Evidence Submission

The role of technology, research and innovation in the Covid-19 recovery.

September 2020

Summary of recommendations

Recommendation 1 – The government needs to harness the evidence from the wider R&D community on the needs of different researchers to achieve its goal in the R&D roadmap of making R&D for everyone. This can support the diffusion of good practice that has been co-developed with the R&D community. In light of Covid-19, the government will need to determine how to capture both pre-existing evidence, but also emerging evidence that shows how the pandemic is affecting different groups of researchers, for example women, ethnic minorities and those at different career stages, including early career researchers. Evidence gathering to understand the effects of Covid-19 on inclusion and diversity in R&D, needs to address both what the longer-term impacts may be and also what nearer-term effects on existing inequalities are surfacing.

Recommendation 2 - Future UK funding for international collaboration must take into account not only the UK's exit from the EU, but also the long-term effects of Covid-19 on new modes of international research and innovation collaborations. Whilst there is likely to still be a place for face-to-face collaboration in the future, the evidence gathering mentioned in recommendation 1 will need to include evidence on the prevalence of, and effects of, new modes of online and hybrid online/ in-person modes of networking, conferencing and performing research, including the diversity of researchers.

Recommendation 3 – The Department for Business, Energy and Industrial Strategy (BEIS) needs to set out how it has used the results of the survey that it commissioned CRAC/Vitae to carry out, to inform its thinking on interventions in the UK R&D system to counter the impacts of Covid-19. The analysis of the survey needs to show differential data on impacts felt by discipline to help build a better evidence base of Covid-19 impacts on laboratory-based R&D.

Recommendation 4 – Research-intensive SMEs in the chemical sciences have clearly demonstrated that they can operate Covid-safe. The government should continue to monitor the evolving situation and needs of SMEs and work with the community to develop any further policy initiatives that may be needed. This includes considering sector specific conditions when deciding on business or sector closures, should there be a second wave. If locked down financial support will be critical to research intensive SMEs to retain talent and ideas within the UK economy and support future economic growth. The government must remember that both a long-term scientific solution to the Covid-19 pandemic, future pandemics more widely and the UK's economic recovery, will need a range of actors working together, including SMEs who are particularly vulnerable.

Recommendation 5: The government should review the impact of Covid-19 on practical work in the sciences, at all levels of education. The review should consider the long-term impacts for these subjects, including progression into further study, employment prospects and how the delivery of the UK's R&D ambitions might be affected.

Recommendation 6 - The impact of the pandemic, and of reductions to the teaching grant, should be monitored at subject level. Additional funding should be provided to universities, if necessary, and it should be ring-fenced for high-cost subjects such as the chemical sciences to ensure the long-term viability of chemistry departments and their ability to train the future workforce.

Recommendation 7– As the government considers options for increased investment in R&D, the UK government must set out transparently how increased R&D investment will translate into funding streams. This includes funding across different disciplines, challenge areas and types of research.

Recommendation 8 – UKRI should outline what criteria they used to prioritise assess and select proposals under their rapid research calls, including how this was informed by discussions with government relating to the ongoing management of the Covid-19 pandemic.

Introduction

We welcome the opportunity to share our global community's experiences of carrying out research and innovation during the Covid-19 pandemic and what learnings this experience may provide for future UK government R&D policy. We draw upon these insights in our evidence and recommendations.

Our response to this inquiry mainly focusses on the following points in the inquiry's terms of reference:

- *How have research and innovation in UK universities, businesses and other settings been affected by the Covid-19 pandemic, and how might they be affected by any lasting changes post-Covid?*
- *How effective have measures adopted by the Government to support research and innovation, such as the support packages for innovative firms and university researchers, and the 'Ministerial University Research and Knowledge Exchange Sustainability Taskforce', been.*
- *In the context of the Government's 'Research and Development Roadmap', what shorter-term measures can best support UK research and innovation in recovering from the disruption of the Covid19 pandemic and adapting to the post-Covid environment?*

1. Collaboration, scientific meetings and networks

The onset and spread of the Covid-19 pandemic has resulted in travel restrictions around the world. For research and innovation, including that which is carried out by the chemistry community, one of the most prominent changes our community is experiencing is the decline in, or cancellation of, in-person scientific meetings, collaborations and network building. This includes international conferences, but also one-to-one engagements, e.g. scientific exchanges where researchers travel to work in a different laboratory for a fixed period of time as part of a collaboration.

