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RESEARCH

Preparing for Crises: Lessons from Covid-19

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The Covid-19 pandemic is an unprecedented crisis for governments across the globe. Despite a timely and effective mobilization of resources, consistent challenges hampered the efforts of many governments and resulted in avoidable losses. With the benefit of hindsight, we focus on two root causes behind the deficiencies in the global Covid-19 response: (i) challenges in collaboration and coordination between multiple actors and (ii) challenges in using existing data infrastructure to inform an evidence driven and dynamic policy response. We argue that adopting an active learning mindset, putting in place protocols and mechanisms for greater coordination and collaboration, and preparing a robust data infrastructure will help governments improve their responses to Covid-19 and other emergencies in the future.

Keywords: State capacity; crisis management; active learning; coordination; data infrastructure

I. Introduction

Covid-19 forced policymakers around the world to grapple with difficult choices. Inadequate state capacity and our limited understanding of the virus made these choices harder and costlier. Through a lengthy and extensive engagement with governments in India and Pakistan, what became increasingly apparent to us was that policymakers were also hamstrung by their limited understanding of *how to acquire* the relevant knowledge and capacity. *Learning to learn* was something that Covid-19 forced on many governments without the requisite training or tools.

In our view, the deficiencies that Covid-19 exposed are conceptually different from the more usual reasons for weak state capacities, whether a lack of effort or a lethargic response, or just plain corruption. In fact, the Covid crisis prompted a tremendous effort and desire to minimize the loss of life and to curb economic losses, with government workers at all levels of national administrations engaged in a sustained long-term effort. With some notable exceptions, policymakers around the world mobilized resources to handle the crisis and minimize hardship for their citizens. Frontline staff, especially healthcare workers, worked tirelessly and at considerable personal risk to assist others and to protect the population. Civil society and non-governmental organizations added to this effort, working around the clock to provide relief, and academics and researchers mobilized to better understand the crisis and provide timely advice to policymakers. While the ability of the state to function at very high levels for a short period of time or in a specific geographical area has been remarked on, the Covid-19 response in many countries showed that the state can function at this high level for a sustained period and over a wide geographical area [1].

Nevertheless, governments around the world were handicapped by the limitations of standard templates for policy problems. They have struggled with how to design, implement, and monitor policies in the context of a virus whose impact varies across space and time. The often-contradictory messages from different experts and disciplines, the lack of effective coordination between different policy actors, and the limited efficacy of top-down policies that pay little attention to citizens' agency have further contributed to the policy confusion. Consequently, while there is considerable debate around how to promote evidence-based policies, Covid-19 elevated a second fundamental problem that many policies are made in an uncertain environment. Covid-19 thus forced governments to contend with how to act when there is an *absence* of evidence.

We argue that the outcomes could have been improved if policy processes had been built on coordination, collaboration, and an active learning mindset from the outset. We hope to understand and learn from the various challenges observed in the response to the Covid-19 pandemic and recommend changes that can address the root cause of these challenges and put systems in place that allow us to respond more effectively to the ongoing pandemic and future crises.

2. Challenges Revealed

2.1. Collaboration and coordination

2.1.1. Academic silos

While epidemiologists and infectious disease experts were at the forefront of the initial response, crises and pandemics rarely come neatly packaged within academic disciplines and therefore expose the limitations of existing siloed approaches and models.

Despite the mantra emphasising the need for an inter-disciplinary approach to crisis response, the reality of the Covid-19 response has been one of limited collaboration across disciplines and regions, with the 'developed' North less willing to learn from the South and the East [2]. This lack of collaboration has been the long-standing norm in most low-income countries but has also been true for OECD countries throughout their pandemic response, despite their established traditions and protocols for collaboration.

This failure to learn from other disciplines and other regions led to multiple challenges, including flawed assumptions feeding into findings and policies, unintended consequences due to inadequate monitoring, and inappropriately high or low weights given to different disciplines. One stark illustration of this was an over-reliance on epidemiological models that, while a great initial step, did not incorporate behavioural responses and uncertainty in their estimates. First generation epidemiological models failed to account for, to name but three, heterogeneity in infectiousness of different strands of the virus, heterogeneity among the population's susceptibility to the virus, or variation in the number of people's contacts. Each of these could quite dramatically alter the trajectory of the epidemic [39]. To date, models have not been able to incorporate human behaviour such as varying levels of compliance to physical distancing policies—which in itself responds to the overall environment.[1] As quickly as 'flattening-the-curve' took hold, without incorporating standard errors on how uncertain the actual response impact was, the estimated response from policies, such as lockdowns, was always a lot more uncertain than what the graphs suggested.

