Smart Containment with Active Learning (SCALE):

A Proposal for a Data-Responsive and Graded Response to COVID-19

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This multidisciplinary proposal draws 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 & 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 intended as a living document that will be updated as more information becomes available.

Updated versions will be available at https://www.hks.harvard.edu/centers/cid/covid-19 and https://www.cerp.org.pk/pages/covid-19-response. For comments, please reach out to us at covidrapidresponse@cerp.org.pk.

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Executive Summary

COVID-19 has presented governments with two very hard and contrasting choices. If they don't act immediately and lockdown, they risk thousands of deaths from COVID-19 and the medical burden it imposes on healthcare. Alternatively, shutting down the economy risks economic collapse with high mortality from non-COVID related reasons, especially in poorer places. Worse, these decisions have to be made in the face of substantial uncertainty: We know the broad parameters of the problem – physical distancing will help but imposes substantial costs – but lack the clarity and precision needed to make the tough tradeoffs.

Our proposal argues that standard frameworks from decision making under policy uncertainty can be used as a way out of this conundrum. For decisions that will essentially remain the same regardless of what information becomes available – such as expanding testing capacity, PPE for health workers and health messaging – we should act immediately and unequivocally. For decisions that can benefit from collecting some information – such as how lockdowns may affect migrants leaving urban areas – we have to put in the resources and time needed to do so before acting. Moreover, many decisions – such as understanding the underlying risk profile and typing policy response to it – can benefit from using prior information on age and health-vulnerabilities present in standard population and health surveys. The key is to recognize that not only should we be learning through decisions taken, but these actions in turn be undertaken to generate the knowledge needed.

We propose an active learning[1] strategy that uses real time testing and refinement of policy responses together with a graded approach that varies by local disease projections. We grade areas into four distinct "alert" levels – from green to red – and develop a set of operational strategies for each level that focus on: (i) smart testing & data collection, with testing evolving with the levels (from symptomatic testing, to contact tracing and testing, to therapeutic & antigen testing) and collecting relevant socio-economic and health outcomes data to inform strategy and policies at each level; (ii) detailed physical distancing measures that vary in their degree; (iii) community messaging and compassionate enforcement that promotes voluntary compliance and trust; and (iv) the strategic decisions and policy refinements that are needed at each level.

Our model of `smart containment with active learning' is a structured way to help governments learn faster and make better decisions in a shorter time period. Our proposal is intended as a sustained policy that adapts to the changing nature of the infection in a given area. We do not see the structure here as a one-time solution, but rather a framework with stages that countries and regions may move between in different areas over time.

[1] We use the phrase "active learning" here in the context of policy decisions, meaning we both learn from enacted policy decisions and value decisions that facilitate learning. This notion is related to, but distinct from, other uses of the phrase "active learning" in areas such as Machine Learning or Artificial Intelligence research.

I. The Problem: A Knowledge Gap Makes for Difficult Choices

Whatever policy response countries adopt, one thing is clear – most are acting under surprisingly limited knowledge. While we know enough to understand the value of physical distancing and lockdowns, we don't have the numbers needed to make the hard benefit-cost calculus that will be increasingly needed in the coming days.

A. What we Do Know:

Public health and infectious disease experts and epidemiologists have helped us understand COVID-19 – we know its symptoms, the incidence of its likely morbidity and mortality, and the speed and nature of its spread. We have also learnt from past experiences – notably the 1918 Spanish flu – that early intervention in terms of physical distancing can reduce peak demand for hospitals and the total number of infections.[2] Discoveries continue apace, with new treatments, new tests and new vaccines at various stages of the product development cycle.

We also know – both from the immediate and projected fallout of the physical distancing actions taken across the world – that the costs of these remedial measures are and will likely be significant. UN's trade and development agency, UNCTAD, estimates that it will likely cost the global economy $1 trillion in 2020. The IMF projects global growth in 2020 to fall to -3 percent in their April World Economic Outlook.[3] With economic activity at a stand-still in most places, this pandemic presents both substantial demand and supply side shocks to the economy.

