INTERNATIONAL PUBLIC POLICY OBSERVATORY

NAVIGATING THE CRISIS

How Governments Used Intelligence for Decision-making During the Covid-19 Pandemic

IPPO

UKRI Economic and Social Research Council

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1. THE PANDEMIC AND THE GLOBAL CHALLENGE OF INTELLIGENCE

Summary

This study examines **how governments — and the societies around them — mobilised intelligence to handle the COVID-19 pandemic and its effects**. It also makes recommendations as to how they could improve their ability to organise intelligence for future challenges of all kinds, from pandemics to climate change. The study draws on dozens of interviews with senior officials and others in many countries including Estonia, Australia, New Zealand, Germany, Finland, USA, Chile, Canada, Portugal, Taiwan, Singapore, India, Bangladesh, UAE, South Korea and the UK, as well as the European Commission and UN agencies — along with roundtables and literature analysis.

The pandemic was an unprecedented event in its global impacts and in the scale of government responses. It required a myriad of policy decisions: about testing, lockdowns, masks, school closures, visiting rules at care homes and vaccinations. Our interest is in what contributed to those decisions, and **we define intelligence broadly to include data, evidence, models, tacit knowledge, foresight and creativity and innovation** — all the means that can help governments make better decisions, particularly under conditions of stress and uncertainty.

Each type of intelligence played an important role. Governments needed health as well as non-health data to help understand how the virus was spreading in real time and its impacts. They needed models — for example, to judge if their hospitals were at risk of being overrun. They needed evidence — for example on whether enforcing mask-wearing would be effective. And they needed to tap into the knowledge of citizens and frontline staff quickly to spot potential problems and frictions.

Most governments had to improvise new methods of organising that intelligence, particularly as they grappled not just with the immediate health challenges, but also with the knock-on challenges to economies, communities, mental health, school systems and sectors such as hospitality.

As we show there was extraordinary innovation globally around the gathering of data, from mass serological testing to analysis of sewage, from mobilising mobile phone data to citizen generated data on symptoms. There was an equally impressive explosion of research and evidence; and innovative approaches to problem solving and creativity, from vaccine development to Personal Protective Equipment (PPE).

However, we also point to problems:

- **Imbalances in terms of what was attended to** — with physical health given much more attention than mental health or educational impacts in models and data, which was understandable in the early phases of the crisis but more problematic later on as trade-offs had to be managed
- **Imbalances in different kinds of expertise** in scientific advice and influence, for instance in who got to sit

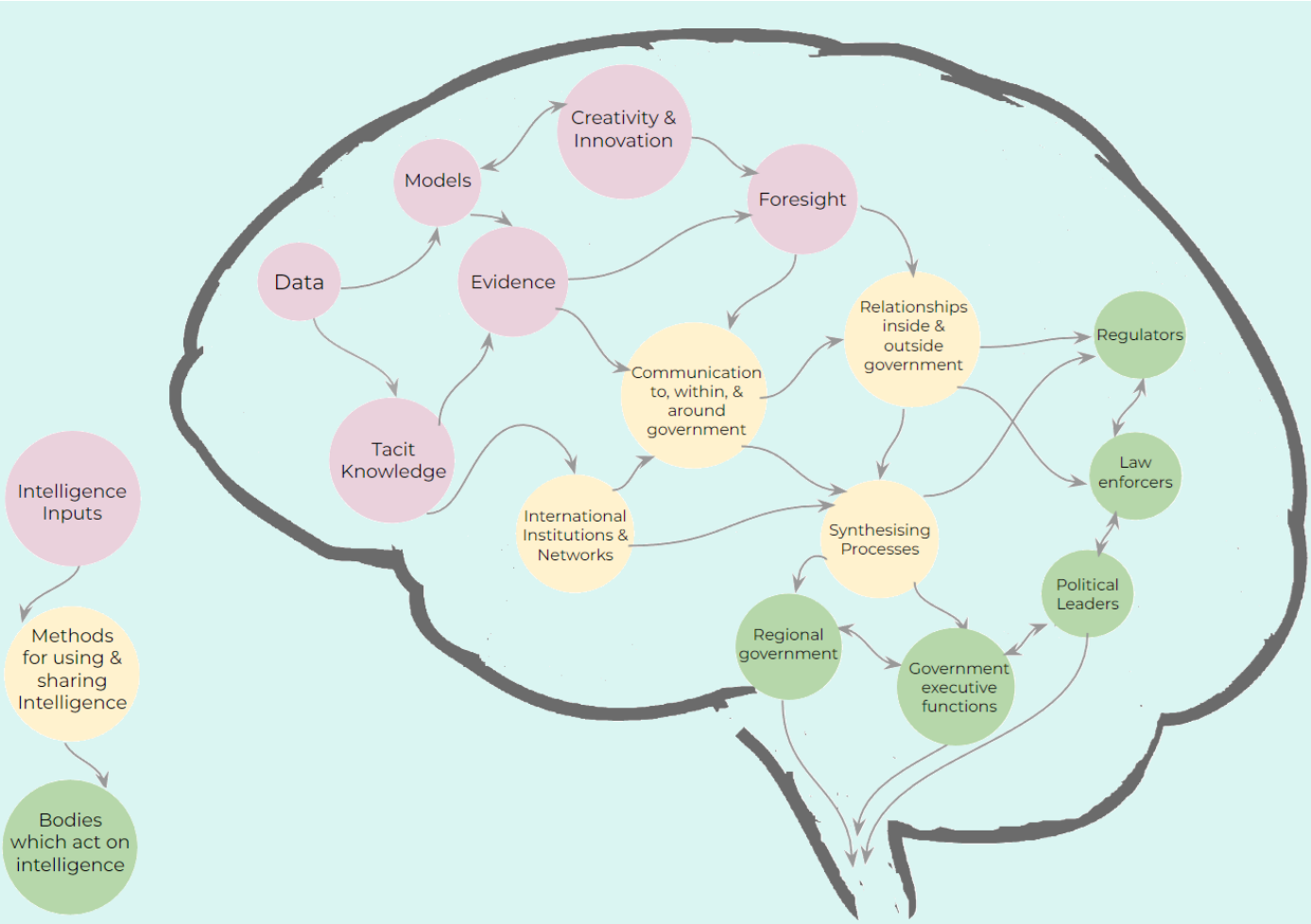


Figure 1: Intelligence flows for government decision-making — from intelligence inputs, to methods for sharing and using intelligence, to bodies which act on the intelligence.

on and be heard in expert advisory committees
- Very varied ability of countries to **share information and data between tiers of government**
- Very varied ability to **mobilise key sources**, such as commercial data, and varied **use of intelligence from outside sources**, such as from other countries or from civic groups,
- Even when there were strong sources of advice and evidence, **weak capacities to synthesise multiple kinds of intelligence** at the core of governments.

Recommendations

The report highlights the need for governments to have well-developed capabilities in each of the key elements of intelligence — from data and evidence to tacit knowledge and foresight — and to ensure these are aligned with the most important priorities as well as risks. This is partly about formal structures, but also about **cultures and relationships**: some countries had strong networks linking different tiers of government, and with external partners, while others lacked them.

A broad theme is the importance of **shared intelligence** — with a shift from intelligence as something to be kept secret and hoarded towards a model of government that emphasises a more open approach to sharing intelligence of all kinds.

Finally, the report recommends **the more explicit organisation of intelligence both in central structures and throughout government**. At present it is divided by function (data, statistics, science advice, economics etc) and by departmental silos (health, finance, education etc). This may have been necessary in the 20th century but given the availability of new technological tools is no longer always fit for purpose.

What is intelligence and why did governments around the world need it?

We define intelligence broadly to include **data, evidence, models, tacit knowledge, foresight, and creativity and innovation** — all the means that can help governments make better decisions, particularly under conditions of stress and uncertainty.

Each played an important role. Governments clearly needed health as well as non-health data to help understand how the virus was spreading in real time. They needed models — for example to judge if their hospitals were at risk of being overrun. They needed evidence — for example on whether enforcing mask-wearing would be effective. And they needed to tap into the knowledge of citizens and frontline staff quickly to spot potential problems and frictions.

But most had to improvise new methods of organising that intelligence, particularly as they grappled not just with the health challenges, but also with the knock-on challenges to economies, communities, mental health, school systems and sectors such as hospitality.

These inputs of different types of intelligence are interpreted and mediated as they feed into decision-making:

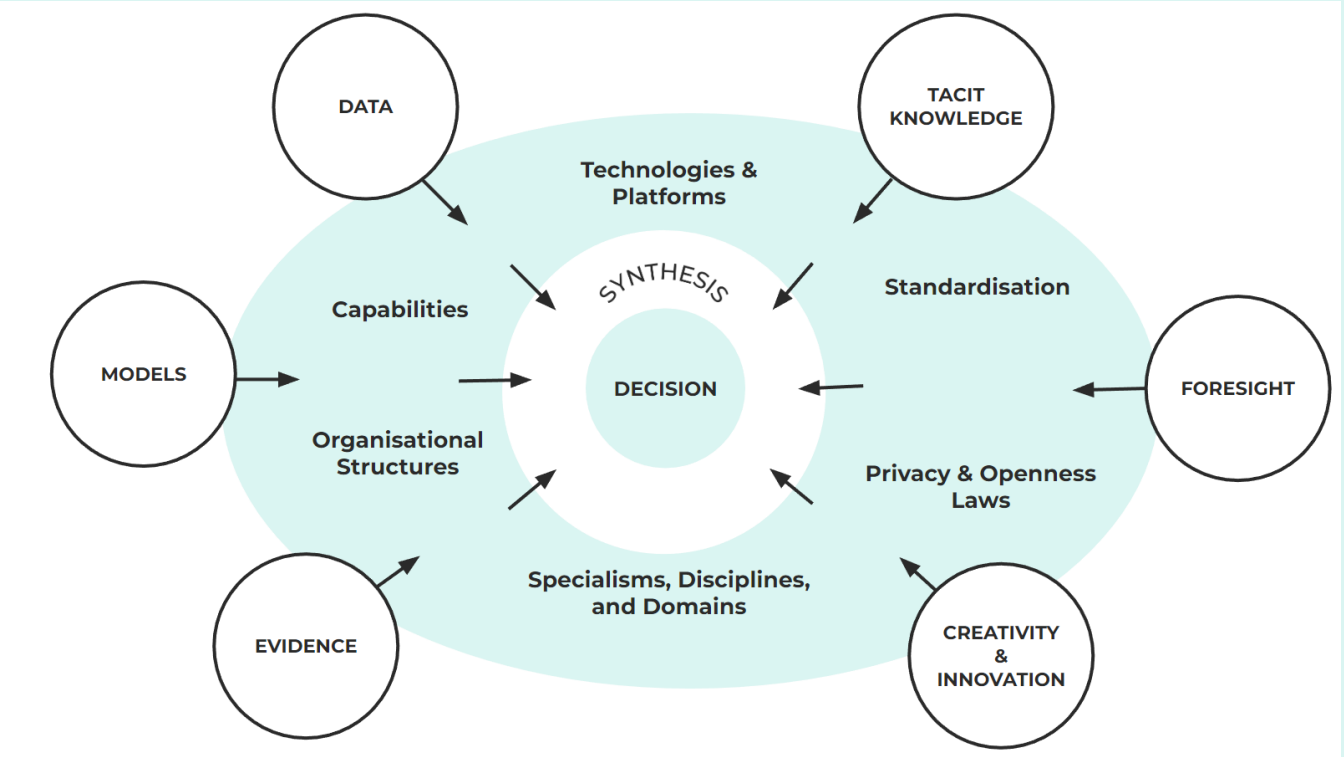


Figure 2: Types of intelligence are mediated and shaped by processes and contextual factors before feeding into decisions

Peripheral vision and focus?

The scarcest resource in any government is attention. Much of our interest is in how governments organised both a wide peripheral vision to spot new issues and threats (whether new variants of COVID-19 that were spreading, or issues such as worsening educational attainment), and sufficient focus to act decisively, drawing on an ability to synthesise complex patterns to guide those actions.

How did governments learn?

No governments were quite prepared for the pandemic, though some benefited from similar experiences in recent decades, particularly with severe acute respiratory syndrome coronavirus (SARS) and Middle East respiratory syndrome coronavirus (MERS). Some had gone through simulations and planning exercises. But all had to learn fast to help them pivot through successive phases of lockdowns and recoveries. Public inquiries will also provide an opportunity for learning lessons, including a rapid one in Australia, instigated by philanthropic organisations and overseen by a former head of the civil service[1] and what is set to be a much slower one in the UK.[2]

What should governments do to prepare for future pandemics?

A key aspect of this study is to point towards how governments might be better prepared for a future pandemic or crisis. We look at what approaches seemed to work well, and suggest how the organisation of intelligence could be made more systematic and efficient.

The most likely error is to plan for crises that will be very similar to recent crises. We will show examples throughout this report of capabilities from past crises which did help to address COVID-19, sometimes in surprising ways. However, governments cannot predict the precise form that threats and crises will take: it is better to have a flexible capability to respond than plans that are over-specified.

Are there lessons for the everyday work of government and for other crises, both fast and slow?

Finally, we look at lessons that can be learned for the everyday work of government and for how they address slower-burn crises such as climate change. We argue for a more synthetic organisation of intelligence — which is often divided between different silos, some defined by sector (health, economy etc.) and others by function (statistics, data, evidence, science advice etc).

These divisions are not efficient. Just as finance is organised in part through the generic role of a Ministry of Finance, and in part through distributed finance functions within departments and agencies, so is there a strong case for organising some centralised intelligence capacity to see the big picture, alongside distributed capabilities within departments, agencies and other tiers of government.

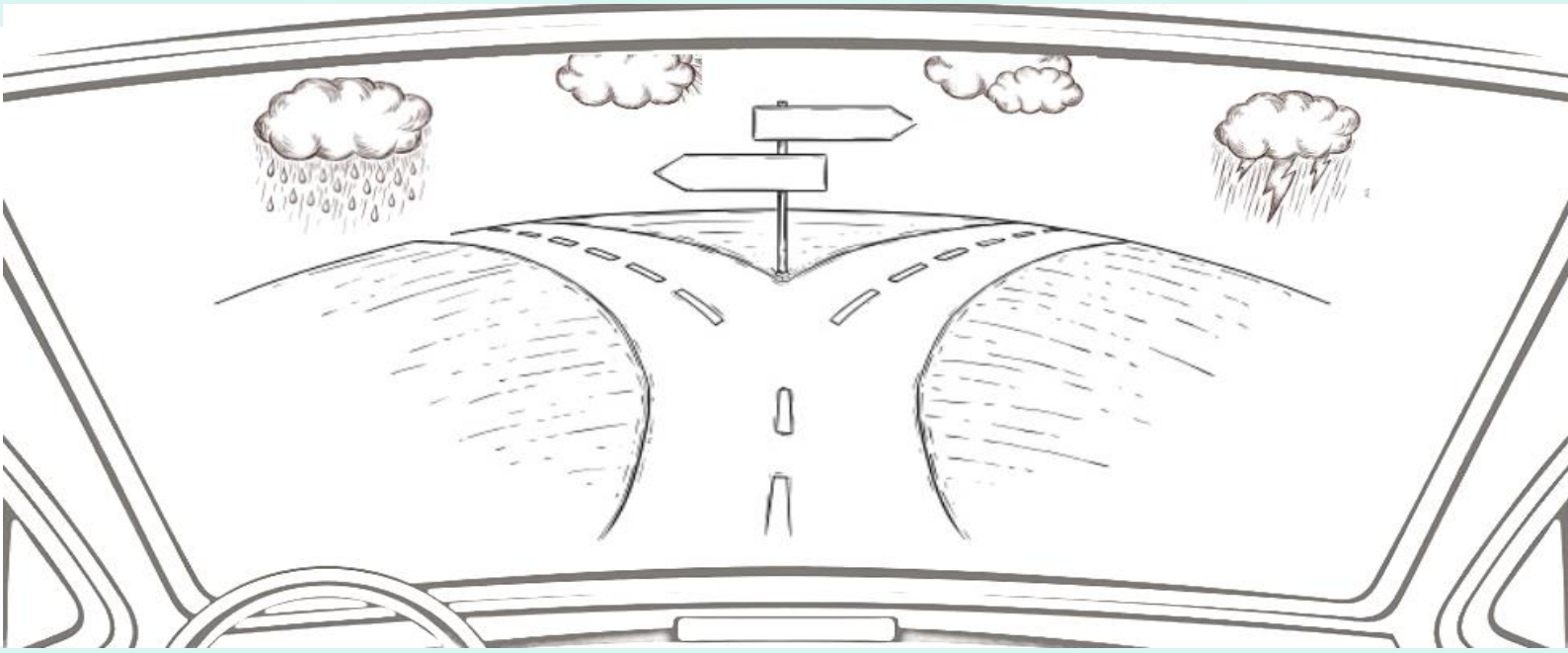
The best approaches are like meshes — with strong flows of data and knowledge both upwards and downwards and horizontally, linking multiple tiers. Some countries suffer from over-centralisation and limited intelligence sharing, while others experienced conflicts between tiers.

Finally, we found that even when there were very high-quality inputs of data and evidence there was an assumption that the centres of government, and politicians, would synthesise this effectively — in the sense of rationally and methodically weighing different forms of intelligence, whether health vs economy, quantitative vs qualitative, or short-term vs long-term. However, it seems that often political or official leaders weighed up and combined their different intelligence inputs in ad-hoc ways, which changed at different points throughout the crisis. So we also advocate more attention to skills and methods for synthesising often conflicting messages from the many kinds of intelligence relevant to decision-making (which range from medical science to politics, public opinion to the practicalities of implementation). We also highlight the importance of skills and capabilities; of strengthening the relationships that become crucial in the heat of a crisis; and the harnessing of international intelligence-sharing through intergovernmental institutions as well as international networks and collaborations.

Structure of this report

Chapter 2 introduces the main types of intelligence mobilised by governments around the world for their pandemic response. These include data, evidence, models, tacit knowledge, foresight, and creativity and innovation. Chapter 3 then discusses the patterns of intelligence flows before they are converted into policy action, including flows 'inwards' into government', 'outwards' from government; and horizontally 'between and within' governments. Chapter 4 considers the role of relationships, both formalised and informal. Chapter 5 looks at international intelligence-sharing while chapter 6 turns to consider how policymakers synthesised intelligence to make decisions. Chapter 7 goes on to explore some cross-cutting issues arising from the organisation of intelligence; chapter 8 presents some policy recommendations for intelligence use applicable beyond COVID-19, to future crises and day-to-day functioning; and finally, chapter 9 looks at the need for future research to connect different ways of organising intelligence to assessments of outcomes achieved.

