Risk management in the UK:

What can we learn from COVID-19 and are we prepared for the next disaster?

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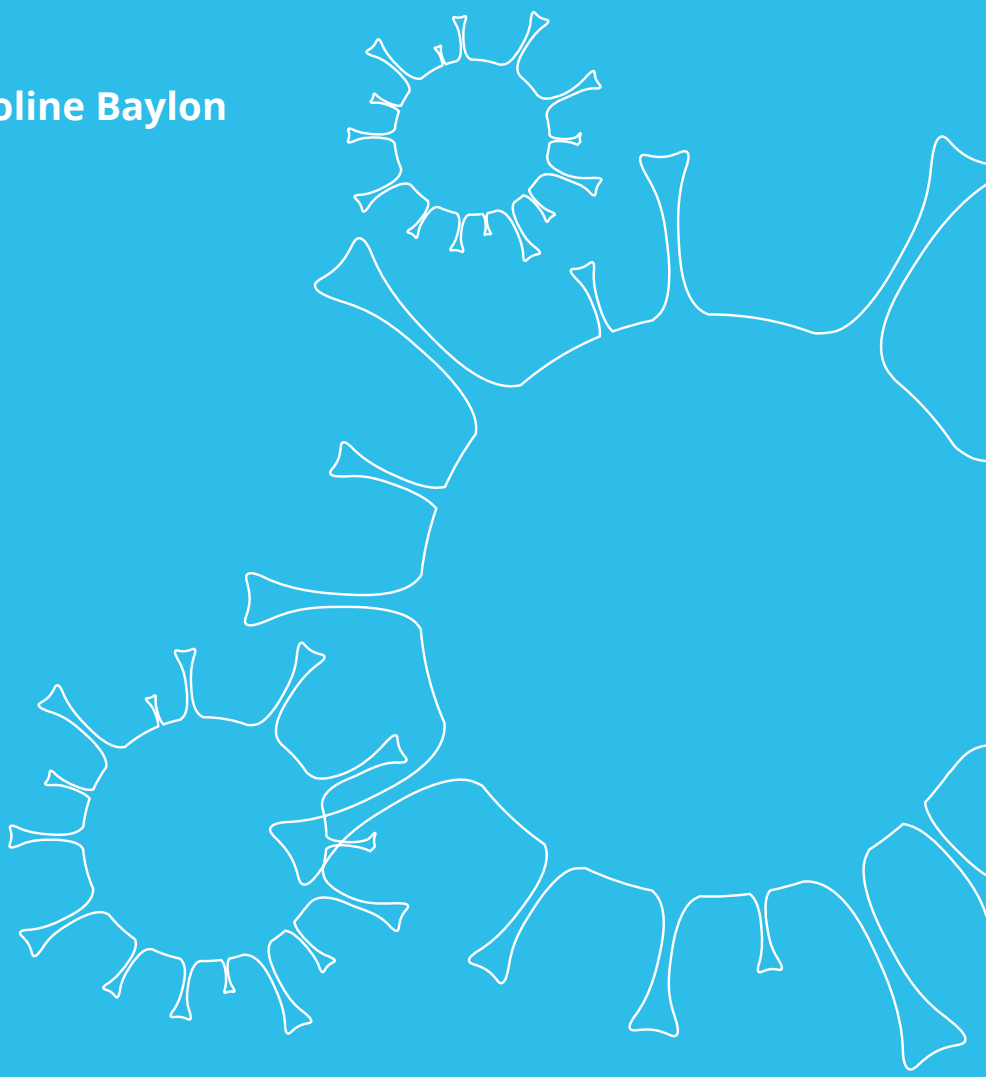

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The Centre for the Study of Existential Risk (CSER) is an interdisciplinary research centre within the University of Cambridge dedicated to the study and mitigation of existential risks.

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Forewords

The world is more connected than ever before, digitally and through travel and trade. This makes us, at the same time, more vulnerable to the rapid spread of diseases like Covid-19 and more resilient to impacts through global procurement of PPE and global development of vaccines.

Managing risk in this super connected world, where the next high impact event may be as different from Covid-19 as it is from the 2008 financial crash, is necessarily challenging. The upside of suffering something as catastrophic and widespread as Covid-19 is the opportunity it provides to improve our management of risk. We need to be more resilient and have more resilient systems. Not just to be better prepared for future high impact events, but resilient to the natural human tendency to reduce budgets and marginalise activity as memories of the last event recede.

Human beings find it difficult to plan for something which has not happened for some time, let alone that which has never previously occurred. Yet with technological change in a steepening trajectory and competitive pressures leading to reduced assessment of potential impacts, novel risks from new technologies can only be on the increase, even when adopted for benign purposes. So, building a risk management system which is flexible and open to the widest expert opinion could be one way of strengthening our preparedness.

This timely paper provides insight and recommendations to strengthen the UK's management of risk. It highlights lessons that can be learned from the private sector as well as from other areas of government policy with long time frames, such as climate change.

Produced by Cambridge's Centre for Existential Risk, the paper results from prolonged and serious consideration of how best the safety and wellbeing of our citizens can be secured.

Graham Stuart
Member of Parliament for Beverley and Holderness (Conservative)

As the Member of Parliament for Enfield Southgate, I have seen my constituents' lives, businesses and livelihoods more endangered and adversely affected by COVID-19 than by anything in recent memory. The UK has experienced one of the highest death tolls worldwide, and its GDP saw a record fall of 20.4% in Quarter 2 of 2020, some five months after COVID-19 first arrived in the country.

Even more concerning, there is a high likelihood that another such pandemic – potentially of even greater severity – could occur again in the coming years. Pandemic risks are increasing due to factors such as the rise in global travel, which makes it difficult to prevent the spread of infectious disease, and increased urbanisation, much of it in Asia and Africa, which results in more people living in overcrowded and unsanitary conditions. As humans further encroach upon the environment, greater human-animal contact increases the risk of zoonotic diseases such as COVID-19 that jump from animals to humans.

Other global catastrophic risks are also increasing. The effects of climate change are intensifying natural disasters like hurricanes, wildfires and floods, making them increasingly destructive. And as our society grows more and more dependent upon technology, the risk of a debilitating cyber attack on critical infrastructure is growing too. For example, an attack on the power grid would take out communications, transport networks, financial systems, and cause everyday life to come to a halt.

It is essential that are properly prepared for these risks. COVID-19 caught us unawares, revealing that we have been primarily planning for risks that we have previously faced in the past; the crisis highlighted our failure to adequately plan for emerging and future risks. To achieve this, we need a proactive approach that requires us politicians to think more long-term.

To this end the All-Party Parliamentary Group (APPG) on Future Generations, which I Chair, has undertaken a workstream around improving risk management as well as on promoting long-term thinking. The APPG held a seminar series for Parliamentarians in 2018-2019 on managing extreme risks which looked at the risks linked to global pandemics, the environment and ways to reduce greenhouse gas emissions, as well as black sky hazards and the need for infrastructure resilience, among other topics. The APPG is also conducting an ongoing inquiry into long-term thinking in policymaking, in collaboration with the University of Cambridge, which has received evidence from senior leaders, including former ministers and ambassadors, as well as prominent academics.

This paper makes an important contribution to the APPG's work in this area. The authors, both Research Affiliates at the University of Cambridge's Centre for the Study of Existential Risk (CSER) as well as Coordinators of the APPG, have carried out a critical study of the UK's approach to risk management, focusing in particular on the lessons that we can learn from COVID-19. They have put forward a series of actionable proposals that could mitigate future disasters and save lives in the future, which we hope the UK government will take up.