Physical distancing and lockdowns are likely to have particularly deleterious effects in low-income countries for multiple reasons.[4] Much of the economy is informal. This means it is harder to provide financial assistance to those who may need it most. The food chain, from crop production to distribution and sale, is more labor intensive and maintaining food supply may become hard in extended lockdowns. A significant fraction of the disease burden remains acute. Childhood diarrhea, pertussis and Tuberculosis all require regular care, and, in a lockdown, this may not be feasible. Fiscal space at the state/provincial level is limited,[5] and unlike in the U.S. or Europe, where money flows in when times are

[2] "The effect of public health measures on the 1918 influenza pandemic in U.S. cities", Bootsma and Neil M. Ferguson PNAS May 1, 2007 104 (18) 7588-7593; https://doi.org/10.1073/pnas.0611071104
[3] https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/
[4] "Poor Countries Need to Think Twice About Social Distancing" Mobarak & Barnett_Howell, Foreign Policy, April 10 2020 https://foreignpolicy.com/2020/04/10/poor-countries-social-distancing-coronavirus/
[5] Flattening the COVID-19 Curve in Developing Countries", R. Hausmann, Project Syndicate, Mar 24, 2020 https://www.project-syndicate.org/commentary/flattening-covid19-curve-in-developing-countries-by-ricardo-hausmann-2020-03

uncertain, in low-income countries, the money flows out. Spending now needs to be more carefully managed against the possibility of a BOP crisis down the road.

B. What we still Need to Know:

While we have learnt a fair bit in a relatively short time, there is even more we still don't know. This lack of knowledge is consequential. We still don't sufficiently understand COVID-19's transmission mechanism or environmental triggers to be able to provide precise projections. While epidemiological models have been instrumental in our response, they need to be developed and refined further using locally relevant data. Moreover, these models do not internalize or account for human behavior, nor do they incorporate the wider health and economic implications of physical distancing measures. Physical distancing policies attempt to lower the "R0" parameter that determines viral growth, but "R0" is an aggregate measure that translates into individual infections through our day-to-day interactions which are, overall difficult to characterize. Further, we are only beginning to understand compliance with these policies and know even less about how effective they actually are in reducing disease spread.

Projections for societal and economic losses are even harder to pin down – and are less reliable in the longer-term. While market reaction is one signal, markets are notoriously volatile especially in the face of such inherently uncertain conditions. Estimates of economic losses can vary substantially. For example, the WTO estimates world trade could fall by between 13% and 32% in 2020 [6] - and even this range could quickly change. Projections on the impact on job losses, poverty, and other health outcomes begin to get even more speculative. In fact, historical evidence may even show that the supposed trade-off between population health and the economy is illusory if, as was found for the 1918 flu epidemic in the U.S., places that locked down faster were also those that recovered fastest after the epidemic was over.

C. Why this Matters

The fear of exponential growth in infections has forced countries to enact policies, but it has also led to panicked and poorly thought out decisions. Not knowing reasonably well what the costs and benefits of these different policies look like, there has been incredible confusion about the timing and extent of physical distancing and lockdowns as well as a strategy to ease them. While one side of experts is clamoring for more aggressive physical distancing, others seem ready to start opening the economy. These decisions are admittedly weighty and even with more knowledge would still involve the usual adjudication over different outcomes. But that is what politicians are supposed to do, and that is what is regularly done for millions of other decisions that are made every year. The

[6] https://www.wto.org/english/news_e/pres20_e/pr855_e.htm

fundamental question then is: What should be done given that we really don't know what the effects of these different policies will be?

II. Enabling an Active Learning Process

In responding to the current crisis, we should recognize that there is a well-developed and well-tested machinery for how to make decisions under uncertainty.[7] We need to adapt it for the current crisis.

Key to understanding this process is the importance of learning. 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*".

We highlight four distinct parts of such an active learning process:

First, there are some decisions that will essentially remain the same *regardless* of what information becomes available. For instance, we just don't see information that will change an urgent requirement to expand testing capacity and PPE for health workers or careful communication regarding COVID-19. In these cases, there is no point waiting for the information to become available. Act Now 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 can't 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, a 2-day survey could have helped the government understand that migrants would leave urban areas with a lockdown 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. Below we will give examples of prior information that is currently underutilized—an idea of the underlying vulnerability of populations so that governments can undertake a spatially targeted strategy.

[7] "Public Policy in an Uncertain World: Analysis and Decisions". Charles F. Manski, Harvard University Press (2013). 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.

Fourth, recognize that every decision will have an impact on the outcomes of interest, but will *also* provide further information. This new learning can critically inform the decision-making process tomorrow. So, a decision that may have little impact on potential outcomes but can massively increase information should be favored. 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.