To date, the experiences of our community moving scientific exchange online reveal a mixed picture. The evidence we present here reflects reports from our community and our own experience of adapting scientific meetings during the pandemic.

1.1. Benefits of online scientific meetings

Initial observations from our own events suggest that attendees from a greater number of countries are joining our events online, despite challenges with time zone differences – i.e. it seems that people are willing to join a conference late at night if they deem the scientific content to be valuable. Researchers are also still keen to participate and present their work using this format, even if their speaking slot falls outside their usual working day. Offering conferences online has also allowed us to significantly reduce registration costs compared to in-person events, due to savings made including venue costs.

The reduction of fees for attending meetings online may have made them more accessible to students who often have to prioritise meetings they wish to attend due to the challenges associated with seeking grant support for travel or making the case for their attendance over another colleague in their research group. It has also been observed that established researchers presenting their work via mass videoconferencing could be seen as 'democratising' scientific exchange. Students (and other conference participants) are able to engage with the work of more senior researchers in a way that may have felt more challenging in a face-to-face situation. Before, a student may have been influenced by the social dynamic of asking a leading researcher a question face-to-face. Now they can type it into the chat box during a talk online, which can feel less intimidating, yet support their own development as an independent researcher by providing them with experience of critiquing others' work. We are also aware of UK research groups proactively reaching out to colleagues outside the UK to set up presentations and discussions on other groups' research in a more informal way as a way of trying to support networking during the pandemic. This has involved getting input from group members to identify researchers that the group wishes to engage with and then setting up virtual meetings to share and exchange current research, keeping international links and collaboration alive.

1.2 Challenges of online scientific meetings and learnings in addressing these

Our community also report some of the benefits we have observed in our meetings; however, they are balanced by some important challenges. In general, attendance has been good and more geographically diverse but informal networking and the exchange of ideas through conversation has been substantially more difficult. Whilst researchers attend conferences to hear about the latest science, often discussing work in an informal setting is as strong a driver for attendance, and they feel that this cannot be done as effectively in a virtual environment. These informal conversations are also a key part of network building, which is a vital feature of developing the connections for future collaborative work and often helps to seed new research ideas.

We are also hearing that challenges around networking are being felt more acutely by early career researchers. In the context of newly independent researchers (ca. 1 year into an independent research career), this can pose a problem, given that network building in order to develop your own area of research is a crucial part of career development at this stage. It has been observed that in a virtual environment, competition to draw researchers into attending online meetings can result in an ever-greater reliance on established researchers regarded as 'big names' to ensure event success, reducing important opportunities for early career researchers.

Within our community, we had already identified early career researchers as a specific group that required support before the Covid-19 pandemic. Examples of our work in this space include signposting early career members to opportunities for peer support,[1] profiling early career researchers that choose to publish their first independent work with us[2] and recognition of early career researchers through specific

awards and prizes for this career stage.[3] Based on some of the feedback to date, we are acting to adapt some of our activities in an increasingly virtual environment including early career researcher speakers as part of our virtual symposia. Our pre-existing work in this area has been informed by views and evidence from our community on the challenges that early career researchers face, including where their career stage intersects with other protected characteristics, such as gender.[4]

1.3. Potential impacts of challenges on the diversity of the research community

The government's R&D roadmap commits to identifying *'actions we can take to increase support for early career researchers and giving them the skills, knowledge and experience needed to progress their careers inside or outside academia'*.[5] This is a vital element of ensuring that in the future, diverse people and teams are carrying out R&D and will involve identifying and removing barriers that lead to people moving away from R&D careers when they may not wish to. The wider scientific community including universities, research institutions, companies, funders, learned societies, academies and publishers already hold vast amounts of evidence on the barriers that affect many groups within the R&D community. If government wants to determine how to make R&D for everyone, it will need to set up structures to harness the evidence and proposals that the community are already developing and applying, to support the spread of good practice.

