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Whitepaper

Developing a day to day dashboard for analyzing COVID-19: Moving beyond daily surprises and guesswork

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This is a collaborative piece written with contributions from the SCALE team of Chief Advisors.

In the first article of our COVID-19 series, we highlighted the importance of getting organized around data, expertise and strategy as we try to manage, learn from and adopt to the evolving COVID-19 pandemic. At the time, we highlighted prevailing confusion around data, wide disparities in utilization of expertise, and only a partially defined overarching strategy.

In this second piece, we delve deeper into the topic of applying data to the COVID-19 discussion.

Introduction

Crises are associated with an inherent level of disorganization and chaos – that is why they are crises. Crises also tend to move at lightning speed. Focus on everything and you will quickly get overwhelmed. Focus too narrowly and you may soon find that your chosen strategy becomes obsolete – perhaps a wonderful solution to yesterday's problem that is no longer relevant today. Despite being a tall order, so much of successfully responding to a crisis is predicated upon focusing on the right variables at the right time.

What we have seen so far in our response to COVID-19 is that we have been consistently behind the curve. Too slow to acknowledge the issue originally, too slow to mobilize expertise and deploy resources, too slow to react to changing phases of the situation, and frequently overly focused on concepts and metrics that ranged from being outdated to premature.

When we were all relaxed in December 2019 as news of the virus was beginning to circulate, we should have been panicking. Our panic button eventually did go off several months later – though perhaps delayed, the panic-induced call to action was better late than never. But, by the time we were panicking, we ideally would have been past that phase and into the slightly calmer, more sober-minded phase of an organized response. In many ways, by the time we panicked, the virus had already set its course.

We have seen lots of statistics and projection models put forth over the past several weeks. We are not coming at this piece from the perspective of being an expert infectious disease physician or an outbreak researcher. And, though the topic of piece is data, our main focus is actually not really about numbers – rather, it is about analyzing the effectiveness of our approach and frameworks for utilizing data in the context of this pandemic.

This piece is written with three overarching takeaways in mind.

1. Much of our response to, and analysis of, the evolving COVID-19 pandemic has been mistimed and reactive.
2. While this may initially sound counterintuitive, we believe point #1 is at least partially driven by a collective fear of deviating from reliance on actual, fully confirmed data. In rapidly changing situations, by the time data is fully confirmed, that dataset is often stale. Responding to a crisis requires an ability to preempt – to get ahead. Armed with the right expertise, tools and supporting program, projecting forward becomes as important as looking back, even if projecting forward means

migrating from pure reliance on fully confirmed actual data into the riskier, more nuanced and more uncertain realm of assumptions and extrapolations.

3. Taking points #1 and #2 together, we should now be acutely focused on defining the datapoints that matter most for successfully bridging us to the outcome we want to achieve tomorrow, not just for describing where we have been to-date.

This piece is divided into two sections.

Section 1: Data Synthesis & Analysis – Our Current Interpretation of the Virus

In Section 1, we make certain statements and projections – many you will likely find uncontroversial; perhaps a few you will disagree with or even find controversial. Our analysis is largely illustrative and we are not suggesting it is precisely correct – there are others who are likely better positioned to refine and build upon this analysis to achieve a higher level of precision. We are simply using Section 1 as a forum to reinforce that reserving room for forward looking analysis based on extrapolations and assumptions may yield conclusions, and in turn strategies, that are materially different from – and no less important than – what the look back approach produces.

Section 2: What Are We Aiming For & How Do We Get There? The Role of a COVID-19 Crisis Response Executive Summary Dashboard

Every second is precious in a crisis – as such, it becomes of paramount importance to focus on the right variables at the right time. In Section 2, we propose a draft COVID-19 executive summary key response metric dashboard intended to frame a conversation around first identifying and then shining a light on performance across the variables that matter most, not for describing the past, but rather for successfully bridging us to the target outcome we are striving to achieve tomorrow.

The data tells us that we are dealing with a virus that is rapidly spreading, widely undertested, and widely underreported.