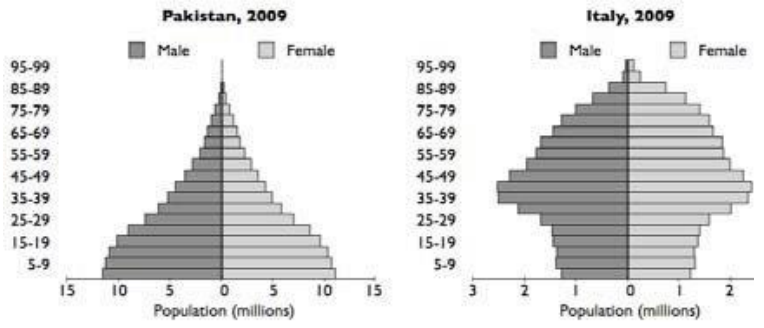
We further elaborate on the third and fourth points.

***Using Prior Information*:**

The difference between a general lockdown and a 'graded' lockdown is that certain groups are allowed greater freedom of movement to keep our economic engines running and offer a degree of hope, especially for the poor. One idea proposed is that of *risk stratification*: Hospitalization risks for COVID-19 increase with age and pre-existing chronic conditions.[8] Therefore, allowing for potentially greater movement among the young and healthy while protecting our elders will allow for the resumption of economic activity *and* gradually build up immunity in our populations; even though the young will remain more likely to be infected.

Can risk stratification be *spatially targeted* by maintaining stricter restrictions in places with a larger agglomeration of older people and/or those with additional co-morbidities? Box I shows that this can in fact be accomplished in practice as there is substantial degree of variation in the number of elderly across

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.



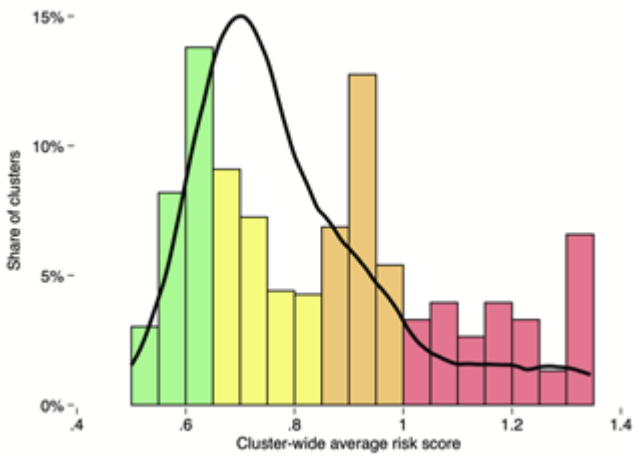
[8] What we know to date about the effects of COVID-19 are in terms of hospitalization and mortality risks are that (a) it affects men and the elderly disproportionately and (b) it affects those with other co-morbidities disproportionately. To date, the co-morbidities that have been considered are all 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.

communities. We are not flying completely blind here. There is enormous prior information that can be brought to bear on this issue. It should.

What about pre-existing risk factors? Box II gives an example from an urban setting and shows there may be significant variation across neighborhoods in a given city and hence potential for a varied policy response even within cities. [9]

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 that allows policymakers to follow a graded approach, both in their precautionary measures, but also in their expectations of hospitalizations if the pandemic hit a village or urban neighborhood. 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.

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 neighborhoods, where green is least risky and red is highly risky. There are a large number of neighborhoods 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 neighborhoods. Poorer households tend to be more predominantly male and with higher rates of smoking. Richer neighborhoods have more people above the age of 65.



Active Learning:

The fourth point, and a key part of the process, is *active rather than passive learning*. We apply this to the biggest question many face at this moment—is lockdown the only option? In order to answer this question, we have to generate structured data on what happens in (say) villages that vary in the strictness of their lockdowns. Knowing the value of this, a "graded approach" - whereby the degree of severity of physical distancing depends on the current and projected situation of an area - becomes invaluable as it generates critical

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

evidence on relative compliance to and effectiveness of our remedial measures rapidly enough that our responses can be readjusted and refined in real time.

Whereas all systems will benefit from active learning, low-income countries stand to benefit even more given the peculiar enforcement, implementation and compliance challenges on policy response imposed by weak state capacity in these countries. This is compounded by governments having to face multiple challenges often in the absence of clear prioritization of policy objectives, coordination across different agencies/actors, and credible communication with the citizens to enable voluntary compliance.