It should be noted that the experiences outlined in our evidence represent an initial view and organisations and individuals are adapting as the pandemic continues. To truly understand how networking and collaboration in science have been affected by Covid-19 and the potential connections to building a diverse R&D workforce, evidence would need to be gathered in a systematic way, over time, across disciplines, sectors, settings and types of researcher to identify differences and commonalities. Finally, it is important for the government to collect evidence in such a way that it can differentiate between what the effects of Covid-19 are on the diversity of scientists in the longer term and what the effects of Covid-19 are on existing inequalities and under-represented groups – answering the question of whether Covid-19 is widening existing gaps.

Recommendation 1 – The government needs to harness evidence from the wider R&D community on the needs of different researchers to achieve its goal in the R&D roadmap of making R&D for everyone. This can support the diffusion of good practice that has been co-developed with the R&D community. In light of Covid-19, the government will need to determine how to capture both pre-existing evidence, but also emerging evidence that shows how the pandemic is affecting different groups of researchers, for example, women, ethnic minorities and those at different career stages, including early career researchers. Evidence gathering to understand the effects of Covid-19 on inclusion and diversity in R&D, needs to address both what the longer-term impacts may be and also what nearer-term effects on existing inequalities are surfacing.

1.4. Potential wider policy implications of moving scientific engagement online

In terms of lasting changes post-Covid 19, it is vital to remember that online conferences and networks represent a new direction and one that we are unlikely to see wholly reversed, even once the disease can be brought under control. Should face to face to engagement at e.g. scientific conferences be possible again in the future, it is unlikely that these will be accepted as standard. Instead, it is likely that there will be a strong impetus to develop hybrid models that allow for both in-room and online engagement to be

combined, in a way that enables parity of experience between the in-person and virtual settings. As outlined above, early feedback on virtual events suggest some benefits, such as enabling the engagement of a wider range of researchers including those who cannot travel for financial, personal or geographical reasons.

This also needs to be coupled with wider global narratives on climate change, decarbonisation and green recovery. We may see attitudinal and societal shifts, not just in the scientific community, but also in society more broadly, about the need for regular travel, particularly by air. The demand for sustainable new technologies was rising before the pandemic. The prominence of this as an opportunity for research and innovation, but also for future economic growth, is likely to grow further.

Alongside the challenges outlined above, it is important to acknowledge the rapid mobilisation amongst the research and innovation community to developing new ways to collaborate online as part of the efforts to find vaccines and treatments to manage the Covid-19 pandemic. Examples that we are aware of from within our own community include the Covid-19 Mass Spectrometry Coalition.[6] Collaborating virtually across borders in this way is not new, but we are seeing researchers move towards these mechanisms ever more rapidly because of Covid-19, addressing the practicalities of restrictions, and as part of the solution to this and future pandemics. Future UK policy on international collaboration will need to take account of increased international digital engagement and the role of appropriate digital infrastructure to support collaboration and the evolving research and innovation landscape. Our recent work on the use of digital technologies in chemistry found that there is an opportunity for the UK to establish a global lead in the new kinds of digital infrastructure that science needs to excel.[7] In the context of a post Covid-19 world, fit-for-purpose digital infrastructure to support research and innovation is likely to take on an even greater significance.

Finally, it is worth noting that the combined effects of changes to modes of scientific engagement due to Covid-19 are taking place as the UK prepares to leave the EU. The UK government has committed in its R&D roadmap document to *'develop a new funding offer for collaboration to ensure the UK can further benefit from the opportunities of international scientific partnerships'*.[8] Any new funding for international collaboration must take into account the recently changed nature of international collaboration, underpinned by evidence and learnings from the community. It also needs to complement association to Horizon Europe. As noted above, researchers are finding ways to share data, carry out joint research, and undertake scientific discourse in the digital environment. Constructing new funding offers with this evidence incorporated into the design will help the UK continue to be an important partner and leader on international research and innovation collaborations.