Diverse expertise could also have shed light on various aspects of the crisis. The role of epidemiologists and infectious disease specialists is obvious for a pandemic response, but we can also leverage the frameworks and toolkits of social scientists to better understand the impact of the crisis. For example, while infectious disease specialists may be more concerned with mitigating Covid-19 spread in the present, education specialists could help us understand the consequences of disruptions in schooling on child development and the future labor force [3]. Other types of disasters have yielded similar findings—Andrabi and colleagues showed the impact of the 2005 earthquake on human capital accumulation [4]. Behavioural experts and anthropologists can shed light on how best to design and enforce public health interventions. Wilkinson and colleagues' anthropological insights from the Ebola pandemic highlight the importance of understanding local contexts, people, and relationships in designing public health interventions, rather than adopting a 'one-size-fits-all approach' [5].

Narrow field perspectives can also be quite costly. While governments correctly prioritized case prevalence rates in their decision making, the evidence on the social, economic, and non-Covid health profiles of different groups of citizens, and on the intended and unintended consequences of policy decisions, received less attention. While it may be the case in rich countries that the trade-off between lives and livelihoods is a false dichotomy, whether this is also the case for low-income countries is less clear.[2] Indeed the literature suggests a potentially starker trade-off in low-income countries due to economic vulnerability, food insecurity, informality, and limited fiscal space [6–8]. However, the absence of regular monitoring data hindered the ability of states and organizations to design lockdown and physical distancing strategies that could potentially mitigate the spread of Covid-19 without incurring the loss of livelihoods and incomes.

These disconnects are also present within disciplines. In the domain of health, there is increasing evidence that the Covid-19 crisis and the resulting response strategies affected a broad range of health indicators, including immunization uptake, maternal health, and infant mortality. WHO and UNICEF have highlighted a substantial drop in the number of children who completed three doses of diphtheria, tetanus, and pertussis (DTP3) vaccine during the pandemic [9]. Roberton and colleagues show that disruptions in health service delivery will likely increase maternal and child deaths due to reduced coverage of childbirth and child health interventions and increases in wasting among children, a measure of nutritional deficiencies, during the Covid-19 pandemic [10]. The burden of chronic diseases such as Tuberculosis

[1] This type of behaviour is known as 'prevalence elasticity', where preventive behaviour increases as a disease spreads through the population, thus limiting the disease spread. Conversely, it decreases as the disease declines, thus progressively hampering the efficacy of public health interventions. This phenomenon was studied extensively in the wake of the HIV crisis in the mid-2000s, but given the complexity of the problem, it was not incorporated into epidemiological models. Key papers on this subject include Hammer and Gersovitz (2004) and Tomas Philpson (2000).

Gersovitz M, Hammer JS. The economical control of infectious diseases. The Economic Journal. 2004 Jan 1; 114(492): 1–27.

Philipson T. Economic epidemiology and infectious diseases. Handbook of health economics. 2000 Jan 1; 1: 1761–99.

[2] Mobarak and Barnett-Howell show that, compared to rich countries, poor countries have lower predicted mortality from the unmitigated spread of Covid-19 but stand to lose more from social distancing policies through reduced economic activity and lower earnings. Given the lower benefits to poor countries from social distancing and the enormous economic costs, the paper suggests alternative policies that can minimize Covid-19 risk while preserving livelihoods. Mobarak, A. and Barnett-Howell, Z. 2020. Poor Countries Need To Think Twice About Social Distancing. Foreign Policy. Available at: https://foreignpolicy.com/2020/04/10/poor-countries-social-distancing-coronavirus.

Ferreira et al. examine the poverty consequences of the pandemic and estimate that the poverty generated by the crisis accounts for a greater share of welfare losses (vis-à-vis the health consequences of Covid) in poorer countries and the poverty burden is more serious for poor countries than the rich. Decerf B, Ferreira FH, Mahler D, Sterck O. Death and Destitution: The Global Distribution of Welfare Losses from the Covid-19 Pandemic. LSE Public Policy Review. 2021.

is also expected to grow with disruptions in service delivery and diagnostics [11]. The drastic drop in TB notifications and alarming numbers of children who missed vaccinations in India shows the lack of planning for continuity of routine health services in designing Covid-19 lockdowns.[3] Protecting the health of populations requires us to take into account the full spectrum of health issues that citizens face, not just those due to Covid-19.

This evidence highlights the need to consider the expertise of specialists across multiple disciplines in order to adequately understand the impact of the crisis and to effectively weigh the costs and benefits of various policy actions designed to mitigate the spread of Covid-19. Evidence that helps us better understand the effectiveness of behavioural interventions and the dynamics of adherence and compliance across diverse geographical and social contexts will be critical for the next crisis [12, 13].

