors and organisations) has enabled the Scottish Government (SG) to draw on the phenomenal talent there is across the country in a joined up way. The threat posed by a global pandemic – which impacted on all our lives in profound ways – was undoubtedly a stimulus, but it has left a legacy of enthusiasm across the science community for continuing to work collaboratively moving forwards, both to help improve Scotland's health and to be prepared for future crises. The degree of collaboration during the pandemic response highlights an exciting potential for the Scottish science community to continue to deliver for societal benefit in the future, recognising also the need to continue to work collaboratively with UK and international colleagues.

The Scottish Science Advisory Council (SSAC) is an independent advisory body to the SG and used its convening power to capture the views of members of the Scottish science community who had been directly involved in the pandemic response, on what had worked well and where improvements could be made. It did this through consulting widely across the life sciences industry, academia and the NHS via a questionnaire and roundtable, followed by a number of one-to-one calls to check facts (Annex 1).

This report highlights the appetite for, and benefits of, scientists across Scotland working across disciplines and for collaboration between organisations (academia, the life sciences industry and the NHS, with respect to health issues) and sectors for the realisation of a common purpose. A crisis brought scientists together, but our findings suggest that the Scottish science community is currently motivated to maintain relevant aspects of the integrated science platform (developed during the pandemic) for delivering a transformation of the health status of Scotland's population, and ensuring resilience to future crises. Action by the SG is required to maintain that momentum.

The recommendations fall into seven areas:

1. Preparation for future emergencies, not just pandemics

2. Strengthening existing and identifying innovative ways of stimulating collaboration across academia, life sciences industry and NHS Scotland science communities

3. Formalising the network of scientific advisers within the SG and its role in accessing integrated scientific knowledge from outside government

4. Enhancing access to high quality health (and linked) data, by repurposing current capabilities to address other pressing health challenges including development of proportionate approaches to data governance for national emergencies

5. Directing the use of laboratories built for COVID-19 testing towards major health issues, while retaining readiness for the next pandemic

6. Seizing the opportunity to broaden participation in clinical trials through digital innovation

7. Deepening the understanding of the policy process across society

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1   Life Sciences Scotland - Capabilities

Overview

The likelihood of a pandemic occurring has long been recognised as a high risk, but the scale of impact was always going to be impossible to estimate since it depends on the actions taken by governments and society. As has been reinforced by this pandemic, science cannot provide a complete understanding of how society and our environment interact, but it does have knowledge and tools to help us manage the impact of crises. The pandemic has taught us that the speed with which these tools can be applied is critical in minimising the impact and hence the primary aim of this report was to provide recommendations to the Scottish Government[2] (SG) with respect to preserving infrastructure and skills and learning lessons on data curation, based on engagement with members of the scientific community who had been directly involved. A secondary aim, however, was to learn lessons regarding the mobilisation of science and scientists in the face of an emergency.

Science has already identified trends (the scientific evidence for the likelihood of, for example, catastrophic climate change[3] and loss of biodiversity[4] is clear), which are increasing the likelihood of major risks; planning for future crises should hence adopt a broad lens. In relation to science, this implies a trans-disciplinary, cross-sectoral approach i.e. ensuring input from different disciplines and drawing on experience from organisations in the public, private and third sectors, as well as academia. Scotland is already in a strong position to adopt a trans-disciplinary approach, due to its relatively small size and past investment (at national and local levels) in collaborative initiatives both in terms of science (e.g. Research Pools[5] and Centres of Expertise[6]) and between the private sector and academia (e.g. Innovation Centres[7] and Interface[8]). Further, during the pandemic new collaborative initiatives have been launched (e.g. SG's Data and Intelligence Network[9]) and many more innovative approaches in gestation were shared with the Scottish Science Advisory Council (SSAC) through responses to our questionnaire, at the expert roundtable and during follow-up phone conversations (Annex 1).

It is the SSAC's view that Scotland's science community is very well placed to enable Scotland to be an international leader in an integrated response to future crises, provided priority is given to continuing to build on and maintain connectivity between disciplines and sectors.

These suggestions are built on a range of evidence sources described in Annex 1 and SSAC would like to acknowledge the engagement of members of the wider science community in highlighting successes and formulating recommendations[10].

Main findings gleaned from engagement with Scotland's science community

It should be stated that this report is not intended to be an audit of what worked and didn't work – rather, our aim was to capture key elements of the science response to the pandemic. The enthusiastic response of the science community to our request for feedback created an opportunity to capture wider views, but this report should not be viewed as a systematic summary of the views of the whole Scottish science community. We were pointed towards many excellent initiatives already underway to address some of the issues raised (Annex 5), but a more systematic approach could well identify more.