Recommendation 2 - Future UK funding for international collaboration must take into account not only the UK's exit from the EU, but also the long-term effects of Covid-19 on new modes of international research and innovation collaborations. Whilst there is likely to still be a place for face-to-face collaboration in the future, the evidence gathering mentioned in recommendation 1 will need to include evidence on the prevalence of, and effects of, new modes of online and hybrid online/ in-person modes of networking, conferencing and performing research, including the diversity of researchers.

2. The effects on chemistry research and development in universities and research institutes

As for any discipline that involves practical science, the impacts on chemistry have mainly been felt through laboratory closures. Whilst in the UK context, laboratory working has been permitted throughout the duration of the pandemic (where safety measures could be put in place to support distancing), rapidly changing guidance from government at the start of lockdown and limited resources meant it was not possible to put measures in place to enable all practical work to continue under safe conditions during this period, and so some research was interrupted. Many universities had to quickly prioritise research labs that needed to stay open to carry out essential R&D, as well as ensuring that technical staff were able continue to carry out crucial maintenance and maintain health and safety standards. For those laboratories that were not able to continue working under the most severe phase of the lockdown (from late March), it is estimated that it may take several months for some of them to reach their prior research capacities, leading to significant amounts of lost research time. The length of the delay will depend on the nature of the research, including the kinds of equipment and reagents used, and the stability and sensitivities of the latter.

We are aware that research is now successfully resuming in universities, with systems in place to ensure Covid-secure working (including reduced occupancy levels in labs to allow for social distancing). Concerns remain around maintaining research continuity, the reduced level of research activity that is possible under reduced occupancy, reduced operating hours, the impacts of research interruptions on researcher careers (see below), and ability of staff to safely access laboratories using public transport. Some university departments and research groups donated supplies of PPE and hand sanitiser to hospitals and care homes to address shortages at the start of the pandemic, and have needed to make additional financial outlay in order to replenish these stocks.

Alongside the impacts on the research itself, there are many personal and professional impacts from the sudden halt to practical work in university research laboratories. These include delays to qualification for students, the expiration of fixed-term contracts and wider impacts on professional development, future job opportunities and the mental health of researchers in these settings. For early career researchers who may have been about to take up a new post in a laboratory setting, we have heard about how the pandemic has affected their ability to get to grips with their new role, impacting their ability to learn from their peers the norms and practices of practical working in the laboratory, or if they are able to join a lab in a safely distanced way, then this learning is often taking longer. In some cases these researchers have been unable to take up their position at all, for example, due to restrictions on international travel, leading to delays in research as well as loss of income.

The government, with UKRI, has worked to put some measures in place to support researchers, including eligibility for the furlough scheme and extensions for some PhD students. These measures have been welcomed, but gaps remain, for example mitigations for students not eligible for the UKRI funding extension (for example international students, and UK/EU students funded by other sources). The measures for PhD students have mainly focussed upon those in their final year. As mentioned in the previous section, the impacts of the pandemic on PhD students in other years cannot yet be fully known, which is why gathering evidence on emerging impacts is vital.

It is important to recognise the specific challenges faced by practical subjects as a consequence of Covid, including the increased cost of running research and teaching labs at reduced occupancy (see below), and the impact of lost research time on careers. This impact is likely to be greater than for subjects which

do not require lab space or specialist equipment and which have therefore been able to transition comparatively more effectively to home-based working.

Evidence from the community will be vital in determining the extent of the impact on research and innovation itself. The Department for Business, Energy and Industrial Strategy (BEIS) commissioned CRAC/Vitae, supported by UKRI and Universities UK, to seek evidence around the implications of the Covid-19 pandemic on the activities of researchers and research groups. Input was sought in the form of a survey.[9] It was stated that the evidence gathered as part of this survey would *'inform BEIS's consideration and design of potential interventions to help protect researchers, research institutions and facilities'*. The results from the survey need to be published and government will need to set out how they have used the findings to inform their thinking on future interventions to recovering from the disruption of the Covid-19 pandemic.

Recommendation 3 – The Department for Business, Energy and Industrial Strategy (BEIS) needs to set out how it has used the results of the survey that it commissioned CRAC/Vitae to carry out, to inform its thinking on interventions in the UK R&D system to counter the impacts of Covid-19. The analysis of the survey needs to show differential data on impacts felt by discipline to help build a better evidence base of Covid-19 impacts on laboratory-based R&D.