2.1.2. Limited collaboration and coordination between policy actors

As frenetic as the policy efforts have been, and perhaps because of the desire to act rapidly, collaborating across tiers and agencies of government in a way that is centrally coordinated but still locally responsive has posed a substantial challenge. Empowering distributed policy actors with local information to act while coordinating their actions and enabling positive spill-overs and learning is key to an effective and cohesive policy response to a pandemic. Unfortunately, politics and transaction costs have often erected insurmountable obstacles that have prevented governments from assessing the broader consequences—particularly unintended ones—of standalone policies, especially when coupled with the idiosyncratic responses of citizens to public policies.

The wave of migrant workers returning from urban areas to their rural homes following the initial lockdown in India sparked a rural Covid outbreak [14] that could have been mitigated with better coordination of policy responses across the country (for example, putting in place quarantine centers and testing facilities before the lockdown was announced to prepare for the returning workers). This is also true elsewhere; Holtz and colleagues show that in the USA mobility patterns in one region were influenced by policy measures in other regions [15].

In most cases, individual policy actors displayed a desire to mitigate the crisis and to improve health and economic outcomes. But the lack of trust at times between different governmental agencies, and the absence of mechanisms in place for them to coordinate with one another, meant effectively collaborating proved to be a challenge. It has not been uncommon to see different agencies within the same government not cooperating and, in some cases, working at cross purposes. Unhealthy competition and a desire to avoid blame has often been a priority for governments throughout the pandemic. Such competition has been apparent in unitary states, where national and local governments conflict, but has been particularly evident in federalised countries, especially where the central and state governments hail from competing political parties, such as in Brazil, the United States, and Malaysia. The failure of these governments to agree on a coherent, cohesive approach has led to contradictory policies existing within national states. Such incoherence has ranged from policies regarding the extent of physical distancing and testing protocols to the sharing of critical data by central governments on mobility using cell phones. This inability to unify has also hurt citizens' trust in the state and the narrative of a shared purpose.

In response to this crisis, policy preferences and decisions have often depended on political affiliations. While in some countries, such as the USA, divisions over the preferred approach played out as a battle between the right and the left—with the latter more likely to be in favour of preventive public health interventions—this was not always the case. Often, rather than an ideological divide, it was a case of opposing parties trying to gain political mileage and discredit opponents. Policy responses within the far-right across European countries, for example, have differed depending on whether the far-right is in opposition or in government [16]. This further weakens policy coordination as competing political parties do not effectively coordinate and unify during crises. In a survey of 3000 Americans, Kushner Gadarian and colleagues found that political partisanship was the most consistent factor in determining differences in health behaviours and policy preferences with regard to the pandemic [17]. Similarly, Neelon and colleagues show an association between governor political affiliation and Covid-19 cases, deaths, and testing in the United States, suggesting that party affiliation may impact policy decisions and, thus, Covid-19 outcomes [18].

Also consistently lacking has been the right balance between politics and expertise. Many governments have failed to effectively rely upon expert authority, preferring political expediency over difficult decisions, while others have outsourced as much decision-making as possible to the experts, with a view of shielding themselves from responsibility for the impact of policy interventions [19]. The UK's Scientific Advisory Group for Emergencies (SAGE) experienced the latter, as the UK Government claimed to be 'guided by the science' in designing its Covid response and also laid the blame on scientists when their policies did not yield the desired impact [20].

Brazil's Covid-19 response starkly illustrates multiple coordination failures. President Bolsonaro was criticized for ignoring scientific expert advice and spreading misinformation about the disease [21], for failing to provide leadership at the national level and the resources necessary for an effective response at the sub-national level [22], and for undermining the leadership of global agencies such as the WHO [23].

[3] https://www.forbes.com/sites/madhukarpai/2020/09/26/tuberculosis-and-covid-19-fighting-a-deadly-syndemic/?sh=4d21ec224c59; https://scroll.in/article/971655/covid-19-has-disrupted-indias-routine-health-services-and-that-could-have-long-term-consequences.

In addition to effective leadership at the national level, there is a significant role for sub-national governments in ensuring there is a coordinated response [24]. Gaskell and Stoker recognize the need for both a strong central capacity, which enables rapid and decisive action, and a strong decentralized capacity, where multiple governance tiers can mobilize different resources and initiate action at different levels, as well as consultation mechanisms that integrate learning into the decision making process. They use the example of Switzerland and how it exhibited a strong decentralized capacity at three governance levels (federal, cantonal/regional, and communal), effectively mobilizing different resources to tackle the outbreak. On the other hand, they observe that in the UK, the lack of capacity at the local level resulted in confusion on how to implement central government's orders [25].