Bambos Charalambous
Member of Parliament for Enfield Southgate (Labour)
Chair of the All-Party Parliamentary Group for Future Generations

Summary

It is important that governments use COVID-19 as an opportunity to learn in order to be able to protect citizens from future pandemics or other disasters.

This paper assesses how prepared the UK was for a pandemic and suggests ways to ensure it is prepared for future disasters. The shortcomings identified should be seen as opportunities for improvement, rather than criticisms – as no risk assessment or risk plans will look perfect in hindsight. Evidence is drawn from both desk research and interviews with current and former UK civil servants from across government, and comparisons of UK government processes with best practice internationally and in the private sector.

There are areas for improvement with the National Security Risk Assessment (NSRA):

- The NSRA does not sufficiently explore high-uncertainty risks (risks where estimating the likelihood is difficult). This is due to the exclusion of low-probability risks and emerging risks, and too great a focus on recent events.
- The NSRA categorises and compares risks in a potentially misleading manner, with descriptions of risks being based on what is considered reasonable to plan for.
- The NSRA process could benefit from greater use of external expertise.
- In the light of COVID-19, it is notable that the NSRA focused too much on influenza rather than other diseases. For example, the most recent National Risk Register claimed that "emerging infectious diseases" (which would include COVID-19) could lead to "up to 100 fatalities".

There is also scope for improving the UK's risk planning:

- There is no set process, body of expertise or oversight mechanism in place to ensure that departmental risk plans are adequate.
- In the light of COVID-19, it is notable that the UK's pandemic influenza strategy did not make any plans for a lockdown, despite this being one of the dominant response strategies to COVID-19.

The UK has good risk management processes by international standards, yet the issues with the NSRA are sufficiently serious that **major risks to the UK may be going unidentified**. We hope the government will recognise the importance and urgency of addressing this.

Some of these issues are symptomatic of broader political and civil service short-termism. We therefore welcome the focus on long-term, expert-led thinking in the government's civil service reform agenda. Other issues can be addressed with simple fixes. We hope that the recommendations in this paper will help the government to address them, and we offer our ongoing support.

Recommendations for government

1. **In learning the lessons from COVID-19, the government must not focus solely on pandemic risks, as the next catastrophe may be entirely different.** All parts of the government responsible for aspects of national risk management should be reviewed or undertake internal exercises to learn from COVID-19.

2. **The UK should take the lead in ensuring that risk management improves globally** by encouraging commitments to spend a target percentage of GDP on risk prevention, convening a global network of government Risk Officers, and sharing best practices.

3. **Ensure the NSRA captures high-uncertainty risks, so as to close gaps in the risk assessment process.** This can be achieved by including low-probability and emerging risks in the NSRA, by looking beyond the recent past, by using techniques such as red teaming and tabletop exercises, and by greater use of a vulnerability based approach to risk assessment.

4. **Improve how the NSRA categorises, compares and communicates risks, so that policy makers have a clear understanding of the risks.** In particular consider moving from reasonable worst case scenarios to pre- and post-mitigation worst case scenarios and finding additional ways to highlight uncertainties.

5. **The NSRA process should make greater use of external experts so as to minimise the risk of blind spots and groupthink.** For example, consider giving a mandate to review and provide feedback on the full NSRA to an independent body.

6. **Establish a government Chief Risk Officer (CRO) and associated unit.** This unit would carry out depoliticised risk assessments, support departments in developing flexible risk plans, assign responsibility for acting on risks to ministers, and hold ministers to account for the quality of their department's risk plans. This unit should have a degree of independence from Ministers.

I. Introduction

The UK has risk management processes in place that aim to identify risks, to ensure that plans are drawn up to mitigate and prepare for disasters and to prevent risks being overlooked despite short-term pressures. Catastrophes provide rare chances to improve these processes. If UK citizens are to be protected from the next big catastrophe it is vital that we learn from COVID-19. The aim of such an investigation should not be to pick out every imperfection in plans but to use the benefit of hindsight to identify weak systems that need improving before future risks arise.

This paper analyses the effectiveness of the UK's risk preparedness functions and provides a set of recommendations for improvement. It focuses on risk analysis and risk planning, where there appear to be lessons to be learned from the early stages of the COVID-19 pandemic. Accordingly this paper does not cover top-level disaster response procedures (such as convening the Civil Contingencies Committee) or national and local level resilience or risk mitigation strategies. The paper looks into how prepared the UK was for a pandemic but excludes consideration of the government response to COVID-19.

The paper begins with a discussion of risk management and the risk management landscape globally and in the UK. It analyses the UK's risk identification process, finding a number of areas for improvement that may lead to serious risks remaining unidentified. It then analyses how the UK plans for identified risks, finding that there is a need for better oversight of departmental risk plans. Finally, it looks at risk management best practice in the private sector and internationally.

The paper contains two special sections highlighted in blue evaluating how prepared the UK was for COVID-19. Noticeable differences between pre-pandemic plans and the reality of COVID-19 that we examine are:

1. **Why did the UK's risk assessment highlight pandemic influenza but downplay non-influenza pandemics**, for example stating that "emerging infectious diseases" could lead to "several thousand people experiencing symptoms, potentially leading to up to 100 fatalities" [1]? In contrast, COVID-19 fatalities in the UK are above 45,000 at the time of writing.
2. **Why did the UK's pandemic influenza plans have minimal discussion of lockdowns** or other methods to reduce the R number, except for "possible school closures" and isolating the ill [2]? In contrast, lockdowns have been the dominant strategy adopted by developed countries to respond to COVID-19.

In preparing this paper, we have drawn on both desk research and in-depth interviews with twelve current and former civil servants from across relevant departments, including the Cabinet Office, the Ministry of Defence and Public Health England. These meetings mostly took place in 2019, prior to COVID-19. (See Annex A for a summary of the key points raised.) We have not had access to non-public government documents such as full copies of the 2019 NSRA.

Box 1: Definitions

For the purpose of this paper we use the following definitions:

1. **Risk assessment:** the process whereby the risks are understood. This includes analysing potential hazards, estimating the scale of the possible harms and assessing vulnerability to those hazards.
2. **Risk planning:** the knowledge and plans developed by governments once risks are understood, in order to be able to effectively respond to and recover from the impacts of disasters.
3. **Risk management:** the application of risk reduction policies and strategies. This includes: risk assessment, risk planning, mitigation to reduce the scale of potential damages, and the acceptance of damages that cannot be mitigated or managed.

II. The challenges of risk management

Before assessing the specific UK situation it is important to highlight some of the general risk management challenges that confront any government.

1. **In our modern, interconnected world, many of the risks we face are global**, such as the 2007-08 financial crisis or COVID-19. Global risks need global management. For example, improving biosecurity in other countries reduces the pandemic risks to the UK. International cooperation is therefore key.
2. **Risk preparation increases after disasters occur, but can abate over time.** For example, financial regulations are often brought in after a financial crisis but then reduced prior to the next financial crisis [3]. Protecting budgets, creating oversight mechanisms or making long-term commitments would help address this.
3. **There is a tendency to "prepare to fight the last war".** Planners tend to assume that the future will have many of the same features as the past, yet future risks often differ significantly from past risks. This is a known issue in defence and risk management, and was raised by civil servants we interviewed. Managing this requires being able to prepare for and handle situations of high uncertainty.

