

From Wartime to Peacetime: Lessons from the Vaccine Task Force

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1. Opening

Thank you, Vice Chancellor, for this invitation and thank you for your personal leadership, energy and commitment to Oxford University, to education and to women. You have led by example and have shown there is nothing that women cannot achieve if they put their minds to it. It is a great honour to be invited to give this lecture.

Nineteen years ago my father, Tom Bingham, then the Senior Law Lord, was himself honoured to give the Romanes lecture, and chose for his title “Personal Freedom and the Dilemma of Democracies”. In it, he said:

“Freedom from executive detention is arguably the most fundamental and probably the oldest, the most hardly won and the most universally recognised of human rights. Yet in times of emergency, crisis and serious disorder it is almost the first right to be curtailed. It is in that sense vulnerable.”

We have all just lived through just such an emergency, just such a crisis. Our personal freedoms have been curtailed, and they have been shown once again to be vulnerable.

Yet so too have events underlined the vulnerability of human lives in the face of the SarsCOv2 virus. In that sense, this lecture too is perhaps part of a wider reflection on what my father called the dilemma of democracies.

It is that vulnerability that I was asked to address when I became Chair of the Vaccine Task Force in May 2020.

But I want to say up front that I would not be here to give this lecture today if

it were not for the remarkable contribution that teams from Oxford University have made to combatting the pandemic. I would mention, in particular, the outstanding contributions made to vaccine development by Professors John Bell, Sarah Gilbert, Cath Green, Adrian Hill, Tess Lambe, Andy Pollard and Gavin Screaton, and the work of Peter Horby and Martin Landray leading the Covid Recovery Trial.

It is astounding to think that now, less than two years after its creation, the Oxford/AstraZeneca vaccine has been used for over 2 billion vaccinations - over 20% of global vaccinations to date in over 170 countries. And the Recovery clinical study was the first to show that dexamethasone - a cheap and available steroid - reduced the risk of dying from COVID-19, as well as proving and disproving the utility of other drugs, thus saving hundreds of thousands of lives around the world

These are towering achievements. I hope it is not inappropriate for me to congratulate not merely these individuals and teams, but Oxford University as an institution for providing such a supportive and effective environment for this astonishing work.

2. Introduction

Let me start with some facts.

To date, the COVID19 pandemic has killed more than five million people globally, with more than 140,000 deaths in the UK- roughly a third of the total UK military and civilian deaths in the Second World War.

Economically, too, the effects of the pandemic have been horrendous with an expected global loss of \$4 trillion in economic output, a fall in UK GDP of 10% in 2020, the highest in our recorded history.

Across our society, the pandemic hit different groups disproportionately by gender, ethnicity, and across generations; and it revealed wide inequalities of education, training, wages, employment and health.

The UK's pandemic plans were narrowly premised on fighting a flu virus, and so the widespread belief that the UK was well prepared for a pandemic proved to be seriously mistaken.

Yet even in the face of this very difficult experience, there are reasons to think that this past pandemic could have been significantly worse. SARS-cov2, the virus that causes the COVID19 disease, despite its high transmission rates, mutates slowly which means scientists have a chance of developing durable vaccines, unlike with many other viruses. So in some respects we have been fortunate in our enemy this time round.

3. The Challenge

Part of the UK Government's response to the pandemic was of course to set up the Vaccine Task Force, which I chaired from May to December last year.

I was new to politics then, and I am still not in any way an expert in dealing with the political world. But it has become clear to me, as it has been clear to others before and since, that for all its many strengths, our current system of executive government suffers from serious structural weaknesses.

Meanwhile, the dangers have not gone away; indeed, they may return in a still worse form. I note that the UN has warned that pandemics will happen more often, kill more people and wreak even worse damage to the global economy than COVID19.

So today I want to tell a little of the inside story of the Vaccine Task Force. But I also want to explore whether there are lessons from what we did in "wartime" last year that might be applicable in times to come, both in relation to a future pandemic response and, more boldly perhaps, to the effective functioning of a "peacetime" government in general.

4. From Wartime to Peacetime

It is important to recognise that a lot had been accomplished, and more was under way, by the time I was appointed to chair the Vaccine Task Force.