Intelligence in decision-making: driving a car through a storm



Imagine you are driving through a storm. Your journey will be affected by multiple factors. Some will be beyond your control — the weather, other cars, the routes taken by the roads. Some will depend on the technology available to you — your car, your fuel, or your map, for example. And others will depend on personal skills — your ability to drive, your passenger's ability to navigate, your confidence in improvising a route if necessary. The inputs that will shape your decisions as you drive are different types of **intelligence**:

- **Data:** How heavy is the rain? What are other cars doing? How much fuel do you have left?
- **Evidence:** How risky is driving in this weather? Is your car safe, as certified by experts?
- **Models**: How does braking distance depend on your speed, given the weather? What might traffic be like under different conditions?
- **Tacit knowledge**: Do you have a feel for how the car behaves in different conditions? Do you know how to keep calm in a storm?
- **Foresight**: Do you know the route and what lies ahead? Will you have enough fuel?
- **Creativity**: What do you do if your car breaks down? How do you get round a fallen tree?

Each of these parallels the kinds of decisions governments have to make in crises – including understanding what can and can't be controlled and trying to ensure the right tools, technologies and capabilities are in place before the journey begins.

2. TYPES OF INTELLIGENCE USED IN THE COVID-19 PANDEMIC

This chapter highlights important types of intelligence used to guide decision-making during the COVID-19 pandemic. It also provides insights into some key ways in which each type was made available and useful to decision-makers.

2.1 Data

The COVID-19 pandemic saw the increased gathering of both health and non-health data for policy making around the world. This data was gathered by governments and others to monitor and understand the spread and impact of the virus, as well as the effects of policy interventions.

Key types of data used

Data about health was clearly important – to understand the facts of the disease, its patterns of spread, its potential future behaviour as well as the effectiveness of various policy interventions at curbing the spread of disease. From early in the pandemic, countries across the world were collecting test data, contact tracing data, hospitalisation numbers, and data on deaths and (from 2021) vaccinations.[3] There was also innovation in methods for collecting data, such as biometrics collected from wearable devices or wastewater testing (now in some 3500

sites across 70 countries) to supplement more traditional health data sources.[4]

Socio-economic data was used to understand how people and organisations were changing behaviour in response to policy interventions — for instance adherence to mask wearing or isolation rules — and the wider economic impacts of these changes.[5] A key example was mobility data, to understand both immediate impacts and also longer-term trends in population movement. Methods for gathering mobility data included aggregated data from mobile phones, immigration data from border officials, footfall data, through to changes of address on driving licence applications.[6] Another example was data from financial transactions, referred to by our interviewees from South Korea, Finland and Estonia, as useful indicators of behavioural changes, particularly early in the pandemic.[7] In slower time, data on employment figures and productivity were used to build a picture of macroeconomic impacts as well as the distribution of impacts on different sectors, to identify those which needed targeted support.[8]

Wellbeing data was used to understand how citizens were affected by the circumstances of COVID-19. This included data from surveys, focus groups, records of suicide rates, and social media sentiment.[9] This was gathered by central governments as well as at smaller scales; for example by the City government of Berlin, the New South Wales government in Australia, or the Scottish government in addition to UK-wide work.[10] Sometimes this research focused on specific groups – particularly young people, given evidence of sharp rises in anxiety and depression (a topic covered by IPPO in 2021).[11] Such data was also used to understand groups who governments considered might demonstrate vaccine hesitancy.[12] Outside of governments, research groups in multiple countries examined sentiment, attitudes, and interests expressed in social media data and online search trends, including to understand risks of misinformation.[13]

Health data was given greater prominence than other types of data, which was not surprising given the nature of the crisis. An OECD study of 85 Open Government Data Initiatives from March to July 2020 found that almost 75% of these initiatives "addressed health communications … with a predominant emphasis on providing situational awareness rather than assessing or predicting impact".[14] We were also shown numerous public data dashboards throughout this project; most of these displayed physical health data, with less economic, social, or wellbeing data, though we were informed that some private government dashboards showed a wider variety of data types.[15] Finally, interviewees from an NGO in India and a University in South Africa suggested that countries across the world may have followed China's early emphasis on tracking health-related data too closely, at the expense of other forms of data.[16]

Taken together this suggests **there may have been, across multiple countries, an over-emphasis on health data over other types of data.** This was understandable in the early phases of the crisis but less so later on as the impacts of lockdowns became apparent.

A related important question is **whether governments were using the *right* data**. For instance, understanding dynamics around household behaviour became particularly important and useful for decision-making around lockdowns. Here there were some useful potential sources of data for governments. 'Household Satellite Accounts', for example, attempt to measure "the value of adult and childcare, household housing services, nutrition, clothing and laundry, transport and volunteering". The UK's Office of National Statistics estimated that these unpaid household services amounted (in 2016) to £1.24bn or 63% of official GDP.[17] Organisations including the United Nations (UN) and Statistics Canada published materials expounding the value of Household Satellite Accounts for understanding the effects of COVID-19.[18] However, our research found little evidence that such data was used to guide decisions or for modelling in this space.[19]

How was data made available to decision-makers?

In many cases data was **directly provided by citizens** — using COVID-19 testing centres or self-tests, downloading symptom tracking or contact tracing apps, responding to surveys, or reporting experiences through government or regulator websites or telephone hotlines. For instance, the UK's Zoe App which allowed citizens to upload their symptoms on a COVID-19 symptom tracker, was created out of a collaboration between Zoe, King's College London, Guy's and St Thomas' Hospitals in the UK in early 2020. The app was eventually used by around 4.6 million people in Britain and collected data that would end up playing a crucial role in understanding which symptoms were unique to a COVID-19 infection, as opposed to a common cold or the seasonal flu, and how the pandemic was spreading through the UK.[20]

Data was also provided by **government agencies and government-related institutions, as well as third parties**. For example, hospitals were a vital source of health data, particularly when new data could be integrated into existing centralised national databases, for example to understand how COVID-19 interacted with existing health conditions, as was the case in the UK's National Health Service (NHS).[21] The NHS also directly provided a 'COVID-19 Data Store' that was used to create a "Strategic Decision Makers Dashboard ... designed to help senior national and regional officials to make policy and strategic decisions in response to COVID".[22] Border forces also provided data on entrants to countries (often in collaboration with airlines), detailing where they had been and where they were staying that could later be

cross-referenced against a positive test result, and genomic sequencing to better understand outbreaks and the spread of new variants.[23]

As an example of collaboration with the private sector, a report from South Korea describes how "credit card statements, CCTV analysis, location data of mobile phones are used to precisely identify recent travel movements of people confirmed with COVID-19 and track the spread of infection".[24] In Taiwan a 'Digital Fencing System' was used to monitor locations based on a phone's position relative to nearby telephone masts; monitoring was conducted by telecoms companies, using phone numbers of quarantining individuals provided by the government.[25] In Bangladesh, health workers from NGOs provided data on infections and poverty that was used to corroborate official government records, as part of a comprehensive 'collective data intelligence system'.[26]

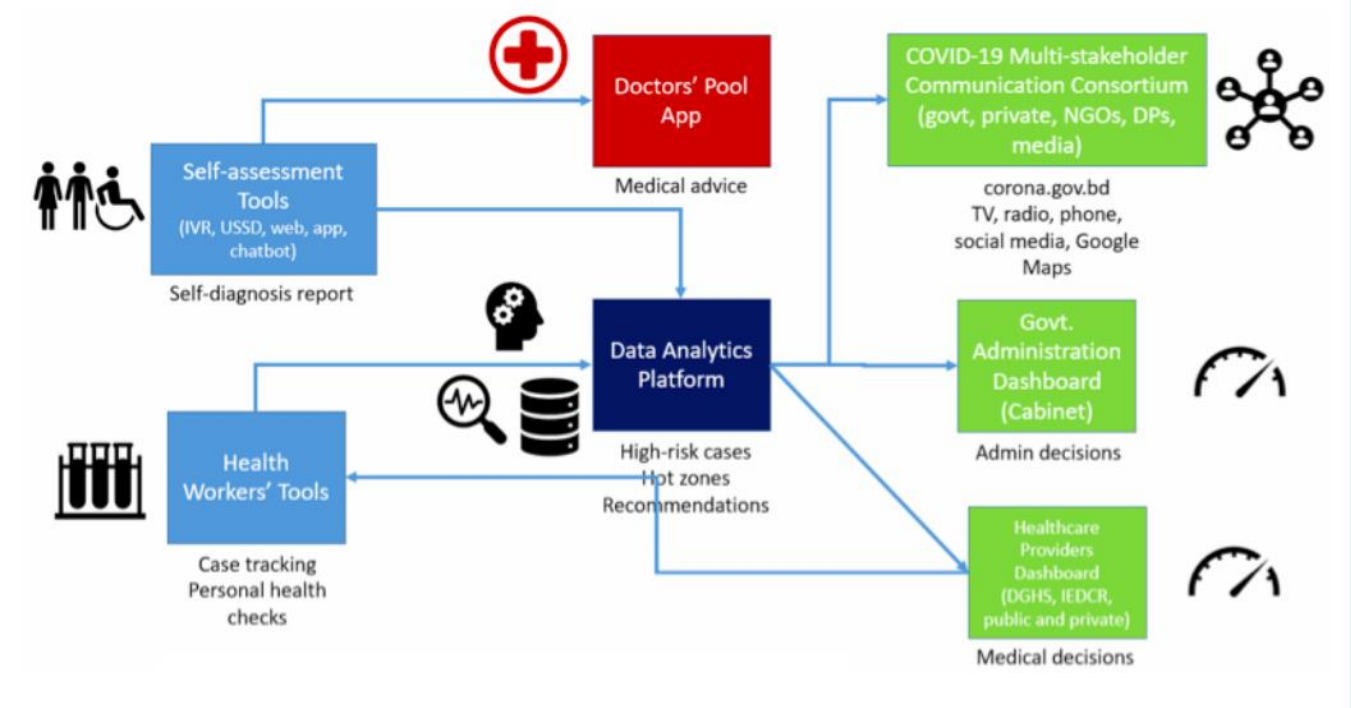


Figure 3: Bangladesh's COVID-19 Collective Data Intelligence System

Data collected and acquired was shared within governments through a combination of **products and direct interactions between civil service staff and decision-makers**. Products usually took the form of either regular static reports, or dashboards (some of which were updated in real time). Automated or semi-automated dashboards were particularly useful for displaying extremely up-to-date data. As described by a UK official, "the ability to have data coming in in a timely and machine readable way, and to be able to 'turn the

handle' and make slide packs" was valuable for efficiently briefing decision-makers.[27] Interactions involved formal meetings and briefings, and informal requests in which data outputs were shared and discussed.

Products and interactions fed into one another; briefings and dashboards were used to guide discussions in meetings, while meetings and requests for information shaped the form of products (both ad-hoc and standardised). For example, interviewees from the Estonian and Bangladesh governments described how products started out relatively ad-hoc, but were standardised by learning from meetings with decision-makers about the types and presentation of data that they found most useful.[28]

A variety of platforms and tools were used to manage, store, and share data. Some governments built on existing platforms and tools, such as the previously mentioned NHS patient data stores in the UK or local databases of poverty held by regional governments in Bangladesh. Governments also faced new questions over data storage, such as for contact tracing; there were debates over whether such data should be stored centrally by governments (raising privacy concerns), or whether to use decentralised approaches made possible through technologies such as the Google/Apple Exposure Notification (GAEN) System which was used in contact tracing apps in over 20 countries.[29] There were also uses of open source tools to orchestrate this type of intelligence at low cost. A good example is the widespread use of the District Health Information Software 2 (DHIS2) platform for managing health data, based in Norway, which was used for pandemic information management in over 50 countries, including middle-income countries such as Sri-Lanka and low-income countries such as Uganda.[30]

Data providers sometimes lacked understanding of what problems were a government's priority.[31] Being clear about the questions for which data is needed is an important aspect of data use, inside and outside government.

Figure 4: Public COVID-19 dashboards from Berlin, the United Kingdom, and South Korea. Note that South Korea's dashboard features economic data such as the Consumer Price Index under its 'major statistics' tab; this was unusual amongst the public dashboards we have seen, which were usually dominated by health data.

2.2. Evidence

For the purposes of this report we focus on evidence that **makes sense of the effectiveness of different policies and interventions**. Many kinds of evidence are used to guide policy, such as the kinds of intervention assessments done by the UK's National Institute for Health and Care Excellence (NICE) or the IPPO studies done for the UK's Department for Education in 2021.[32]

Often evidence gathered by policy makers throughout the pandemic was related to answering specific policy questions, such as 'how effective are masks in reducing infections'? This allowed for scarce research attention and resources to be focused more efficiently on filling specific knowledge gaps.

Evidence used during the crisis

The pandemic catalysed an extraordinary production of evidence into pandemic-related topics. One study found that 4.6% of all research outputs globally in 2020 related to the pandemic. That share almost doubled through 2021, to reach 8.6% of research outputs — equivalent to all research published on cancer, cardiovascular medicine and non-COVID-19 infectious diseases in the same period combined.[33] The types of issues for which evidence was drawn upon within the pandemic response was broad. They ranged from investigating the efficacy of wearing facemasks to treatment options, online education to the impact of

government communications on behaviour and compliance.

A crucial example of the challenges of using evidence during the pandemic was the question of **behaviour and how citizens would respond to lockdowns and/or other interventions.** Some governments had Behavioural Insights teams in-house prior to the pandemic. For instance the UK has used a Behavioural Insights Team for over a decade and the head of the unit, David Halpern, was a contributor to the UK's Scientific Advisory Group for Emergencies.[34] Some capabilities were constructed specifically for COVID-19, such as the Corona Gedragsunit [Behaviour Unit] in the Netherlands, based in the National Institute for Public Health and the Environment; or the International COVID-19 Behavioural Insights and Policy Group created by the Organisation for Economic Co-operation and Development (OECD).[35]

However, this evidence was not always used effectively and often threw up divergent views. In the Dutch case the Corona Getragsunit provided a "monitoring" role of reviewing literature and studies, but not an "effecting" role of designing or advising on behavioural interventions.[36] In the UK the notion of "behavioural fatigue" — that citizens would tire of lockdown measures and not comply — seems to have played a role in discussions around delaying initial lockdowns. Some experts on the UK government's official behavioural science advisory team (the Scientific Pandemic Insights Group on Behaviours) have publicly distanced themselves from the concept.[37] Studies of European and OECD countries found that behavioural scientists sometimes struggled to feed into government decision-making.[38] Reasons given included under-resourcing of relevant teams; under-powering of behavioural insights on scientific committees relative to health-related experts; lack of clarity over the methods and remits of behavioural science; and overly distributed behavioural expertise, rather than strong networks of collaboration. However there were some successes; for example one European country reported a 60% increase in testing within a few days of implementing a new behavioural-science informed communication approach.[39] Overall, we are still awaiting a thorough analysis of what did and did not work in behavioural science advice in pandemic policy.

International comparisons to inform policy approaches often proved valuable. Projects like the COVID-19 Government Response Tracker from Oxford University and CoronaNet, tracked government policies and their effects; one researcher involved in this work informed us that this was used as an evidential basis for decision-making.[40] In Taiwan in 2022, a report analysing Omicron in over 90 countries (including fatality rates in every province of China, and every state of America) was used to decide on moving away from Taiwan's previous zero-Covid

strategy.[41] However, interviewees also noted that international comparisons require caution as they can be cherry-picked to support particular decisions.[42] Approaches borrowed from China — where the virus originated — may have been adopted too quickly, without full consideration or testing of how they might fare in other national contexts, particularly poorer countries.

How was evidence made available to decision-makers?

Specialist experts played an important role in production of rigorous evidence. A key example was the role of scientific advisors. Some were employed as scientific advisory committees or boards, such as the UK's Scientific Advisory Group for Emergencies or the Science Task Force in Switzerland. Such bodies met directly and regularly with decision-makers to pass on or synthesise evidence from various disciplines to support decision making. Many advisory groups worked to find and present consensus views (through their respective domain experience or various academic literature reviews and researcher sub-groups) around a particular policy question or issue to their respective policy makers. However, this is not the only way to provide advice: an alternative approach would be to form caucuses to present competing views for decision-makers to select from. We did not encounter any use of the science of meeting design to improve the effectiveness of scientific advisory groups. Advisory boards also provided awareness of, and contacts with, broader networks of expertise.[43] New Zealand's Chief Scientific Adviser to the Prime Minister informed us that "an informal network of Chief Science Advisors globally were well connected and supported early data gathering and sharing."[44]

Within governments, evidence was also produced by teams with broader analysis or data presentation skills. An example was open-source intelligence teams, who made use of openly-available research as well as media reportage, social media, and other sources.[45] While these officials may not have had domain-specific expertise, a public sector open-source intelligence team in Australia suggested that close integration with government and contact with officials allowed them to provide rapid light-touch evidence, which could be corroborated with experts where required.[46] Other teams in governments who worked closely with decision-makers made use of their experience in understanding how best to use and summarise evidence for the decision-makers.[47]