The science community worked together in unprecedented ways in the pandemic response: There was general agreement that the degree of collaboration between scientists in universities, colleges and research institutes, the NHS, the life sciences industry, government and its agencies made a major contribution to management of the pandemic. However, for historical reasons some disciplines are better represented within SG than others and hence the opportunity to take advantage of that unparalleled integration of scientific knowledge was under-exploited. This could be an opportune time to reappraise the role of science advice within the SG. The office of the Chief Scientific Advisor (CSA) for Scotland is (even on a per capita basis) very significantly less resourced than in the UK Government, thus limiting opportunities for taking advantage of this greater science integration in future. It was good to hear (repeatedly) that there was excellent science collaboration across the four nations during the pandemic and that the intention is for this to continue, enabling Scotland to draw on UK-wide expertise. The opportunity to draw on experience from other countries through international networks was also critical during the pandemic and in the post-Brexit era, resources to maintain and enhance these networks should receive a high priority since they are a key part of maintaining Scotland's potential to mount an integrated response to the next crisis.

Data analysis was a critical tool used by governments during the pandemic: Scotland produced a national, linked COVID-19 surveillance platform[11] which, for example, enabled the world's first real-world data on the effectiveness of the Pfizer-BioNTech and Oxford-AstraZeneca vaccines[12] based on a study of the whole population. But we could have done better. In a report published in 2021[13] SSAC had already drawn attention to the need for the NHS in Scotland to "*improve the geospatial context and Geographic Information Systems (GIS) compatibility of their data, and a skills-gaps analysis undertaken to identify the cause(s) of gaps in their data*". During the pandemic there was a 10 month delay due to the lack of agreed approaches to proportionate information governance in the context of pertinent emergencies. Indeed, while Scotland (in a 2021 report) was ranked fifth out of 23 Organisation for Economic Cooperation and Development (OECD) countries in terms of data governance, it ranked 19th in terms of data set availability and use[14]. Statisticians within SG created a Data and Intelligence Network[15] in May 2020 and a partnership between the SG, Scotland's leading academic institutions and public bodies (Research Data Scotland[16]) was created to facilitate insight from data and improve economic, social and environmental wellbeing in Scotland. These networks need to continue to be resourced and promoted and built on to ensure future data requirements can be met, but, there are outstanding issues about speeding up accessibility in a time of future crisis which need resolution. For example, the need to establish a "Once for Scotland" national data architecture and governance system[17]

11 Usher Institute - EAVE ii
12 pubmed ncbi nlm nih
13 SSAC Future Landscapes Report on Geospatial Knowledge
14 OECD April 2021 National Health Data Infrastructure report
15 Scotland's Data and Intelligence Network
16 Research Data Scotland
17 First Minister's Environmental Council: first report, key priorities and future work programme

The Lighthouse Lab in Glasgow and NHS labs in the regions were established with unprecedented speed: The rapid availability of testing laboratories is recognised as a major Scottish success story. The Lighthouse Lab benefited from a collaboration of partners working together representing universities, the NHS and industry. NHS Scotland also funded three regional hubs, which adopted similar high throughput PCR testing with highly automated and efficient laboratory processes (Annex 4). Provision of labs by a number of organisations in the early part of the pandemic should also be recognised. Repurposing the infrastructure and skills created to transform progress in addressing other major health issues could cost-effectively enable them to be maintained (to some extent) in readiness for future pandemics. We received suggestions on priority diseases to tackle, but prioritisation requires a systematic approach, adopting a range of criteria, including explicit consideration of the needs of deprived communities.

Commitment of the public to engagement in research and clinical trials was excellent: The engagement of members of the public in volunteering to be part of research programmes as the country faced a common threat was welcomed and there is an opportunity to build on this. Scotland is currently losing out to England in both non-COVID-19 clinical trial investment and the development of an effective health data infrastructure. To achieve the same successes as were seen during the pandemic, SG and NHS leaders will need to show the same level of leadership in health and science in the post-pandemic recovery period as they did during it. The four nations of the UK published advice on the future of clinical research delivery in March 2021[18], which provides a vision linked to delivery on five key themes. (Science communication is also a key aspect of societal engagement, but the Royal Society of Edinburgh (RSE) COVID-19 Commission studied this in some detail so no further comments are made here[19]).