The team from Oxford's own Jenner Institute was very quick to recognise the seriousness of the unknown virus causing a pneumonia-like disease in Wuhan. Based on their earlier work on MERS or Middle East Respiratory Syndrome, caused by another coronavirus, they designed and developed a COVID19 vaccine using a modified adenovirus isolated from chimpanzees in an amazing 65 days.

The Jenner team has a small-scale production capability in the university, suitable for manufacturing clinical trial material, but it was never intended for the industrial manufacture of millions of vaccine doses. So the team started to collaborate with UK BioIndustry Association's bio-processing manufacturers to scale up their vaccine in February 2020, before striking a deal with pharmaceutical giant AstraZeneca to develop this vaccine on a non-profit basis around the world.

Moreover, by sheer good luck the government had a Chief Scientific Adviser in Sir Patrick Vallance whose own career had been in vaccine and pharmaceutical R&D. He had spotted the potential for vaccines to make a difference early on. But still more importantly, he recognised that Whitehall did not have the skills to drive forward the development and procurement of unproven COVID vaccines. He therefore suggested setting up a Vaccine Task Force to bring those skills into government rapidly, and in a genuinely courageous move, the PM agreed to set up the VTF as a specialist unit led by and working through outsiders.

We now know that all these moves made a major difference. But that was not how the picture appeared at the time. On the contrary, the facts facing the new Vaccine Task Force were stark and none too promising.

For one thing, it typically takes ten to fifteen years to bring a new vaccine to

market, and the historical failure rate of vaccines exceeds 95%. So it was likely that most vaccine candidates against COVID19 would fail. The expert consensus was that there was a 15% chance that any of the vaccine candidates would work.

Worse, the new COVID19 vaccines that were most advanced were based on new adeno and mRNA technologies - vaccine formats that had never been approved for use in any product, ever. So it was far from clear whether these vaccines could ever prove to be both safe and effective in protecting against COVID19. Given all this, the UK could hardly afford to rely on the Oxford vaccine as a sole exit strategy from the pandemic.

Finally, there were the facts of commercial life. The UK is a relatively small customer compared to the USA, the EU and Japan. At that time, the advice from the JCVI, the Joint Committee of Vaccination and Immunisation, was to secure vaccines for individuals most at risk from serious disease and death, which totalled approximately 30 million UK adults. The other countries had many more people and so were much bigger customers.

In a global race to acquire vaccines therefore, the UK was very likely to be overtaken quickly, and, to change metaphor, if it came to a bidding contest we were likely to have limited firepower against these superpowers. We could have joined an EU procurement process, but that would have meant we had no control or influence over the process, timing or supply, which might itself be a significant source of risk.

5. What the VTF did

So, I have to say, the overall position did not look especially rosy in May 2020, when I was appointed Chair.

My mandate was simple: to secure and deliver vaccines quickly to the UK and abroad. Speed was of the essence, because people were dying every day. I was authorised to bring external industrial, scientific and technical

experts into government to make this happen. My first recruit was Dr Clive Dix to act as my deputy, a superb drug hunter and entrepreneur, and Clive brilliantly led the work to prioritise the vaccines and shape the relationships with the vaccine companies, and Nick Elliot was appointed from the civil service to act as the VTF Director General within the Department of Business, Energy and Industrial Strategy, or BEIS. From the start, we worked as a single empowered team, even if we were largely on zoom. There are still senior members of the VTF with whom I worked intensively for seven months, but whom I have never actually met.

What did we do?

The first priority was to get set up. Within the first six weeks, the VTF developed our vaccine procurement strategy and built a team of industry and technical specialists alongside a small team of Whitehall officials who were expert in project management, commercial negotiation and diplomacy. There were over 190 potential vaccine candidates being developed around the world. We prioritised a shortlist of the most promising vaccines and started due diligence in earnest. Since we had all spent decades in the industry, we knew the vaccine companies well and understood the risks and challenges of vaccine discovery, development, manufacturing and regulatory approvals.