This tendency to prepare to fight the last war affected how well prepared states were for the COVID-19 pandemic. An influenza pandemic has topped lists of UK concerns since swine flu in 2009, and the UK prepared for influenza rather than a coronavirus (or for a pandemic more broadly) [4], as we discuss below. Meanwhile countries that had experienced outbreaks of SARS (a coronavirus) in the early 2000s had better plans to handle COVID-19 [5][6][7].

If the UK government's response to COVID-19 is just to better prepare for pandemics, or even just to better prepare for zoonotic pandemics or coronavirus pandemics, then the UK would be making this same mistake again. The next catastrophe could well be something else: a global food shortage, a solar storm, a nuclear incident, an attack on critical infrastructure, or an unexpected societal consequence of an emerging technology. As such, we recommend:

Recommendation 1:

In learning the lessons from COVID-19, the government must not focus solely on pandemic risks, as the next catastrophe may be entirely different. All parts of the government responsible for aspects of national risk management should be reviewed or undertake internal exercises to learn from COVID-19.

The international risk management landscape

> *"National health security is fundamentally weak around the world. No country is fully prepared for epidemics or pandemics, and every country has important gaps to address."*
>
> – 2019 Global Health Security Index [8]

Internationally, government risk management is poor. COVID-19 has highlighted a fact that was already known: that governments do not sufficiently prepare for disasters. For example, the 2019 Global Health Security Index [8], found that the UK was one of the most well prepared countries for a pandemic but that every country had significant weaknesses.

The UK does reasonably well at risk management compared with other countries. The UK has been a world leader in this space. Although there are lessons to be learned from elsewhere, (see Section VI) the UK still has a more comprehensive risk assessment process than most countries [9][10].

The UK is still an internationally respected leader in risk management. Given the global nature of many modern risks, we believe this presents an opportunity for the UK to take a leadership role in helping improve risk management globally. As such we recommend:

Recommendation 2:

The UK should take the lead in ensuring that risk management improves globally.

The UK could do this by:

- **Encouraging international long-term commitments** to spend a target percentage of GDP on risk management, so that plans to address risks are not gradually cut between catastrophes.
- **Encouraging countries to run effective national risk offices** or put in place Chief Risk Officers.
- **Convening a global network of independent national risk officers** to collectively address global risks. This could be done in conjunction with existing meetings such as the Munich Security Conference, WEF Davos or UN Security Council meetings. The Bank for International Settlements' Basel Process meetings, which facilitate Central Bank coordination, is a useful comparator.
- **Sharing information and best practices.** The UK could lead a global project to learn the lessons of COVID-19.

III. Overview of the UK government's risk management approach

Until recently the UK has had two cross-cutting risk assessments, the National Risk Assessment (NRA) and the National Security Risk Assessment (NSRA). Since 2019 these have been combined into a single risk assessment, retaining the moniker **National Security Risk Assessment (NSRA)** and bringing together domestic, international, malicious and non-malicious risks [11][12].

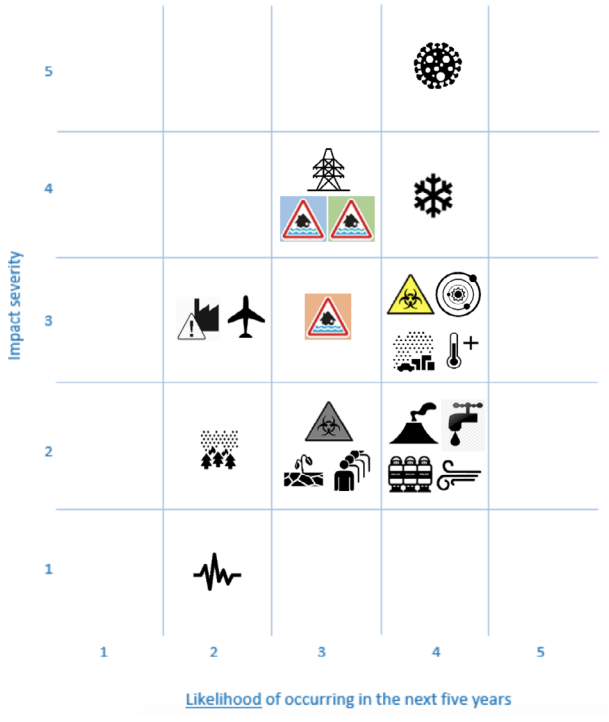
The NSRA includes single events or emergency situations [10] that can cause serious damage and that have a reasonable likelihood of occurring within two years of the risk assessment date. Risks are grouped together, for example, "emerging infectious disease" is treated as a single risk, and effort is made to ensure that the risks can be compared in terms of likelihood and impact [11][12]. **Risks are represented by "reasonable worst case scenarios" (RWCS)** that provide a "challenging yet plausible manifestation of the risk" [10].

The NSRA drafting process is led by the Civil Contingencies Secretariat (CCS), which sits within the Cabinet Office. **Each risk is owned by a government department**, which carries out initial assessments of impact and likelihood, with departments drawing on available expertise. The CCS supports departments in this work and compiles the risk estimates. The estimates undergo a stakeholder scrutiny process that includes a range of government officials and academics. The CCS works to ensure this whole process is continually improving [11][12].

A public version of the NSRA is known as the National Risk Register (NRR) [13]. This is for use by the public and businesses [12]. The NRR has been made available at least every other year from 2008 until 2017 [13].

The NSRA is used to inform national resilience planning and underlies a set of national resilience planning assumptions. Risk planning is spread across government and each department is responsible for the risks it owns. Responsibility for risk planning is also spread across the devolved administrations and local-level responders [12] [14].

The government reviewed its risk management processes in 2012, by commissioning the Blackett Review of High Impact Low Probability Risks. The Review concluded that there was a "need for the inclusion of external experts and readiness to consider unlikely risks" [15].



The NRR and the NSRA use a matrix to compare the likelihood and impact of risks on scales of 1-5. [1]

IV. The UK government's risk assessment process

Risk assessments are difficult to carry out. They need to account for high levels of uncertainty, and the frequently changing and evolving nature of the risks.

The NSRA process has a number of strengths. It is regular, occurring every two years. It is centrally coordinated, collating risks into a single document. It provides a reasonable level of detail, recognises uncertainty, considers compound and linked risks, and is largely depoliticised (although we discuss limitations of this later in this section). While this paper focuses on identifying the problems, so that improvements can be made, this should not take away from recognising these positives.

Nevertheless we have identified three main areas for improvement:

1. **Greater consideration of high-uncertainty risks** is needed, including low-probability risks and emerging risks.
2. **Risks and risk scenarios should be presented in a clear way** that allows comparability.
3. **Greater use of external experts** could be beneficial.

High-uncertainty risks

> *"There is a tendency in our planning to confuse the unfamiliar with the improbable."*
>
> – Nate Silver, statistician and author

As the catastrophes with the heaviest impacts are often the unfamiliar ones, it is important to consider high-uncertainty risks: those where it is difficult to ascertain how likely they are or what form they may take. They are typically either low-probability risks, emerging risks or risks without a clear known historical precedent. COVID-19 was a high-uncertainty risk – a novel highly infectious disease that quickly spread across the globe, in part due to a trend of greater international travel.