An integrated science platform can benefit increasingly complex policy decisions: During the pandemic, SG decision making adopted the "Four harms framework"[20]. In other policy areas such as climate change, the risk of unintended consequences becomes yet more complex. The need for *integrated* science advice thus becomes yet more critical. Through discussion with policy colleagues the SSAC has been developing a convening role, working with civil servants and analysts to map some of the inter-dependencies (unintended consequences) between policy areas through bringing policy makers together with other advisory bodies, the private sector and scientists from multiple disciplines to generate a pathway towards more cohesive and objective advice to underpin government decisions on priorities. The SG recognises the potential trade-offs between policies through alignment of its National Performance Framework with the Sustainable Development Goals (SDGs)[21] and formalising and strengthening the scientific advice structure within the SG should enable more effective use of the scientific knowledge being generated within Scotland to accelerate progress towards those goals. The NHS Artificial Intelligence Laboratory[22] (NHS AI Lab) is a good example of bringing government, health and care providers, academics and technology companies together and the Campbell report[23] is an excellent example of collaborative working: SG seeking advice on attracting investment from the health sector on building a national health innovation life science cluster. These initiatives might serve as exemplars for other sectors where private sector investment could both stimulate the economy and help prepare for future emergencies.

18 The Future of UK Clinical Research Delivery
19 RSE Post Covid-19 Futures Commission
20 Covid-19: Framework for decision making
21 SG National Performance Framework - Sustainable Development Goals
22 The NHS AI Lab
23 The Campbell Report: Roadmap to Investment for Health Innovation Life Sciences and Healthtech

There is a need for simplified entry points to government: Overall SG leadership was generally praised for consistency throughout the pandemic and the Chief Scientist's Office (CSO) was instrumental in initiating calls for highly pertinent research. However, that is not the whole story and many respondents expressed frustration at delays in finding the most appropriate person to talk to. When there are 14 separate Directorates in the Health and Social Care Directorate General in the SG and 14 Regional and 7 Special NHS Boards[24] it can be difficult for those outside the SG with relevant evidence to share, to navigate their way to the most appropriate individual. Initiatives such as the Centres of Expertise[25] and the Scottish Policy and Research Exchange[26] have tried to fill that gap but there is more to be done. One example of the contribution of the Centres of Expertise to the pandemic response is the work of the Centre of Expertise for Waters in stimulating the monitoring of wastewater for coronavirus ribonucleic acid.

24 Scotland's Health on the Web
25 SEFARI: Scotland's Centres of Expertise
26 SPRE Scottish Policy and Research Exchange

Specific Recommendations

The aim of this piece of work was primarily to learn from those scientists directly involved in the response to the pandemic on what they saw as priorities with respect to preserving infrastructure and skills and learning lessons on data curation. A secondary aim, however, was to learn lessons regarding the mobilisation of science and scientists in the face of an emergency. Since our consultation community was mainly restricted to those from the health sector, we could only scratch the surface of the second aim and our first and last recommendations, therefore, should be viewed as just the starting point for further developing an integrated science platform to underpin Scotland's resilience with science.

1. Prepare for future emergencies, not just pandemics

The nature of the next emergency is unknown. Preparation for future emergencies needs to look beyond viral pandemics (while recognising the importance of the Standing Committee on Pandemics[27] in learning the lessons from the past two years) and be flexible enough to be ready to launch a rapid response to the next shock. Societal changes are happening rapidly in the 21st century and awareness of the *context* of applying solutions can enhance the effectiveness of their application. **Greater integration of the social sciences into planning for future emergencies is essential as is planning for scaling up volunteer activity with clear lines of command and leadership.**

2. Strengthen existing and identify innovative ways of stimulating collaboration across academia, life sciences industry and NHS Scotland science communities

Many Scottish universities already have multi-disciplinary Centres and various funding mechanisms (at Scottish, UK and European level) have supported collaborative working between universities and also between universities and research institutes. Funding mechanisms to stimulate innovation also exist. An example from the Health sector of a collaboration involving 15 partners from across industry, the NHS, and academia is The Industrial Centre for Artificial Intelligence Research in Digital Diagnostics[28]. The Scottish Funding Council (SFC) is in the process of developing a strategy for future initiatives and **we support the intention of SFC to encourage universities to support cross-institutional collaboration and to catalyse challenge-led, inter-disciplinary research programmes. Links between such programmes and the private sector (perhaps with the involvement of Innovation Centres) could be part of the requirements for the proposed "Challenge-led consortia", given both the urgency of societal challenges (e.g. the twin emergencies of climate change and loss of biodiversity) and also potential benefits for the economy.** Strengthening the porosity of employment between academia, the public and private sectors during careers would also strengthen networks and mutual understanding in advance of collaboration being required.