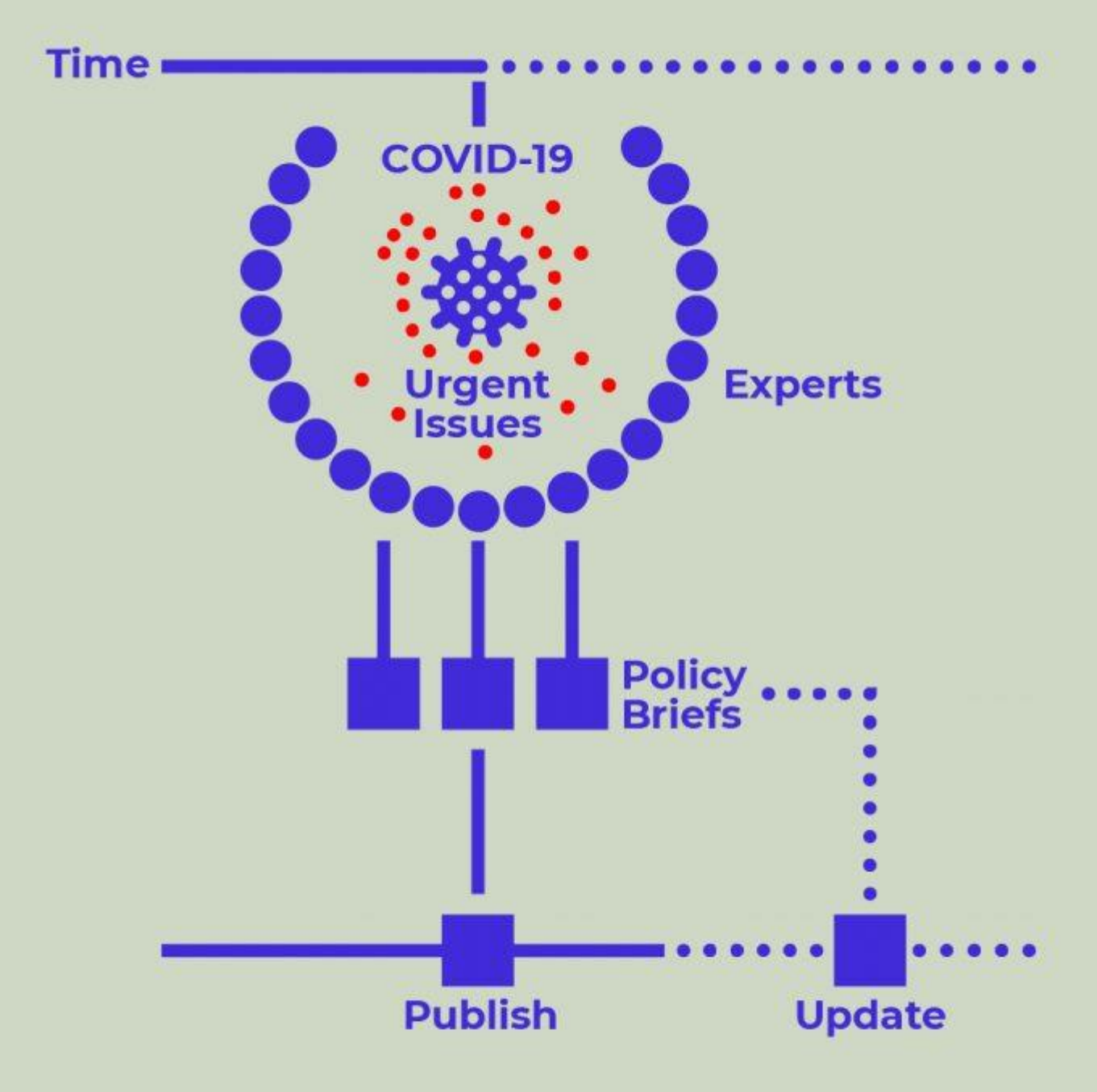


Figure 5: Schematic diagram from the Swiss National COVID-19 Task Force

External partners also produced evidence for governments, either on commission or proactively. Sometimes these projects were generally neutral research programmes to understand a broader picture, for instance serological studies conducted in India by Artha Global (which showed over 80% prevalence of antibodies, providing evidence that school closures were unlikely to have further protective benefits).[48] Other times these were part of explicit lobbying for particular courses of action. For instance, the think-tank the Grattan Institute in Australia and a macroeconomic advisory firm Wigram Capital Partners in New Zealand both produced evidence in

favour of 'zero-Covid' strategies very early on in the pandemic (Jan-March 2020).[49]

However, there were often **imbalances in the provision and use of evidence across countries and different policy questions.** A new study on how education policymakers used scholarly research during the pandemic finds that governments tended to use relatively narrow sources of research, primarily citing sources from their own countries, rather than drawing on the best available and relevant research. The analysis also highlighted a difference between research fields, with policymakers more effectively utilising recent medical research, but struggling to absorb the latest education research.[50] Sometimes, for example in the UK, there was detailed evidence synthesis on the issues of physical health, but far less comparable synthesis on the economic or social aspects of the crisis (despite various suggestions being made, for example to the UK Treasury, to create committees of economic advice comparable to those in the natural sciences).[51]

Finally, **there were issues of timeliness.** One researcher who produced evidence on behavioural fatigue noted that even a pre-print took months to produce, when decisions were made on scales of days and weeks.[52] We discuss the important question of balancing rigour and speed — and developing capabilities which enable this — in section 7 of this report.

2.3. Models

"Proper epidemiological modelling, not by civil servants but by scientists, was taken extremely seriously and considered in a fair amount of detail. It did make Ministers change their minds about certain things — so in particular the speed and the roadmap out of lockdown in early 2021 was heavily influenced by the modelling at that point, and I think in a positive way."

- *Representative of the COVID-19 Task Force, Cabinet Office, United Kingdom*

Models are mathematical representations of systems, and informed pandemic policy making in countries around the world. Of particular relevance during COVID-19 was epidemiological modelling, such as disease transmission models. Modelling economic and social impacts also played an important role in informing policy decisions during the period.

Key types of models used

Epidemiological models helped to understand and predict the speed, severity, distribution and impact of the virus, and effects of various interventions.[53] These helped governments make decisions about planning, targeting support, communications, and nature and length of interventions such as lockdowns.

Models were also developed to estimate the **socio-economic impacts**, both direct and indirect, of COVID-19. This includes estimates around the impact on the labour market, consumption spending, financial markets and international trade impact of COVID-19 supply shock on global value chains.[54] Some modelling was also done of **mental health and lifestyle impacts** of the COVID-19 pandemic.[55] However, evidence suggests that the use of models in decision-making within the pandemic response was generally skewed towards epidemiological modelling over socio-economic modelling or the effects on mental health and education.

Models deployed varied in rigour and complexity. Epidemiological models broadly fell into two categories — those based on statistical analysis of existing data, and those which were mechanistic and based on underlying theoretical principles.[56] Simpler models sought to estimate infection rate in a community. More complex models sought to estimate distribution of infection, impacts of mobility (or other transmission dynamics), impacts of policy interventions as well as assess the trade-offs between the health and socio-economic impacts of alternative policy interventions.

According to Professor Neil Ferguson, who led Imperial College London's COVID-19 Response Team in the UK, the value of different types and complexity of models varied depending on the stage of the pandemic:

"Early on we had very limited data to go on, so we used very simple models that can be written down mathematically to project the early phase of the epidemic. As we move on, we're trying to capture patterns of transmission in populations, using classical epidemic models. Then there's the most complex models we use, where we're interested in modelling specific interventions, using simulations which give the finest scale of representation of disease transmission. It really depends on the application."[57]

More complex models also allow for the bringing together epidemiology with social-economic parameters such as mobility and behavioural and geo-spatial impacts of the virus spread and specific policy interventions. However, a 2021 study of the UK suggested that while epidemiological models have been central, it was not clear whether models to support decision-making in the UK sought to integrate epidemiology considerations with broader health, wellbeing and economic implications.[58]

The most complex or rigorous models didn't always perform better, in terms of forecasting outcomes, than mathematically simpler models. One study compared four types of models with varying degrees of mathematical complexity for forecasting COVID-19 cases across four different countries.[59] The study found that a so-called ARIMA Model (which could technically be used to model almost any curve, without requiring specific epidemiological information) outperformed the other three in the case of prediction, including an SIR Model which is more complex as it integrates epidemic-specific parameters.[60] One interviewee from a private analytical firm in New Zealand reported that their simple time-series models, based on similar models for SARS, were more predictively useful in the early pandemic (Jan-Feb 2020) than mechanistic models produced by academics.[61]

How were modelling outputs made available to decision-makers?

Modelling, and the communication of modelling outputs, can require high levels of expertise. In-house governmental analytics teams or private consulting firms generally had the capability to develop simpler models themselves, and communicate outputs to policy makers. But more complex epidemiological models required highly specialised expertise which perhaps only a handful of people in a given country — people with dedicated careers in the field – might have possessed. In terms of communication, complex model outputs

were often communicated to decision-makers through academic papers or consensus reports from advisory panels.

Modelling was conducted at country-wide levels; also in multiple cases, including the UK and Australia, regions produced their own models.[62] The UK government also funded multiple independent university-based epidemic modelling teams to provide alternative competing models, rather than a single source of truth.[63] The UK's Joint Biosecurity Centre combined various models — producing an epidemiological "Multi-Model Ensemble" – aiming to reduce the uncertainty that may stem from a single model, explore potential model biases and make model predictions useful for decision-makers (see figure below).[64]

Sometimes advisory groups had modelling sub-groups, as with the UK's Scientific Advisory Group for Emergencies sub-group Scientific Pandemic Influenza Group on Modelling, and their reports would funnel up through to ministers for use in decision-making. Models often drew upon a range of other forms of intelligence. For instance, models commonly used data such as testing data or mobility data; or drew on evidence to formulate assumptions around, for instance, human behaviour and adherence to lockdowns.

Training around how models and their inputs and outputs are communicated is critical. How a modeller communicates outputs such as uncertainty in relation to 'best case' or 'worst case' scenarios to decision-makers and the public, and how these are understood, can have serious consequences.

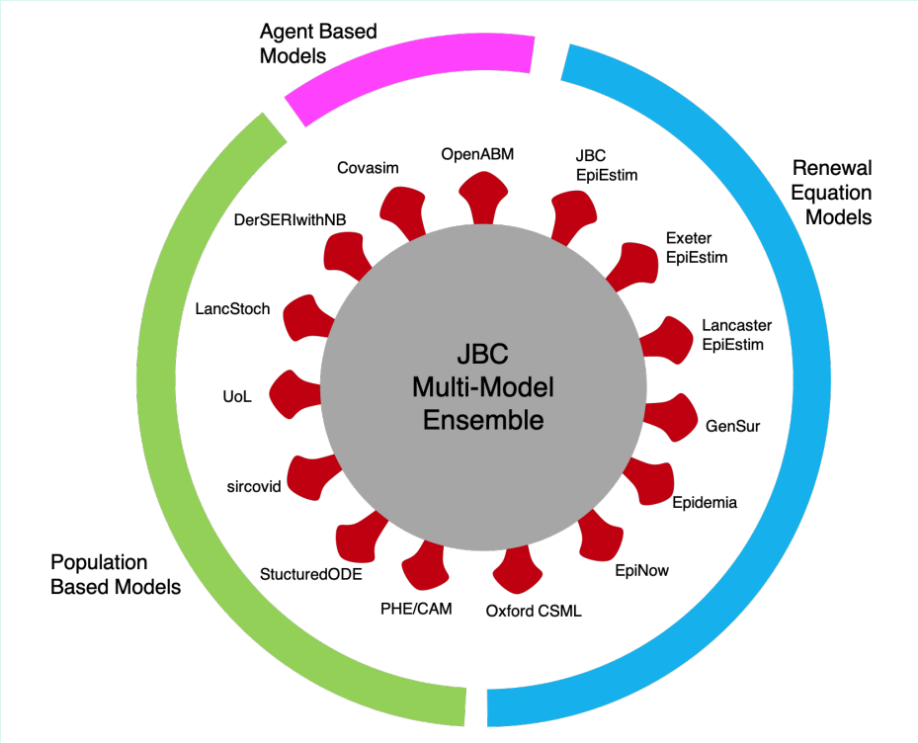


Figure 6: The UK Joint Biosecurity Centre's overview of models employed in their ensemble (from Park et. al. 2021).

2.4. Tacit knowledge

Tacit knowledge is knowledge that is not codified or formalised. It can refer to knowledge both of what is happening (such as public mood or willingness to comply with rules) and of how to act (such as a front-line responder's accumulated experience).[65] This kind of knowledge can be vital during fast-moving phases of a crisis when measured data may not capture the most important dynamics. This is why many governments tried to harvest nuanced front-line insight in real time, whether from staff in hospitals, police or local authorities. Some had well-established systems for doing so: for example, the Bank of England has long combined its use of formal data and models with inputs from a network of 'agents' tapping into experience in over 1000 businesses.[66]

One interviewee argued that tacit knowledge is more important than data in detecting signals of an emerging pandemic. More generally, there are good reasons for governments to want to tap into front-line tacit knowledge when devising many kinds of policy (and many decisions are made in many governments with little or any input from those with direct experience of how they may impact on real life).

However tacit knowledge can present problems for a large-scale crisis such as COVID-19, where standardisation was often important to compare and understand situations across regions. There were also glaring gaps — IPPO research and roundtables throughout 2021 found that while the health services often had well-established communications channels up to decision-makers, the care homes sector in the UK and elsewhere was often weaker, without either the systems, status or willingness to listen that hospitals could rely on.[67] This section considers how governments tapped into tacit knowledge of all kinds, and formalised it to guide decisions.

Key types of tacit knowledge used

Tacit knowledge can be key to understanding the lived experiences of people in a crisis. During COVID-19, this was particularly relevant for understanding the impacts of, and adherence to, behavioural interventions. We have already discussed forms of data collection, in particular surveys, which aimed to gauge sentiment and awareness amongst the public. But citizens also reported, complained, and queried in their own words — sometimes revealing 'unknown unknowns' to government. For example, in Australia weekly

"In a crisis... everything depends on tacit knowledge and the ability to maintain tacit knowledge flows."

- *Senior official involved in the global pandemic response*

conversations between senior government officials and community leaders revealed that some communities interpreted 'stay at home' as 'stay with family'.[68] UK officials found from similar conversations that some faith groups were resistant to vaccination on religious grounds.[69] A Swiss interviewee described how, early in the pandemic, residents of different cantons responded differently depending on experiences of countries bordering them.[70]

The **previous experiences of officials and other crisis responders** were also repeatedly referred to in interviews as inputs into government decision-making. An interviewee from Cape Town referred to a "way of being", an "embedded intelligence" that officials involved in crisis response had built up during droughts between 2016 and 2019. These experiences had also engendered trust in the crisis responders amongst senior decision-makers; this meant they were more empowered and nimble during the COVID-19 response than their counterparts in other cities.[71] Interviewees from the East Asia and Oceania region spoke of the experiences of previous respiratory diseases SARs and MERs providing them with an early sense that 'Covid felt like it could be worse'.[72] Some countries have tried to instil an approximation of this 'lived experience' of crisis in officials and decision-makers through the use of simulation exercises; we discuss such forms of pre-emptive preparation in our forecasting section.

However, it is important to avoid previous experiences encouraging too much attention to past crises, ignoring relevant features of the current one.

The **experience and tacit knowledge of front-line staff** is also an important factor in the efficacy of a pandemic response.[73] Dr Li Wenliang, a Chinese doctor who raised the alarm about a new SARs-like virus in the early days of the outbreak in China, and eventually died from the disease, acted in response to clinical experience rather than formal studies. While capability building and training are vital components of building a strong disease outbreak response amongst front line staff, particularly in rural or provincial areas in regions where infectious disease outbreaks are considered more likely, those with previous experiences with such outbreaks are likely better able to draw on this during a crisis.[74]

Further, the mental and physical health risks associated with the experiences of front line staff during an Infectious Disease Outbreaks have been studied,[75] as has the impact of experiences of past outbreaks in building psychological resilience when working in new outbreaks.[76] However, more research is needed to better understand the role that tacit knowledge plays within front-line staff, and therefore how decision-makers might take that into account in their decision-making.

A final important example of tacit knowledge raised with us was in relation to **the in-country experts of the World Health Organisation (WHO)**. The WHO draws heavily upon the tacit knowledge of in-country experts to detect and corroborate signals of potential pandemics. Such work is vital to address the vast range of signals that might confirm or disconfirm a health emergency. In addition to their formal expertise, these in-country experts also draw on their tacit knowledge to gather, sift and feed vital information back to the centre of the WHO's formal channels.[77] We discuss intergovernmental institutions further in chapter 5.

How was tacit knowledge made available to decision-makers?

Different processes for communicating tacit knowledge to decision-makers can be seen, in simplified form, as a pyramidal structure in which a wide range of disparate experiences are conveyed from life 'on the ground' to central decision-makers. As shown in the figure, this may be a steep pyramid, with **tacit knowledge being relayed through a chain of many conversations**; or a shallow one, in which a **large number of reported experiences are used to produce summaries**.

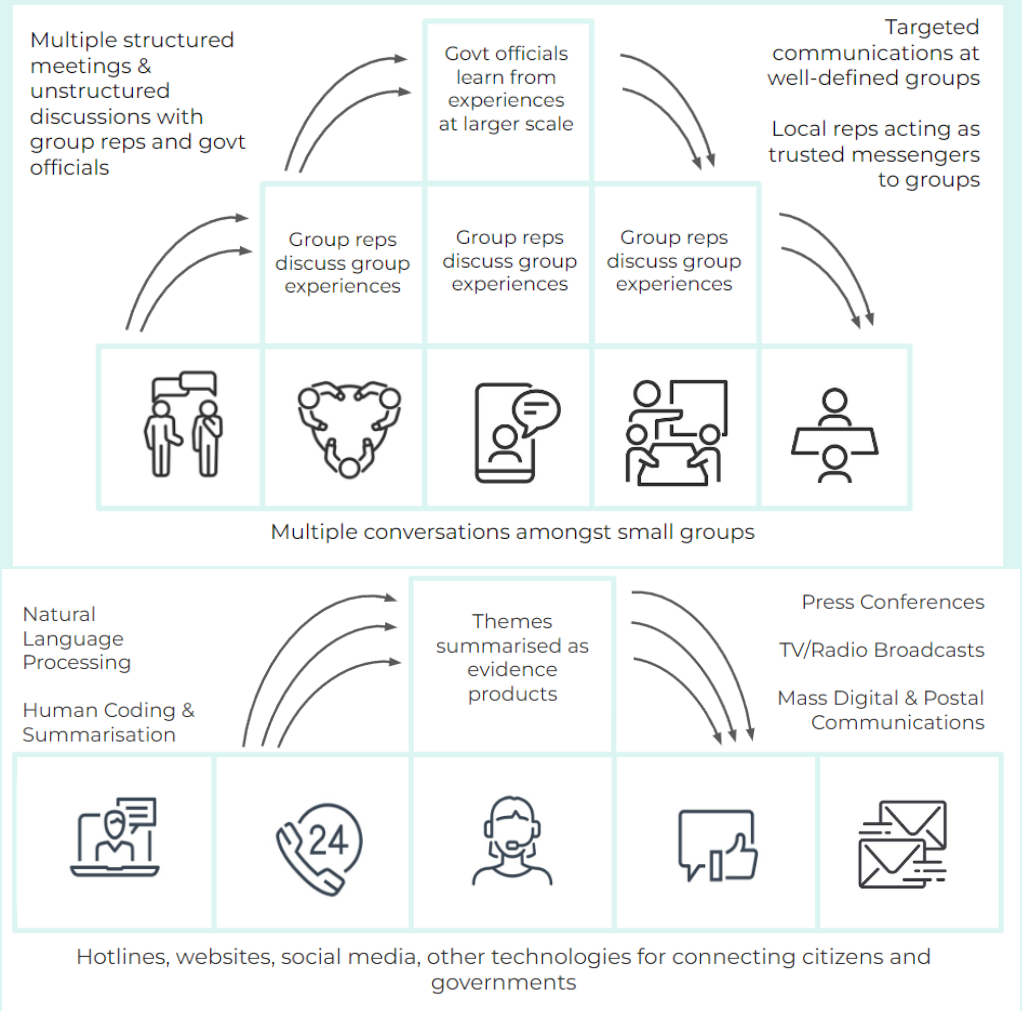


Figure 7: Schematic illustrations of two ways tacit knowledge can flow – gradually, through chains of conversations (top), or through summaries of a range of multiple experiences (bottom)

They are not mutually exclusive — indeed, both can benefit the other by providing both breadth and detail. In both processes there will need to be summarisation, maybe even some standardisation and formalisation. Nonetheless with tacit knowledge, it can be the vivid anecdote which best conveys the information rather than aggregated data, so effort should be made to retain this where possible.