Tying policy response to active learning does not come easy to governments as they face pressures from media, political and citizen groups and sometimes other governments to respond as if they fully know the best response. Following the herd is seen as less risky as failing in common with other countries is perceived as less politically damaging than failing in charting your own response.

However, knowledge gained from other contexts, though useful, cannot be blindly applied. Part of active learning comprises context specificity in knowledge-generation and application. This means policy experiments done in parallel and calibrating policy response in real time. As well as clear protocols and standard operating procedures (SOPs) to better support generation and application of active knowledge by the relevant actors that enables decision-making, coordination and compliance and the optimal mix between centralized and decentralized decision-making. Having a “learning state” is key to ensuring effective policy response at present and to producing greater resilience for dealing with crises in future.

III. The Plan: A Graded & Data-Responsive Smart Containment Policy

An action plan that works has to be clear and decisive, yet flexible and modular to incorporate rapid learning, public and credible to enable coordination and compliance, and yet simple and feasible enough that it can be implemented in states with varying capacity and resources. This calls for a graded approach that will provide governments a clear direction to act and coordinate among different agencies while generating the information governments need to make tough tradeoffs and policy calibration to their own contexts. This will also mitigate the last-mile problem by providing citizens clear signals to manage expectations and change behavior.

The plan we propose therefore emphasizes the following key features: (i) the critical role of data; (ii) the need for policy responses to be data-responsive; (iii) “smart containment” with the degree of physical distancing be based on local conditions; (iv) the importance of community messaging and compassionate enforcement to ensure voluntary compliance; (v) catering to both immediate considerations but also accounting for more

sustained and longer terms needs; and (vi) partnership with on the ground implementers to leverage existing capacity.

The table below shows this graded action plan. We envision these plans being carried out by regional units of decision making authority "D" (these are sub-national units such as provinces/states, districts, counties etc.) which have the mandate, administrative capacity and local information to tailor their response at the smallest feasible geographically contiguous and potentially isolatable areas "S" (these could be neighborhoods in urban areas or villages/village clusters in rural areas).

Stage	Level 1 *No infection* **PREPARE**	Level 2 **Infection detected & moderate projections** **DISTANCING**	Level 3 **Infection detected & severe projections** **LOCKDOWN**	Level 4 **Widespread disease** **RESTORE**
Smart Testing & Data	Screening of high-risk/high-impact people; Syndromic testing and Sentinel surveillance; Establish baseline data on health indicators	Level 1 plus: Contact tracing & testing; Testing of front-line workers and high impact individuals; surveys to assess other impacts, monitor compliance, monitor health indicators	As in Level 2 but expand to adjacent S areas, and begin surveys of recovered cases	Test primarily for therapeutic purposes, begin seroprevalence surveys; Collect additional data on impact of morbidity and health sector capacity; Continue monitoring health indicators
Physical Distancing	Basic physical distancing preventive measures	Stronger physical distancing, isolate confirmed cases & quarantine contacts	Move towards lockdown in S & quarantine in D	Continue Level 3 w/ added health & welfare support; consider distancing/lockdown easing in S based on seroprevalence survey data
Community Messaging	Consistent with Social Distancing measures and Community Messaging principles	Level 1 plus, keep people informed on prevalence of infection (w/o revealing identities) and welfare measures, and appropriate healthcare seeking behavior	Same as Level 2 and expand to entire D	Emphasize severity, reassure people of government preparedness and support measures
Actionable Decisions	Monitor and prepare contingency plans; leverage/build capacity for implementing plan; Prepare for changes in healthcare service delivery	Launch and assess effectiveness of implementation plan; Monitor and use data to refine response, assess adverse impacts and target support; Adapt healthcare service delivery as needed	Same as Level 2, and expand to entire D. Prepare for Level 4 through new capacity, ask for support from higher tiers	Same as Level 3, and prep for expanded medical, food and social security needs.

The *Smart Containment with Active Learning Operational Plan* provides a more detailed version of the Table along with details of the recommended actions. Here we highlight a few key aspects. First, as we noted above, key to the response is recognizing that it will be heterogeneous based on an area's current and projected disease prevalence and impact. In order to communicate this effectively – both for the response teams and public at large – we borrow from the "public alert" terminology and color code each situation (columns in the Table).