Multilateral, international agencies can play a critical role in times of global crisis, but their achievements, or rather lack thereof, in responding to the Covid-19 pandemic were best described by UN Secretary-General António Guterres, who said it was a failed test of international cooperation [26]. Instead of the WHO rising to the occasion, its mandate to coordinate a global public health response, to act as an information repository providing knowledge to countries worldwide, and to facilitate international agreements has been diminished as countries have refused to comply [27].

While policymakers around the world made a tremendous effort to contain the pandemic and mitigate its adverse impacts, they struggled to coordinate effectively across agencies and countries, resulting in suboptimal outcomes. Partially owing to the need to act immediately, as well as to the lack of mechanisms in place for coordination between various tiers of government and countries, policy actors operated in silos. The growth in divisive and ideology-driven politics also played a role in hampering coordination and diminishing the soft power of multilateral agencies.

Overall, more empowered local governments and strong central leadership and coordination, as well as more effective mechanisms to cooperate and share information and learnings globally, could have enabled a more cohesive pandemic response.

2.2. Failure to utilize existing data infrastructure

The pandemic has indeed also been an 'infodemic', with vast swathes of information, some true, some false, and some uncertain, spreading rapidly, sowing chaos and confusion among the populace.[4] This is not surprising, because the speed at which pandemic-type crises accelerate and evolve means it is difficult to gather and deploy the knowledge needed for an effective policy response. In addition to a lack of information around the nature of the disease and its transmission dynamics at the outset of the Covid-19 crisis, there was also a lack of information around the effects of different policy interventions. Despite the uncertainty, which often resulted in poorly thought-out decisions, confusion, or paralysis, some informed decisions could have been taken if already available information had been effectively used.

For example, existing data could have been used for better stratification and targeting of responses. Consider governments deciding between a general lockdown and a 'graded' lockdown, whereby certain groups are allowed greater freedom of movement to keep our economic engines running and so offering a degree of economic sustainability, especially for the poor.

One way of doing so would have been through *risk stratification*: Hospitalization risks for Covid-19 increase with age and pre-existing chronic conditions.[5] Therefore, allowing for potentially greater movement among the young and healthy while protecting our elders could have allowed for the resumption of economic activity *and* gradually built up immunity in our populations; even though the young will remain more likely to be infected.

Such risk stratification could also be *spatially targeted* by maintaining stricter restrictions in places with a larger agglomeration of older people and/or those with additional co-morbidities. For example, Italy introduced spatially targeted lockdowns based on risk stratification. It implemented a four-tier system, with areas with higher infection levels facing tighter restrictions. The government could have even more finely grained the stratification by taking into account morbidity profiles. **Box I** shows that this can be accomplished in practice as there is substantial degree of variation in the number of elderly across communities. We are not flying completely blind here. There is enormous prior information that can be brought to bear on this issue. It should.

Another example focuses on pre-existing risk factors. **Box II** shows there may be significant variation in such factors across neighbourhoods in a given city and hence potential for a varied policy response even within cities.[6]

These kinds of risk profiles can be built up using pre-existing data (like population censuses and health surveys) to construct a more comprehensive spatial vulnerability index. Such an index would allow policymakers to follow a graded approach, both in their precautionary measures, and in their expectations of hospitalizations, for instance, depending on whether the pandemic hit a village or urban neighbourhood. Policymakers can start from simpler approaches, using only age and sex, and as more data becomes available, these can be modified in real time to reflect the latest learning from the field.

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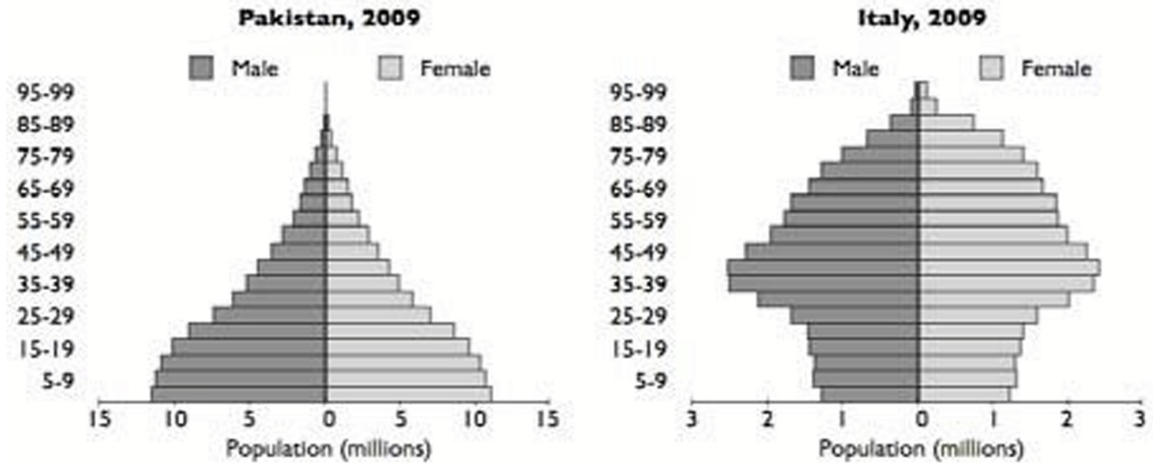
[4] The term 'infodemic' was first used by political scientist David J. RothKopf to refer to the 'information epidemic' during the SARS outbreak: https://www.washingtonpost.com/archive/opinions/2003/05/11/when-the-buzz-bites-back/bc8cd84f-cab6-4648-bf58-0277261af6cd/.