Section 1: Data Synthesis & Analysis – Our Current Interpretation of the Virus

Though daily headlines continue to focus on growth in reported case volume, this growth trajectory should not be surprising.

The data tells us that we are dealing with a virus that is:

- Rapidly Spreading
- Widely Undertested
- Widely Underreported

Rapidly Spreading

It has been reported that each carrier of COVID-19 is estimated to infect an average of approximately 2.2 people. We have been tracking the growth rate in patient deaths and it has remained relatively steady at around 10% per day. Our thinking is that deaths as a percentage of total cases has likely remained relatively constant to-date and, as such, growth in deaths is a reasonable proxy for growth in total case volume. Growth in reported case volume is subject to material noise due to variations in testing volume and the prevalence of undetected cases.

So, for now, we are suggesting the 10% per day growth is deaths as a proxy for per day growth in total cases. This growth rate would be largely representative of the virus' growth potential absent strong intervening forces, such as lockdowns, since deaths to-date are likely more a function of cases that originated prior to the more extreme control measures that has since been implemented.

Reported global cases are currently close to 450 thousand, though we believe the true total global cases may actually be approaching three million, as explained below. Applying a 10% per day growth rate to the projected pool of three million infected to-date, if left unchecked, the virus would be projected to infect one billion people within approximately two months. Fortunately, we are beginning to see early signs of the aggressive lockdowns effectively slowing the spread across various countries and cities.

Between the highly contagious nature of COVID-19, the virus' incubation period and the lag in testing, currently reported case and morality data is a reaction to cases that were contracted weeks – and perhaps months – ago. What we see is the light from a star, but never the star itself until we actually visit the star. It is similar to a magic trick – what you think you see is not in fact there at all. The magic is in the math and in the speed of this moving object – the virus – faster than we can seemingly imagine.

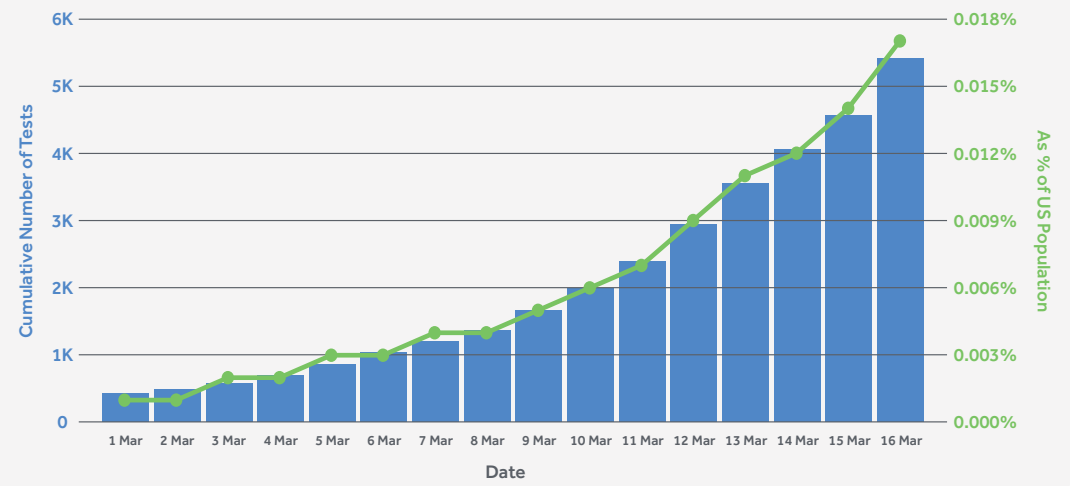
Whether or not Chancellor Merkel's prediction proves to be precisely correct, she understood this data-driven reality and used it to communicate a forward-looking projection that captured the essence of it. Others have since caught up to the many layers of what she was communicating in her statement.

Widely Undertested

As you can see from the below chart, the cumulative number of completed tests has been increasing and was over 50,000 as of March 16th. However, this still represents less than 0.02% of the total population. As testing catches up to the virus, we should expect continued growth in reported case volume – what does not get tested cannot be reported.