3. The effects on chemistry research and development in business settings

Covid-19 has led to changes in the private as well as the public sector. Many in our industrial community in larger companies have been proactive in adapting their operations, initially to support near-term continuity. Across chemistry, some adoption of automation of experiments may be helping, in part, to support rapid implementation of Covid-safe working. Our Digital Futures report found that safety is one of the many benefits of automation of physical experiments; a shift that was taking place in chemistry-using businesses before the pandemic.[10] Businesses in our community have reprioritised and considered what the pandemic may mean longer-term, as well as reorienting their provision of goods or services in the near-term. As a result, we are aware that many of them have chosen to postpone major initiatives for 2020, e.g. new product launches, particularly in sectors such as FMCG (fast moving consumer goods), which are directly linked to consumer markets and therefore sensitive to fluctuations in consumer spending patterns. Shifts in consumer spending during the pandemic suggest that the areas of healthcare and wellbeing represent future opportunities for business, and by extension, for research, development and technology in terms of addressing changing consumer need.

3.1. Experiences of Small and Medium Enterprises (SMEs)

For SMEs in our community, the situation has been more mixed. As outlined in our previous response to the committee on UK capability in global disease outbreaks, SMEs comprise a significant part of the chemical and pharmaceutical sciences space. Many of these are R&D performing companies. They employ highly skilled and specialised people who undertake R&D as part of their day-to-day roles within laboratory settings. At the early stages of the pandemic, for many SMEs survival was the critical issue. From the start of the UK lockdown we worked quickly to identify three crucial needs of SMEs in our sector and shared this with government to inform their own thinking on support required for the sector. These needs were; fast tracking grants for SMEs whilst encouraging private investment; continued laboratory

access and; efficient and prompt communication to those who could provide support to address the pandemic.[11]

We were amongst stakeholders that fed back rapidly to government in the early stages of the implementation of the Coronavirus Business Interruption Loan Scheme (CBILS) and the Bounce Back loan scheme, highlighting initial gaps in the system that meant e.g. pre-revenue companies were still at risk. Further schemes including the Future Fund, additional grants via Innovate UK[12] and the extension of the CBIL scheme, following on from changes to EU state aid rules,[13] have also been introduced in recent months. The schemes introduced to support SMEs, when coupled with the furlough scheme, have addressed the majority of needs of SMEs in our community enabling most SMEs in our community to stabilise in the short-term. Many SMEs in the chemical sciences regard their people as their greatest asset. They require highly specialised skills and often seek out researchers with experience not just at degree level, but also at postgraduate and postdoctoral level to secure the niche skill sets that they require.[14] The furlough scheme has been critical in supporting this. Avoiding the loss of these highly skilled roles in SMEs is vital in ensuring that companies survive and that talent and ideas are retained in the UK economy, supporting economic growth driven by research and innovation. Longer term, we will not know what downstream impacts the pandemic may have on recruitment, in businesses and more widely. As mentioned in the previous section, combined changes to the mobility of researchers and the effect that this may have on people's training and careers will need to be monitored to elucidate potential effects.

Laboratory access has presented a diverse range of challenges for SMEs in our community. Some have managed to continue operations throughout the pandemic using a mixture of home working and safe onsite laboratory working. However, some of those based on university campuses were not able to continue their operations in the early stages of the pandemic. Co-located SMEs are highly dependent on the Covid safe approaches taken by their host institution, with many required to close during lockdown affecting research, investment and staff. Co-located SMEs and universities need to work together to achieve a Covid safe working environment in the face of any future waves.

Many SMEs in our community have been adept at pivoting their own capacity in order to address the pandemic response. In some cases, this may mean direct production of PPE, but in other cases, they are working on potential Covid-19 treatments or testing technologies. We have also heard that in the early stages of the pandemic, the services of Contract Research Organisations (CROs) were in higher demand, due to pressures in other businesses to quickly adapt their operations in light of lockdown.