[5] What we know to date about the effects of Covid-19 in terms of hospitalization and mortality risks are that (a) it affects men and the elderly disproportionately and (b) it affects those with other co-morbidities disproportionately. To date, the co-morbidities that have been considered are all chronic conditions (hypertension, diabetes, and obesity) as well as smoking. There are many other possibilities in low-income countries, ranging from anemia (especially in women) to asthma and pollution-related problems to Tuberculosis. We do not know what hospitalization and mortality risks will look like in populations with a very different morbidity burden; neither are we sure about the likelihood of infection.

[6] One cautionary note is that while such variation as shown in Box II can help determine the degree of lockdown, to the extent that we tie support services, we need to be cognizant of not exacerbating underlying inequalities. If, for example, the red neighbourhoods are concentrated among poor areas or among members of one ethnicity, then these policies have to take such pre-existing inequalities into account.

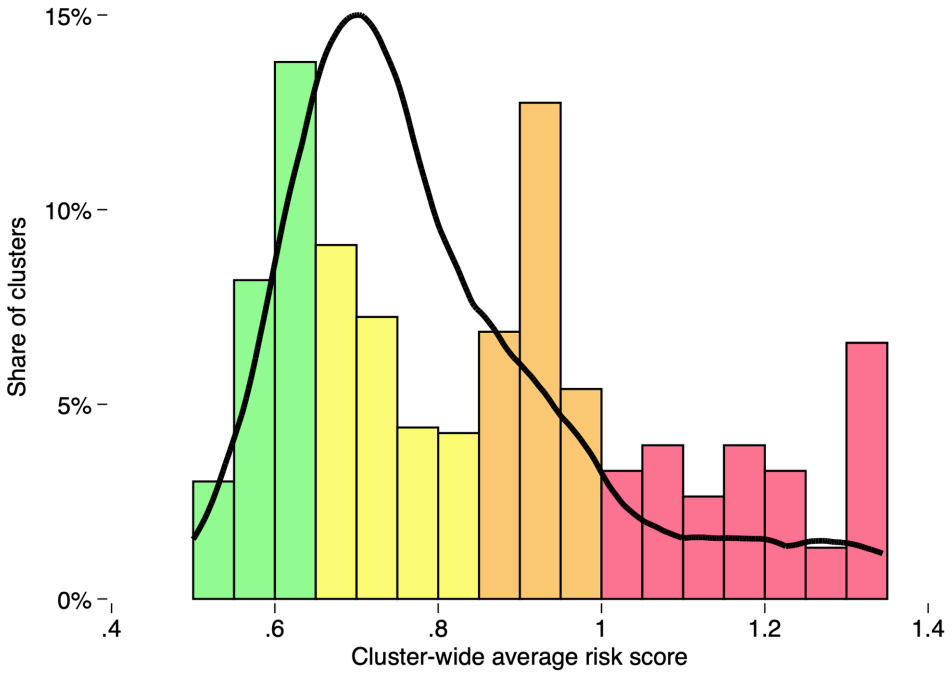
Box I: Using Age for Spatial Targeting

The figure below shows the age distribution in Pakistan, according to the U.N databook for 2007. The striking fact is that only 3.3% of the population is above the age of 65. Contrast this with Italy, which has a much higher fraction of elderly. What does this mean for rural areas? Assuming that the rural population is 63% of the country (World Bank) and there are 50,000 villages in the country, there are an average of 63 people above the age of 65 in the average village (and around 35 males). These people will not be distributed evenly—there will be some villages with a large number of older males; there will be others with a small number, perhaps even less than 10.