Number of Completed Tests vs. % of US Population

Source: CDC



Further, the data does show that the United States is a negative outlier compared to other countries considered to be leading the response and achieving relatively low mortality rates. As we discuss below, perhaps the United States' mortality rate will drop to be in-line with these other countries as more tests are performed. That remains to be seen. What the data does tell us for now is that the United States is lagging behind in cumulative testing – which is to say, the United States is still lagging behind in obtaining critical situation clarity.

The United States continues to actively promotes a strategy of not testing asymptomatic people. Our Vice President this week stated "do not get the test if you have no symptoms, leave it for those that are in need." We still have no program in place for testing of random asymptomatic people for the purpose of finding out a great deal more about our new neighbor, the virus. It's amazing to think – we have been aware of this pernicious deadly foe for approaching 4 months and this remains the stance?

United States Compared to South Korea

- As of March 19th, South Korea had performed around 300,000 COVID-19 tests. We in the United States had at that time only performed 18% as many tests as South Korea.
- In part due to measures put in place after the MERS outbreak, South Korea was able to quickly implement testing of up to 20,000 people per day. In 59 days, the United State was able to complete an aggregate total of only 54,000 tests. The daily test rate in the United States eventually reached 8,500, which is 58% lower than the daily test rate in South Korea.
- South Korea offers re-confirmation that a large part of containing this virus was about being incredibly prepared for it almost day one. The rest then becomes about mitigation. As a nation, we are now fully in mitigation mode – the preemptive containment ship sailed away a long time ago – think early January.

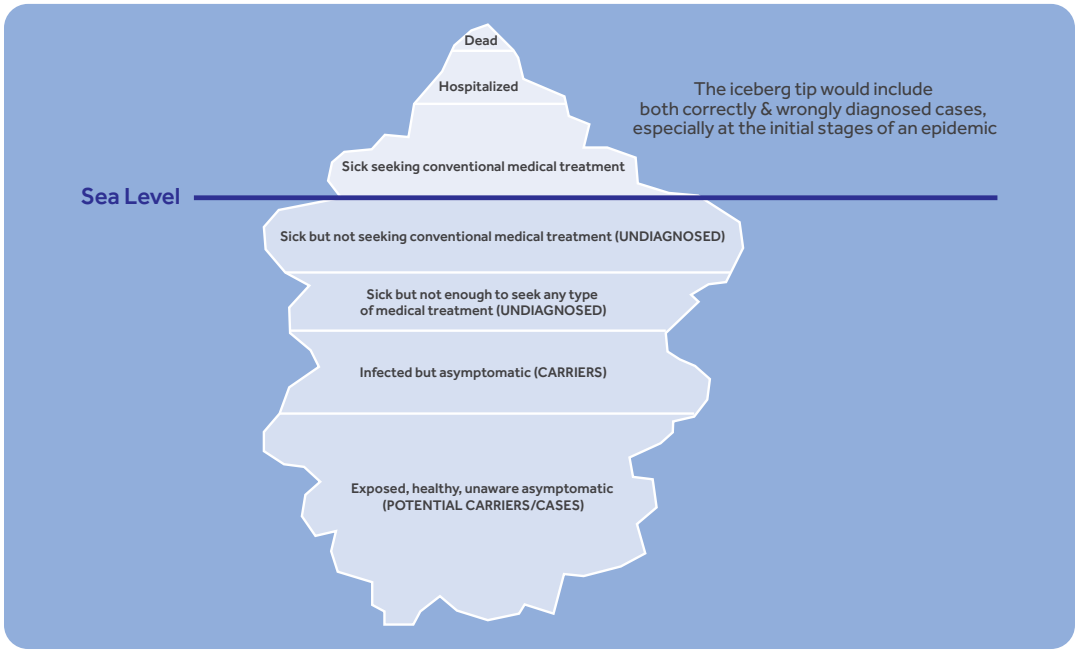
United States Compared to Germany

- Germany's National Association of Statutory Health Insurance Physicians stated that the country has the capacity to conduct approximately 12,000 COVID-19 tests per day. On March 16th, the United States only performed 8,500 tests, or approximately 29% less than the daily test capacity in Germany.