For examples of the steeper pyramid, multiple countries had systems for **conveying conversations at local levels to central decision-makers**. In the UK, Local Resilience Forums brought together regional leaders from multiple agencies (police, healthcare, etc.) to produce situation reports for central government; also 'Resilience Advisers' from central government would regularly attend meetings with local leaders, such as Chief Executives.[78] Similarly in Australia, senior officials held roughly weekly meetings with 40-80 community and religious leaders. This provided broad and complex pictures of experiences amongst different regions and/or groups, which in turn informed other discussions (such as how to effectively encourage vaccine uptake amongst different groups).[79] Building up such informal networks can take many years and can be painstaking work but are essential for sharing potentially sensitive information with a trusted expert network.[80]

Examples of the shallower pyramid **resembled forms of more structured data collection**. Phone hotlines provided standardised data, such as numbers of callers with particular problems; but they also, to give one example, allowed officials in Australia to hear broad responses to announcements of planned new measures before formalising the precise form of those measures.[81] The Anti Corruption and Citizens' Rights hotline in South Korea — which had already existed as a broad interface for citizens to relay complaints or questions to government — allowed citizens to report a wide range of problems which did not necessarily fit into specific ministerial or regulatory briefs; officials would later triage concerns to relevant decision-makers.[82] Similarly the WHO has processes for gradually sifting signals to a central consensus on a situation, with a vital role played by in-country experts.

2.5. Foresight

Foresight involves thinking through potential future trends to guide decision-making in the present. This includes thinking about what might happen, what is more or less likely, and what preparations should be put in place. While most people were inevitably working day to day and week to week, it was important to have small teams looking a step further out to plan for potential returns to normality.

Many other forms of intelligence may be used to support foresight — examining trends in data, analysis, interpretation, forecasting, expert deliberation and more. However, foresight also involves imaginative leaps and forward planning which are not fully captured by other forms of intelligence.

Key types of foresight used

Scenarios of what might happen in upcoming months — a long timescale compared to the days and weeks more common in COVID-19 responses — were used to aid decision-makers. For instance, an Australian public sector team was tasked with looking at possible routes out of the pandemic as early as mid-2020 (when intelligence about variants and vaccines was limited).[83] In the UK, the Chief Scientific Adviser and Chief Medical Officer proactively commissioned work from outside bodies; for instance the Academy of Medical Science was asked to think ahead to potential challenges of the first winter.[84]

Scenarios can't be accurate predictions of what will happen but they help governments to think more flexibly — as an Estonian government official told us, even if scenarios "weren't precise... it's still better if you have different experts from different government areas chip in to understand what might be coming, because then you can try to build your preparedness".[85] Foresight exercises meant that different actors were already "speaking the same language" when problems, which had already been discussed, actually arrived.[86] The Australian public sector team which was tasked with looking for routes out of the pandemic also noted how scenarios can help decisionmakers to "understand and monitor for triggers... of when we're shifting into a different scenario".[87]

Simulations were also used by multiple governments to prepare for crises from pandemics to terrorist attacks. Exercises simulating pandemics prior to COVID-19 included the UK's Winter Willow (2007), Alice (2016), and Exercise Cygnus (2016); a 'Simulation Exercise for Foot and Mouth Disease' across five Nordic countries, and the international exercises Valverde (2015) and Event 201 (2019).[88] To support such simulations, in 2018 the WHO developed guidance.[89] While such guidance was a welcome development in supporting countries in testing and updating their national pandemic preparedness plans, one analysis suggested "...it could have a stronger emphasis on identifying lessons and translating these into action plans".[90]

However, simulations don't always result in the right actions. This was a conclusion of the UK National Audit Office's review of pandemic simulations.[91] Another problem, flagged in the context of the US, was turnover; according to one report, almost two-thirds of participants in pandemic simulations held in the transition to the Trump administration left government before the onset of the COVID-19 crisis.[92] Finally, some simulations may have been too narrow; only including highly specialist participants, for example, not including economic impacts,[93] and not involving the politicians who may end up playing crucial roles when real crises hit.

How was foresight produced for decision-makers?

Many governments had **dedicated functions pre-Covid for forward planning and 'horizon scanning'.** Usually these teams work on patterns that may influence their societies over decades rather than months or years: for instance monitoring patterns of ageing or the deployment of technologies. At their best they use written materials as well as events to encourage dialogue with decision-makers — including politicians and civil servants — to be better acclimatised to possible futures, and so to either exploit opportunities or prepare for risks. During COVID-19 these capacities could be pivoted towards thinking in terms of upcoming months, not just years and decades.

An example is Singapore's Centre for Strategic Futures which was established in 2009 to build "capacities, mindsets, expertise and tools for strategic anticipation and risk management", and consider possibilities ranging from financial crises to cyber-attacks. Their 2017 Foresight report listed pandemics as an example of a 'black elephant' event: a problem that is visible to everyone but no-one wants to address. They presented Singapore's response to the 2003 SARS crisis as an example of good foresight thinking, in that foresight counteracted the risk that the potential severity of the outcomes could have led to government overreaction.[94] However, one academic study of Singapore's response to COVID-19 suggests that foresight was in fact not effectively translated into action during the pandemic, in particular government failures to address the extent of the infection risk of crowded dormitories of migrant workers.[95]

Foresight teams can be aided by **Futures and Foresights Toolkits and Capabilities,** which guide thinking about potential scenarios. The UK Government Office for Science (GOScience) has distinguished between *Futures Thinking* — "systematic approaches to thinking about the future" — and *Foresight* —"the specific act of applying futures tools, processes or methods,"[96] and have produced a 'Futures Toolkit' of such approaches for policymakers.[97] Some governments applied systematic futures thinking to pandemic preparedness and response.

For instance, the COVID-19 Group in the New Zealand Department of the Prime Minister and the Cabinet informed us that during the pandemic "multiple analytical tools were used to make future assessments... Utilising analytical tools was a core component of the intelligence work, to inform the assessments".[98]

Finally, numerous teams and analysts have argued for the importance of **separating government's foresight teams from immediate crisis response**, to ensure medium and long term planning continues despite immediate pressures — which were so relentless in many phases of the pandemic that 'medium term' could mean extending the timeline by as little as a few weeks.[99] However a scientific advisor for Wales related how "fighting the fire that's in front of you as well as thinking ahead — that was hard."[100] The Institute for Government in the UK has suggested the UK government should create a unit within the Civil Contingencies Secretariat unit to assess departments for long-term crisis preparedness (echoing the steps made in the early 2000s after the crisis of BSE disease in livestock).[101]

"Multiple analytical tools were used to make future assessments. Cone of Plausibility was used to make assessments about the future. Other analytical tools included SWOT [Strengths, Weaknesses, Opportunities, and Threats] indicators and warning generation, Backcasting (for refining indicators and warnings), trend analysis, and Analysis of Competing Hypotheses. Utilising analytical tools was a core component of the intelligence work, to inform the assessments."

- *COVID-19 Group, New Zealand Department of the Prime Minister and the Cabinet*

2.6 Creativity and innovation

Tackling crises involves learning from the past, but also involves developing novel approaches to deal with the specifics of a new crisis. Possessing the creativity to solve problems which emerge from new crises, is an important aspect of intelligence, whether at the individual, government or societal level. There was a huge range of positive examples of innovation during the pandemic — from the repurposing of 10,000 train carriages to ambulances in India; to the quintupling of bike lanes in Bogotá and the rapid building of new hospitals in China.

For governments, the greatest challenge is how to organise and leverage creativity effectively. Sometimes that requires setting up small, well-resourced and highly skilled teams; sometimes it involves backing the most capable existing teams, in universities and companies; and sometimes it requires using digital technologies to mobilise citizens to develop ideas.[102] Various methods were deployed by governments, in collaboration with partners, to facilitate creativity and innovation during the pandemic. In this section we focus on a few key examples: directed innovation; rapid repurposing; working with the private sector; and citizen engagement and open innovation.

Directed innovation

Some innovation was directed by governments, with government identifying the problem that needed solving, offering financial or other compensation to external organisations with ideas for solving it, and mobilising other resources, including regulation and public services. There is a long history of this kind of directed, strategic innovation, particularly during wars. A prominent example of directed innovation in the pandemic was **the extremely fast and effective development of COVID-19 vaccines**. Vaccine development and rollout drew on a range of different types of intelligence, ranging from computational biology and structure-based antigen design to protein engineering and new manufacturing models[103] as well as planning, tacit knowledge around attitudes towards vaccines and much more.[104] They also involve a combination of private sector work in R&D and innovation, supported and shaped by government activity through investment in basic research, regulation and integration into national healthcare systems.

The global effort to produce COVID-19 vaccines was enormously accelerated during the pandemic — such that vaccines were safely produced and rolled out within months rather than years. Vaccine rollouts were supported by government programmes such as Operation Warp Speed in the US or the Vaccines Task Force in the UK.[105] Support was most obvious in ensuring guaranteed access to funding (on an extraordinary scale), but also in a range of other ways — for example providing U.S. Army Corps Engineers to support construction of vaccine manufacturing facilities.[106] The success of these programmes relied on effective and efficient sharing of intelligence between numerous government and non-governmental actors; from updates and approvals from latest trials, to updates on potential bottlenecks in production, to sharing information on procurement to minimise risks of bidding wars between states (as seen, for example, in the EU Commission leading negotiations for the Member States).[107]

Vaccines were a very visible form of directed innovation, but there were other examples which aided government decision-making during the pandemic. Examples included innovations in data sharing and visualisation technologies, in particular data dashboards which allowed decision-makers to conveniently see the latest data from across a range of sources. Government officials worked with decision-makers to create dashboards which were designed to inform decisions; in some cases external consultants were also procured to provide support and input.[108] Some government teams also developed technologies such as Natural Language Processing technologies to automatically detect key themes in citizens' contacts with governments through hotlines or online methods (see

chapter 2.4 on tacit knowledge).[109] In Taiwan, the Central Epidemic Command Centre commissioned HTC DeepQ (an AI software development company) to create a health-focused Natural Language Processing chatbot, which became known as the "Disease Control Butler' to be launched on Line (a popular instant messaging app in Taiwan). [110] This allowed citizens in self-isolation to ask questions and report their health status, lessening the work on front line health responders. Scaling up wastewater testing, as occurred in many countries to measure the prevalence of the COVID-19 virus in wastewater, required new collaborations – for example the National Wastewater Surveillance System of the US Centre for Disease Control — between government, academics, and water companies.[111] The products of such collaborations could bring benefits beyond fighting COVID-19, as seen in the fast detection of Polio in UK wastewater in June 2022.[112]

Rapid repurposing

Many innovations drew upon **pre-existing ideas and platforms, configured in new ways to solve problems related to the pandemic**. In some cases the new usage was relatively similar to previous usage, but pivoted towards the new crisis. The GoodSAM app, used by the NHS in the UK to coordinate volunteers, already had origins (from 2013) as a technology to support emergency health responders in the UK, and subsequently in many other countries.[113] Paper databases of poverty held by local governments in Bangladesh were rapidly updated by working with front-line responders, and used by the central government (later in digitised form) to help distribute economic support.[114] In Taiwan, "notifications about the quarantine monitoring obligations closely resembled — deliberately and by design — emergency messages for earthquake and flood warnings, to which Taiwan's population is very accustomed."[115]

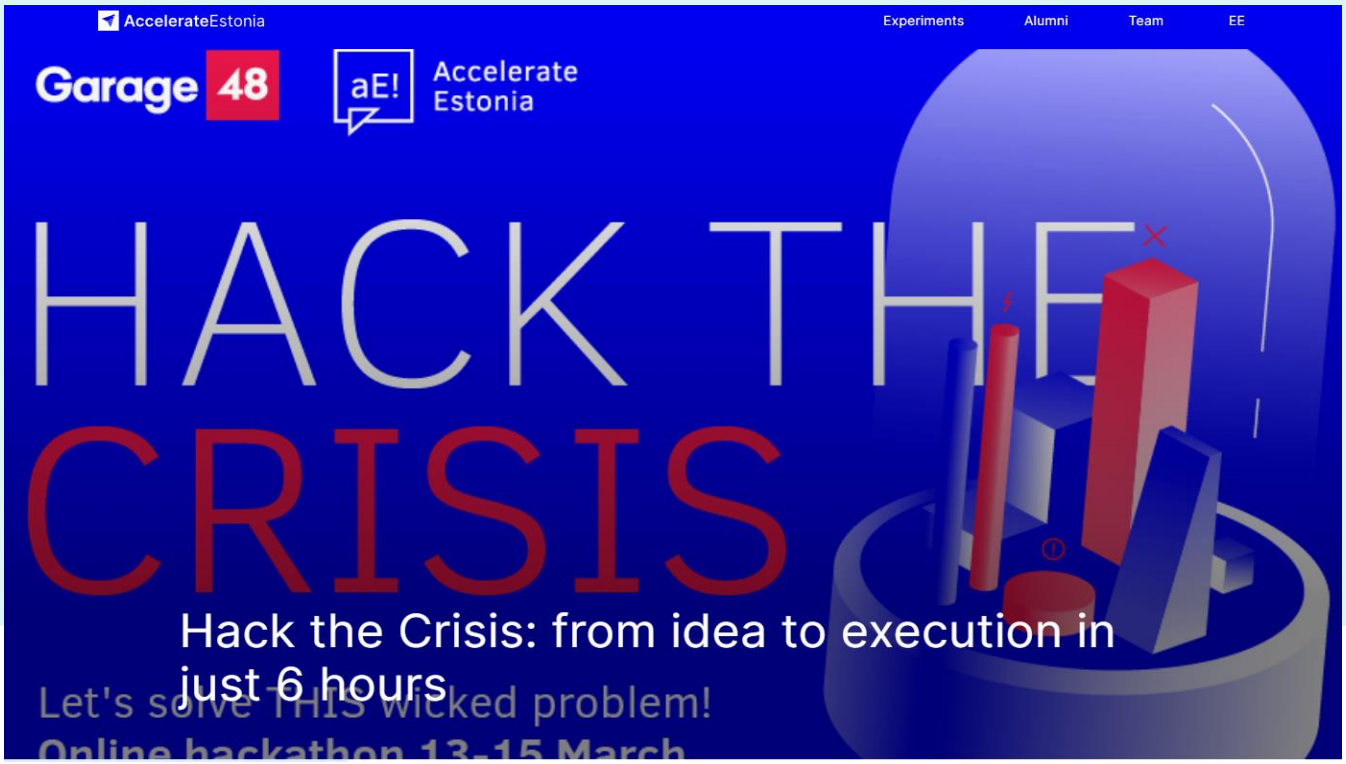
Other repurposing moved further from the original usage, sometimes in surprising ways. For instance, the Digital Infrastructure for Knowledge Sharing (DIKSHA) national e-learning platform in India, built on the Open Source Sunbird platform created with the support of the EkStep Foundation, began providing not only general lessons for school pupils, but also specialised COVID-19-related training courses for healthcare workers.[116] The data from this platform, which could be disaggregated to a regional level, also provided insight to governments on what courses people were taking in different regions, and as such broader educational provision needs.

Working with the private sector

Governments drew on the innovation and manufacturing capabilities of the private sector in multiple ways. We have already discussed the example of vaccine rollouts, of which the research, development, and manufacturing capabilities of pharmaceutical companies were an essential part (in collaboration with

universities, governments and other partners). Another key example was the Google/Apple Exposure Notification (GAEN) System which enabled Google and Android devices to measure distances to one another via Bluetooth, allowing users to be notified after contact with an infected person. Having initially been used in multiple states in the US, it was increasingly used in contact tracing apps in over 20 countries across the world.[117] Some of these countries' public health services had initially attempted to develop their own apps, such as NHSX in the UK and the Norwegian Institute of Public Health.[118] However, GAEN offered advantages including more effective background monitoring, and decentralised storage of data (rather than centralised storage by governments, with associated privacy concerns). There were alternatives; for example, in Taiwan a 'Digital Fencing System' was used to monitor locations based on triangulating a phone's position relative to nearby telephone masts; monitoring was conducted by telecoms companies, based on a list of phone numbers of quarantining individuals provided by the government.[119]

Partnerships with other, often specialised, national businesses also played an important role. We have already seen examples of governments working with water companies to scale up wastewater testing, or with financial organisations to track behaviour through spending patterns. In Taiwan, the Ministry of Economic Affairs met with facemask manufacturers in February 2020 and agreed on a face mask production plan. As one study noted, "the government coordinated all the machine tool companies to produce more facemask machines, matched raw materials suppliers with downstream facemask manufacturers, assigned quotas to every company, and set the purchasing price structure … Taiwan managed to ramp up its mask production eightfold in 3 months to 16 million per day".[120] As another example Seegene — a South Korean company which specialises in molecular diagnosis — developed test kits for detecting COVID-19 in January 2020 prior to any detected cases in South Korea. In this example the Korean Ministry of Food and Drug Safety deployed emergency use authorization, approving the kits for use within a month (compared to the usual 12 months). A review by the Korean National Information Society Agency suggests that this reduced time and cost of developing kits by a factor of 100, and "led to drastic reduction of time required for each testing from 24 hours to 6 hours, further containing the domestic spread of COVID-19."[121] Effectively balancing in-house government capabilities (as discussed later in chapter 7) with private sector capability can support responses that are innovative and efficient, directed towards broadly social beneficial outcomes.