There was a high degree of mutual knowledge and trust, both within the team and with the many external commercial and academic players. Our goal was to build a portfolio of the best vaccines as early as possible, including different vaccine formats, manufacturers and delivery schedules in order to maximise the likelihood of success and guard against the risk of failure of a particular format or contract.

The second priority was to deal with the problem of size I mentioned earlier. The UK is a small customer relative to the US, the EU and Japan. So what to do? We took a very commercial decision. We decided that the only way we could compete was by turning the UK into the best possible client, by doing everything we possibly could to make this country the most attractive place in

the world to develop a vaccine.

So we developed a manufacturing strategy led by our industrial expert Ian McCubbin. As part of that, the VTF provided upfront funding to develop capabilities in the UK to support the vaccine companies, in the expectation that they would also provide flexible long-term resilience against future pandemics. Specifically, we supported manufacturing scale-up with industrial innovators at the contract manufacturing organisations OxfordBiomedica, Cobra Biologics and Fujifilm Diosynth and a small vaccine company Valneva in Scotland.

But we also worked with government-funded catapults. We partnered with CPI, the Centre for Process Innovation. We acquired a veterinary vaccine plant that is now managed by the Cell and Gene Therapy Catapult. And we accelerated and expanded the scope of VMIC - the still under construction Vaccine Manufacturing and Innovation Centre at Harwell.

Finally, we purchased long term “fill and finish” contracts, to give the UK domestic capability to receive bulk vaccine and put it into vials, even though we did not know then which vaccines we would be using. We also ensured we had sufficient stocks of vials, stoppers, tubular glass to make the vials and even the borosilicate sand needed to make the glass. We didn’t want to take any chances when the stakes were so high.

But rapid and flexible scale-up and manufacturing of the vaccines wasn’t enough. To make our “best global client” strategy work, we needed to demonstrate quickly that these vaccines were safe and effective. Here again, we saw an opportunity, to use the national NHS network to run clinical trials to our competitive advantage.

To see how this works, we need to step back a little. The bottlenecks in clinical development are typically two-fold: first, to secure the regulatory and ethical approvals to run the study and secondly to enrol the volunteers.

On the regulatory side, the Medical and Health Products Regulatory Agency, or MHRA, led by June Raine, proved to be an exceptional regulator: flexible, collaborative and quick, with a rapid streamlined, rolling review process of clinical trials and manufacturing.

But we thought we could go still further to accelerate the recruitment side.

So we created the NHS Vaccine Registry. This allowed anyone to sign up on the NHS website and give consent to be contacted about clinical trials. Over 500,000 people enrolled, including 35% of over-60 year olds, a critical demographic: after all, we had to demonstrate that the vaccines we were trialling would be safe and effective for those most at risk from serious disease and death.

The Registry has turned out to be incredibly successful, way beyond our early hopes. Our national clinical trials network of academics and doctors embraced the challenge of these massive studies and recruited volunteers into a range of vaccine trials more rapidly than had ever been done before.

It is a matter of some regret however, that many of those who volunteered to take part in clinical trials are still not recognised in the NHS app as being vaccinated, and so are now being penalised for their altruism.

Our third priority was an international one. My mandate was to secure and deliver vaccines quickly to the UK and abroad, and I took the last two words very seriously. So the VTF team helped to design the global vaccine facility for low- and middle-income countries called COVAX. We also supported the Government in making pledges of £500m and 100m vaccine doses to ensure equitable distribution of vaccines around the world. I will return to this later.

6. The Role of Government

On its side, the response from Government was rapid and in many ways highly effective. I have already touched upon the important role of the

MHRA, and the early leadership of Sir Patrick Vallance. But there were three other major factors that helped make the VTF a success.

The first was that we had a brilliant Director General in Nick Elliott, a commercial projects expert who hired an exceptional leadership team, including two senior women he had worked with in defence project management and commercial negotiation. When our industry experts were combined with these experienced officials, the result was a VTF team with the right skills and backgrounds, connections across Whitehall and personal energy needed to make things happen.