Level 1 (Green) is the preparation grade for districts that do not have any detected infections; Level 2 (Yellow) is for cases where a community acquired infection has been detected in the district, but the projected disease spread and underlying vulnerability index in the village is low. This may be, for instance for areas where the population density and number of elderly males are low and/or co-morbidities are limited. Level 3 (Orange) is for cases where multiple cases have already been detected in area S and the population has a high projected spread and vulnerability index. Finally, Level 4 (Red) is for areas where there is already significant community spread, which implies that the infection is already rampant.

The rows in the Table highlight the key action items that are needed. First and foremost of these is the testing and data collection strategy to be adopted. Testing balances the need for both therapeutic and disease prevalence information, plus the role aggressive testing plays in detecting cases in the community early. We recognize this may be especially challenging for countries that have weak testing/reporting infrastructure or where there is risk of under-reporting. However, this is an area where the government will have to deploy all possible resources and embrace transparency if they have any hope of a smart and cost-effective response. We also highlight additional data that needs to be collected beyond testing that captures non-COVID related health as well as relevant socio-economic outcomes that will be critical in alleviating the impacts of remedial policies and targeting support more effectively. This information directly feeds into and validates the physical distancing strategy (row 2) that varies depending on the underlying situation (i.e. column).

Community messaging (row 3) is key for crises in general but especially those where individuals' own decisions – such as voluntary and informed compliance to policies - will have huge implications on the efficacy of policy measures.[10] Such a policy calls for "compassionate enforcement" so (infected) individuals don't feel ostracized or victimized but are confident that their needs will be taken into full consideration. The last row emphasizes the strategic and operational decision cycle for key decisions that are to be made based on the information gathered. This pertains to the decision-makers responsible for ensuring implementation and coordination of the overall plan. The refinement process envisions a 2-3 week decision making cycle after which the actions are again modified according to what we have learnt.

While the specificities of these actions in each stage will depend on the context and capacity of each country, and necessarily evolve as we learn more, here we highlight some key aspects of these decisions for each prevalence level (colors in the columns).

[10] Nour, M., Alhajri, M., Farag, E.A., Al-Romaihi, H.E., Al-Thani, M., Al-Marri, S. and Savoia, E., 2017. How do the first days count? A case study of qatar experience in emergency risk communication during the MERS-CoV outbreak. *International journal of environmental research and public health*, *14*(12), p.1597.

In Level 1 areas, our advice closely mirrors best practices being adopted in other countries. The focus here is on testing, surveillance and community messaging. For testing, we are suggesting PCR-based tests for high risk individuals, such as healthcare workers and/or those involved in law and order, as well as for symptomatic individuals, we are not suggesting testing of random samples (unless they can be pooled at sufficiently large numbers) since the possibility of picking up an infection is extremely small given limited testing capacity. For messaging, it is imperative that citizens understand the basic health preventive messaging – physical distancing, washing etc. – with regards to COVID-19. For surveillance, we are suggesting that any testing of individuals be accompanied with a short questionnaire that helps build up better predictive models of the sickness and quickly allow for better models of high risk in these populations.

In Level 2 areas, our advice again follows best practice, but it does not advocate for a full lockdown. For testing, we suggest contact tracing and testing as well as testing of frontline workers and high impact people. We are suggesting stronger physical distancing measures, as well as isolation of people who are sick and quarantining of their families. However, we are not suggesting that the entire S area be shut down with zero economic activity. We suggest restricting non-essential economic activity to those that allow physical distancing and de-densifying industries where feasible.

One key difference between low-income contexts and OECD countries is that other infectious and acute diseases that require immediate care may exact a heavy toll. Therefore, in terms of the data, we suggest that in these areas, a full log of *all* mortality be maintained carefully, with some basic information on the cause-of-death. Verbal autopsy methods are available, in case there is administrative capacity to implement these.

Finally, in terms of messaging, we are adding that people should be given specific information on a regular basis about how many cases there are in each area, and how people are being cared for. These messages have to be carefully designed to ensure that there is no panic, while at the same time, providing clear, accurate and actionable information. One of the most important factors that is emerging is that sick people—and their families—may face stigma and discrimination. There are already cases where people are scared of being taken to a quarantine facility or having their illness leading to a lockdown of their village with a real possibility of starvation. This would be a disaster as the news will quickly spread that they must do everything in their power to not be detected with the illness, especially if they are young and therefore may face lowered risks. There is a real possibility that people will not report their illness, even if severely sick. The messaging **must** reassure people that, in any quarantine center or hospital, people will be treated with dignity and compassion, and will have all the necessary amenities. Of course, this message will only be believed if it is actually true—stories to the contrary will immediately seed doubt in people's minds.