3. Formalise the network of scientific advisers within the SG and its role in accessing integrated scientific knowledge from outside government

The SG has teams of analysts (economists, social scientists and statisticians) in most if not all Directorates as well as scientists in key marine and agricultural Directorates and there are many more in, e.g., the NHS, in government agencies, in Universities and Further Education Colleges and in the private sector. Links between these scientific communities have been developed and strengthened during COVID-19, but more could be done to map (and strengthen) the ecosystem and hence accelerate the exchange and application of knowledge. **Strengthening the role of the CSAs within the SG[29], together with more formal links into the centre of government, could help the SG to capture benefits from the strengthened collegiality of the Scottish science community to make holistic evidence available to inform government thinking[30].**

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27 Standing Committee on Pandemics

28 ICAIRD - Industrial Centre for AI Research

29 Currently there is a Chief Scientific Adviser for Scotland, a Chief Scientist (Health) and Chief Scientific Adviser Environment, Natural Resources and Agriculture but that still leaves a lacuna for networking to other disciplines. The Chief Scientist's Office (CSO) has a specific role in formulating and implementing the research and development strategy for the NHS in Scotland but this leaves a gap in health and life science advice within government, relative to other devolved nations.

30 Since Scotland is a small country this will also require excellent communication with the other nations of the UK and with international networks.

4. Enhance access to high quality health (and linked) data, by repurposing current capabilities to address other pressing health challenges and development of proportionate approaches to data governance for national emergencies

Scotland has outstanding health data assets which have extensively been used for forecasting/modelling, risk stratification, vaccine uptake, effectiveness and safety and health system disruption, but rapid availability of quality data (which connects data around a person, a place and a household and is cleaned, linked and curated) remains an issue. The capacity and capabilities developed during the pandemic need to be maintained through repurposing to address other major health challenges facing Scotland thereby enabling a rapid pivot to address other crises, as required. There is an urgent need to implement recommendations which have been around since 2012 on joint working in the health sector. **We support the need to identify clear accountability (for example work being led by Life Sciences Scotland) for delivery of metrics aligned across Health Boards, strengthened geo-referencing (recommended by an earlier SSAC report[31]), enhanced quality of data and agreed processes for developing more proportionate information governance during a time of crisis.**

5. Direct the use of laboratories built for COVID-19 testing towards major health issues

The high throughput laboratories were rapidly operational due to a successful collaboration between the NHS, life sciences (and other) industry and universities. Tough decisions lie ahead on future resourcing priorities, but opportunities for using them to tackle other major health issues in Scotland need to be considered, in order to capitalise on the investment to date, while retaining readiness for future pandemics. **Advice on appropriate resourcing level needs to take account of advice from the Standing Committee on Pandemics (amongst others) on the level of resource required for rapid rescaling up for the next crisis, but the prioritisation of which diseases to tackle will require the adoption of a systematic approach drawing on multiple disciplines.**

6. Seize the opportunity to broaden participation in clinical trials through digital innovation

Digital healthcare improved greatly during the pandemic and this provides an opportunity for Scotland to position itself as a single trials infrastructure, using linked data to enable recruitment and long-term follow up efficiently and at scale. The UK collectively (agreed by all four Health Ministers) has already formed the sector-wide UK Clinical Research Recovery Resilience and Growth (RRG) programme with visions outlined and strategies and delivery plans under development. **In Scotland, the extent of our health inequalities are well documented and a particular focus should be on facilitating participation amongst under-served and diverse groups to help tackle those inequalities. Once again, an inter-disciplinary approach will be required.**

7. Deepen the understanding of the policy process across society

Understanding the public response to pandemic-induced regulations is an ongoing research topic, but given the urgent need to engage society as a whole in changing behaviours to tackle, for example, greenhouse gas emissions, there may also be merit in helping more people (scientists and the general public) understand the policy process. Feedback received suggested frustration at the opaqueness of the structure (and processes) within the SG. **The SG already partially funds Scottish Policy and Research Exchange (SPRE)[32], an initiative which could be built on alongside the Scottish Funding Council's (SFC) suggestions around micro-credentials (which could include a policy module)[33]. There may also be advantages to be gained from ensuring that the Modern Studies curriculum in schools includes an understanding of government and that modules on the policy process are considered more widely in tertiary education.**

31 SSAC Future Landscapes Report on Geospatial Knowledge
32 SPRE Scottish Policy and Research Exchange
33 SFC Review: Review of Coherent Provision and Sustainability

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