Box II: Pre-existing conditions

Using data from the National Family Health Survey (V), Das & Daniels show tremendous variation in Delhi in age, sex, hypertension, diabetes, and smoking and, hence, risk of hospitalization. The figure below plots risk variability across neighbourhoods, where green is least risky and red is highly risky. There are a large number of neighbourhoods in Delhi that are green but also a longish tail that is red; it is the red areas where we would expect the highest number of hospitalizations to come from if Covid-19 hits. Further, risk profiles are very different for poorer and richer neighbourhoods. Poorer households tend to be more predominantly male and with higher rates of smoking. Richer neighbourhoods have more people above the age of 65.



These examples show how using pre-existing data such as population and health censuses could have contributed to a more informed and nuanced policy response. In practice, governments were ill-prepared to leverage this data on demand. Although censuses are often a highly politicized exercise in some developing countries, making such data easily accessible is key to improving service delivery and to designing effective policies and programs.

There is also data that, while not 'standard', is readily available, provided governments can resolve access and privacy related issues and collaborate effectively with the private sector. For instance, despite how valuable mobile

phone-based mobility data has been in crisis contexts (such as predicting the spread and timing of dengue outbreaks) [28], most governments were unprepared or unwilling to use it in the context of the Covid-19 crisis. This reluctance was despite demonstrations of its effectiveness. South Korea, for one, used mobile phone data coupled with other data sources to implement a response strategy that was effective in lowering Covid-19 positivity and fatality rates [29]. Although some critics thought South Korea's use of private data too invasive, European mobile operators also offered to share mobile phone data in compliance with Europe's data privacy legislation, yet this opportunity was not taken up [30]. The World Bank has shown spatial data can predict potential clusters of pandemic, enabling governments to prioritize health and other support services. Their methodology used population density data alongside building heights data to identify a first set of hotspots, combined with mobility and other data to identify a second layer of potential hotspots [31].

Appropriate frameworks around the use of such data—including decisions on data ownership and consent, ensuring the data is aggregated and anonymized, enacting sunset clauses and purpose limitation clauses on the data as safeguards against misuse and mission creep, and ensuring transparency on who can access the data and for what purposes—are essential components of the data infrastructure.

3. A Way Forward

As the world continues to cope with the Covid-19 crisis, it is important to understand how the crisis response can be improved and how we can avoid repeating the same mistakes in the future. This can help us devise a better long-term response to the current pandemic as well as ensure we are ready to face the next crisis. Many of the solutions offered have focused on symptoms, rather than honing in on the root cause of the failures observed in the crisis response. We suggest three solutions that could rectify many of the challenges the world has faced in responding to the Covid-19 crisis.

3.1. Adopting an active learning mindset

A crisis response that works must be not only clear and decisive, but also flexible and modular to incorporate rapid learning. In an uncertain world, policy responses must be based on data and evidence and they must be data responsive. For this to take place, we must recognize that we are in a learning environment marked by experimentation. Governments and policymakers should not only act based on existing knowledge, but also take steps to better understand the costs and benefits of each policy and to refine actions in accordance with new knowledge.

In situations with limited prior information, we should recognize that there is a well-developed and well-tested machinery for how to make decisions amid uncertainty [32].[7] Key to understanding this process is the importance of learning, and within this, learning how to learn. Not only should policy actions inform our learning so that policies are tested and refined in real-time, but knowing that learning is so valuable, we should also take actions that speed up the learning process. In other words, learn as you act and act to learn.

In the context of the Covid-19 crisis, there are four distinct parts of this Active Learning process:

First, there are some decisions that will essentially remain the same *regardless* of what information becomes available. For instance, information is unlikely to change the need for testing and PPE, faster vaccination for health workers, or careful communication regarding Covid-19. In these cases, there is no point waiting for the information to become available. Governments should act immediately and communicate unequivocally.

Second, there are other decisions that are best made after collecting *some* information—especially if that information is relatively costless to collect. These decisions are ones where more information may change the decision. Suppose you are driving a car and you cannot see beyond a point. You have been told that beyond that point, either there is both a cliff and you will die if you go over it, or there is a beautiful meadow where you can stop and have a picnic. The obvious decision is to stop the car before that point and check before driving on. For countries that imposed sudden lockdowns like India, even a rapid real-time survey could have helped the government realize that migrants would rapidly leave urban areas if a sudden lockdown was imposed, and this would have allowed multiple mitigation measures to have been put in place. Countries can be prompt in their response but without rushing blindly into decisions.

Third, in making decisions, all prior information should be used. Maps that allow us to better understand the underlying vulnerability of populations so that governments can undertake a spatially targeted strategy are one example. Understanding population density in areas using census data, as well as mobility patterns based on cell phone data, could help identify areas that are more susceptible to infection spread and therefore may be candidates for greater monitoring and containment policies.