A second key factor was that from the outset we had the authority required to ensure rapid and nimble government decision-making. Given the urgency of the situation I had deliberately sought and obtained a personal mandate from the Prime Minister when I accepted the role of Chair, and the PM recognised that in order to act quickly, we would need to take risks and provide up-front funding to build a portfolio of vaccines before we knew which if any vaccine might work.

Thirdly, we took a leaf from the venture capital playbook, and set up a single Cabinet level investment committee. This included the Cabinet Ministers responsible for the Departments of Business, Health, the Cabinet Office and the Treasury.

The investment committee were willing to make some very big financial bets, requiring upfront cash commitments of £900 million for us to build a portfolio of vaccine orders. They did so because they recognised that the costs, which ultimately averaged a little over £10/dose, paled into insignificance compared with the economic cost of lockdown.

Given the fact these vaccines had never been scaled up in bulk, we had relatively little idea early on of what the final cost would be, or how far if at all that final cost might be influenced by our proactive manufacturing strategy. In retrospect, though not all of the strategy has been fully implemented, it turned

out to be much more successful and more cost-effective, than anyone could have predicted.

This accelerated decision-making process, both as regards spending and industrial strategy, was game changing for the UK. But it is important to be clear. While all these three steps - the rapid assembly of the VTF civil service team, the prime ministerial authority, and the investment committee of Cabinet ministers - were radical departures from the usual Whitehall process, all of them respected the key principles of civil service practice. The VTF outside team gave expert advice. The core VTF staffing, project management, negotiation and day-to-day spending functions were carried out by civil servants. And ministers, and only ministers, took procurement decisions and committed public money.

7. Results

So: what happened?

- On December 8th 2020, the UK started vaccinations before any other Western country.
- Led by Clive Dix and his team, the VTF picked seven vaccines from a universe of at least 190 possibles and all seven proved to be safe and effective vaccines; indeed, they include the best vaccines available.
- The UK was the first country to sign contracts to buy the Pfizer/BioNtech vaccine and, of course, the Oxford/AZ vaccine.
- Our decision to start early and sign term sheets with vaccine companies in July and August 2020 meant that the NHS teams had months to prepare for what was a complex national vaccination roll out last winter.

It would be wrong to end this summary of what was achieved without paying tribute to the NHS, to PHE and to ministers and volunteers for the astonishing job they did on the vaccination roll-out. The UK's early vaccination deployment was the envy of the world.

8. Barriers to success

So then, this was how we got set up, our strategy, what we did, and what was achieved. But now I want to shift focus: to what did not go right, what could have gone better, and what we might be able to learn for the future?

Despite our successes, there remain several serious barriers and problems, which if not fixed, will stop the UK from responding efficiently next time. I will outline three clear challenges.

A Lack of relevant skills

The first challenge is what seemed to me to be a notable lack of scientific, industrial, commercial and manufacturing skills both among civil servants and politicians.

Indeed, it was Patrick Vallance who wrote presciently before the pandemic that *“Britain’s civil service is suffering from a serious lack of scientific talent that threatens its ability to compete with nations such as China.”*

My experience was that officials seemed to use strategic and operational consultants quite freely, and doubtless at great expense. But this has a doubly bad effect: not only does bringing in hired guns from the outside not build real capability within Whitehall itself, it actually reduces the incentive to confront and deal with this problem.

It should not need saying that this is not a criticism of individuals. Nor was there any lack of intelligence, willingness or hard work from officials during the crisis. The problem was that the department lacked knowledge of the commercial biosciences landscape, and lacked the science and technical understanding needed to be operationally effective.

Again, it is helpful to step back a little to see the wider problem. Less than 10% of the fast-track civil service have backgrounds in science, technology,

engineering and mathematics (STEM). That is lower than countries like US, France and Germany, and the number is dropping according to a Cambridge Industrial Innovation Policy report published earlier this year. Yes, there is a fast track STEM civil service entry stream, but this only recruits a grand total of 20 new civil servants each year - far too small to have any impact.

Nor is the situation better among the most senior officials. I have only been able to identify three permanent secretaries - the senior civil servants who run government departments with STEM degrees. This is a group dominated by historians and economists, few of whom, it seems, have ever worked outside Whitehall.