In Level 3 areas, we are suggesting that the S areas be entirely locked down till infections reduce to very small numbers. For testing, contact tracing and testing of high-risk workers be extended to adjacent areas as well. The key difference is in terms of the physical distancing measures. For at least the initial 2-3 week learning period, we are suggesting that these areas be fully locked down, with no entry into the S area or exit from it. We are also suggesting that people be required to remain in their houses. This will require substantial mobilization from relevant authorities, as it will both require a degree of compassionate enforcement and a parallel effort to make sure that people have all the necessities they need for the duration of the lockdown. Therefore, authorities will have to ensure the delivery of food (and water where required) packets to every household on a daily basis, as well as the delivery of medicine (for those who need them on an ongoing basis) and transport of sick individuals to hospital care. After a 2-3 week lockdown we advocate conducting serological surveys as well as phone surveys that look at other health (including deaths) and socio-economic outcomes to capture the costs of imposing such strong physical distancing measures.

Finally, in Level 4, “Widespread Disease” phase, we are suggesting that testing be used primarily for therapeutic processes. While the affected S area would need to be “quarantined” even more from surrounding areas, lockdown status could be eased *within* the S area if prevalence surveys using antibody tests show a high degree of infection (and herd immunity) in the population. We are suggesting that there is such a prevalence survey of sufficient sample size. We fully recognize that these tests are not yet perfect, but they will give us an idea of the extent of disease spread in the S area after the lockdown as well as the presentation of the infection (how many were asymptomatic etc.). At the same time, we suggest clear messaging for residents and adequate facilities to maintain the relevant precautions and protocols for monitoring, managing and controlling further transmission. We also suggest authorities adopt preventive measures to protect the elderly, vulnerable population and frontline workers from getting infected. Moreover, it is critical that these areas be provided substantial and expanded medical, logistical and financial support so that their (increased) needs are met completely.

Re-evaluation: It is worth emphasizing that a key component of our strategy is *reevaluation* of the specific policy measures being taken every 2-3 weeks. This is critical in helping us better understand the benefits and costs of each policy and in refining the details of each response. For example, consider the two contrasting policy choices (a) a weaker lockdown where there is isolation and care for those who are sick but there is also greater freedom of movement. In particular allowing essential workers, such as food producers and distributors, to continue their work or (b) strict quarantines and physical isolation which will require massive investments in maintaining food chains, ensuring necessities for every family and providing critical care for those who need it—regardless of the underlying condition.

In our proposed plan we are effectively deploying a form of choice: choice (a) for level 2 and choice (b) for level 3. Based on data collected after the first 2-3 weeks there are three possibilities: (i) the outcomes between Level 2 and Level 3 were similar (ii) the outcomes were worse in Level 2 S areas or (iii) the outcomes were better in Level 2 S areas. Here outcomes are not only those from COVID-19, but also from mortality due to other causes and economic outcomes. If this strategy is followed, we will be able to provide a full accounting across multiple outcomes on how Level 2 S areas fared versus Level 3. This will provide valuable evidence that policymakers and politicians require on how to move forward.

This process of continuous re-evaluation can provide a full roadmap for the next 18 months that is fully guided by the evidence informing the implementation and extent of physical distancing measures as well as enabling the subsequent and eventual easing of these measures and better targeting the support measures needed to rebuild the economy and society.

IV. Concluding Thoughts

COVID-19 presents a unique challenge to all countries, especially low-income ones, but thus far, active learning has not been incorporated into country plans. Therefore, decisions are made in the face of substantial uncertainty, but there isn't a clear guideline for how those decisions *should* be made to resolve the uncertainty as rapidly as possible. Our graded smart containment action plan incorporates prior information and best practice in a structured fashion to help resolve this problem. Implementation of such an action plan will allow us to better formulate policies for the country rapidly and in real time. In the spirit of learning, we intend to update this document as we learn more from our and others' experiences – especially since countries have adopted varying approaches that we can all learn from. Such learning will be key for us to succeed in addressing the current pandemic and becoming resilient to future ones.