Whilst the evidence from our SMEs demonstrates their adaptability and resilience in the face of the current challenge, this partly reflects the extensive support provided by Government to the economy. SMEs often operate in precarious conditions, particularly when pre-revenue. In order to maintain this critical capacity to address the current pandemic and support economic recovery the government will need to consider sector specific conditions in response to future economic changes whether in response to the pandemic, leaving the EU or additional economic challenges.

At the end of the transition period EU UK SMEs may lose access to EU Framework Programme Funding. For SMEs in our community, we know that this has been vital, in terms of financial and non-financial benefits including connections to scientific, business and investment networks and entry into new markets.[15] The joint timing of the end of the transition period, without clarity on association or what UK alternatives UK SMEs can access, the end of the furlough scheme and a winter season where it is anticipated further lockdowns may take place could prove fatal for many SMEs in the UK.

In our previous response to the committee, we outlined the vital role of SMEs in the drug and vaccine discovery chain; finding a long-term solution to Covid-19 will need SMEs as well as larger healthcare and pharmaceutical firms. In the context of this inquiry, which focuses on the role of technology, research and innovation in the UK's economic recovery, many of these businesses can grow and further invest and create jobs – a vital part of economic recovery. We reiterate that SMEs are a group whose situation must be monitored by government to identify any rapid policy interventions needed to support them.

Recommendation 4 – Research-intensive SMEs in the chemical sciences have clearly demonstrated that they can operate Covid-safe. The government should continue to monitor the evolving situation and needs of SMEs and work with the community to develop any further policy initiatives that may be needed. This includes considering sector specific conditions when deciding on business or sector closures, should there be a second wave. If locked down, financial support will be critical to research intensive SMEs to retain talent and ideas within the UK economy and support future economic growth. The government must remember that both a long-term scientific solution to the Covid-19 pandemic, future pandemics more widely and the UK's economic recovery, will need a range of actors working together, including SMEs who are particularly vulnerable.

4. Laboratory closures – the effects on chemistry education and training

The closure of laboratories in universities, but also closure of schools and colleges more widely has led to changes in the way that chemistry, a practical subject, has been taught during the pandemic. During the pandemic, many institutions have switched to alternatives such as online simulations or redesigning courses to move laboratory work to later in the academic year. It is vital to recognise that alternatives to practical teaching being used during the pandemic are exceptional. They have been deployed out of necessity, pragmatism and safety, not because they offer a long-term alternative. As mentioned above, there are also immediate issues at postgraduate level, where new intakes of masters and PhD students would typically be expected to learn from others in a research group within the physical laboratory environment, yet are no longer able to do so or must do so slowly. One of the biggest challenges is understanding the scale of the issue and starting to determine what this may mean in terms of lasting effects on the R&D workforce pipeline. As a first step, the Royal Society of Chemistry has already called for the government to review the impact of Covid-19 on practical work in the sciences, at all levels of education.

4.1. Potential longer-term impacts on R&D people pipeline of changes to chemistry education and training

Longer-term to fulfil its R&D ambitions, the UK must have science graduates with practical skills. It is what businesses expect and what is needed to fuel world-leading R&D labs in our universities and research institutes. For chemistry, this is vital, in common with many other science and engineering subjects. A large unknown is what the reality of teaching in all settings will look like in the new academic year and the knock-on impacts on training the skilled workforce of tomorrow. For example, we are aware of one university planning to reduce the number of students taught at one time from 160 to 42. The timing of this inquiry means that many are in the final stages of preparation for teaching in the new term, but the implications of this during the next academic year have yet to reveal themselves.

There are also other areas of potential longer-term impact on those in education and training now that will only fully emerge in the coming months and years. Examples include whether or not there will be knock-on impacts on future cohorts of new workers in industry and postgraduate chemistry researchers, if these come from a cohort of students that has not been able to undertake the same amount of practical science as previous years. Also, for those students on undergraduate degree courses that offer an industrial placement, these have been disrupted in the near-term and early indications suggest the number available may decline for cohorts in the coming years. Again, the longer-term effects of these changes on the UK R&D workforce are unknown at this point, but efforts need to be made to capture and understand the possible long-term effects.