But my concern does not just focus on Whitehall; there is also a huge lack of relevant skills and experience in Westminster too. The present Cabinet is the youngest ever, averaging 48 years old. Barely a third of its members have any kind of non-finance commercial background. Is it possible, then, that here too there might be a lack of industrial, manufacturing or operational non-political experience?

Nor are we awash with junior ministers educated in STEM subjects. Since ministers are generally not appointed based on any skills outside politics, and are typically rotated every 18 months or so, there is no time for them to build up deep expertise in any single area. And within Parliament, matters have not been helped by the recent trend for former Prime Ministers, Chancellors and senior ministers to leave the Commons soon after stepping down from office.

But without this expertise it is not merely difficult to take decisions and hold civil servants or ministers to account: it is difficult even to frame the right question when considering policy options and choices. As the Chief Scientific Adviser has said, *“The way in which questions are framed often prevents us from recognising that a scientific solution might be possible. The ability to frame questions in a more productive manner often requires an understanding of scientific method in those responsible for policy-making.”*

Quite.

B. Culture

The second challenge relates to the culture of the civil service. At the VTF we were given unusual “wartime” autonomy to identify, assess and scope out deals with our target vaccine companies. At the top level, the advice and decision-making about key spending and investment was very effective. But operationally, there were very few people in Government with the experience and knowledge to assess, support or indeed challenge our work.

That problem was compounded by the tacit and explicit incentives set for individual officials by the culture and practices of the civil service. While I was in post, I saw an almost obsessive desire among officials to avoid any suggestion of personal error or scope for criticism, and a concern amounting to paranoia about media handling and the possible public reaction. This created groupthink and a massive aversion to risk, which in turn held back innovation and the pace of execution.

Officials are not generally rewarded for specialist skills, flair or drive, but for following correct procedures. Individual energizers and doers were outnumbered by officials able to think of reasons *not* to do something. I was frequently challenged with worries about future select committee inquiries, for example, if officials followed some unconventional path which the VTF recommended.

To be clear, I am not remotely suggesting that appropriate agreed procedures should be ignored or abridged. But what I repeatedly saw was a compulsive preoccupation to follow a specific and frequently time-consuming and wasteful formal process, rather than place the focus and emphasis where they ultimately should be, on the outcome. The paradox is that the obsessive desire to avoid a known risk to oneself in the short term, often creates a much bigger unknown risk that falls on others, or on society as a whole. I do

not think that the civil service has properly understood and absorbed this point.

Perhaps I can give a specific example? Early on we came across a deeply impressive technology able to manufacture virus-like peptide vaccines within a six-week period. This botanical technology promised to enhance our ability to manage future pathogens and variants, a massive and inevitable risk to society.

A six week manufacturing approach could potentially reduce the time to produce bulk protein vaccines by 90% compared with the slow, current protein processes. So it seemed a powerful and flexible technology, especially given it had proven value in the manufacture of flu vaccines, which we as a country are always likely to need.

We identified a North American company with this botanical technology and introduced them to a UK company with whom they could partner. Outline terms were agreed and sites were identified in the north of England with the capacity to provide on-demand pandemic manufacturing based on UK soil, as well as the ability to supply bulk vaccines globally.

However, this all stalled when, in the middle of the negotiations, officials laid down a requirement that any deal should be subject to non-pandemic procurement processes. Literally thousands of forms were requested, and the process stalled and ultimately failed. Even this might have been prevented if there had been any real grasp of what was at stake, of the fragility of small firms and of the radical novelty of what was being proposed, which made conventional comparisons impossible. But because Whitehall lacked the strategic and scientific understanding of this remarkable technology, we lost the chance to build this rapid protein production capability in the UK, losing both the resilience to manage future pandemics, as well as losing an attractive economic opportunity - all of this in a sector which is supposed to be a key government priority.

C. Relations with industry

The final challenge lies in the often fraught relationship between government and industry. Perhaps this is inevitable, since there are sectors which either have substantial political or economic power or intrinsically close links to government, and which have traditionally been regarded as highly effective lobbyists for taxpayers' money. There are also well-motivated concerns about the threat from subsidies to competitive markets. But this is largely not the case in the biosciences, or in a host of other specialist technology-related sunrise industries that are vital to the UK's long-term economic growth. In these industries there is clearly scope for the development of far more mutually trusting and effective long-lasting relationships.