Challenges

At present, three features of the NSRA process lead to high-uncertainty risks being under- explored:

1. **The NSRA excludes low-probability risks.** It only includes risks that are more likely than their threshold of 1 in 100,000 year scenarios.

   This threshold approach rests on the assumption that a reasonably accurate estimate of likelihood can be generated. For high-uncertainty risks this is not the case. This threshold approach forces risk assessors to exclude risks based on highly speculative estimates of likelihood. This is in stark contrast to best practice in the private sector that cautions against putting too much weight on likelihood assessments (see Section VI below).

   Furthermore, even where likelihood can be reasonably estimated, it is still important to include low-probability risks in the NSRA where those risks are high-impact and could result in the death of millions of UK citizens [16]. The threshold used is inconsistently low relative to how carefully risks are managed elsewhere [17]. It is also problematic that the maximum level of 5, on the NSRA's 1-5 scale for the severity of risks, corresponds to roughly a 1% national fatality rate, when some risks could be much more serious [18].

2. **The NSRA excludes emerging risks.** Since the NSRA only considers risks over a two year time window, this excludes many emerging risks. Emerging risks are those that have a low chance of occurring in the next few years but a higher chance of materialising beyond that timeframe, such as risks from new technologies and other ongoing trends.

   Furthermore, this short-term approach is inadequate for making decisions regarding risks that need significant planning or infrastructure to address, such as antimicrobial resistance, floods or wildfires [12]. We recognise that the NSRA discusses the influence of future trends, that it can be useful to assess risks that may be rapidly evolving over shorter timescales, and that other government documents provide a longer perspective [19]. However, this two year limit seems insufficient and too short-term.

   Indeed, this short-term approach has recently become even shorter. In 2019 the NSRA process shifted from a five year forward look with longer-term considerations to a two year forward look with much of the long-term thinking removed. (This is discussed further in the "Underlying causes" section.)

3. **The NSRA evaluates risk likelihoods largely on the basis of recent past events of a similar nature.** Looking at past events is often a useful approach for evaluating risks. But high-uncertainty risks, emerging risks or particularly large-scale risks [20] should not be evaluated this way as their unfamiliarity means that the recent past will not be applicable. It is unclear how these kinds of risks are evaluated by the CCS (or even if they are considered) and further investigation of this would be beneficial.

   Furthermore, in focusing on the *recent* past **the NSRA often ignores relevant historical data**. As a result, risks may be overlooked. For example, the risk from volcanic ash was only added to the NRA in 2012 after the 2010 and 2011 Icelandic eruptions [21], despite the availability of significant historical evidence from the 1700s that suggested such an event was highly probable [22][23].

The way forward

In order to ensure that high-uncertainty risks do not go unidentified there is a need to consider low-probability risks, emerging risks and risks beyond those observed in the recent past. The private sector accomplishes this by focusing on vulnerability assessments rather than likelihood assessments (discussed further in Section VI). Additionally, techniques such as red teaming, tabletop exercises and discussions with a broad range of experts can help risk assessors understand high-uncertainty risks (see the "Use of experts" section).

We can summarise these points with the following key recommendation:

Recommendation 3:

Ensure the NSRA captures high-uncertainty risks, so as to close gaps in the risk assessment process. This can be achieved by including low-probability and emerging risks in the NSRA, by looking beyond the recent past, by using techniques such as red teaming and tabletop exercises, and by greater use of a vulnerability based approach to risk assessment.

Categorisation and communication of risks

"The reasonable worst case is, of course, that Bird flu becomes transmissible and we get a 60% case fatality rate. That was felt certainly to be a worst case but almost unpreparable for. So from the point of view of something reasonable for the NHS to plan for and reasonable in terms of cost, that is why the Spanish flu example was used."

– Professor Neil Ferguson [24]

Risks do not fall into neat, clearly delineated categories. Yet in order to feed into policy making and provide information to decision makers, risk assessors need to find effective ways to differentiate and compare risks. They then need to present and communicate these risks in a way that captures nuances and makes sense to political actors and policy makers.

Challenges

As the quote above illustrates, the UK's worst case influenza pandemic scenario was chosen on the basis of what was "reasonable for the NHS to plan for". This highlights a serious issue with the NSRA:

1. **The NSRA's reliance on reasonable worst case scenarios (RWCS) is misleading.** The RWCS are designed as scenarios that would be a challenge for government to respond to yet reasonable to expect government to prepare for [10][25]. As such, they are not based solely on the nature of the risks but incorporate policy assumptions regarding what is expected of government.

   This is problematic because the NSRA uses these RWCS as if they were objective measures of risk. The RWCS are used for mapping the scale of risks, comparing risks, and generating planning assumptions. Using these RWCS in these ways leads to incorrect conclusions and is misleading to policy makers. Furthermore it is not made clear to readers of the NRR (and maybe also to readers of the NSRA) that these scenarios are developed in this way.

There are two further areas within the NSRA where there may be scope to improve the categorisation and communication of risks:

2. **The NSRA could better highlight the scale of uncertainty and the potential impacts of cascading, compound and linked risks.** It is a boon of the NSRA that it identifies uncertainty and compound and linked risks. However there is scope for improving communication to ensure that readers are aware of these factors and not lulled into simply preparing for the specified RWCS. Practitioners we spoke to specifically flagged a lack of attention in the NSRA given to cascading, compound and linked risks.
3. **Risk assessment scales are not necessarily comparable across categories.** The NSRA assesses the various impacts of each risk on scales from 1 to 5. However, it is unclear, for example, what steps have been taken to ensure that a 5 on "human welfare" impacts is the same as a 5 on "security" impacts. Where these scales are logarithmic, care needs to be taken in how they are combined.

The way forward

The NSRA should either move away from the use of RWCS or clarify their limitations. To this end, best practice in the private sector involves the use of pre- and post-mitigation worst case scenarios (see Section VI). The NSRA could also do more to draw attention to uncertainty and highlight compound and linked risks. Some of the recommendations from the Blackett Review could be adopted, such as quantitative probability estimates of risks combined with a score to communicate the quality of evidence for each risk. Additionally, scales of risks need to be comparable across categories.

We can summarise these points with the following key recommendation:

Recommendation 4:

Improve how the NSRA categorises, compares and communicates risks, so that policy makers have a clear understanding of the risks. In particular consider moving from reasonable worst case scenarios to pre- and post-mitigation worst case scenarios and finding additional ways to highlight uncertainties.

Use of experts

> *"[The National Risk Assessment is] far too attached to the Intelligence machinery, paying too little attention to open source material and other governments' policy development."*
>
> – Baroness Neville-Jones, former Minister for Security and Counter Terrorism [26]

Risk assessors should draw information from a range of sources and input from independent experts. This ensures unbiased assessments and helps to avoid groupthink, which occurs when groups are too homogeneous, and blind spots where key risks are overlooked.

Challenges

There are two issues with the NSRA in this regard:

1. **More could be done to invite input from external experts.** Although the CCS engages relevant experts both within and outside government as part of the NSRA process, academic risk experts have expressed concern that their voices are not sufficiently heard.
2. **Government departments may be over- or under-playing specific risks** to affect their prioritisation. This concern was raised in the 2019 Parliamentary Office of Science and Technology report on risk assessment [12] and similar comments were made by those we interviewed.