Citizen engagement & open innovation

A crucial role was also played by **citizens, civil society groups, and entrepreneurs through open innovation.** A combination of civic engagement activities and digital technologies allowed for collaborative problem-solving, and connected a diverse range of participants. Modern digital communications technologies, from Zoom and WhatsApp to apps such as GoodSAM, played a valuable role in coordinating community engagement. One interviewee flagged the vital role of Whatsapp in particular in energising and coordinating Community Action Networks in South Africa.[122] Some other uses are documented in IPPO's recent study of evidence on volunteering and social capital.[123]

Technology also allowed for digitally-connected groups of technological innovators and 'civic hackers' to work together — sometimes in 'hackathons', events in which a range of participants are invited to collaborate to solve problems or create new technologies within a short timeframe. Germany and Estonia held national hackathons called, respectively, 'WirVsVirus' and 'Hack the Crisis'.[124]

Products from these hackathons ranged from Tutor.id, linking quarantining children with tutors;[125] to a chatbot called UDO developed to help German employers apply to the Federal Employment Agency for financial support.[126] These hackathons were arranged in a matter of days, and some of the new ideas were available for use within hours.[127] As well as hackathons, groups such as g0v ('gov-zero') in Taiwan collaborated to build on open data and existing open source software in ways which could support the government; these included supporting facemask distribution (as discussed below), and included improving government websites that were not easy to use. Digital Minister

Audrey Tang is a member of g0v, which gave her closer awareness of these projects.[128]

In addition to hackathons, some private individuals took their own initiative to innovate and support citizens; in some cases, this was helped by government actions. For example, when the Taiwanese government banned mask exports and requisitioned all masks made in January 2020, there was panic buying and hoarding. This prompted Howard Wu, a Taiwan-based engineer, to create a face mask map by using Google GPS and Place API. Within hours of launching the platform, it went viral and left him with a bill of $26,000 from Google.[129] Wu posted this issue on HackMD, a publicly hosted collaboration tool popular with Taiwan's "civic tech" sector, and came to the attention of Digital Minister of Taiwan Audrey Tang (who had herself used the map).[130] The next day Tang and her team contacted Wu and Google who later waived the fees.[131] Tang and the g0v group worked to connect pharmacies to a system run by the National Health Insurance Agency to ensure data was collected and reported in a regularly updated fashion which did not rely as strongly on voluntary reporting.[132]

Another case, which illustrates some of the challenges of government-supported open innovation was Koroonakaart, a volunteer-built website which provided Estonian coronavirus statistics to the general public.[133] Before there was open data available to citizens, the website used press releases and crowdsourcing for data. It became so widely used that the Estonian health board directly provided data and directed citizens to the platforms. However, this did not translate into government funding or other support, and eventually the lead organiser left over disagreements with the government on LGBT+ policy and the dashboard was discontinued. This reflects a broader problem with open innovation around questions such as: who funds, maintains, and scales the idea once it has been released for wider use?

Over the last decade a common theme has been to redesign hackathons with more of a focus on staged follow-ups, often involving potential purchasers and investors.[134] Enthusiastic groups of volunteers working to short time frames can produce a lot of ideas quickly, but once the hackathon is over they "very rarely spark real, lasting innovation" according to MIT Sloan School of Management senior lecturer Anjali Sastry and Mission Spark cofounder Kara Penn.[135] A key finding of GovLab research into use of non-traditional data was that many initiatives, particularly those not directly related to health, have been discontinued due to lack of long-term support and funding; also many were designed with specific questions in mind and weren't able to adapt to other questions without large investment.[136] If open innovation is to be used effectively, governments need to consider ways to guarantee more sustainable support.

3. UP, DOWN AND ACROSS: HOW INTELLIGENCE WAS COMMUNICATED

Any analysis of how intelligence was used by governments during the pandemic must account for the vital role of communications.

Intelligence, for example on infection levels, new variants, and socio-economic impacts, needed to be communicated 'inwards' to governments in order to inform decision-making.

Governments also needed to communicate 'outwards' to the wider public to inform, engender trust, and encourage certain behaviours.

Finally, intelligence needed to be shared within governments, to incorporate inputs from different departments and regions, for example on issues of implementation.

In this chapter we consider these three main forms of communication — inwards, outwards, and within — in turn.

3.1 Communicating into government

We have already encountered numerous ways in which intelligence was absorbed into governments for decision-making — ranging from data collected from individual citizens, up to data provided by larger institutions.

Given that COVID-19 affected extremely large populations, and produced a huge range of data, communicating data from citizens was often made possible by technologies. To summarise key examples from chapter 2:

- Smartphone apps. These ranged from apps where people could self-report test results, and/or be alerted when they had been near an infected person; through to apps which also helped monitor and support quarantining people, or check mask supplies in pharmacies, as seen in South Korea.
- Hotlines, many of which were repurposed from existing government hotlines (for example in Bangladesh, South Korea, and Finland). These could be used to collect quantitative data (e.g. options chosen from automated menus) and/or qualitative data (e.g. transcripts of phone calls).
- Free text boxes in online tools and apps, or options to email or message a government department or associated body. For instance, in the UK the Office for Statistics Regulation website had website and email options for people to query reporting of official numbers. As with phone lines, these often existed pre-COVID-19 but saw substantial increases in usage.[137]
- Monitoring technologies such as mobility data collection from smartphone apps, technologies which track financial transactions, or monitoring sentiment from social media.

In addition to citizens, intelligence was communicated to governments from various other institutions involved in the pandemic response. A key example was institutions involved in the response from a medical perspective, assessing capacities and shortages of (for example) intensive care units and acute care beds and/or protective and medical equipment, as well as supporting the steering of surge capacities across hospitals and regions.[138]

Some countries used existing monitoring systems, including most Nordic countries, the Netherlands, and the UK.[139] Others set them up during the COVID-19 pandemic,

for instance Greece created a digital registry to monitor stock of gloves, masks, and protective gear, plus hospital, intensive care, bed capacity and occupancy, in real time.[140] In Germany, a web-based register was created to report free ventilation places, intensive care capacities and the COVID-19 cases treated in participating hospitals. In Switzerland, a platform of intensive care bed occupancy combined forecasts and real-time data on occupancy for individual hospitals.[141] However these had limitations; for example, Germany's register only showed whether critical care beds were available, but did not show the availability of ventilators.[142]

An important question was the extent to which governments' intelligence collection required voluntary engagement, or was collected involuntarily (whether through compulsion or surveillance). For example, apps which monitored potentially or actually infected people required either (i) legal compulsion or (ii) willing use by enough of the population. Many other methods, such as voluntary COVID-19 tests or hotlines, similarly required active participation from citizens. Multiple countries — including South Korea, which had initially succeeded in intensive track and trace — encountered diminishing participation as the perceived severity of COVID-19 waned and fatigue with lockdowns increased, which decreased the usefulness of these technologies.[143] Work by the GovLab found that innovative data initiatives were often implemented without the necessary social license to do so, which led to public concerns and initiatives being discontinued.[144]

Surveillance methods, such as some methods for tracking mobility or analysis of social media sentiment, were less reliant on conscious participation from users, raising questions about the ethics and legality of monitoring which are discussed further in chapter 7.

3.2 Communicating outwards from government

Traditional communication methods, in particular televised press conferences, were used extensively — in many countries, these were broadcast daily for many months at a time.[145] In Taiwan, for example, the Central Epidemic Command Center (CECC) live streamed 1-1.5hr long press conferences featuring CECC commanders and relevant Ministerial staff, with an average of 200,000 real-time viewers (sometimes reaching 600,000).[146] These were useful for communicating general messages to extremely wide populations.

More modern technologies such as social media and search advertising were also used to research and reach various audiences.[147] The UK government pivoted its Rapid Response Unit, set up in 2018 to detect and respond to specific instances of mis- and disinformation on social media, to COVID-19-specific work as part of a wider government Counter Disinformation Cell.[148] Taiwan built on the already strong use of social media as rapid response, with "meme engineering" teams in each government department working to respond to disinformation efforts within 60 minutes with the government messages "packaged in such a way that you can't help but want to share it." Minister Audrey Tang has labelled this the "humour over rumour" approach.[149] This approach was not limited to social media, as shown for example by the appearance of the below image from a television broadcast showing Premier Su Tseng-chang's figure with the slogan: "We have only one butt," to counter toilet paper stockpiling.[150]

Figure 8: Use of a humorous meme format in government communication on Taiwanese television

Intelligence was also used to understand and respond to features of specific audiences in outwards communications; for instance understanding the needs of, and supporting, informal traders in South Africa,[151] or tailoring messages towards groups who were found to be more hesitant of vaccines (whether specific faith groups in the UK or 'hyper-masculine' young men in Australia).[152] Manual and digital track and trace activities were also used to target messages specifically to potentially and/or actually infected people. In multiple countries COVID-19 tests and tracing apps were combined with text message, emails, and contact tracers ringing potentially infected people. In South Korea, a combination of automated call systems and human operators were used to communicate important messages to people during quarantine.[153]

Finally, numerous interviewees referred to the importance of presenting intelligence in outwards communications – for example showing the latest data on infection rates, or evidence of vaccine efficacy and safety. Interviewees in South Korea reported that a major learning from the MERS outbreak in 2015 was the importance of transparent public communication – including displaying up-to-date intelligence for the public – to minimise misinformation.[154]

Communicating intelligence also helped citizens to have their own frameworks for risk, allowing them to make their own decisions rather than simply following (or not following) black-and-white rules.[155] Further, who communicated mattered as much as how information was communicated, and many governments gave prominent roles to scientists and doctors alongside politicians.[156]

3.3 Horizontal communication within and between governments

A government is not a single entity. According to one estimate the UK has some 12-13,000 governments, including the UK government, 3 devolved administrations, around 400 local authorities and thousands of parish councils. The US has some 93,000 governments by similar measures, China and India many more.[157] These sit alongside an equally complex web of agencies, regulators and others.

Throughout COVID there was frequent sharing of intelligence within and between governments – whether amongst departments of the same government, regional governments in the same country, and even between governments in different countries. Effective communication and coordination here is key for achieving good results.

Some countries, such as Australia or Switzerland, have federal political systems. Here regional governments controlled important intelligence sources and held powers around how and to whom they would share intelligence. An Australian interviewee, in particular, highlighted that most major responsibilities and decisions lay with the states, from healthcare to closing borders.[158] Larger regions, such as German Länder, sometimes needed communications to take place at a sub-regional level. For instance the Berlin

Senate – the executive body governing the city and state of Berlin — occasionally struggled to fully collect and synthesise data from health centres and schools in different districts.[159] Some federal systems also had central bodies which did intelligence gathering and communication at a national level somewhat independently of regions, for instance the Robert Koch Institute in Germany.[160] Some countries, for example the UK, South Korea, and Taiwan — all unitary states – operated in a relatively centralised way; i.e. their national governments controlled key sources of intelligence and determined who that was shared with (though as we show later South Korea did well in linking different tiers). However even unitary systems needed to communicate with local and regional governments; and all governments needed to ensure effective communication between departments.

As with other forms of communication, technologies played an important role in joining up different governments and parts of governments. The South Korean Anti-Corruption and Human Rights Commission used artificial intelligence to extract themes from complaints to their hotline and website, which were then distributed amongst relevant departments.[161] In Essex, a county in the UK, a tool called VIPER was used to share real-time data on vulnerable people with emergency responders.[162] Taiwan's Central Epidemic Command Center, brought together government departments to integrate the National Health Insurance database with the immigration and customs database by January 2020, allowing healthcare professionals access to a patient's travel history, profession, and contact history.[163]

In addition to technological mediation, different forms of interpersonal communications played important roles in within-government communications. An interviewee from Bangladesh raised "organising conversations" as a key skill needed during the pandemic.[164] Some governments, including in the UK and Estonia, used "red-teaming" during the pandemic, specific conversations designed to challenge assumptions and expose potential risks.[165] Effective internal government communication – such as how to mix official email chains or formal meetings, with more ad-hoc WhatsApp or in-person conversations – was a skill that many officials and some external partners already brought to government, but also a skill some specialist interviewees (for example, from regulators) felt that they learned during the crisis.[166] How these communications took place, and how effective they were, depended also on interpersonal relationships which we turn to are the subject of our next section.

4. THE ROLE OF RELATIONSHIPS

Relationships were key to intelligence sharing. Sometimes they were formally coordinated – for example putting people together in designated teams, or creating rules or documents which explicitly lay out responsibilities and hierarchies.

Others were informal, drawing on past contacts and connections to allow more flexible and ad-hoc working. As we shall show throughout this chapter, the combination of formal and informal is vital for effective functioning.

This chapter discusses three groupings of relationships:

- Within national governments, and the departments within them.
- Between central governments and regional governments, and between multiple governments.
- Between governments and external partners.

4.1 Within national governments

Formal relationships within government consist of organisational structures, sometimes underpinned by laws, which specify responsibilities and authority. Many governments have specific structures and laws for crisis responses, many of which have built on experiences of previous crises. The UK Strategy Unit review of risk in the early 2000s contributed to a clutch of measures to better embed risk management including horizon scanning, risk responsibilities in departments, the creation of the Civil Contingencies Secretariat and Local Resilience Forums, which were codified by the Civil Contingencies Act of 2004.[167]

Taiwan's COVID-19 response similarly followed a law – the Communicable Disease Control Act, which had been amended following an enquiry post-SARS – which allows the rapid creation of a command centre that coordinates all necessary resources (both public and civic) to prevent an outbreak.[168] This Command Centre consists of senior civil servants from almost every ministry, but no elected politicians. The Taiwan Centre for Disease Control had also already been training and recruiting a public health taskforce (including a standby Central Epidemic Command Center) and built a surveillance system that integrated reporting and laboratory diagnosis data (the National Notifiable Disease Surveillance System) – all of which played critical roles during the pandemic. In addition to these crisis-specific functions, other existing government capabilities – from an open-source intelligence team in Australia to Bangladesh's a2i public sector innovation programme – were redirected to focus on COVID-19, and sometimes even temporarily renamed to make their new priorities clear.[169]

However, one cannot understand government functioning – in a crisis or otherwise – purely by reference to formal rules and organisational charts. During COVID-19, informal personal relationships between officials played extremely important roles. This ranged from discussions amongst senior officials who had worked with one another previously – some of which were used to set up teams run by 'safe pairs of hands' — to quick ad-hoc requests for help from officials who had relevant knowledge and were more convenient to contact than the 'official' experts.[170] In the latter case, even if specialist experts were later consulted, these officials could quickly provide enough background to formulate better questions for the experts. However, because such interactions leave no written records there are bigger risks of abuse and corruption.

An important factor that shaped relationships, referred to by multiple interviewees, was the role of trust and collaborative attitudes towards fellow government officials. For instance, trust built up between senior officials and crisis responders in Cape Town during earlier droughts allowed responders to be empowered on the basis of trust rather

than formal structures.[171] An interviewee from a UK regulator also argued that achieving widespread trust amongst both the public and government prior to COVID-19 – largely by adopting a pro-openness approach to publishing – gave them greater influence within government.[172]

The experience of the pandemic altered many existing relationships and attitudes within governments. For instance, it may also have catalysed newly collaborative attitudes. A South Korean interviewee referred to how the Infectious Disease Control and Prevention Act had, since its inception in 2015, struggled with departments not sharing intelligence unless it would support their individual interests. However the urgency of the COVID-19 crisis galvanised cooperation in the manner anticipated by the original law.[173] This was an unusual crisis in that everyone was affected, including those working on the response.[174] An Australian official also noted that COVID-19 was *the* overriding priority for all departments, allowing them to align more effectively on tasks.[175] An interviewee from Bangladesh described how long-standing hierarchical protocols for communicating within government were superseded by informal WhatsApp groups.[176] These could be quicker, more flexible, and more candid than formal communications.

In concluding, we have referred multiple times in the above discussion to flexibility. This is vital in a crisis. While formal arrangements can ensure everyone knows their responsibilities, and plan resourcing, they can conflict with the need to respond flexibly. In the words of an interviewee from India, "If there are too many hard-coded platforms and structures and the responsibilities shift, the level of responsibility actually goes down rather than up."[177] We have noted throughout the examples above that informal relationships can allow for greater flexibility. However, during COVID-19, such personal relationships and capabilities sometimes had to be built mid-crisis, particularly between central government and local government or regulators.[178] It is therefore important to plan ahead in a manner which incubates these informal, interpersonal aspects; for example through regularly bringing disparate groups together for planning and simulation.

4.2 Between central and regional governments, and amongst regional governments

Formal structures and expectations can be extremely important in relationships between central and regional governments, particularly given officials in these different parts of government may be more physically distant, experiencing different challenges and have different access to resources, and may not work extensively together on a day-to-day basis. South Korea had a strong machinery for linking the tiers and building 'collaborative governance', exemplified by the Prime Minister creating a task force early in the pandemic of all national ministries as well as regional and city governments.[179] Following the experience of MERS in 2015, South Korea amended their Infectious Disease Control and Prevention Act, to mandate (amongst other requirements) that "the State and local governments (including superintendents of education) shall… mutually cooperate in order to efficiently treat [infectious] diseases and prevent the spread thereof."[180] A Taiwan-based researcher also illustrated the importance of various levels of collaboration in enforcing quarantine:

"Local governments cooperated with the Central Epidemic Command Center to ensure the quarantine. Based on these and later border controls, the Central Epidemic Command Center required all travellers arriving in Taiwan to be quarantined for 14 days and their information to be passed to local governments.

Next, street-level officers in district governments visited those quarantined to make sure that they were healthy and abiding by the requirement, and they were provided with an antivirus pack including masks and disinfectant. Those quarantined were fined if they went outside.

The district governments were responsible for monitoring those quarantined by tracking their cell phones. The police also worked to find those quarantined who went outside or even tried to escape the quarantine"

- *Irving Yi-Feng Huang, 'Fighting COVID-19 through Government Initiatives and Collaborative Governance: The Taiwan Experience'*

By comparison the UK had weaker systems for collaboration. Its Local Resilience Forums brought together multi-agency meetings to produce situation reports which were fed up to central government, and 'Resilience Advisors' from central government departments would regularly attend meetings with local authority chief executives.[181] This structure had been mandated by the Civil Contingencies Act of 2004 (a response to floods in 2000, and the foot and mouth outbreak of 2001).[182] However the relationships had decayed since the disappearance of Government Regional Offices which had acted as intermediaries. One UK government employee cited the lack of strong personal relationships between officials in central and regional governments as an issue.[183] This was exemplified by the creation of a national track and trace system that did not, in the first phase, make use of the well-established systems in local government.

Regional systems in particular required structures for assigning different levels of power and responsibilities, often through specific laws. For example in Switzerland the Besondere Lage ('emergency situation'), declared in March 2020, gave the central government more public health powers than in normal circumstances.[184] However, key elements of the response remained in the hands of cantons, sometimes leading to inefficiencies in key elements of their pandemic response, such as initial inconsistencies in the vaccine roll out, where some cantons were far ahead of others in vaccinating groups.[185] And, in

the absence of a centralised data infrastructure, the federal government had additional challenges associated with monitoring the spread of disease and new variants.[186] In Australia, according to an interviewee from a think-tank, central government's influence on states was limited, largely to exerting political and media pressure.[187] Even where formal processes were in place relationships could be tense. An Australian interviewee spoke of the central government "deliberately undermining the states" via media briefings to try and encourage less strict lockdowns, in the absence of formal power to force their decisions.[188] This dynamic can also be seen in Taiwan where local mayors, often from opposition parties, publicly criticised the central government around issues such as vaccination.[189]

"What should be a systematic way to ensure that we do institutionalisation of some of the best practises that we did? Breaking up of silos - that was fantastic and I've never seen anything like it before - between private sector and within the government. So how should we capitalise on that crisis moment?"