The long-term need is evident. The UK investment in R&D is 1.74% of GDP, materially lower than US, Japan, Germany and France. Commercial (as opposed to government funded) R&D is also lower in the UK. The UK life sciences sector generates annual turnover of £80bn and the pharmaceutical sector is the the largest commercial sector funding R&D in the UK. But pharmaceutical R&D in the UK dropped from 2010-2018 as these companies secured more attractive commercial offers for their high risk and long term R&D from Belgium, Ireland and further afield. So the industry is sending a very clear signal to the UK that other countries are better to work with.

Even in the business department, there was a limited understanding about how our industry actually works, reinforced by a deep suspicion about the motives of entrepreneurs and managers. Again, I would be the first to seek proper transparency and effective due process in dealings between government and business. But all too often, companies that have been created by principled, idealistic doctors and scientists seeking to make the world a better place and save lives, are instead seen and treated as money-grabbing fat-cats, whose only interest is to rip off the taxpayer. More deeply, government seems to have no means, and little interest, to detect the differences between negative rent-seeking and economically valuable corporate behaviour.

Again, an example may help. I have in mind the inexplicable recent decision by the government to cancel the contract agreed by the VTF with the pioneering French vaccine company Valneva three weeks *before* its pivotal Phase 3 trial results were announced. This decision was accompanied by a ministerial claim in Parliament that the vaccine would never be approved. Among other things, the result of these actions was to cause the Valneva share price to fall by around 50%.

When we began discussions with Valneva, our reasons were risk mitigation and flexibility for the future, in addition to supply. We believed that Valneva's inactivated whole virus-based vaccine would provide both a *safe and proven* vaccine format, which we needed for balance in the VTF vaccine portfolio. Valneva's adaptable approach could be used to produce whole virus-based vaccines against disease X - whether Sarscov2, variants or future pandemic viruses - and provide critical infrastructure for the future.

We judged that even though this vaccine would come online *after* the early vaccines might be approved, it would prove to a valuable option for vaccine boosters, for children and for export overseas.

The government's decision to cancel the contract with Valneva may have been on the grounds the UK had enough vaccines even for boosters, and in a way that is an understandable view. After all, the contract allowed for "at will termination" subject to paying costs incurred up to that point. But it was a very narrow view. For one thing, it sat uneasily with the Prime Minister's instruction to the VTF in my original letter of mandate to secure and deliver vaccines quickly to the UK and abroad. This decision did not consider the needs of COVAX, the international vaccine purchasing agency, and the fact that Valneva's stable vaccine could be sent to low-income countries without needing complex cold chain infrastructure. For another, this decision set aside the need to build resilience in the UK's pandemic preparedness capability through a new flexible state-of-the-art manufacturing plant able to manufacture vaccines of any format as might be needed, including flu

vaccines.

What was still worse, was the way in which the contract was ended. With Cabinet support, early on the VTF had encouraged Valneva to upgrade and build a new manufacturing plant in Livingston just outside Edinburgh. The result of contract termination was that these plans were instantly put on hold, discussions for supplying the EU were paused and 100 plus new jobs immediately lost. But instead of an amicable wind-down with a company that had massively extended itself to help during the pandemic crisis, the Government alleged a breach of contract, apparently as a means to avoid paying for the costs incurred up to that point, costs incurred at the request and for the convenience of the government. Some might consider this behaviour as acting in bad faith.

As it turned out, the Phase 3 data showed that the vaccine was highly effective and safe, and the ministerial statement in Parliament had to be corrected. The company's share price has since recovered, reflecting the view in the rest of the world that this is a valuable company with a valuable set of vaccines and technologies. New manufacturing jobs are being created in Eastern Germany with Scottish jobs now at risk.

Valneva remains, as I have described, in dispute with the British government, which it had trusted and worked closely with during the height of the pandemic. The biosciences world is a small one. Is this really, all in all, an example of industrial strategy of which the Government can be proud?