The way forward

To improve expert engagement, the CCS could reach out to a broader range of individuals, make more of the NSRA public or refer the entire NSRA to an academic institute for an independent second opinion, as is done in Switzerland (see Section VI). The CCS also needs to have the power to push back on departmental risk estimates and ensure the process is fully depoliticised.

Security issues pose an obstacle to sharing sensitive information but this could be overcome by sharing redacted information or by providing more security clearance checks to external researchers. The government may wish to consider setting up a new independent institute for catastrophic risk research that is staffed by security cleared individuals and has a mandate to provide feedback on the NSRA (similar to the Cabinet Office's existing What Works Centers [27]). This could play a similar role to the third line of defence used in the private sector (see Section VI).

We can summarise these points with the following key recommendation:

Recommendation 5:

The NSRA process should make greater use of external experts so as to minimise the risk of blind spots and groupthink. For example, consider giving a mandate to review and provide feedback on the full NSRA to an independent body.

We note that the UK has world leading research in this domain. The Centre for the Study of Existential Risk at the University of Cambridge and the Future of Humanity Institute at the University of Oxford produce a significant quantity of high quality research on catastrophic risks.

COVID-19 analysis: The NRR estimate of "up to 100" fatalities

> *"It is difficult to forecast the spread and impact of a new flu strain or disease until it starts circulating. However, consequences may include:*
>
> *• for pandemic flu: up to 50% of the UK population experiencing symptoms, potentially leading to between 20,000 and 750,000 fatalities and high levels of absence from work.*
>
> *• for emerging infectious diseases: several thousand people experiencing symptoms, potentially leading to up to 100 fatalities."*
>
> – UK National Risk Register 2017 [1]

The most recent NRR (2017) set out in a concise manner a broad range of risks that could impact the UK. It did highlight the risk of an influenza pandemic, listing it as the biggest non-malicious risk to the UK. However, the risks from **emerging infectious diseases beyond influenza were significantly underestimated**.

Looking back at this in the light of COVID-19, it is notable that **the NRR stated that "emerging infectious diseases" could lead to "up to 100 fatalities"**. This estimate was very far from the mark and as such deserves some analysis and explanation.

According to our interviews, this estimate was considered by civil servants to be a justifiable estimate of non-influenza infectious disease risks. Yet **this was clearly out of line with the evidence available at the time**. Academic papers available in 2017 raised the risk of a global outbreak due to emerging infectious diseases of all types [28][29]. Other assessments of global risks highlighted that non-influenza pandemics could kill millions [30][31]. There appears to have been a widespread view across academia that a SARS type pandemic could very easily have gone global [32] and that there was a reasonable probability of an emerging disease killing one billion or more people globally [33].

Coronavirus is not influenza and it appears that **the narrow focus on influenza was detrimental to government preparedness**. For example, the government stockpiled the Personal Protective Equipment (PPE) needed for influenza but did not have sufficient gowns or visors for preventing COVID-19 transmission [34]. Similarly, the UK had well rehearsed plans to develop an influenza vaccine within six months [1], but these could not be applied to COVID-19 [4].

There are a number of steps that appear to have gone wrong, closely correlated to the issues with the NSRA discussed in the previous sections. They can be summarised as follows:

- **A lack of attention was given to uncertainty due to emerging trends.** The risk of pandemics may be higher than historically as a result of increased global interconnectedness. There is also the possibility of accidental releases of pathogens from a lab or deliberate malicious releases.
- **Pandemic estimates were based on events in the relatively recent past**, notably Spanish flu in 1918, SARS in 2002, and Ebola in 2013 [35]. CCS did not consider historical events (such as Cholera pandemics in the 1800s or various plague epidemics).
- **The way risks were delineated and categorised was flawed.** The risk of a mass infectious disease was explicitly linked to influenza. (See Box 2 below for an example of how risks could have been categorised better.)
- **The RWCS for pandemics were developed to be scenarios that were "reasonable for the NHS to plan for"** rather than to be truly comparable scenarios illustrating the scale of different risks.
- **Academic research with contrary information was not given due consideration** and relevant academics were not consulted.

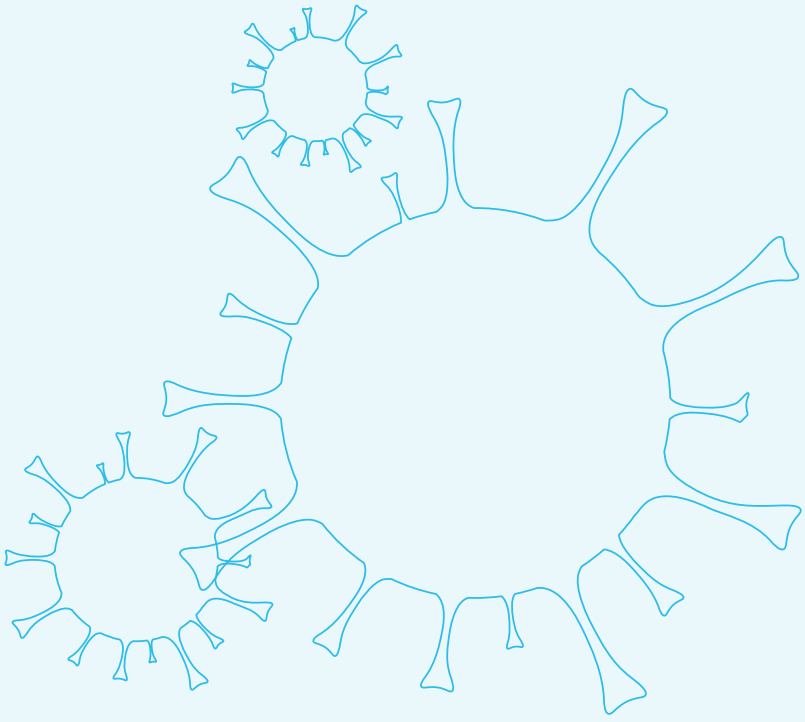
While no risk assessments are perfect in hindsight, we conclude that the estimate of an "emerging infectious disease" causing "up to 100 fatalities" was not a one-off bug or mistake but an inevitable feature of the current system, which has inherent design flaws. As such, **it is quite possible that the UK risk assessment process has missed other risks**.

Box 2: An alternative approach to categorising risks from disease

This illustrates how, on the basis of information available in 2017, UK risk assessors could have better delineated disease risk in a manner that supports decision making by breaking it into three scenarios:

1. **A highly infectious effectively uncontainable disease with a low but not insignificant fatality rate.** A RWCS could be modelled on the Spanish flu but should recognise that there could be uncontainable diseases that are not influenza.
2. **A somewhat infectious but still containable disease with a high fatality rate.** A RWCS could be based on SARS or Ebola.
3. **A highly infectious, uncontainable disease with a high fatality rate.** A RWCS could be based on a red teaming exercise with experts to develop scenarios.

To the best of our knowledge this final worst case scenario is plausible but has not been raised or prepared for. It is possible that this work is happening in secret.