Widely Underreported

Perhaps most importantly, the data is telling us that much of the public discourse is based on statistics that draw from a materially incomplete dataset.

Some commentary and analytical models have estimated that upward of 85% of those infected are non-symptomatic and / or go undetected. I**n the absence of mass testing, broadly disseminated statistics have been centered around the estimated 15% subset of total infected patients who are symptomatic and did receive positive test results.** As a result, the statistics we are drawing our conclusions from describe only the tip of the infected iceberg. This makes a huge difference in our understanding of the situation.



The Total COVID-19 Case Iceberg

Source: Tirumalai Kamala
February, 2020

Illustrative Projection - Implied Total COVID-19 Cases

By grossing up the 15% of infected cases that are symptomatic and tested positive to account for a potential large pool of cases that are asymptomatic and / or go undetected, we see a much larger number of infected cases – i.e., the true infected case count is more than 6x greater than the reported case count.

	United States	Global
Total reported COVID-19 cases (1)	55,528	441,207
Estimated share of total cases go undetected	85%	85%
Implied true total COVID-19 cases	370,187	2,941,380
Total cases as multiple of reported cases	6.7x	6.7x

Note: Data as of March 25, 2020 as per Worldometer

The bad news from this is that COVID-19 is likely far more pervasive than is being reported – perhaps more than 6x more pervasive. I**f we believe this to be true, the practical implication could be that the task of effective containment may be a taller order than originally anticipated, if not an impossible one absent a vaccine.** In turn, this may warrant a different strategic approach that takes this into account.

On the other hand, however, this could also mean that the mortality and critical condition rates being reported are overstated, again by a factor of more than 6x. **If we believe this to be true, the practical implication could be that public messaging around COVID-19 mortality rates should be modified. While still transparently communicating the higher figures based on the subset of actual, fully confirmed results, the public could be educated on the potential for a materially lower morality rate. Then, a healthy degree of residual panic could be redirected from focusing on mortality rates derived from relatively small datasets to focusing on holding leaders accountable for progress and results across the key variables that will most likely to determine whether achieve the target lower mortality rates or fall short of the mark** (see Section 2 for further discussion).

Illustrative Projection – Adjusted Critical Case & Death Rate

Using the implied total reported + unreported COVID-19 case counts from above, let's look at the critical case and death rates to-date in the United States. We show two scenarios.

- **Scenario 1:** Critical case and death rates based just on the total reported cases. These are the widely reported rates.
- **Scenario 2:** Critical case and death rates based on the implied total reported + unreported cases as previously calculated.

	Current to date	
United States	**Scenario 1: Total reported cases**	**Scenario 2: Estimated true total cases**
Total		
# of cases	55,528	441,207
% of population	0.02%	0.11%
Critical		
# of cases	1,175	1,175
% of total cases	**2.12%**	**0.32%**
% of population	0.00%	0.00%
Deaths		
# of cases	791	791
% of total cases	**1.42%**	**0.21%**
% of population	0.00%	0.00%
Critical cases + deaths		
# of cases	1,966	1,966
% of total cases	**3.54%**	**0.53%**
% of population	0.00%	0.00%

Note: Actual data based on Worldometer as of March 25, 2020

We then applied the adjusted Current To-Date Scenario 2 critical case and death rates to a potential future scenario in which COVID-19 has infected 70% of the total population – i.e., the Chancellor Merkel scenario.

	Current to date	Potential Future
United States	**Scenario 2: Estimated true total cases**	**Assumed infection rate: 70% of population**
Total		
# of cases	370,187	231,340,240
% of population	0.11%	70.00%
Critical		
# of cases	1,175	734,291
% of total cases	**0.32%** →	**0.32%**
% of population	0.00%	0.22%
Deaths		
# of cases	791	494,319
% of total cases	**0.21%** →	**0.21%**
% of population	0.00%	0.15%
Critical cases + deaths		
# of cases	1,966	1,228,610
% of total cases	**0.53%** →	**0.53%**
% of population	0.00%	0.37%

Note: Actual data based on Worldometer as of March 25, 2020

Putting Our Projections in Context

A large portion of the current discourse has gravitated toward easy headlines and binary conclusions. On the one hand, a contingent relies exclusively on "reported adjudicated cases" that represent an inherently narrow and self-selecting data pool that is unlikely to be representative of the broader reality. On the other hand, the counter-response is too frequently dismissive of the fully-confirmed data set and, therefore, comes across as overly cavalier, deriving confidence purely from intuition and hope.