It is interesting to reflect that the behaviour of the Government appears to have changed significantly from my time in the VTF. At that time, in line with our "global best client" strategy, we actively sent experts to work closely with the vaccine companies, to support their vaccine development and scale up in whatever way we could. We very badly wanted them to succeed, and we wanted vaccines early and in scale, both the UK and for the world. But it now appears that the waters have closed over this approach, and officials have reverted to their usual practice, and the pre-existing culture of distrust of

business. It is hard not to think that a massive opportunity to win has been lost, indeed converted into something of an own goal.

By contrast, the US has shown a much greater willingness to work with industry to prepare for public health medical emergencies. For example, the US Biomedical Advanced Research and Development Authority, or BARDA, has a standing annual budget to collaborate with industry. The team at BARDA is expert and well-informed, and proved highly effective during the COVID pandemic, striking 97 industry partnerships to secure vaccines, diagnostics, therapeutics and rapidly deployable capabilities for both immediate and long-term use. There is absolutely no reason why the UK, on a smaller but no less expert and nimble scale, should not do the same.

9. Solutions

Despite our recent successes with vaccines, then, much of the wider story is not a good one: little relevant scientific and business experience across government, a culture of under-performance in delivering outcomes, a distrustful and often dysfunctional relationship between government and the biosciences industry. The result of all this, is that at present, the UK government, both in Whitehall and Westminster, is not skilled or organised to manage complex scientific challenges, a task which requires flexible working with industry and academia.

I turn now to solutions. Specifically, I believe what is needed is a fundamental reset that goes far beyond addressing individual symptoms.

This will not be cost-free, but the main costs are not financial but lie in organisational change and re-orientation. Moreover, little analysis is required to see that these costs will be dwarfed by the costs of failing to address these issues now, from the resultant loss of productivity, reduction in economic growth and adverse effects on public health and individual wellbeing.

A. Adopt a venture capital mindset

As an entrepreneurial investor, my job is to interpret incomplete and fluid scientific, preclinical and clinical data, build plans and teams, mitigate risks and invest to develop new drugs to save lives, protect people and meet the needs of my investors. In my judgement, this innovator mindset was critical to the success of the VTF. That mindset is not present in today's government machine.

So: how can the wartime innovator mindset be brought to bear in peacetime?

B. Embed scientific thinking

First, scientific thinking and specific scientific knowledge should be embedded in policy making. Over the past thirty years, it has become unthinkable for policy not to be deeply informed by economics. The same should be true of science, starting now.

When we wrote business cases at the VTF recommending the purchase of vaccines which may have involved upfront funding for scale up or for clinical development, the business case comprised multiple different areas of analysis including the strategic case: the economic case, which included the cost benefit analysis: the commercial case, the financial case, the management case and a legal review.

Much of this was unnecessarily cumbersome and repetitive, reflecting the official focus on process *not* substance and outcomes. But crucially, even with all these cases there was - and is - no such thing as the science case. In the VTF, our due diligence provided the scientific case that gave me and my team confidence in our recommendations, but elsewhere the science case does not seem to be required for Whitehall nor for government decision making, let alone embedded in official practice.

Science is there to solve problems. Scientific thinking recognises risks and uses data to inform decision-making. Scientific understanding is critical to deal with pandemics but more broadly to understand and manage the threats of climate change, of an ageing population and of national security. Scientific thinking and evaluation is not a nice-to-have option, but a critical capability for any modern government.

C. Improve recruitment, development and incentives

Secondly, the recruitment, professional development and incentives of civil servants should be reviewed and overhauled. Science-related competencies, operational experience, problem-solving skills and quantitative analysis should be made essential requirements for officials if we are to be successful in today's data-based and innovation-driven economy.

This need runs right through the civil service, from the top administrators through the officials who commission new policy, to the new entrants at the starting point of their careers. In the short run, the present gap can only be countered with the combination of more ministerial training and super-competency at the top of the civil service. That means more scientifically trained Permanent Secretaries with research and operational experience, as well as economic skills. It might help if the award of honours to civil servants and politicians on retirement was delayed by two or three years so that a better judgement could be reached of their actual achievements and effectiveness while in post.