Addendum to Section IV: Underlying causes

> *"At one stage there were some discussions around how useful people found the longer-term view of risk. When people look at risk they're often looking at much more certain, or higher-probability, higher-impact risks. When they develop a risk register, that's where people tend to."*
>
> – UK civil servant

The quote above is from a civil servant discussing the UK's shift from a five year to a two year NSRA. We see the inability of the NSRA to capture low-probability risks, emerging risks and other high-uncertainty risks as symptoms of a broader cross-government challenge. Our interviews suggest there are two underlying causes:

1. **Political short-termism.** It can be difficult for ministers to think beyond their time in office, as their bandwidth is taken up by short-term issues, and good long-term risk management has not traditionally led to political gain. As the civil service exists to serve ministers, this filters down, meaning that there is little inducement for staff to produce forward-looking information.
2. **Insufficient fostering of long-term thinking, systems thinking, futures thinking and technical expertise across the civil service.** Those we interviewed commented that civil servants may see it as a career hindrance or may be ignored if they try to highlight uncertain risks or raise new issues. While the NSRA process itself includes horizon scanning exercises to identify novel risks, there is a need for a better understanding of risk and uncertainty across the civil service. There has been some movement in the right direction, in particular the work of the Government Office for Science to enhance foresight capability across government.

Ultimately there is a need for a better governance structure to oversee and support good depoliticised expert-driven risk assessments. We will return to this point in Section IV.

V. The UK government's approach to risk planning

Risk planning is inherently challenging. Flaws that may affect risk assessments, such as the tendencies to prepare for the last war or to overlook high-uncertainty risks, also affect risk planning – this means that flaws can compound and lead to greater unpreparedness. Plans need to be flexible given uncertainty; they must account for cascading risks, compound risks, and linked risks; and they require difficult tradeoffs while not focusing solely on the negative by ignoring opportunities.

There is a lot to commend about the UK government's approach to risk planning. The NSRA is used to inform national risk planning. Responsibility for each national risk identified in the NSRA is assigned to a specific department. This approach of spreading responsibility for risks across government is appropriate and in line with best practice (see Section VI). The CCS helps departments to better understand these risks. The Emergency Planning College does important work as well, supporting departments to train for disaster response.

Challenges

On the basis of our interviews, we have identified three main limitations in the risk planning process:

1. **There is limited centralised oversight of or support for departmental risk planners.** There is no central accountability mechanism to ensure that departments draw up adequate plans to address risks. Nor is there a pool of expertise available to assist departments in developing high-quality risk plans. (CCS's focus is risk assessment, so its support is limited to helping departments understand the risk assessment.)
2. **Civil servants, across all levels, need to have skills and incentives to understand and work with risk and uncertainty.** Practitioners have expressed concern to us that unless they can be very clear about a concrete imminent risk, decision-makers will not engage.
3. **Greater expenditure on preparedness is needed.** There is evidence that the UK government has been under-investing in preventative spending [36]. Disaster prevention has been shown to save money over the long term [37].

The way forward

We see a need to improve expertise in and oversight of risk planning. In part this can be achieved through more training for staff on managing risks and high-uncertainty situations and on systems thinking and through more support for staff to use foresight methodologies, tabletop exercises, red teaming and scientific expertise. There also a need for improved incentives to use such tools and cultural changes across government. Drawing this together with the points raised at the end of Section IV about the need for a better governance structure for risk assessments, we recommend:

Recommendation 6:

Establish a Government Chief Risk Officer (CRO) and an associated unit.

This unit should carry out depoliticised risk assessments, support departments in developing flexible risk response plans, coordinate risk planning across government, assign ownership of risks to departments and hold government ministers to account for the quality of their department's risk plans. This unit should have a degree of independence from Ministers and ideally be accountable directly to Parliament (or an independent board). The Cabinet Office would continue to coordinate crisis response at the national level.

This approach is analogous to the 'second line of defence' in private sector risk management and is similar to the approach taken elsewhere by the UK government to support long-term thinking through independent units (see Section VI).

An alternative approach would be to assign these functions to existing bodies. For example, risk accountability for risk management could be part of National Audit Office audits.

COVID-19 analysis: Pandemic plans that did not have a lockdown option

> *"5.13 There is also very little evidence that restrictions on mass gatherings or on internal travel arrangements will have any significant effect on influenza virus transmission. The emphasis will instead be on encouraging all those who have symptoms to follow the advice to stay at home and avoid spreading their illness."*
>
> – Department of Health plan, 2012 [38]

Given the UK government's prioritisation of influenza, it drew up a number of plans between 2011 and 2014 for responding to this risk, including the 2011 Influenza Pandemic Preparedness Strategy. This plan was detailed, clearly drew on the available evidence and considered the impact of an influenza pandemic on all sections of society.

Although COVID-19 is not pandemic influenza, there are important similarities. In particular, the transmission pathways and fatality rates of the diseases are similar and both diseases can be spread asymptomatically. We would thus expect similar strategies for preventing the spread to be applicable.

The dominant strategy followed by the UK and most other developed countries to respond to COVID-19 has been to implement lockdowns. **However the UK's pandemic influenza strategy had no discussion of lockdown or other methods to reduce the R number**, except for "possible school closures" and isolating the ill. Instead, they aimed for a herd immunity-type approach, "supporting the continuation of everyday activities as far as practicable" and recommended no restrictions on international travel or public gatherings [2].

Not developing plans with a variety of options, including a lockdown option, appears to be a significant shortcoming of the influenza pandemic plans. (Note: We are not opining on the effectiveness of lockdowns as a strategy for addressing pandemics, but simply that they should have at least been identified as an option.) This may have been due to the following:

1. **The plans were not sufficiently flexible.** A flexible, adaptable plan that accounted for high uncertainty would have mapped out a broader range of strategies [39], and might even have partially mitigated the NSRA's over-focus on influenza.
2. **There was a lack of systems thinking and speculative political thinking.** A systems thinking approach might have identified a lockdown strategy as politically desirable and developed plans for it accordingly. Similarly, a former US Pentagon official reported that the Pentagon under-prepared for the politicisation of decision making involving the COVID-19 response [40].
3. **The plans were not regularly updated.** For example, although the Department of Health reviewed the evidence on restricting gatherings in 2014 and stated that "restrictions of mass gatherings can reduce transmission" [41], no changes were made to the pandemic strategy based on this evidence. It is unclear to us if sufficient steps were taken to consider updating the strategy. Similarly, in 2016 the government carried out a simulation exercise of a flu outbreak, Exercise Cygnus, but the findings were not fully integrated into government plans [34].

This analysis suggests that UK political leaders inherited plans that were not well suited to the COVID-19 situation. This tallies with and could explain the criticism that has been levelled at the government that it initially responded slowly to the pandemic [42][43][44]. While, with hindsight, some problems with risk plans are always to be expected, more oversight of and support for risk planning would be advantageous to ensure the UK is better prepared for future disasters.

VI. Best practice in the private sector, the public sector and internationally

It is important to examine and learn from other disciplines when possible. This section sets out existing best practices in risk management in the private sector, other parts of the UK public sector and internationally, on which the UK government may wish to draw to improve its risk management practices.

The private sector

The private sector makes extensive use of risk management. Innovation has been driven especially by developments in enterprise risk management in the financial sector since the 2007-08 financial crisis. Drawing on desk research and conversations with a senior professional from the aviation industry, we highlight here a number of areas of best practice:

A "three lines of defense" approach to risk governance. This is common in the private sector.

It is important that **risk planning and risk mitigation are firm-wide** and not seen as someone else's job, and as such risk ownership is spread across the business. This is the first line of defence.

Companies then typically have a **Chief Risk Officer (CRO)**, a board-level executive with responsibility for risk management policies and for the risk assessment process. The CRO provides an oversight function and a strong senior-level voice to ensure that all parts of a firm are acting to address risks [45]. This is the second line of defence.