Even in our assumption-driven estimate of where we currently are and where we may be heading, we have left out so much. You could critique our interpretation in a hundred different ways. Perhaps the asymptomatic number is much larger or much smaller than we currently assume - without blind random testing how could we begin to know? To what extent will mortality rates respond further in response to shortages or adequate solutions for stocking medical supplies? What about the changing weather? Statistically warm and very cold climates appear to be significantly outperforming mild climates regardless of their healthcare infrastructure and overall preparedness. The day-to-day inputs are changing for the virus not just for us; there is no such thing as certainty on where we will end up.

But, the point remains, where is the model that we are modifying and being educated on day in day out? Do not just show us volumes of infected patients going up and call it a day. In times of crisis, one of the first things we should do as a nation is to ask our leaders and our media representatives to sign off on a **HIGH-QUALITY DASHBOARD**. Why haven't we rallied around someone's website dashboard that tracks key performance metrics succinctly and well? Once this dashboard makes sense to us collectively, intuitively and scientifically, with the knowledge at hand shouldn't we continue to modify it as we learn more and most of all shouldn't we share this prism for understanding with the whole world as quickly as possible – so we truly understand this virus in unison?

What we have laid out in this section of our ongoing analysis includes a mix of known realities, such as persistent undertesting, and projected estimates, such as adjusted mortality rates and potential future scenarios. Whether our adjusted critical case and death rates prove to be correct or not, by no means would an estimated lower mortality mean that we should not be worried or reacting to the virus.

We are simply advocating for what we believe is a more attractive alternative to discussions around COVID-19 data. We believe deeply in developing systems to arrive at factual, statistically relevant data as quickly as possible. Having, and then using, actual data is critical. At the same time, **we believe in the value of reserving room for alternative analysis and models based on interpretations and extrapolations of evolving circumstances**. Though not risk-free, thoughtful forward-looking projections, with the right monitoring and controls in place to measure results, may well prove to be critical in hindsight to getting ahead of the crisis.

Section 2: What Are We Aiming For & How Do We Get There? The Role of a COVID-19 Crisis Response Executive Summary Dashboard

You can see how things quickly become very complicated. Both actual and projected data require a highly informed and calibrated lens through which to view the information that few people have. Given the technical and rapidly changing nature of the crisis, **what role does data play in navigating through the crisis and communicating with the public?**

In a time when it seems too many reports alternate between using data to binarily seed panic or dismiss risk, is there a realistic opportunity to coalesce around data en masse for healthier objectives? To build awareness around evolving facts, as well as transparently and accurately communicate risk, convey hope and explain the pro and cons of various alternatives. We learn a great deal about who we are in a time of crisis - we learn that we love each other, we care for each other and that protection does require sacrifice. But, can't we also learn that in panic we need to become even more calm and focused on the best tools to help us deal with the crisis, with data and good scientific analysis being near the top of the list? There is the clinical analysis we rely on, then there is statistical analysis – they are not the same disciplines.

In our illustrative projected mortality rate calculated in Section 1, we applied our current adjusted critical case and mortality rates to a potential future scenario. This assumption of linear progress could prove to be to be overly optimistic or overly conservation. It is dependent upon an abundance of variables:

- How quickly do these cases come – all at once or over a protracted period of time?
- How well-prepared is the healthcare system to treat those patients in greatest need of care?
- How quickly will a vaccine or other forms of mitigating care arrive?
- Will the changing weather, the seasons interrupt the virus, to what extent?
- The list goes on...

These are all critically important questions. And we believe these questions underscore how data can play a helpful role.

How would we like to see data used?