The need for more relevant scientific and operational skills also applies to the crucial layer of mid-level officials. Here I would suggest that specific training and skills transfer should be supplemented by a clear requirement that, in order to advance, officials should have at least two years of productive industrial or commercial secondments or public sector operational delivery. This focus on experience and outcomes would, I believe, also help to mend the present rather shaky relationship between government and industry.

At the lower end of the civil service, Whitehall should set a target of recruiting 50% STEM graduates at entry, prioritising those with research, analytical and statistical expertise, and these new STEM graduates should also be trained in economics so that they have a breadth of relevant skills. Professional development and promotions should downplay the present rapid rotation between roles and departments, and be reoriented towards the development of skills of demonstrable value shown to be important in policy decision-making and operational delivery.

Specialist science skills should be valued and rewarded as much as, if not more, than generalist skills. An individual's tempo or pace of activity, and their capacity to focus on and deliver outcomes should be rewarded. Slowing down the turnover of posts within the civil service would allow time to build embedded expertise. And if promotions, pay and status were based more on actual performance against substantive outcomes, then there would be less incentive to seek regular promotions except on merit.

There is a case to review how far Whitehall can adopt proven practices of organisational management in the private sector. Two obvious examples are the ability to promote outperformers and to seek references on past performance of prospective candidates. I believe I am right in saying that the civil service presently recruits people from outside based on references, but - doubtless from a concern about being fair and open to all candidates - routinely limits the ability to take references on internal candidates for promotion. If so, this is bizarre and hugely counterproductive. Still more bizarre is the fact that strong performers often cannot easily be paid more so as to stay in their jobs; they have to move in order to be paid more.

The combination of these two features is that the current system of promotions in Whitehall does not allow poor performers to be identified and weeded out. I doubt that either Northcote or Trevelyan, the founders of the civil service, would have wanted this; after all, their specific purpose was to create a civil service based on recognising and rewarding merit.

I have one final thought, which I note just for completeness: the need to curb the present obsession with PR and political presentation. When I was Chair of the VTF I discovered that the business department had 120 communications staff. I struggle to understand what such a large group could actually achieve, apart from getting in the way of delivery and talking to other communications people. There is surely scope to redeploy this talent to more productive use. This would send a clear signal that the focus on government is on content and delivery rather than presentation.

10. Dealing with the next pandemic

There are many other things to be said, notably about how government and business can work more effectively together, but this is not the place for them.

My final suggestion is more specific and prosaic: that the Government should appoint a permanent pandemic security expert from the private sector, perhaps as a minister, with authority for building and maintaining a coordinated UK pandemic preparedness capability.

Healthcare threats are just as serious as national security and defence and should be treated with at least the same importance.

We invest in our conventional forces, we recognise the importance of developing intelligence and we plan for a vast array of different scenarios, yet we are neglecting the most likely threat to the nation - the next pandemic. An effective response will require Prime Ministerial authority with close collaborations across Whitehall as well as with companies and governments globally.

The new pandemic security adviser or minister will need to convene a small team of experts to stay close to developments in science and technology. There will need to be a budget to support their work, just as there is for the National Security Council, which has a £1 billion Conflict, Stability and

Security Fund for tackling instability overseas. The UK will need to continue to invest in next generation vaccine and antivirals, partnering with companies, researchers and AI experts to predict future pandemic threats and design new vaccines and drugs.

In wartime, such as the COVID19 pandemic, government is the market maker and buyer of critical services and products.

In peacetime, we need to ensure that the UK has the competence and judgement to make policy and spending decisions, that will protect our citizens and the wider world.

COVID19 has shone a spotlight on our country in many ways, and among them it has highlighted the effectiveness and collaborative nature of UK life sciences in times of crisis.

Now, in more normal times, we need to improve the effectiveness of government in working with the life sciences sector,

to ensure our domestic resilience and security,

to create long-term economic prosperity,

and to protect the lives and freedoms not just of the vulnerable,

but of us all.

Thank you very much.

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