An **audit function** that has a degree of independence from the day-to-day work, reports to the board and acts to ensure that risk management is working effectively forms the third line of defence.

Worst case scenarios to compare risks and highlight residual acceptable risk. Current best practice in the private sector is to use two sets of scenarios [46]. The first set illustrates the scale of the risk and expected damage *pre-mitigation* (using the assumption that there is no risk management) – this allows risks to be compared. The second set illustrates the level of residual risk and damage expected *after mitigation* – this highlights for executives the level of risk and damage they are still willing to accept and the cut-off point at which further mitigation is deemed too costly.

Vulnerability assessments. The private sector is moving to an approach that primarily assesses risks in terms of both their scale and the level of vulnerability of the business with regard to them. This highlights the gaps that need to be closed in the current system and supports flexible risk planning. (This approach is also time-independent, so avoids the issue of different risks needing to be assessed according to different timelines.)

This differs from the more traditional approach of risk assessment based on the scale and likelihood of the risk. In the areas of the private sector where likelihood assessments are still used, risk assessors caution against putting too much weight on highly uncertain likelihood estimates and caution against overusing cost benefit analysis for prioritising risks, as these techniques can give a false impression of precision [47].

The public sector and internationally

Owing to the variety of national approaches there is no clear best practice approach to national risk management. Some areas of best practice that the UK government may want to consider, drawn from international counterparts as well as from other parts of the UK civil service, are:

The publication of quantifiable predictions. This allows an organisation to learn from its errors and to improve and be accountable for its mistakes. The UK Office for Budget Responsibility already does this publicly for economic forecasts [48]. A similar approach is used for national security in the United States' internal Intelligence Community Prediction Market.

Seeking expert and public feedback on risk assessments. The Swiss government refers its risk assessment to the multi-disciplinary Paul Scherrer Institute for an independent second opinion. The Norwegian government has a wide consultation process that has driven feedback from all sectors at all levels [10].

A degree of independence. Those bodies in the UK that most successfully produce depoliticised research or facilitate long-term government planning tend to be (or be overseen by) bodies that are independent from ministerial departments. For example the Committee on Climate Change, the Office for Budget Responsibility or the Educational Endowment Foundation.

The adoption of Chief Risk Officers and enterprise risk management best practices. This has become widespread within government agencies. In the United States, over 40% of government agencies have Chief Risk Officers [49].

VII. Conclusions

> *"If this Government is to reform so much, it must also reform itself."*
>
> – Michael Gove MP, 2020

Technological and societal changes are accelerating. This century brings with it huge promise, but also a host of threats to current and future citizens, in the UK and around the world: pandemics, nuclear war, climate change, food insecurity, cyber attacks, election interference, misuse of algorithms, and financial collapse. It is imperative that modern governments are prepared to address these challenges as they arise.

Risk management is a difficult task for any government. It requires flexibility and agility, effective communication, long-term thinking, and planning for situations of high uncertainty.

The UK has an internationally respected, in-depth, regular risk management function. However, with the benefit of hindsight provided by COVID-19, we have identified a number of areas for improvement.. Risk assessments could be improved by greater exploration of high uncertainty risks, better categorisation and comparison of risks, and greater use of external expertise. There is also a need for more oversight of and support for risk planning.

Some of these areas for improvement are symptomatic of broader political and civil service short-termism. The current administration has expressed an eagerness to build a government and civil service that addresses the long term, including the risks, challenges and opportunities that the UK faces.

Some of these areas for improvement can be addressed with simple technical fixes, such as looking ahead more than two years or ensuring risk assessments are not based on what is "reasonable to plan for". We offer our support to assist the government in addressing such issues and would happily discuss this further with policy officials.

Some areas for improvement remain unidentified. We are hopeful that COVID-19 and the reflections that will necessarily follow, can prove a catalyst to enhance the governance of risk in the UK and around the globe. We highlight some areas for further research in Annex B.

Overall the issues identified meant that UK leaders facing COVID-19 inherited an inadequate set of plans. Furthermore, these issues remain. They are collectively serious enough that the UK may not be adequately prepared for future risks. We hope the government recognises the importance and urgency of addressing them in order to protect UK citizens from future disasters.

Annex A: Evidence collected from civil service interviews

> *"It's a natural tendency in some ways, when budgets are going down, to prioritise the immediate needs. I've been in that position myself and it is hard to make long-term decisions … I think we do need structures which allow decision makers to break out of short-term political cycles."*
>
> – Former civil servant who worked on public health policy

We interviewed or talked to 12 current or former civil servants from across relevant government departments including the Cabinet Office, the Ministry of Defence and Public Health England. These meetings mostly took place in 2019, prior to COVID-19.

Those we talked to highlighted a number of best practices that are crucial for good risk management, based on their experiences. These included:

- **Flexibility and agility** – This is necessary for handling uncertainty and making useful, adaptable plans. For example, the UK Armed Forces display a relatively high degree of flexibility.
- **Coordination and communication** – Good communication is needed at all levels, between experts and senior staff, across government departments and between central government and local government. For example the CCS carefully considers how best to communicate in a way that empowers local risk planners.
- **Expertise** – Long-term staff with technical expertise and experience in futures thinking, systems thinking and strategy, as well as external input, are crucial for understanding risks. These experts need senior champions to be able to highlight risks issues. For example, the Chief Scientific Advisor role works well.
- **Depoliticisation** – Risks must be considered beyond parliamentary timescales and there must be consistency from government to government. For example, Counter Terrorism has a protected budget that is allocated technocratically.
- **Cross-border collaboration and sharing of best practice** – The UK is good at this, for example in our collaborations with other Five Eyes countries.

Those we spoke to, however, identified challenges that they or the government face with regard to risk management:

- **Political short-termism.** Government ministers will care more about risks that might happen in their tenure and not risks that will happen in the future, and it is hard to find the funding for long-term preventative policy.
- **Short-term thinking is easier for staff.** It is less of a career risk to prepare to fight yesterday's war than to raise new issues or highlight novel or uncertain risks.
- **Difficulty in communicating risks and uncertainty.** Communicating uncertainty is challenging and products explaining risks need to be written in a way that works for multiple audiences with different use cases. Risk analysts sometimes find that unless they can be very clear about a concrete imminent risk, decision-makers will not engage, but this leads to a narrow events-based way of looking at risks.
- **Risk management is a difficult and evolving field.** The UK prepares for each identified risk, but it is not clear if this is the best approach. Preparing for consequences, addressing vulnerabilities, or preparing for extreme scenarios may be better.

Annex B: Suggestions for further work

This paper has mainly focused on the NSRA and how the NSRA feeds into risk planning. However, there are a number of other important areas for further investigation. These include:

- **Risk mitigation** – What steps does the UK take to prevent risks arising and how well does this work?
- **Risk response** – How does central government coordinate risk response? How well does the Civil Contingencies Committee function in a crisis? How does good or bad leadership affect response and how can we prepare for such differences? How effective is Emergency Response training and what can we learn about this from COVID-19?
- **Risk recovery** – How can the UK recover well from shocks?
- **Risk communication** – How effectively are risks communicated, both within government and publicly? Why was the NRR not published in 2019?
- **National resilience** – How can the UK become a society that is resilient to shocks? What can be learned from COVID-19, for example about supply chain resilience and about how the public responds to crises?
- **National security** – Does the UK's grand strategy and foreign policy focus attention on the correct risks? Does its framing of national security place too much emphasis on security risks and are these in fact the biggest risks the country faces?
- **The international arena** – How can the world prepare most effectively to respond to global risks? What role can the UK play in that global process?
- **Specific risks** – How aware of and prepared for specific risks is the UK government? Is enough attention given to high-impact, high-uncertainty, risks such as extreme pandemics, nuclear conflict and risks arising from emerging technologies?
- **Opportunities** – What can be done to ensure the UK is able to identify opportunities as well as risks?
- **Repeating this analysis with access to non-publicly available sources of information**, such as complete copies of the NSRA. This could lead to different or more refined conclusions.
- **Repeating this analysis after the COVID-19 pandemic has passed** and identifying other areas where lessons can be learned.
- **More in-depth analysis of any aspect of this research** – For example, examining in depth the precise mechanisms used by the CCS to draw on academic expertise, or looking in detail at the risk planning process.