- *Anir Chowdhury, Policy Advisor, a2i Programme of the Government of Bangladesh*

4.3 Between government and external partners

Government officials also worked extensively with external organisations, and people and teams based within them. As we have already seen throughout this report, these included specialist experts (particularly academics), front-line responders, private sector organisations, Parliaments, regulators, and civil society.[190] Sometimes these existing relationships were relatively long-standing and formalised, for example between the South Korean government and large national businesses,[191] or between NGOs and governments in India and Bangladesh.[192] Finland benefited from a long tradition of involving business in regular exercises to simulate military threats.[193] Other times these links were more informal, such as external actors with past connections to government officials; non-government interviewees from Australia and New Zealand spoke of using personal connections to senior government decision-makers to lobby for zero-COVID-19 strategies (though these informal connections were often later codified into official supporting roles).[194] Often relationships mixed formal and informal aspects. For example, Bangladesh's response built on connections to communities of practice–- including NGOs, academics, and private sector actors – which originally emerged in pursuit of the Sustainable Development Goals.[195]

Resourcing, from funding to personnel, was also important in these relationships with external partners. In Estonia, emergency funds were provided to do monthly research, through adapting a funding system originally designed for much longer projects.[196] One interviewee, who ran privately-funded serological testing in India, felt that bureaucracies–- including large international donors–- were less effective as donors than smaller donors who took a "venture capital style approach", i.e. taking risks on who they funded, and transferring money within the space of 1-2 weeks.[197] In these cases personal relationships are both a help – in that they speed up decisions – and a potential problem in that they could favour insiders and cronyism.

The scale and intensity of the pandemic provided a strong motivation for external experts to provide help. External experts in Australia and New Zealand were highly motivated to push zero-COVID-19 elimination strategies in the face of, as

they saw it, strategies that were a direct risk to their country (even if some were uncomfortable moving into such explicit lobbying roles).[198] NGOs developed research programmes and open-source software to support extremely poor areas of the world, which had limited ability to pay for such resources.[199] In Wales a Science Policy Cell of over 200 experts from academia and public health agencies "gave their time freely" and brought intellectual property with them.[200] Interviewees from Bangladesh highlighted the role of expat expertise, such as from Yale-based economic modeller Mushfiq Mobarak.[201]

Finally, the pandemic opened up opportunities for new connections and relationships between experts and government decision-makers, providing opportunities for researchers as well as governments.

"Honestly that [secondment to the European Commission] wouldn't have been taking place without any experience of the pandemic … I was very frustrated as a scholar in disaster risk research related to the fact that all we knew, since a long time ago, research on crisis management was not fully taken on board, or very little perhaps depending on the country."

- *Scira Menoni, Professor of Urban and Regional Planning at the Politecnico di Milano-Italy and expert in scientific advice on crisis management.*

5. INTERNATIONAL INTELLIGENCE SHARING

Flows of intelligence internationally can be vital in a crisis, enabling rapid responses, avoiding duplication and particularly helping poorer countries which may lack sufficient capacity. Here we provide a brief overview of the role played both by intergovernmental institutions and by international networks and collaborations.

5.1 By intergovernmental institutions

Intergovernmental institutions produced, communicated and used intelligence throughout the COVID-19 pandemic. For instance, financial institutions — such as the International Monetary Fund and the European Central Bank — researched the economic impacts of COVID-19, including looking at potential long-term consequences and how to build financial resilience.[202] UNESCO in collaboration with UNICEF and the World Bank, conducted research into the pandemic's impacts on education, concluding that the current generation of students risk losing $17 trillion in lifetime earnings.[203] The OECD provided data and conducted research on a range of cross-cutting issues including effects of national policies and potential long-term effects of the crisis.[204] Intergovernmental institutions also provided guidance for national governments: UNESCO, for example, produced guidance on using

online educational resources during the pandemic.[205] However, it's less clear how much these were used in practice.

A key intergovernmental institution during COVID-19 was the World Health Organisation (WHO). The WHO monitors for signals of potential health emergencies and uses these signals to help assess whether there is a need for substantive dialogue with a national authority. Under the International Health Regulations (IHR) — which were updated in 2005 following the SARS outbreak of 2005 — member states are obliged to share "all events that might constitute a public health emergency", plus a broad range of "other reports" gathered by the WHO. All this work is supported by the Global Outbreak Alert & Response Network (GOARN), a network of experts skilled in sifting and critically analysing potential signals of a health emergency and corroborated with tacit knowledge from country-based experts, using trusted networks built from years of being based in the field. In this way, information from across the world is collated, reviewed and synthesised within the WHO Secretariat. As such, the process for reaching such a decision involves sharing of numerous forms of information in a similar manner as described in chapter 3, on an international scale: inwards to central organisations; outwards to the world; and between teams, departments, and national governments.

Some commentators have argued that the pandemic highlighted problems with the WHO, and other international institutions. In particular, there are accusations that slow intelligence sharing by China to the WHO delayed the announcement of a PHEIC, and thereby gave countries false assurance.[206] By some accounts, Taiwan's ongoing public monitoring system spotted an early reference to COVID-19 in Wuhan on an internet bulletin board in December 2019; Taiwan flagged this to the WHO, and sent two scientists to Wuhan two weeks later.[207]

However, it is unclear whether this information was effectively used by the WHO. Indeed I-Chun Lo, Deputy Director-General of Taiwan Center of Disease Control, has suggested that by not having full membership status of the WHO, Taiwan actually benefited as their government: "kept thinking, well, we must have missed important information. That actually gave us that urgency and anxiety that we should be protecting ourselves much better by searching all the necessary social media … and not just rely on WHO's goodwill or other countries' goodwill to share information with us."[208]

The WHO also had its own dashboards tracking case data, but LoTempio and colleagues noted that this was "incompatible with country dashboards and does not disaggregate the data by sex or age, important risk factors".[209]

These issues reflect longer standing criticisms of the WHO as an organisation that sometimes "knows everything, and

does nothing."[210] They also reflect wider issues the pandemic raised for intergovernmental agencies; Ilgu Özler, Director of the SUNY Global Engagement Program in NYC, has argued that the broader UN and affiliated agencies "are still able to foster cooperation, [but] their success is limited by the organisation's inability to establish some form of authority and command."[211]

Playing an international co-ordination role in a pandemic is a long-standing and well prepared-for function of the WHO — there are protocols and expert networks designed to sift, challenge, and assess intelligence around disease outbreaks, and they have carried out this function across numerous disease outbreaks prior to COVID-19. Also, as noted in a Max Planck International Law research paper, "in comparison to other international organizations, it [the WHO] enjoys extensive powers".[212] It is not clear that other potential international crises — for instance a mass loss of internet connectivity, or climate change induced catastrophes — have been so extensively and precisely prepared for by intergovernmental institutions, and so could raise even greater challenges for international co-operation.

Other examples point to the potential benefits of better intergovernmental collaboration. Intelligence-sharing amongst EU Member States around vaccine contracts, facilitated by the EU Commission, ensured that states did not end up in bidding wars with one another over vaccines (at the expense, some have argued, of an initially slower and more bureaucratic vaccine rollout in Europe).[213] In a situation of uncertainty, the expertise of intergovernmental organisations may provide valuable guidance, particularly for countries less well-equipped to create their own national intelligence. International organisations can also support national responses in more diffuse ways, such as supporting the development of national monitoring mechanisms pre-crisis (which is a key role for the WHO under Article 6 of the IHR), and providing "a yardstick against which state responses can be measured". The Taiwanese Centre for Disease Control, for example, "used the risk assessment protocol published by the [WHO] and the European Centre for Disease Prevention and Control (ECDC) as a guide to perform daily risk assessments in response to the COVID-19 outbreak".[214]

5.2 By international networks and collaborations

A huge variety of networks and collaborations enabled international intelligence sharing. A key example was intelligence sharing amongst scientists who were studying the origins of the new virus, the epidemiology of outbreaks and the movement of viral variants across the planet.[215] For example the Global Initiative on Sharing All Influenza Data (GISAID), which provides an online data repository for genomic data on influenza viruses, acted as the largest global database for COVID-19 genomic sequences. [216] By April 2021 GISAID held more than 1.2 million coronavirus genome sequences from 172 countries and territories. [217] In addition to knowledge sharing around disease surveillance and early detection, many journals lowered paywalls, or made data available through repositories (e.g. GitHub).

Knowledge sharing internationally had a crucial benefit over national scientific research: it ensured the benefits of specialised capabilities in particular countries could be of wider assistance, as seen for example in the detection of the Beta variant by South Africa's advanced genomic sequencing (which in turn was supported by broader regional and international networks, including the Africa Pathogen Genomics Initiative, and the WHO and the Africa Centres for Disease Control and Prevention).[218]

Beyond scientific research into the virus, international networks and collaborations played various other roles during the crisis. For instance, various international networks also tried to provide synthetic evidence (we look later, in chapter 6 at the difference between evidence synthesis and synthesis for action). IPPO and equivalents around the world such as the Societal Experts Action Network (SEAN) in the US provided governments with rapid evidence reviews and more in-depth syntheses on issues such as the impacts on care homes or homelessness.[219] The Partnership for Evidence and Equity in Responsive Social Systems (PEERSS), which includes partners from 13 countries,[220] and COVID-END (Evidence Network to support Decision-making), which was established as a time-limited network, brought together more than 50 of the evidence-synthesis, technology-assessment and guideline-development groups from around the world[221] covering public-health measures, clinical management, health-system arrangements and economic and social responses across low-, middle- and high-income countries.

Some important networks were regional rather than fully global. For example, Africa saw a remarkable number of initiatives, including the Africa Evidence Network[222] and the African Centre for Evidence (ACE) based out of the University of Johannesburg which provided evidence synthesis to a network

of several thousand officials, aiming to be responsive to the needs and contexts of African decision-makers during the pandemic.[223] Uganda's Africa Centre for Rapid Evidence Synthesis (ACRES)[224] based in Makerere University, are aimed at providing a rapid response service to support policy makers, for example on protecting health workers[225] and local lockdowns.[226] Other interesting examples grew up in Burkina Faso[227], South Africa[228], Zimbabwe (with the Zimbabwe Evidence Network ZeipNET)[229] under the WHO Alliance for Health Policy & Systems Research (AHPSR).[230]

Some of the networks and collaborations described here faced challenges. One of our interviewees, a think tanker from India, referred to a phenomenon of "not built here" as a "major problem" during the pandemic — i.e. countries, or even regions, repeating work which they could have imported elsewhere, to ensure it could be championed as a national (or regional) success. [231] However, when used well, international collaborations meant governments had access to the range of research available from across the whole world, not just their own experts. This not only helped the progress of medical interventions, but also made up-to-date research available for Rapid Evidence Review teams in governments, though the sheer scale of information could be overwhelming and it could be hard to establish the reliability of research.[232]

6. BRINGING IT ALL TOGETHER: THE CHALLENGE OF SYNTHESIS

Decision-making depends on synthesis. Synthesis is a very old concept. Whereas analysis often involves breaking issues down, synthesis means bringing them back together.

This was clearly vital for making decisions about issues such as lockdowns, where governments needed to consider multiple factors (including effects on the spread of the virus, economic impacts and impacts on wellbeing) *and* how all these factors would interact.

Typically, governments have to draw on many different kinds of input to understand a situation and then to act on it.[233] But having good inputs is no guarantee that these will be synthesised well.

6.1 Synthesis for understanding and synthesis for action

Governments need both:

- **synthesis for understanding** to make sense of what is happening and the options (drawing on all the types of intelligence described earlier as well systematic evidence reviews and expert advisory teams producing consensus statements); and
- **synthesis for action** (for example, decisions by a government to propose lockdown or travel restrictions).[234]

As we showed in the section on evidence in Chapter 2 there are well-established methods for synthesis for understanding in many fields, including complex advisory mechanisms bringing together scientists and social scientists to feed into the government machine, offering insights and evidence. Sometimes these are orchestrated by people with formal advisory roles such as Chief Scientific Advisers, Chief Economists, Chief Medical Officers and so on. In Chapter 5 we surveyed some of the other evidence synthesis mechanisms — such as the Societal Experts Action Network (SEAN) in the US, the Africa Evidence Network (ACE) and observatories like IPPO and the Economics Observatory.

However, these tend to only synthesise certain kinds of relevant knowledge, missing out many that are relevant to decisions. So, a second kind of synthesis goes a step further, drawing on all of these to make decisions. In some countries, new structures were created to do this job. Portugal's appointment of an Admiral Henrique Gouveia e Melo, shown in Figure 9, to oversee government action was a good, and successful example.[235] Portugal was often seen to have

Figure 9: Deutsch Welle reportage on Admiral Henrique Gouveia e Melo, appointed in Portugal to oversee government action during the pandemic.

performed better than comparable countries, for example achieving a high vaccination rate — over 86% — faster than other EU members.

Taiwan's Central Epidemic Command Center played a similar role. Elsewhere it was assumed that this job would be done by a Prime Minister, Mayor or committee of ministers, often meeting in crisis control centres. But as we will show the methods to be used at this point are often opaque and much cruder than the methods used for synthesising evidence and science.

"There aren't really capabilities within governments, that I've seen, where there are people that can actually integrate across all those different types of evidence. Where there are good analysts they're stuck in very large bureaucracies, which we need to deliver very large programs to help populations, but what it doesn't allow you to do is easily synthesise evidence across those different lines."

- *Researcher into government pandemic responses*

6.2 Types of knowledge relevant to decision-making in a pandemic

For the busy official or minister there were many types of knowledge that could be critical at different points of the crisis (each of which has its own professions, networks and ways of thinking). These include:

Statistical knowledge: for example, of unemployment rises in the crisis.

Policy knowledge: for example, on what works in stimulus packages.

Scientific knowledge: for example, of antibody testing.

Disciplinary knowledge: for example, from sociology or psychology on patterns of community cohesion.

Professional knowledge: for example, on treatment options.

Public opinion: for example, quantitative poll data and qualitative data.

Practitioner views and insights: for example, police experience in handling breaches of the new rules.

Political knowledge: for example, on when parliament might block a new lockdown.

Legal knowledge: for example, on what actions might be subject to judicial review or breach Human Rights Conventions.

Implementation knowledge: for example, understanding the capabilities of different parts of government to perform different tasks.

Economic knowledge: for example, on which sectors are likely to contract most.

'Classic' intelligence: for example, on how global organised crime might be exploiting the crisis.

Ethical knowledge about what's right: for example, on vaccinating children who may have relatively little risk from a disease.

Technical and engineering knowledge: for example, on how to design an effective tracing system or build a new high speed rail line.

Futures knowledge: foresight, simulations and scenarios, for example about the recovery of city centres.

Knowledge from lived experience: the testimony and experiences of citizens, usually shared as stories, for example about experiences of the pandemic.

The challenge for governments is that there is no obvious hierarchy to show why some of these types of knowledge might matter more than others. Knowledge from the 'hard' sciences may be more important in some situations, such as the peak of a pandemic, and less in others. Indeed, the status and influence of these different sources of knowledge may correspond only loosely to what is needed at any particular time (the UK system, for example, often does better in mobilising scientific knowledge than more practical engineering and technical knowledge, such as on how to handle data during a crisis) as indicated in a recent piece by past and present Scientific Advisers.[236]

In democracies, political knowledge (and interests) can sometimes trump other kinds of knowledge.[237] Moreover governments do not have explicit models or heuristics to show which kinds of knowledge, and which models or frameworks, are relevant for which tasks and when. In practice this tends to be a matter of experience or hunch.

6.3 Who does the synthesis?

It's sometimes assumed that synthesis for action has to be done by politicians helped by political advisers, albeit supported by expert advice. But they rarely have the time or skills to do this well, and often there is a mismatch between the sophistication of the inputs and the often much cruder methods then used to turn these into actions.

Sometimes it's assumed it will be done by senior civil servants — but again they may or may not have the skills to do this well (and are likely to be much more confident dealing with issues of law and economics than with data or science). Even the most sophisticated accounts of science advice and knowledge brokerage still present it as an input and support for decisions that are taken by others, leaving the crucial moments of decision as a kind of black box.[238] The result is often an imbalance between the quality and quantity of advice on the one hand and synthetic capability on the other.

Governments facing pandemics have had to think and act synthetically at great speed. In the absence of capacity, methods or time to do sophisticated syntheses they have had to rely on synthesising with heuristics — like the conclusion that there weren't trade-offs between health and economics, because tackling the health issues was a precondition for economic revival; or the heuristic that tough early action was usually better than procrastination or waiting for more data; or the heuristic that almost any level of public debt was better than a COVID-19 induced recession. However, although some of these heuristics worked well for a time, none worked well through multiple phases of the pandemic.[239]

Instead, governments had to adapt. In April 2022, for example, Taiwan moved from a zero-COVID strategy, to a strategy connecting three considerations: 1. Keep

the country's health system load below its critical threshold 2. Minimise severe cases of Covid and 3. Maximise herd immunity and vaccinations.[240] This shift provided a clear framework for decisions and appears to have helped it avoid some of the many challenges mainland China faced during 2022.

Our interviews suggest that synthesis for action was mostly accomplished through individual judgement rather than formalised frameworks for decision-making, with officials drawing on their own experience to present materials in a manner amenable to the decision-makers they worked with and coloured by their own personal networks.

Intelligence was collected, summarised, and communicated up to political decision-makers empowered by democratic mandates, or other forms of governmental mandates; for instance in South Korea cross-department synthetic decisions were often taken by the Chairman of the Anti-Corruption and Human Rights Commission, a role appointed by the President.

In all countries the contradictory signals from different kinds of knowledge had to be weighed up. Sometimes these created conflicts. An interesting example is Chile, widely seen as an exemplar in its pandemic management.[241] At a crucial point in the crisis, as the government decided to give vaccinated people freedom to move around, a war of words broke out between the Ministry of Health and the Medical Doctor's Union (MDU), with the director of the MDU, Cristobal Cuadrado, asking: 'Where are the "experts" who consider a mobility pass a good idea in the context of this health catastrophe? Will any of them show their faces? How to know who are the accomplices of the criminal handling of the pandemic of [the President]?' At that time weekly surveys showed high levels of trust in the MDU (peaking at 80%), but as new cases fell sharply their trust levels fell (to around 60%) and the official in charge, Paula Darza saw her trust rise to 79%. Many other countries saw similar arguments as some scientists resisted any easing of lockdowns and restrictions, while ministers and officials had to take a more synthetic view.