Fourth, governments must recognize that every decision will have an impact on the outcomes of interest and will *also* provide further information. This new learning can critically inform the decision-making process tomorrow. For example, consider a policy of locking down part of a city. While the immediate purpose of doing so may be to prevent disease spread, understanding how people react to such policies—not just in terms of compliance but also whether this affects mobility patterns in other parts of the city—can help us understand how such partial lockdowns would affect

[7] To the extent that we may be in a world of Knightian uncertainty, dynamic risk management with active learning trial and error based experimental approach is even more important.

longer term disease spread. Similarly, actions that generate critical information—even if they lead to limited immediate benefits—gain priority under such a perspective. As an example, sewage-based testing for disease prevalence, while less helpful in targeting treatment response, could help identify areas where disease may be spreading.[8] This moves us away from *passive to active learning* and must be a key component of the strategies in both high- and low-income countries.

Our experience has been that an Active Learning mindset can help coordination and collaboration between disciplines, because it allows an admission of what we do not know and what we (jointly) hope to be able to learn.[9] In adopting such approaches it is critical for governments to use a 'big tent' approach comprising economists, data scientists, infectious disease and public health specialists, technology sector leaders, as well as testing partners and government departments—and for governments to tailor this group to the specific crisis faced. This allows for a robust response plan that can balance various incentives and outcomes, such as mitigating disease spread while allowing for the provision of essential goods and services and some continuity of economic activity. Efforts to assemble broad coalitions and diverse expertise must be systematically done, because disciplines often do not naturally coordinate with each other. Sharing, deploying, and discovering knowledge together is cost-effective, fosters collaboration, and allows for more impactful and timely response. In a crisis, this Active Learning mindset can enable rapid action despite substantial uncertainty, while ensuring that the policy response is refined and improved over time.

3.2. Improving coordination and building state capacity for crisis response

While performance is correlated with existing state capacity, the heterogeneity in Covid-19 policy responses demonstrates that governments with high state capacity can fall short while governments with more limited capacity can formulate timely and effective policy responses to the pandemic. The key test of a dynamically effective response lies in whether governments can leverage the current experience to build robust state capacity for responding to crises in the future. This depends to a great extent on politicians leveraging the experience of shared sacrifice into a sense of common purpose that justifies and underpins a shift in future policies. But this is also dependent on the presence of learning-centric and dynamically evolving institutional arrangements supported by policies and protocols for leveraging data analytics for active learning. Building an institutional environment that is responsive, has the capacity to deliver, and that values data and knowledge has benefits beyond the current pandemic and can potentially change the trajectory of state capacity in many parts of the world. Such an institutional environment also values error correction mechanisms and real-time learning.

To create a learning state that can coordinate between the relevant actors, it is, first, important to prepare plans and templates and to introduce organizational structures based on current knowledge for managing potential crises. These plans must be flexible and capable of revision and refinement based on new knowledge. It is critical to bring in expertise across relevant agencies and disciplines, including relevant roles (authorizers, mobilizers, and implementers) as well as across different domains of expertise (whether inside or outside government). As Andrews argues, governments need to create new structures in the face of crises. These structures do not have to exist in advance but can be introduced mid-stream, created on the basis of new knowledge, and they are also not solely the preserve of wealthy, highly resourced countries [33]. For example, Liberia and Sierra Leone were able to create fast, flat, and flexible structures to successfully deal with the Ebola epidemic [34, 35].

Second, it is critical to create central structures that can coordinate across agencies, empower distributed leadership and decentralized actors, enable local innovation, and disseminate active learning through experimentation. The central entity can also ensure sufficient focus on both the short-term, emergency response to the crisis as well as considering the medium- and long-term analytical work for augmenting preparedness by building more robust, capable, and self-correcting structures.

Third, to create a learning and cooperative culture, governments must devise ways to escape organizational turf wars and blame-games. This is best done through creating norms and procedures for sharing credit for policy innovations and successes, and similar processes for mitigating blame in case of failure. This can be promoted by bringing distributed leadership across agencies under a common central structure, by promoting a common purpose narrative, and by fostering new norms of responsible and active learning where failure is an opportunity to learn and course correct.

Fourth, it is critical to build capacity in using and analyzing data in relevant public agencies dealing with crises. Because generalized trainings are rarely effective, this capacity should be linked to providing concrete answers and supporting specific decisions and actions. Fostering new norms of adjudicating tough policy decisions through evidence and building analytical capacity inside and outside government for problem solving is important.