References

[1] Cabinet Office (2017). National Risk Register Of Civil Emergencies

[2] Department of Health (2011). UK Influenza Pandemic Preparedness Strategy 2011

[3] IMF (2018). Regulatory Cycles: Revisiting the Political Economy of Financial Crises, WP/18/8, January 2018

[4] Professor Van-Tam (2020) DQ1008 Oral evidence: UK Science, Research and Technology Capability and Influence in Global Disease Outbreaks

[5] The Guardian (2020). Experience of Sars a key factor in countries' response to coronavirus

[6] Axios (2020). SARS made Hong Kong and Singapore ready for coronavirus

[7] Fortune (2020). SARS taught Taiwan how to contain the coronavirus outbreak

[8] ghsindex.org (2019). 2019 Global Health Security Index. The Global Health Security Index was an assessment of global health security capabilities produced by Johns Hopkins, the Nuclear Threat Initiative, and the Economist Intelligence Unit.

[9] OECD (2017). The UK's National Risk Assessment (NRA)

[10] OECD (2017). National Risk Assessments: a Cross Country Perspective

[11] Cabinet Office (2019). National Security Risk Assessment (visible at: The Guardian (2020). What does the leaked report tell us about the UK's pandemic preparations?)

[12] Parliamentary Office of Science and Technology (2019). Evaluating UK natural hazards: the national risk assessment

[13] Gov.uk (2017). National Risk Register (NRR) of Civil Emergencies

[14] Gov.uk (2013). The role of Local Resilience Forums

[15] Government Office for Science (2012). Blackett Review of High Impact Low Probability Risks

[16] For example, a super volcano that could stop all global food production is a 1 in 100,000 year scenario. It could be inexpensively prepared for by stockpiling mushroom spores and bacteria that could feed off wood, and then be fed to humans. Denkenberger and Pearce. (2015). Feeding everyone: Solving the food crisis in event of global catastrophes that kill crops or obscure the sun

[17] Health and Safety Executive (HSE) (1992). The tolerability of risk from nuclear power stations, p. 30. HSE asks UK nuclear power stations to reduce their total risk of a single death to any 1 member of the public to less than an estimated 1 in 100,000 years.

[18] The NSRA's scale for impact cuts off at 5, for reasons of neatness. This roughly corresponds to a 1% mortality event. However some threats to the UK could be many times worse than this. For example, the Black Death had >30% mortality (considerably less than 1,000 years ago). And some threats may still be many times greater than this if we consider intergenerational impacts, as for example from threats like a full-scale nuclear war that could lead to complete civilisational collapse.

[19] Such as the Climate Change Risk Assessment, and the Global Strategic Trends report.

[20] Cirkovic, Sandberg and Bostrom (2010). Anthropic Shadow: Observation Selection Effects and Human Extinction Risks

[21] Centre for the Observation and Modelling of Earthquakes, Volcanoes and Tectonics (2016). Quantifying health and aviation hazards from Icelandic volcanic eruptions to inform government policy

[22] Thordarson and Self (2003). Atmospheric and environmental effects of the 1783–1784 Laki eruption: A review and reassessment

[23] Cabinet Office (2015). National Risk Register of Civil Emergencies chapter 2: risk summaries

[24] Professor Neil Ferguson (2011). Question 82. House of Commons - Scientific advice and evidence in emergencies - Science and Technology Committee

[25] Cabinet Office (2011). House of Commons - Science and Technology Committee - Written Evidence

[26] Views provided directly to us during the research process (2020).

[27] Gov.uk (2019). What Works Network

[28] McCloskey, Dar, Zumla and Heymann (2014). Emerging infectious diseases and pandemic potential: status quo and reducing risk of global spread.

[29] Machalaba and Karesh (2017). Emerging infectious disease risk: shared drivers with environmental change.

[30] World Economic Forum (2016). The Global Risk Report 2016. This paper highlights that an emerging infectious SARS like disease could lead to tens of millions of fatalities. (p. 59)

[31] Global Challenges Foundation (2017). Global Catastrophic Risks 2017. This paper highlights the risks of emerging infectious diseases that could kill tens or hundreds of millions including the scenario of a SARS type outbreak that is worse than the previous outbreak.

[32] Monaghan (2003). SARS: Down but still a threat - Learning from SARS

[33] Future of Humanity Institute (2008). Global Catastrophic Risks Survey. This survey of academic risk experts shows some degree of academic consensus on emerging infectious diseases as one of the largest threats.

[34] Institute for Government (2020). How fit were public services for coronavirus?

[35] This is based on reading through previous copies of the NRR at National Risk Register (NRR) of Civil Emergencies, and drawn from our conversations with civil servants.

[36] National Audit Office (2018). Improving government's planning and spending framework (Summary).

[37] Shreve and Kelman (2014). Does mitigation save? Reviewing cost-benefit analyses of disaster risk reduction

[38] Department of Health and NHS (2012). Health and Social Care Influenza Pandemic Preparedness and Response

[39] Biosecurity Research Initiative at St Catharine's College, Cambridge (2020). A solution scan of societal options to reduce SARS-CoV-2 transmission and spread. This solution scanning exercise, designed to inform policy makers on how to respond to COVID-19, is a good example of flexible risk planning in practice.

[40] Anonymous source (2020). Views provided directly to us during the research process.

[41] Department of Health (2014). Impact of Mass Gatherings on an Influenza Pandemic Scientific Evidence Base Review

[42] Institute for Government (2020). Decision making in a crisis

[43] The Guardian (2020). Two-thirds of public think UK coronavirus response too slow – poll

[44] Business Insider (2020). The UK's former chief scientific adviser says Boris Johnson's slow response to the coronavirus pandemic cost lives

[45] Deloitte (2010). The Chief Risk Officer: your business ally

[46] Risk Management Capability Ltd (2013). Capability Guidance: Pre and Post Mitigation Estimates

[47] Health and Safety Executive (1992). The tolerability of risk from nuclear power stations

[48] Office for Budget Responsibility (2019). Forecast evaluation report – December 2019

[49] Wall Street Journal (2019). Enterprise Risk management, Long Used by Companies, Takes Hold in Government

Abbreviations

CCS	Civil Contingencies Secretariat
CRO	Chief Risk Officer
NRA	National Risk Assessment
NRR	National Risk Register
NSRA	National Security Risk Assessment
SARS	Severe Acute Respiratory Syndrome
WEF	World Economic Forum
R number	Reproduction number (a measure of a disease's ability to spread)
RWCS	Reasonable Worst Case Scenarios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