Firstly, we would like to see a clearly defined universe of priority metrics. What metrics are we focused on to help proactively bridge us to our desired outcome? We care about ventilators, ICU beds, surgical masks, percentage of population tested, number of people in "lockdown," days elapsed since lockdown commencement, etc. Though these concepts are often discussed, a formally defined universe of metrics summarized on a dashboard would convey leadership and organization; provide the public with clarity, confidence and consistency; and, if well-crafted, provide something for public and private stakeholders, including the general public, to uniformly rally around.

Secondly, we would like to more focus on target performance levels – not just reporting of actual historical results in a vacuum. If our leaders can not only articulate the metrics that matter, but also define target performance levels we are seeking to achieve, that implies that an organized strategy is supported by clearly and simply defined execution mandates. What could that look like? "We are very focused on available ventilator count, because rapid access to a ventilator is a key determinant of success with treating critical cases. Based on our current projections, we estimate that we may ultimately need a total of 300 thousand ventilators across the country. This breaks down into 20 thousand in State X, 15 thousand in State Y, etc."

Thirdly, we would like to see regular reporting on target vs. actual performance variance across the defined priority metrics. This would help ensure status transparency, accountability, and appropriately calibrated levels of relative panic or comfort. "Within State X, we are targeting 20 thousand ventilators. We currently have ten thousand, which represents 50% of our goal. Last week, we added two thousand and we have plans to add a total of five thousand more over the next two weeks." Is this virus, and our target response, behaving every day in the way we anticipated, or is it strengthening or weakening? We have stated publicly that we are looking for a peak, a sign that the virus is slowing down not speeding up - why aren't there publicly available metrics that we can all follow to highlight this search? Weakening in random tests results and the broad spread? Weakening in moving averages? Weakening in mortality rates? Despite the field of metrics that should we tracked versus target performance levels, we seem to be largely fixated on reporting only one metric, which is documented cases of symptomatic individuals being shown to have COVID-19?

Fourthly, we would like to see more real-time strategic segmentation of the case volume and outcomes data. Breakdown by age, geography, urban versus rural location, gender, income level – as many categories as are deemed relevant. Strategically segmented data can help communicate trends that are arising as well as convey that authorities are focused on efficient resource allocation.

Lastly, we would like to see more benchmarking. Both at a state level and on an international level. What are we seeing in State X versus State Y or Country A versus Country B? What strategies are working and not working? Can we see the minutes from committee meetings between stakeholders where they use the benchmarking data as a starting point for facilitating meaningful discussion? Wouldn't it be great to see that best-practice and evolving lessons learned are proactively and efficiently flowing between stakeholders to help improve results, save lives, and reduce costs and mistakes along the way?

Taking the above together, what could a COVID-19 crisis response executive summary dashboard look like? We have included a draft below as an illustrative concept. Again, there will be parties more informed than us to advance the specific focus areas and target levels.

Draft United States COVID-19 Crisis Response Executive Summary Dashboard

This initial version is meant for illustrative purposes and is populated with placeholder data that is based partially on reported estimates.

	Target	Actual		Weekly	Rolling 2 week avg.
	Level	Week 1	Week 2	% change	Week 9
Testing volume activity					
Available testing capacity per day	**20,000**	5,000	8,500	70%	6,750
Cumulative # of tests completed	**49,572,909**	30,000	50,000	66.7%	40,000
% of population	**15%**	0.01%	0.02%	66.7%	0.01%
Case volume					
Total cumulative reported cases to-date		45,000	55,528	23.4%	50,264
Estimated total cases (factoring in undetected cases)		300,000	370,187	23.4%	335,093
# of active serious condition cases		1,040	1,175	13%	1,108
% of total reported cases		2.3%	2.1%	(8.4%)	2.2%
% of total estimated cases		0.3%	0.3%	(8.4%)	0.3%
# of deaths to-date		150	791	427.3%	471
Death rate as % of total reported cases (Public Panic Index)		0.33%	1.42%	327.4%	0.94
Death rate as % of total esimated cases		0.05%	0.21%	327.4%	0.14%
Medical staffing					
Required available RNs					
Required available internal medicine MDs					
Required available internal medicine PAs					
Equipment					
# of available ventilators	**300,000**	160,000	180,000	12.5%	170,000
# of available ICU beds	**300,000**	59,055	59,055	0%	59,055
# of available hospital beds	**1,400,000**	510,949	510,949	0%	510,949
Economic indicators					
# of initial claims	**200,000**	200,375	1,000,000	399.1%	600,188

Draft COVID-19 International Radar Watch

This initial version is meant for illustrative purposes and is populated with placeholder data that is based partially on reported estimates.