6.4 Mechanisms for synthesis

In the security and defence fields many countries have well-established mechanisms for synthesis of both interpretation and action, which could have been adapted to the pandemic (and partly were in some cases such as Bangladesh's Intelligence Unit and Estonia's National Situation Centre).

In the UK, for example, the Joint Intelligence Organisation provides 'all source' assessments of threats, supported by an intelligence assessment profession of some 1700 staff, an academy and many processes for making sense of complex signals.[242] The US has its National Security Council, drawing on many sources of analysis and feeding into decisions.

Domestic policy, in both the US and UK has little comparable (though in the UK case there are small teams under the Economic and Domestic Secretariat in the Cabinet Office, and The Cabinet Office Briefing Rooms — more commonly known as COBRA — machinery for crises). Generally, domestic policy relies on much more fragmented approaches to inputs (with separate structures for data, statistics, science advice, economics, policy advice and so on, and separate capabilities in the main departments). Ad hoc arrangements brought these together during the crisis (partly under the direction of the Chief Scientist and Chief Medical Officer) but without the more systematic methods used in 'classic' intelligence, and relying heavily on personal contacts and networks.[243]

6.5 When to link together and when to separate

How far should synthesis go? On some issues governments had to take very over-arching decisions, such as when and how to ease lockdowns. But in other cases they could break the tasks down into distinct elements. Often the best response to a complex problem — even if it has a single cause, like a pandemic — may be an assembly of multiple elements rather than a single approach. This is very clear in the case of COVID-19 which has required multiple responses in relation to:

- Testing and tracing
- Vaccines
- Economic support for households and businesses
- Policing
- Care homes
- Education
- Homelessness
- Mental health

The best responses in each of these cases are relatively independent of each other. To over-synthesise them would have been inefficient. A good example in the UK is how the prisons handled the crisis: a grasp of the science and the practicalities of prison life enabled the service to take effective steps to manage the pandemic.[244] For centres of governments the priority may be to identify important linkages and interrelationships, or where decisions have much broader impacts (such as lockdowns) and focus on these: enough synthesis, but no more.

In a previous IPPO paper[245] we suggested some of the methods that could be used to do synthesis more systematically, and one key implication of this study is that many governments may need to prioritise better approaches to synthesis, including:

- Training a critical mass of officials and politicians in the skills needed to understand complex patterns and how to shape them, from pandemics and financial crises to climate change, rather than relying on traditional skills in economics and law (synthetic people)
- Creating institutions within the heart of governments that see it as their

role to see both tasks and actions in the round (synthetic institutions)

- Processes which enable multiple types of intelligence and knowledge to be engaged with and brought together to guide decisions whether on pandemics or issues like climate change (synthetic processes).

7. SOME CROSS-CUTTING CHALLENGES IN THE ORGANISATION OF INTELLIGENCE

In this section we summarise some of the other difficult challenges all governments faced.

- How to prioritise and manage trade-offs?
- How to mobilise intelligence fast enough?
- How to tap into deep specialist intelligence?
- How to manage interdisciplinarity?
- How to ensure sufficient standardisation?

7.1 Linking strategies to (sometimes conflicting) values

All aspects of intelligence — what is looked at, what is included and left out, and how intelligence is expressed — are shaped by values, including what is seen as 'good' in moral, ethical, or social senses (e.g. how much privacy can citizens rightfully expect, how to weigh up saving as many lives as possible and imposing extremely strict restrictions). Again and again through the crisis Governments had to explain the choices they made in terms of values, in particular the supreme value of preserving life.

However, that was not always easy because values often clashed, including weighing the value of protecting life against the value of sustaining normal everyday life; the value of protecting the elderly against the value of protecting opportunities for young people. This kind of ethical (and political) reasoning could be challenging for the technical experts, some of whom saw the protection of life as an absolute value.

Moreover, the strategies chosen by different countries often reflected different underlying values. For example, Sweden presented its choice to avoid draconian lock-downs as, in part, a reflection of its social values and trust in its people to make the right decisions.[246] The strategies then chosen in turn affected government priorities. An example is the importance placed on intelligence from border controls: interviewees from Bangladesh and Australia in particular referred to the importance of robust intelligence gathering from borders as an important aspect of their zero-COVID strategies.[247]

As the pandemic progressed, conflicts between priorities — such as 'health vs the economy', or 'elimination vs suppression' — became more visible.[248] Some interviewees felt this shift hampered collaboration and information-sharing, as some sought evidence that would support their preferred approach.[249] Ideally, values are discussed openly so that if, for example, a choice is made to deprioritise people in care homes, or the place of mental health, this should be debated rather than becoming an artefact of the design of intelligence systems.

7.2 Speed

All governments struggled with the dilemmas of speed, having to work at much faster pace than usual. At the start of the crisis decisions had to be made very fast, including on lockdowns, rules and financial compensation. But later, too, speed became an issue. For example, countries such as South Korea or New Zealand, which had relied on extremely up-to-date track and trace systems to pursue zero-Covid strategies, struggled with the appearance of the highly infectious Omicron variant, as they simply could not collect data fast enough to track the spread.[250]

Medical experts with clinical backgrounds sometimes had more experience of providing directly actionable evidence at speed.[251] But this was less familiar for other researchers. Relaxing usual standards of rigour, and/or acceptance of simpler, faster analyses, can help governments to make decisions faster. As an example, the Office for Statistics Regulation in the UK relaxed their previous rule that official statistics would only be published once per day, at 9.30am, and introduced lighter-touch "Rapid Reviews".[252]

More generally the kinds of evidence that are likely to be most useful in a fast-moving crisis are different from those in

normal times. The below diagram from forthcoming work by Eleanor Williams summarises which types of evidence are most likely to be useful in conditions of pressure such as pandemics, being both relatively easy to generate and easy to absorb.[253]

Even for experienced government officials, operating in a crisis can be different to normal government functioning. One important factor is the lived experience and mindsets of working in a crisis which may be particularly important as crises overlap.[254] As noted by the UK's Office for Budget Responsibility, "just two decades into this century, the UK has already experienced two 'once in a century' economic shocks — the 2008 financial crisis and the 2020 coronavirus pandemic."[255] However, as flagged by multiple interviewees, the fatigue of working with a crisis can diminish creativity, affect decision-making, and inhibit medium and long term planning; this could severely worsen in a state of 'perma-crisis'.[256]

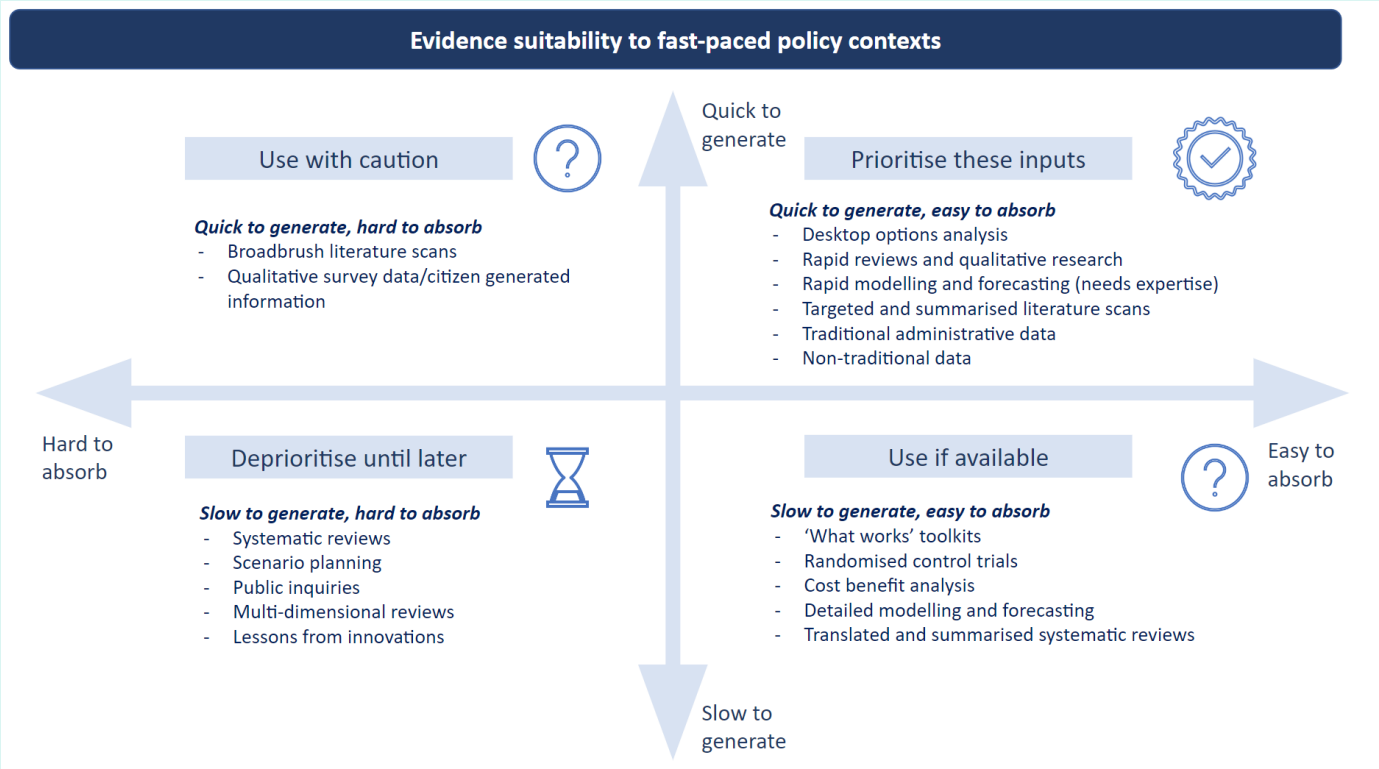


Figure 10: Types of evidence that are most likely to be useful in conditions of pressure, from forthcoming work by Eleanor Williams (UCL/STEaPP and University of Queensland).

7.3 Specialism, generalism and responding to policy demands

The demands of the crisis also created challenges for experts. Research on scientists on European advisory boards found discomfort in moving from "providing evidence" to "providing an answer to specific questions and offering a more definitive answer". [257] Interviewees from Australia and the UK mentioned experts' reluctance to compromise on rigour, sometimes resisting questions (even when quick answers would be useful) or making assessments from limited information.[258] Researchers expressed concerns to the Office for Statistics Regulation in the UK, through emails and web forms, about lowering of traditional standards of peer reviewing in academic research.[259]

Sometimes specialists did not always fully understand how governments would use intelligence; for example officials from the New Zealand government found that "some disciplines such as those within Science and Health were less familiar with Intelligence language such as the use of probability yardstick terminology... additionally, information handling protocols and understanding of security classifications could be an area for development."[260] However some interviewees suggested that domain specialists found opportunities to learn policy-related skills during the pandemic, such as how to convey messages, or use both formal and informal contacts within government.[261] Bringing domain expertise and policy skills together was therefore an important capability in its own right.

In Taiwan many of the senior civil servants in charge of the pandemic response had scientific backgrounds, in particular vice-president Chien-Jen Chen and the vice-premier Chi-Mai Chen (respectively, a former epidemiologist and one of his former students.[262] In other cases specialist and policy expertise were combined via officials' skills in summarising and communicating intelligence from specialist experts. In Bangladesh civil servants in an 'Intelligence Unit' worked with, and explained data to, decision-makers to formulate key 'what do we need to know' questions, which were then used to guide more detailed discussions around collecting and analysing data.[263] An interviewee in Australia felt that their team benefitted from developing enough domain expertise to ask specific questions of experts, which often prompted expert input in the face of the aforementioned reluctance.[264] Ensuring that governments

"This concept of science-policy interfaces is something that we're still trying to develop. Somebody who knows the organisation and civil service - a bit like the internet it works, but nobody quite knows how - and the science, that's difficult and abstruse, we need to be a Babel Fish in communicating that together."

- Senior science advisor, UK

have the skills for this interpretative work in-house is important.

7.4 Helping different disciplines to work together

Disciplinary differences and uneven experience with quantitative vs. qualitative, real-time or delayed, formal or tacit could also present challenges. One study interviewing scientists on advisory boards in Europe found that "understanding of what constitutes 'evidence' seemed to differ among board members who were not always familiar with methods used by other disciplines", with social scientists in particular struggling to gain equal respect and biomedical sciences dominating; however, this may have improved with ongoing collaboration. [265] An interviewee involved in the global pandemic response also noted an important relationship between disciplinary or domain expertise and personal connections; it is easier to accumulate and maintain trusting personal relationships with people in a similar domain. This means flows of intelligence, particularly tacit knowledge, can be easier within a domain than between them; a phenomenon they regarded as a "major constraint."[266]

Nonetheless, interdisciplinarity was 'baked in' to many processes for producing and using intelligence. Many of the scientific advisory boards closest to senior decision-makers were interdisciplinary in form, even if some disciplines tended to predominate. Disciplines sometimes needed to borrow from one another to inform their own analyses. In the words of Richard Hughes, Chair of the Office for Budget Responsibility in the UK, "when I want to make an economic model, the first people I speak to are the epidemiologists". [267] However, it is rarely, if ever, possible to create models that capture the insights of multiple disciplines without these becoming unwieldy and weak in predictive power.

7.5 Standardisation to support cooperation

Common logics, frameworks and standards can make it easier to share and use intelligence. However during the pandemic even data such as numbers of deaths were defined and recorded differently across countries and regions, which posed issues for analysts and policy makers looking to understand how the virus was behaving across different regions and cultures. A study by the GovLab on use of non-traditional data during Covid found that lack of coordination and institutionalization led to a lot of work being held in silos and duplication of efforts.[268]

Sharing intelligence horizontally, as well as inwards to a central authority, raised questions around which standards to use. For example, intelligence collected in different regions of federal systems — such as Swiss cantons and German Länder — was not necessarily standardised, or used different technical

interfaces or APIs.[269] Our interviewees also raised some of the underlying difficulties that arise in any process of standardisation. Who should be empowered to set standards, particularly in federal systems which are supposed to have decentralised power?[270] Should standards persist over time, allowing for ongoing understanding of a phenomenon; or adapt as situations change?[271]

A key theme related to standardisation was digital infrastructure. Countries with strong pre-existing digital infrastructures — sometimes backed up by legislation requiring data sharing — were better able to collect, combine, and analyse data to adapt at speed. In South Korea, a combination of digital infrastructure and cultural preferences towards digitally-facilitated transactions (such as ride-hailing and food delivery apps) provided valuable data on behavioural changes during the pandemic.[272] A research and regulatory body in the UK had, pre-Covid, already taken steps to digitise their processes of conducting and publishing research; during COVID-19 this helped them to share survey data within 24 hours. They felt this could have been improved by integration *across*, rather than simply *within*, regulators — something that began later in the pandemic, but required "a lot of retrofitting".[273] Other countries struggled more with digital infrastructures. An interviewee from Cape Town noted that databases even within the same state — for instance of water access, energy access, and clinics — were not interoperable.[274] Bangladesh had pre-existing databases of 'ultra-poor' citizens, but these were held in regional centres and were often physical in form. Work had begun to digitise these, but when the pandemic hit these efforts were accelerated.[275]

However, our interviewee from the Federal Council Coronavirus Crisis Unit in Switzerland noted that, even with pre-existing digital infrastructure in place, lack of interoperability between interfaces and APIs can still create work and burdens for gaining a national picture of the crisis.[276] Legal and technical preparedness to support appropriate key sources of intelligence gathering on a national level could help such situations in the future. Again, this raises the question of who gets to define the standards. Another interviewee from an NGO also noted that alternatives to full digitisation in data collection infrastructure can support data collection — for instance in the Indian context, many people in rural areas may not have smartphones but do have ID cards which, when taken to a local kiosk, can allow them to make and receive money digitally.[277]

7.6 Openness, secrecy and privacy

A traditional view of intelligence flows in government sees it as a funnel that passes information into government where it is then analysed, with decisions made in a fairly untransparent way. However, numerous cases throughout the COVID-19 pandemic illustrated the importance of openness. Governments opening up their data brought benefits to numerous other actors; the fully open data of the Berlin Senate was more useful to journalists than the closed dashboards of the national Robert Koch Institute,[278] and in South Korea companies and coders used open data to make apps with which citizens could track medical supplies in their local stores.[279]

Governments also benefited in turn from open data. Making data, evidence, and models open allowed for more analysis from outside actors, improving the rigour and trust of government outputs[280] — although in some cases data initiatives used by governments weren't published until after the fact, which led to privacy concerns.[281] The products of open data and open innovation also produced new intelligence which could be used by governments — see examples in our section on creativity. At its best this can create virtuous cycles; for example the World in Data dashboard drew upon data made open by governments, and was in turn used by governments to build evidence of how COVID-19 was progressing in other countries.