We have recently published work that outlines the economic contribution of chemistry-using professionals to the UK economy and the skills they bring to the UK workforce. Chemistry-using professionals make a significant contribution to innovation and economic growth, both through the nature of the occupations they undertake and because they tend to be highly qualified returning an average of £83bn per year to the economy.[16] This work highlights the importance of skills and talent to the UK economy. The government has already acknowledged in its R&D Roadmap that R&D '*will be critical to economic and social recovery from the impacts of Covid-19*'.[17] To achieve this, the government must start now to investigate the effects of the Covid-19 pandemic on the research and innovation people pipeline.

Recommendation 5: The government should review the impact of Covid-19 on practical work in the sciences, at all levels of education. The review should consider the long-term impacts for these subjects, including progression into further study, employment prospects and how the delivery of the UK's R&D ambitions might be affected.

4.2. Potential wider impacts on R&D from Covid-19 financial impacts on HE institutions

In the higher education (HE) sector, members of our community have raised a number of concerns about the financial effects of Covid-19 on chemistry departments and what this may mean with regards to capacity to teach and train researchers. The biggest concerns stem from the uncertainty regarding the number of undergraduate students that will take up places to study at institutions in the soon-to-begin 2020/21 academic year. Whilst applications for places have increased compared to the previous year,[18] institutions still do not have a full picture on the intake numbers for the next year, with admissions being finalised during this period of evidence gathering by the committee. Recent confusion over A-level results has created further uncertainty, and obligations on universities. It is likely that some will be over capacity, and some potentially left with a shortage of students and therefore shortage of income. It is also unclear what the full impact will be of postponements from both domestic and international students.

Chemistry teaching in HE is classed as "very high-cost" – estimated to be £10,500 per student each year. Additionally, infrastructure and resources must be maintained even when student numbers decrease. Fluctuations in the numbers of both undergraduate and postgraduate students could have implications for the finances of chemistry departments, in turn potentially affecting the extent of research that can be carried out within universities. Coupled with wider potential institutional deficits from tuition in all subjects and real-terms decreases in quality related (QR) funding despite uplifts in recent years, many in the chemistry community are concerned about possible longer-term impacts and the potential for these to hit higher cost subjects more severely.

When considering the implementation of the R&D roadmap in the aftermath of Covid-19, the government needs to work effectively across departments to understand potential long-term consequences for the UK's ability to undertake R&D brought about by nearer-term changes in the institutions that train the researchers and innovators of tomorrow.

Recommendation 6 - The impact of the pandemic, and of reductions to the teaching grant, should be monitored at subject level. Additional funding should be provided to universities, if necessary, and it should be ring-fenced for high-cost subjects such as the chemical sciences to ensure the long-term viability of chemistry departments and their ability to train the future workforce.

5. Funding for research and development during the pandemic and beyond

New funding schemes have rightly been set up rapidly in direct response to the pandemic, for example, the UKRI open call for ideas that address Covid-19.[19] However, some in our community feel that an underlying prioritisation towards not just Covid-19, but healthcare more widely, is now taking place through other funding schemes too. Our community outside the UK is also observing this shift.

One example came from a UK SME in the decarbonisation space who reported that there were requirements in grant funding that they pursued tied to the Covid-19 situation, either in terms of directly addressing Covid-19 impacts or in terms of continuity (i.e. potentially prioritising companies that had existing government grants for continuity support during the Covid-19 pandemic). Whilst Covid-19 is undoubtedly a severe and immediate challenge, society more broadly continues to face many other challenges, from climate change to air pollution to the need for sustainable materials. Whilst it is right that R&D funding should be channelled to support viable and scientifically robust ideas for stopping or managing the Covid-19 pandemic, funding for other areas of R&D that address challenges such as sustainability must not be disproportionately reduced because of this. The UK still needs to fund R&D that addresses the challenges like achieving net zero and sustainable use of resources. It is also important that new entrants are not, or do not perceive that organisations bringing new approaches or capability to the table, in the non-health R&D space, will be penalised by new qualification or quality criteria. Decisions on the balance of funding between priority areas and how this relates to the structure of specific schemes must be transparent and effectively communicated.