	Actual		Weekly	Rolling 2 week avg.
	Week 8	Week 9	% change	Week 9
Virus reemergence watch				
China				
Cumulative reported cases	80,881	81,218	0.4%	81,050
Estimated total cases (factoring in undetected cases)	539,207	541,453	0.4%	540,330
Reported new cases	146	337	130.8%	242
Active cases	8,967	4,287	(52.2%)	6,627
Cumulative deaths	3,189	3,245	1.8%	3,217
Death rate – reported cases only (Panic Index)	**3.9%**	**4%**	**1.3%**	**4.0%**
Adjusted death rate – estimated total (factoring in undected cases)	0.6%	0.6%	1.3%	0.6%
Strong performers watch				
South Korea				
Cumulative reported cases	8,236	9,037	9.7%	8,636
Estimated total cases (factoring in undetected cases)	54,907	60,247	9.7%	57,577
Reported new cases	923	801	(13.2%)	862
Active cases	7,024	5,410	(23%)	6,217
Cumulative deaths	84	126	50.0%	105
Death rate – reported cases only (Panic Index)	**1%**	**1.4%**	**36.7%**	**1.2%**
Adjusted death rate – estimated total (factoring in undected cases)	0.2%	0.2%	36.7%	0.2%
Germany				
Cumulative reported cases	7,272	32,991	353.7%	20,132
Estimated total cases (factoring in undetected cases)	48,480	219,940	353.7%	134,210
Reported new cases	6,232	25,719	312.7%	15,976
Active cases	7,188	29,542	311.0%	18,365
Cumulative deaths	17	159	835.3%	88
Death rate – reported cases only (Panic Index)	**0.2%**	**0.5%**	**106.2%**	**0.4%**
Adjusted death rate – estimated total (factoring in undected cases)	0%	0.1%	106.2%	0.1%
Weak performers turnaround effectiveness watch				
Italy				
Cumulative reported cases	27,980	69,176	147.2%	48,578
Estimated total cases (factoring in undetected cases)	186,533	461,173	147.2%	323,853
Reported new cases	20,073	41,196	99.9%	30,901
Active cases	23,073	54,030	134.2%	38,552
Cumulative deaths	2,158	6,820	216.0%	4,489
Death rate – reported cases only (Panic Index)	**7.7%**	**9.9%**	**27.8%**	**8.8%**
Adjusted death rate – estimated total (factoring in undected cases)	1.2%	1.5%	27.8%	1.3%
Spain				
Cumulative reported cases	9,942	42,058	323.0%	26,000
Estimated total cases (factoring in undetected cases)	66,280	280,387	323.0%	173,333
Reported new cases	9,268	32,116	246.5%	20,692
Active cases	9,070	35,273	288.9%	22,172
Cumulative deaths	342	2,991	774.6%	1,667
Death rate – reported cases only (Panic Index)	**3.4%**	**7.1%**	**106.7%**	**5.3%**
Adjusted death rate – estimated total (factoring in undected cases)	0.5%	1.1%	106.7%	0.8%

Closing Thoughts

Our hope is that some of what we have included in this piece can be incorporated into our on-going response to this and future pandemics, future crisis of any kind. We also believe that what we learn from this crisis will inform us on an individual level for our personal crisis that await each of us. Our companies that we return to will be faced with volatility and risk countless times. Can we incorporate analytical dashboards early on that leave room for projection based on interpretation or will we be doggedly wedded to simply the known knowns?

Whatever may not be feasible at this current juncture can perhaps form the basis for the eventual conversation on how we organize ourselves to prepare for next time. We plan to return to this topic of planning for next time in more detail during an upcoming piece in our COVID-19 series.