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[8] Biobot Analytics, Inc., a firm started at MIT, is using 'wastewater epidemiology' to monitor disease prevalence. Biobot Analytics, Inc. Cambridge, MA. https://www.biobot.io/.

[9] Smart Containment with Active Learning (SCALE) is a multidisciplinary effort that has drawn on the expertise and experience of researchers and practitioners in public health, infectious diseases, epidemiology, economics, policy and public management, technology, and data science as well as business and non-profit leaders. Elements of this proposal are being tested in various places, including Pakistan, where several members of the team have been actively supporting the state's response efforts at national and sub-national levels. The proposal is available at https://www.hks.harvard.edu/centers/cid/covid-19 and https://www.cerp.org.pk/pages/covid-19-response.

3.3. Preparing data infrastructure for crisis response

Crises require immediate action, and delays can be very costly. In the context of Covid-19 and other health pandemics, policy paralysis could result in unmitigated spread of the disease. This urgency applies to other disasters as well. For example, in the aftermath of an earthquake or tsunami, governments need to act immediately to launch rescue operations to prevent further loss of life. To proactively prepare for future crises and ensure timely action, we should work now to devise ways of better utilizing available data sources by putting in place the required infrastructure.

Building information/data systems to support effective and rapid decision-making is critical. But rather than building systems from scratch in the midst of a crisis, or acting blindly in the absence of such systems, governments need to plan strategies and to build data infrastructure before a crisis hits.

First and foremost, digitizing census data is critical and can yield huge benefits for service delivery. Governments should invest now in establishing pre-existing systems of digitized, geo-coded data infrastructure overlaid with useful data (demographic, public sector, and new, digital sources of data), along with protocols to activate, access, and build upon these in real time to support coordination during emergencies by both public, private, and non-profit actors. In times of crisis, these systems can simply be switched on and immediately leveraged to design a data-driven policy response to target those affected, to forecast needs, and to evaluate the impact of policy measures. There are already various web-portals that help coordinate relief that provide proof of concept, but there is need to do this at a national and global level. For example, in response to the October 2005 earthquake in Pakistan, a team of researchers launched a website, Relief Information System for Earthquakes Pakistan (RISEPAK), which combined data, including demographics, damage suffered, assistance received, and maps on the earthquake-affected areas, to ensure no village was overlooked in the relief efforts. Similarly, in Kenya, Ushahidi, a crisis mapping software application, was launched to map reports of post-election violence in 2008 to help people in the affected areas stay safe [36, 37].

Second, governments can undertake a number of measures to build a data infrastructure that leverages existing data sources, especially administrative data, and which standardizes and links different data sets. In doing so, it is important to work with the private sector to securely harness 'big data' through mobile records, electricity consumption, and other sources, and to design voluntary mechanisms for citizens to share relevant data, while ensuring they are done in line with data sharing and anonymity protocols. As example of the latter, the city of Medellin in Colombia asked residents to register their symptoms online, incentivizing cooperation by using the same platform to provide financial support; this resulted in nearly 90% of residents voluntarily sharing their information [38].

Finally, while it is important to be creative in how we think of data, data and technology needs should be directly tied to policy needs. Existing large-scale household surveys can be replaced or augmented with new technology-based data sources, such as call detail records (CDR), satellite data, and electricity consumption. However, before doing so, one needs to clearly define what types of data are useful to researchers and policymakers, establish how these data can contribute to development programs and humanitarian efforts, and build robust frameworks around data privacy and security. This should result in a digitized data infrastructure with key datasets—protected by robust data protection laws—which can be accessed, understood, and leveraged for crisis response.

4. Conclusion

Faced with an overwhelming crisis, governments across the world grappled—and continue to grapple—with difficult policy choices in response to Covid-19. The limited knowledge policy actors had about Covid-19 at the outset and the lack of preparation for a response to a large-scale disaster made policy choices even more difficult. While the genuine desire to respond and mitigate health and economic impacts was admirable, the lack of collaboration and coordination across jurisdictions, governments, disciplines, and domains, along with a weak data infrastructure, limited the efficacy of policymakers. Resolving these challenges now—by adopting an active learning mindset, enabling greater collaboration, and setting up a robust data infrastructure—can prepare us to better mitigate the medium- and long-term impacts of Covid, as well as to effectively respond to future crises.

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Competing Interests

The authors have no competing interests to declare.

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Das is a member of the SCALE consortium, a member of West Bengal's Covid-19 global advisory board a member of the Lancet commission on Covid-19 in India. Khan, Khwaja, and Malkani are also members of the SCALE consortium and have been closely involved with Covid-19 policy response in Pakistan.

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