The contrast between the traditional view of government and some virtuous cycles facilitated by open intelligence are displayed schematically in the figure over the page:

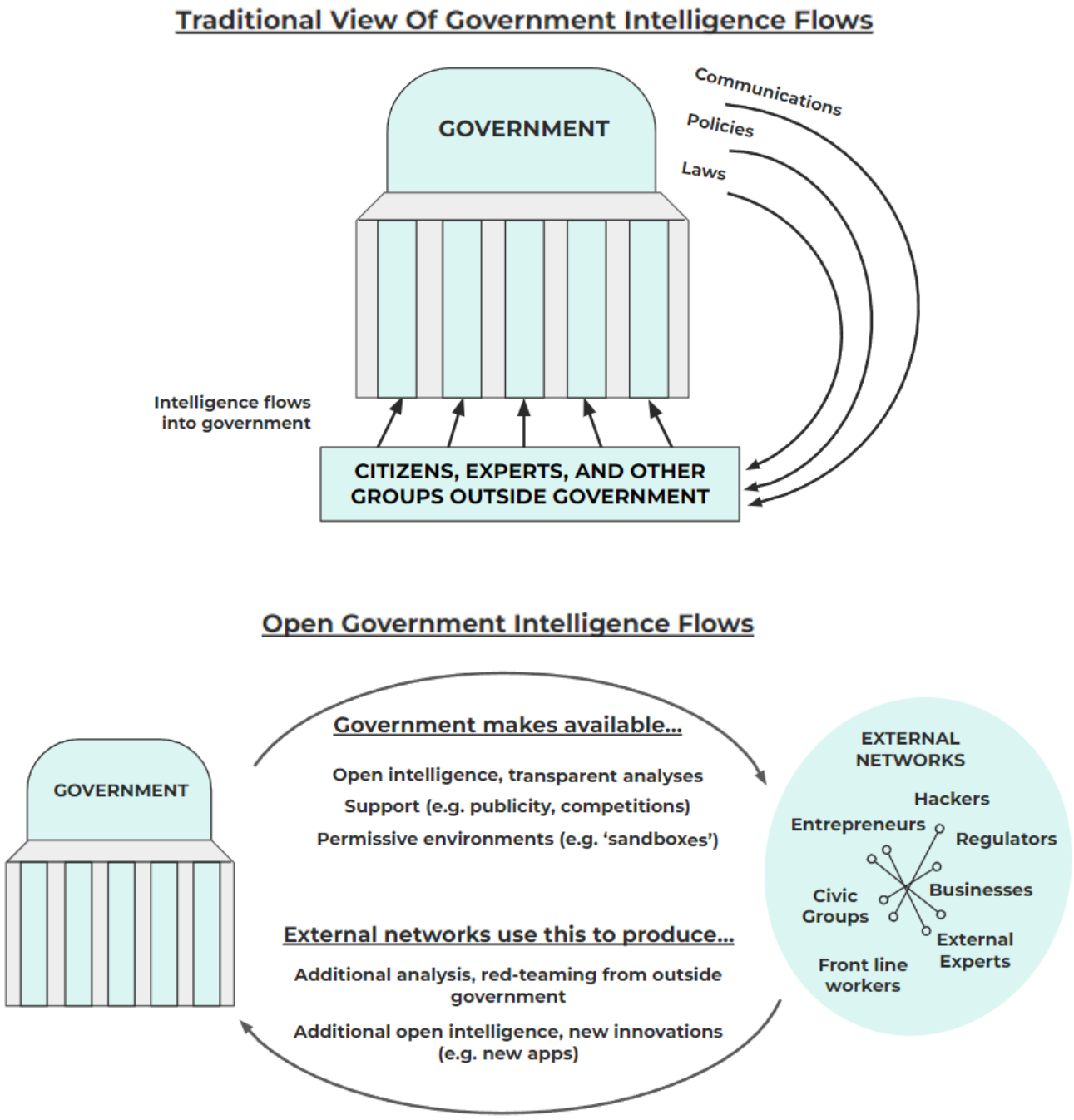


Figure 11: Traditional vs. open approaches to intelligence flows between government and external groups.

The traditional view (top) is characterised by one-way flows of intelligence into government, followed by analysis and decisions made with limited transparency, followed by communication (e.g. of policies) back out of government. The open view is characterised by continual access to transparent intelligence, analysis, and decision-making by groups in wider society; these groups can then network together to provides critiques and innovations, which in turn support production of new intelligence and better analysis. Support and resources from government can also support this process.

At the same time openness has to be balanced against privacy risks. Providing too much information can lead to individuals being personally identifiable, as happened for example in South Korea.[282] Privacy can be highly context dependent. Numerous commentators have drawn distinctions between East Asia, where laws and public views were held to be relatively permissive of technological surveillance, and Europe, which tended towards greater protections of privacy.[283] However it should be noted that (i) citizens in South Korea did raise privacy concerns over monitoring practices, particularly as the severity of the COVID-19 threat decreased[284] and (ii) in Europe there were cases of, for example, German police using contact tracing apps to locate criminals, in violation of the apps' original data collection purposes.[285] The New Zealand government had to consider privacy in the context of (i) having very low case numbers, such that case data could personally identify individuals if not handled carefully and (ii) differing cultural notions of privacy, in particular the collective notion of privacy held by the Māori population (which led to legal challenges around whether the government should comply with requests from Māori leaders for personal information on vaccinations).[286]

Various laws played a role in ensuring privacy. The General Data Protection Regulation (GDPR) in Europe allows for higher levels of data sharing when necessary to protect life and/or public health,[287] but this may not have always been flexible enough; for instance one interviewee from Berlin suggested that there were limits on the detail of economic data which could be shared, and an Estonian interviewee described synthesising data "as much as possible, within the GDPR".[288] On the other hand, some officials in Bangladesh were concerned that some uses of personal data during the pandemic may have not given enough consideration to privacy, and Bangladesh is now developing a new privacy law.[289] In Taiwan, Digital Minister Audrey Tang argued that the "Digital Fencing" approach to monitoring quarantining individuals preserved privacy as (i) the system re-uses data, as phones will "already have its signal strength checked by the nearby telecom towers anyway" (ii) there is a constitutional limit of 14 days on tracking an individual.[290] The New Zealand government reported that a learning from COVID-19 was that "it would be beneficial if good information sharing agreements were in place ahead of time, or as an early priority".[291] Ensuring that data can be shared efficiently and legally before a crisis hits is one specific example of how good planning and foresight can ensure responses can be fast and flexible while also maintaining necessary safeguards.

Beyond legal and ethical privacy concerns protecting individuals, governments must also balance openness against other risks. In particular, governments releasing

intelligence too quickly, or in too great a volume, risks miscommunications and misunderstandings. The UK-based epidemiologist Professor Neil Ferguson, who worked closely with the UK government, argued that releasing models before the government had a chance to complete internal analysis could lead to "unhelpful parallel analyses in the media".[292] There is also the risk, in relation to informal interpersonal flows of intelligence, that releasing material too readily could damage trusting relationships and limit candid communication.

Finally, making sure materials are suitable for official publication by government, and addressing responses, can take work and create further capacity pressures.[293] While many institutions provided access to their data for the first time during COVID-19, the value of these efforts was often hampered by a lack of institutional frameworks to keep things going.[294] Weighing these against the benefits of openness, the best approach for a government may be openness by default, but with pockets of secrecy where necessary.

8. BEYOND COVID-19: GOVERNMENT INTELLIGENCE IN THE FUTURE

No crisis is quite like the last one and there is always a risk of seeking to fight the last war rather than the next one. But we think there are some clear lessons for governments, not just in how they plan for crises, but also in how they mobilise intelligence for everyday tasks.

Almost everything governments do depends on the quality of their intelligence, and the structure of Chapter 2 provides a good starting point for thinking about how they might do better (and ensuring it is part of someone's job to answer these questions):

- Do they have the right data? If not, how can they mobilise it, perhaps with distinct rules during crises?
- Do they have the right kinds of evidence and evidence synthesis? If not, how could they formalise this?
- Do they have strong flows of tacit knowledge, including from lived experience?
- Are they thinking ahead?
- Are they using the best possible tools to mobilise creativity and solve problems?

As we've shown, a useful metaphor for thinking about this is to imagine driving a car through a storm. To get from A to B the driver needs good data, good understanding of evidence (for example on braking distances in rain), tacit knowledge on how to handle steering, an ability to look ahead, and, if a tree has fallen, some creativity in getting around obstacles. Many of our findings suggest the value of thinking in these quite simple ways about how to use intelligence to steer government, and whole societies, through crisis.

But the messages of our research also go beyond this simple metaphor, partly because the organisation of intelligence in a complex government is not as simple as driving a car, and partly because the best solutions often require widely distributed capacities to solve problems, rather than assuming that the driver can do it all themselves. In other words, what matters is also something akin to an immune system — widely spread

capacities to confront challenges. Here we suggest a few areas of action that can help both in preparing for future pandemics and in improving the more day-to-day operation of governments:

- Creating roles at the heart of governments responsible for organising intelligence and strengthening the links between the creators and users of intelligence.
- Ensuring officials and politicians are prepared with the right skills and mindsets.
- Cultivating the relationships — particularly between different tiers of government — that become so vital in a crisis.
- Developing norms and methods for opening up intelligence in all its forms.

8.1 Roles: more systematic organisation of intelligence

A key message of our research is that the organisation of intelligence in governments is unnecessarily fractured. It is mainly divided by functional departments — health, economy, education and others — and then overlaying this is a division between specialisms — data, evidence, foresight, statistics and science advice. When a crisis hits, governments must quickly improvise more holistic, synthetic and integrative approaches that bring these together, using everything from crisis control rooms to multidisciplinary teams.

Our argument here is that these should in the future be the starting point rather than an occasional improvisation, with appropriate roles, structures, processes and cultures that deliberately straddle the silos.

Classic intelligence functions have always put more emphasis on synthesis, with structures such as the UK's Joint Assessment Staff which draw on inputs from many different agencies and aim to provide a synthetic view of events and threats. We would argue for a comparable approach to be taken for domestic policy, particularly in relation to potential crises. In other words, there should be a clear allocation of responsibility for the organisation of intelligence around governments' main priorities, linking together data, evidence, experiment and so on. Such 'synthetic' structures are common in some governments but weak or non-existent in others.

Governments might also be helped by a more synthetic approach in universities. At present they are equally silo-ed in their approaches. We are not aware of any which have a centre or department focused on intelligence in the round. Solving this is bound to be difficult given

the strength of disciplines (from economics and public policy to computer science, medicine and engineering), and given the nature of peer review, it is bound to be difficult to shift research funding in this way. But a more systematic approach to intelligence could deliver big dividends in the long-run, and we recommend that organisations such as UK Research and Innovation (UKRI)in the UK consider how they could contribute.

It is very difficult to improvise the use of new technology or a new platform if you have not done this in 'peacetime'. Better organisation of intelligence in normal times should provide benefits in times of stress and crisis.

8.2 Skills — being better prepared

An obvious lesson is to ensure better skills and capabilities through training, simulations and exercises. We need decision-makers to be as confident in handling issues of science and technology as they often are in law and economics. Governments need a critical mass of people, whether officials or politicians, who have had some training in how to think systemically, understanding how to use data, how to make sense of potentially exponential trends and how to act in conditions of crisis.

Some of these skills can be learned through traditional pedagogy, of the kind provided by Masters of Public Administration (MPAs) and civil service colleges. here are many good examples of training programmes, from China's Executive Leadership Academy in Pudong to Bangladesh 2041 programme and India's Mission Karmayogi for training civil servants, the Australia and New Zealand School of Government (ANZSOG), and Australia's recently created academy for politicians (the McKinnon Institute). Increasingly these are putting a greater emphasis on science, engineering and technology issues, systems thinking and coping with crises.[295]

But a common message is that some of the most important skills are learned best not through classroom exercises but through simulations that provide the feel of real crises, so as to explore emotional reactions as well as rational and analytic methods. In some countries, such as Finland, these involve business and civil society — and provide the added benefit of better mutual understanding and relationships.

We've also observed that some governments use reserve pools of experts/academics on hand for crisis response. In some cases they are paid — with the proviso that they have to be available within hours of a call. In other cases their roles are more informal. But it is bound to be the case that expertise will primarily lie outside the boundaries of government itself.

8.3 Growing robust relationships

Our research has emphasised the importance of relationships, both informal and formal, and of trust: these can greatly

help when a stressful crisis hits. Some governments encourage relationships between different tiers through the circulation of people — for example national civil servants in France have to spend time working in local government, and the new 'Institut National du Service Public' aims to reinforce engagement between the centre and public servants on the ground. Others do so through events and networks that deliberately mix people up, like ANZSOG in Australia that trains national and state officials.

The collaborative model used in some countries also mobilises working groups that cut across tiers and hierarchies to encourage both better insights and stronger collaborative relationships.[296] Similar methods have at times been used in health systems — and there is a long history of using these to support innovation, improvement and trust across the system, but these methods are less common in other public services and the core civil service.

Other methods include the deliberate organisation of reserves — not just the networks of experts mentioned earlier, but also officials and people retired from teaching, the military, police and health services. Emergency preparedness and resilience is likely to be an important priority after the pandemic — and requires building up databases and training in normal times so as to be ready for crises.

8.4 Opening up intelligence and sharing data

In the past governments understood intelligence as something to be pulled in, hoarded and kept secret. While that approach remains very valid in the face of threats from hostile nations it is quite inappropriate for challenges like pandemics and climate change. For these the priority is to share intelligence in all its forms as widely as possible so as to enable society to act and adjust. This can involve sharing information and advice, but it goes further than this. As one of our Indian interviewees said, the key role of platforms is not to scale up and distribute solutions but rather to scale up and distribute the capacity to generate solutions.

"Between crisis and disasters you need a confident and very responsive civil service system which could take quite a few years at our scale to build... How do you configure systems? Otherwise, if there are too many hard-coded platforms and structures and the responsibilities shift, responsibility actually goes down rather than goes up. So that's important question of how do we retain that "Lego Thinking" and responsibilities rather than only in the infrastructure and resilience... how do we design this assuming they will break? Because there's nothing that's foolproof. There's nothing watertight in systems."

- *Sanjay Purohit, Chief Curator, Societal Thinking, EkStep Foundation*

Such approaches are becoming more common even in the context of classic intelligence, with the decisions of US and UK intelligence to share information in late 2021 on the likelihood of Russia invading Ukraine. There were also many good examples during the pandemic, such as the 1,100 experts who responded to the Parliamentary Office of Science and Technology Knowledge Exchange Unit;[297] the 750,000 who volunteered to help the National Health Service on the GoodSam app;[298] and the 4m who volunteered to contribute information through the Zoe App.

Many governments committed to opening up data in the 2010s (linked by the Open Government Partnership) and there have been further drives to open up evidence, including the US Congress' Evidence for Policy-Making Act in 2018.

However, these types of approach are not yet fully mainstream, and data and knowledge of all kinds are still often hoarded. One potential legacy of the pandemic is to make them more common, and to see the sharing of intelligence as a natural part of governing. This will apply to all the categories mentioned in Chapter 2. A first one is much more systematic sharing of data, and ensuring that the right protocols are in place to activate in the case of a crisis. Several countries — including Portugal — are now considering introducing a public interest requirement for commercial data to be shared, in an anonymised form. This could prove vital to successful action on slower challenges like climate change, where most of the relevant data is proprietary and held by private companies (though some fear that such moves could in the future threaten privacy).

More systematic investment in evidence synthesis and overviews is another part of this shift, with the UK's National Institute for Health and Care Excellence (NICE), What Works Centres and observatories like IPPO and the Economics Observatory as useful models. There is also the potential to open up tacit knowledge through sharing frontline observations and reports, or patterns from case notes. Collective intelligence platforms also have a larger role to play — with some examples now at very large scale linking up professions or fields to rapidly share information, knowledge and problem-solving.[299]

All of these point to a future where governments are more energetic and more systematic in mobilising and orchestrating intelligence of all kinds, not just to help them make decisions, but also to help their societies and economies make better informed decisions too.

9. FUTURE RESEARCH - ANALYSIS LINKING INTELLIGENCE METHODS TO OUTCOMES

In this report we have provided a snapshot of how governments used intelligence and we have made some recommendations. However, we realise that the key question is how different methods of organising intelligence contribute to outcomes. The justification for gathering data and evidence, or organising functions in new ways, must be to make better decisions and reduce harms.

Unfortunately, it remains hard to make any definitive judgements about these patterns through the pandemic. There have been some attempts to map the very different strategies followed by different countries, such as, for example, work by the International Network for Government Science Advice (INGSA) in tracking government responses.[300]

A key metric for comparing government, developed by the Oxford Blavatnik School COVID-19 Government Response Tracker (OxCGRT), is the stringency of responses.[301] Looking at stringency, there were two main clusters of government responses.[302] Some countries pursued 'elimination 'strategies, aiming to maintain zero levels of COVID-19 by very strict interventions. This was particularly common in the East Asia and Pacific region. Such interventions ranged from very strict time-limited lockdowns (for instance in New Zealand) to very intensive monitoring and quarantining of new entrants and confirmed cases (as pursued by South Korea).

Others pursued 'flatten the curve' strategies, aiming to reduce infections to avoid overwhelm of health systems while maintaining some openness, often through varying policies as infection rates changed. This was more common in Europe, Africa, and the Americas; indeed INGSA research suggests it was the most common form of strategy deployed.[303] But even now it is still draw firm conclusions about which worked best, and one reason is that the patterns of performance have changed over time.

The Bloomberg Covid Resilience tracker[304] has ranked countries on the basis of "the best and worst places to be during the pandemic" based on a range of measures including fatality and vaccination rates, stringency of restrictions, and GDP growth. They updated the ranking 20 times between November 2020 and June 2022. The changing rankings show that many countries which pursued elimination strategies — for instance China, South Korea, and New Zealand —

initially managed to minimise both loss of life and economic damage compared to other countries.

However, the growth in prevalence of the highly infectious Omicron variant from December 2021 onwards meant that by the autumn of 2022, these countries were experiencing greater social and economic impacts than countries which aimed to suppress the virus (largely through vaccination). The differing effectiveness of elimination strategies at different times can be seen in the huge changes in performance ranking for countries such as New Zealand, Australia, Taiwan, and Mainland China (though some countries such as South Korea maintained relatively strong performance throughout, and some other countries which pursued suppression strategies also saw very wide changes in ranking, such as France and Belgium).

These are reasons why it remains hard to make definitive judgements. We hope that the research presented in our report is supplemented in the future by more in-depth studies linking the methods used by different governments and reasonably objective measures of their performance on many fronts, from mortality to economics, mental health to childrens' education. This will contribute to more fine-grained understanding of which types of intelligence activity were most useful in minimising harms, managing trade-offs and planning routes out of the crisis.

APPROACH TO RESEARCH

This study aimed to learn lessons about how governments thought and acted under enormous pressure during the pandemic. We realised that a period of extraordinary innovation and improvisation might offer lessons for how governments could be organised in the future, not least because the tools available to decision-makers are different from a generation ago. Many governments which had not been seen as models in the past had outperformed others that used to be seen as exemplars (though, as we show in Chapter 9, it is still hard to make definitive judgements about comparative performance).

The aim of our research was to focus on intelligence in a more holistic way, considering the many inputs that can help to inform and shape decisions. The research drew on a range of sources including published materials, interviews with over 40 government officials and experts based in over 20 countries across the world, 2 international roundtables, as well as other IPPO research on many other aspects of the pandemic including several large public events. Many of the interviews had to be anonymous because of the sensitivity of the issues.

The work aimed to combine description, analysis and prescription, and was designed to be broad and rapid in order to help government decision-makers across the world as they consider how to apply lessons from the pandemic to other complex challenges. We hope it may prompt other more in-depth analyses of intelligence in the round.

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Institute, Australia. However this could backfire without a clear and shared communications strategy; for instance early interviews with scientists in the UK may have spread public confusion around the idea of 'herd immunity' as a strategy.

[157] According to analysis by Professor Colin Talbot.

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[159] Interviewee from the Open Data Berlin Division at the Berlin Senate in Germany. There are 16 German Länder with populations ranging from around 700,000 to over 17 million.

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[170] Interviewee from the UK Government Communication Service, Interview with a Public Service Team, Australia

[171] Interview with Dr Gareth Haysom, Senior Research Officer, African Centre for Cities, University of Cape Town, South Africa.

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[174] Interviewee from the UK Government Communication Service

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