Recommendation 7– As the government considers options for increased investment in R&D, the UK government must set out transparently how increased R&D investment will translate into funding streams. This includes funding across different disciplines, challenge areas and types of research.

There are also learnings from the fast-track funding competitions that UKRI has delivered which can be used to determine next steps for the R&D roadmap. In our previous evidence to the committee on UK capability in global disease outbreaks, we shared some experiences from our community regarding the availability and responsiveness of research funding during the earlier stages of the pandemic. There has been a huge response from the UK R&D community in terms of quickly identifying and proposing key research questions, innovations and technologies that could address Covid-19 and the pandemic's wider impacts.

For example, the Innovate UK managed *'business-led innovation in response to global disruption'* competition, which opened for proposals for 14 days in April,[20] provided up to £50,000 for the development of products or services that have emerged, or for which need had increased because of the pandemic. Over 8,600 companies applied for £20 million of funding – this is more than the number of companies that applied to Innovate UK for funding across all of its competitions in 2019. The funding pot was doubled to £40 million given the number of applications and over 800 companies were successful.[21]

One CEO of an SME in our network that applied to this competition shared their views on the experience with us. He explained how on reviewing the winners listed, he found a much larger, well-established UK company that was a direct competitor. The breadth of the grant meant that SMEs were competing with much larger companies for an amount of money that can be transformative for SMEs, but would often involve the funder taking a larger risk in terms of allocating money to a less well-established organisation. Whilst in the context of this competition, this may have been an appropriate consideration, the person we spoke to felt that this was not clear in the criteria shared with applicants and it is reflective of a wider culture within the UK R&D funding system of an aversion to risk, especially in supporting SMEs. They felt that a large proportion of publically funded R&D that enables risk sharing with private sector was focussed on ideas and proposals from larger companies that focussed on near-certain incremental returns, as opposed to risky, transformative ideas from smaller, less well-known organisations. The specific technology proposal that this SME was developing was recently recognised and rewarded in a European Commission programme on Covid-19 technology solutions.

Concerns have been reported to us in our engagement with the community regarding the transparency of criteria applied during the assessment of rapid response grants, not only in industrial competitions but also in academic competitions, as noted in our previous response to the committee. There are strong perceptions that due to the large amount of applications for Covid-19 related rapid response calls, post application criteria, which are not communicated to applicants, are applied in grant assessments.

As we mentioned in our previous response, there is much to be commended in UKRI's rapid response to the research challenges that Covid-19 presents. However, there must also be room for learning. The R&D roadmap asks the community how government can *'be more prepared to take risks to achieve potentially greater gains from research, and adopt long-term approaches to investing in research'* and commits to *'launching a major review of research bureaucracy and methods in UKRI'*.[22] The rapid response Covid-19 funding calls can provide us with an important case study about reducing research bureaucracy to support promising research more quickly. UKRI acted adeptly to action these calls, but as set out above, some in our research community have felt that this has come at the cost of opaqueness in terms of how proposals are assessed. As outlined in our previous evidence to the committee, researchers are sensing a different kind of bureaucracy, with a lack of clarity on how much interaction there was with central government during the assessment of proposals.

The research funding competitions set up in response to Covid-19 have revealed a rich ability in the UK's latent R&D capacity to move at speed to address immediate challenges. Transparency on the criteria used by UKRI and its agencies to prioritise, assess and ultimately select proposals for these calls is a key part of the evidence base in assessing whether by reducing bureaucracy in situations of rapid need, it does result in *'freeing up the best researchers to focus on ground-breaking research that goes on to make a difference'*.[23]

Recommendation 8 – UKRI should outline what criteria they used to prioritise assess and select proposals under their rapid research calls, including how this was informed by discussions with government relating to the ongoing management of the Covid-19 pandemic.

About us

With about 50,000 members in over 100 countries and a knowledge business that spans the globe, the Royal Society of Chemistry is the UK's professional body for chemical scientists, supporting and representing our members and bringing together chemical scientists from all over the world.

The Royal Society of Chemistry would be happy to discuss any of the issues raised in our statement in more detail. Any questions should be directed to policy@rsc.org.

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[23] ibid