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In spring 2020, New York City became the acknowledged epicenter of the COVID-19 pandemic in the United States. To keep residents informed, Governor Cuomo conducted a streak of 111 daily press briefings reporting critical information about the status of the pandemic in the State at large, and New York City in particular. We show that through these briefings Governor Cuomo introduced an audience of New Yorkers and others to concepts basic to data-driven decision making such as data, science, models, and projections, and in so doing claimed that his decisions were unrelated to politics or whim. But we further suggest that data-driven decision making is not always immune from politics and human frailty in government. We conclude that basing policy decisions on data requires that policymakers insure the creation of a resilient and trustworthy health care data infrastructure to function as the scaffolding upon which policy making takes place.

CCS Concepts: • **Applied computing → Computing in government**; **Life and medical sciences**; **Health care information systems**;

Additional Key Words and Phrases: Data-driven decision making, COVID-19, data science, data models, policymaking, health care data, health data infrastructure

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INTRODUCTION

From March through May 2020, New York became the acknowledged epicenter of the COVID-19 pandemic in the United States. Responding to a virus outbreak approximately 20 miles north of New York City, Andrew Cuomo, three-term governor of New York, announced on March 11 the creation of a two-week long, 1 mile radius "containment area" around the suburb of New Rochelle where most of NY's 173 COVID-19 cases had been diagnosed [Nir Maslin and McKinley 2020; Jacobson 2020]. A scant 6 days later, Governor Cuomo declared that, beginning March 22, New York State was "On PAUSE" (Policies that Assure Uniform Safety for Everyone], which meant that non-essential workers, 75% of the workforce, were ordered to stay inside their homes except for critical travel to grocery and drug stores. This unprecedented directive was deemed necessary as virus counts

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climbed past 8,500 [Slattery et al. 2020] to an apex at that time unknown. The "PAUSE" order was extended to June 13 for most of the state, although by May 14, five regions had reached health data benchmarks entitling them to begin Phase 1 of a four-stage state reopening plan [Coote 2020].

Throughout this remarkable period of time in which over 400,000 New Yorkers became infected and over 30,000 individuals perished, Governor Cuomo conducted a streak of 111 daily press briefings [Harris 2020] reporting critical information about the status of the pandemic in the state at large, and New York City (NYC) in particular. He used these briefings to bring this critical information into public discourse. Cuomo discussed plans to respond to the pressures on the NYC's health care system, which threatened to be overwhelmed. Most briefings began by reviewing the data points, curves, and dashboards indexing the status of the pandemic, including numbers of hospitalizations, intensive care unit (ICU) admissions, intubations, and fatalities. These numbers served as evidence for Cuomo's repeated claim that his strategy for addressing conditions that could break the back of New York City's hospitals was driven by data, science, and the need to "flatten the curve."

Cuomo's strategy illustrates a type of policy making that those in the digital government community would regard as "data-driven decision making," that is, decision making that relies on the collection, analysis, and interpretation of data to inform practice and policy, which is viewed as more rigorous, productive, and transparent [Mandinach 2012; Matheus et al. 2018; Provost and Fawcett 2013] than alternatives. In this commentary, we make two points: First, we show that through his daily briefings Governor Cuomo introduced an audience of New Yorkers and others around the country to some basic concepts of data-driven decision making: data, science, models, and projections, and their use in creating public policy. His explanations can be viewed as short but convincing illustrations of the relationship between personal behavior and the data that informed the decisions he made in the early days of the pandemic. As an elected leader, he sought to demonstrate that his decisions were data-driven and thus based on imperatives unrelated to politics or whim.

However, we suggest, second, that data-driven decision making is not necessarily immune from politics and human frailty in government policy making; we provide several reasons and illustrations, also related to the pandemic, for why this is the case. Indeed, basing policy actions on data requires, we argue, that policymakers ensure the creation of a resilient and trustworthy data infrastructure to function as the scaffolding upon which policy making takes place.

Data and Science Drive NYS's COVID-19 Pandemic Decisions

Cuomo's daily data-focused briefings quickly attracted national attention, perhaps because at the height of the crisis in New York City he used them to beg for personal protective equipment (PPE), hospital beds, and ventilators that data projections suggested would soon be needed. But he was also perceived as a sober, communicative, and empathic decision maker, for his ability to define issues, explain processes, and justify the actions he was taking [McKinley 2020; Smith 2020] as well as for expressing a set of values that also informed his decisions. He warned against imperiling elderly relatives, including his own mother; advised listeners to seek silver linings to the lockdown in their interactions with family members; and spoke movingly about his dedication to saving every possible life. These qualities endeared him to viewers; the briefings were soon hailed as must-see TV [MacAdam 2020].

Cuomo's presentation of New York's data in mid-March outlined a situation with a dire future. He used frequency counts, histograms by date, and dashboards to display increases in the numbers of coronavirus cases in New York and to describe the implications of those increases for future hospital needs. Cuomo introduced the public to the idea of the data curve and its menacing attributes as based in fact and knowledge:

> There is a curve, everyone's talking about the curve, everyone's talked about the height and the speed of the curve and flattening the curve. I've said that curve is going to turn into a wave and the wave is going to crash on the hospital system. I've said that from day one because that's what the numbers would dictate, and this is about numbers, and this is about facts. This is not about prophecies or

> science fiction movies. We have months and months of data as to how this virus operates [Cuomo 2020, March 17].

In the same briefing, Cuomo described how one uses, or projects from, the curve in this case to the future need for hospitals beds:

> So just project from what you know. You don't have to guess. We have 53,000 hospital beds in the state of New York. We have 3000 ICU beds. Right now, the hospitalization rate is running between 15 and 19% from our sample of the tests we take. We have 19.5 million people in the state of New York. We have spent much time with many experts projecting what the virus could actually do … looking at our rate of spread because we're trying to determine what is the apex of that curve, what is the consequence, so we can match it to the capacity of the healthcare system …. That is the entire exercise [Cuomo 2020 March 17].

He then explained why the health care system in New York City was in danger of becoming overwhelmed:

> The "experts," …. they're all using the same data that the virus has shown over the past few months in other countries, but they're extrapolating from that data. The expected peak is around 45 days. That can be plus or minus depending on what we do. They are expecting as many as 55,000 to 110,000 hospital beds will be needed at that point. That, my friends, is the problem that we have been talking about since we began this exercise. You take the 55,000 to 110,000 hospital beds, you compare it to a capacity of 53,000 beds and you understand the challenge[Cuomo 2020, March 17].

Two days later, Cuomo explained why his decision to place New York "On PAUSE" was essential by referring to the need to make behavioral changes – reducing the density of human contacts – that would diminish the numbers of coronavirus cases simultaneously within the same short period of time:

> We've been taking increasing steps on density reduction, because the numbers have been increasing. And again, this is driven by science and by data….. The numbers have gone up overnight. I am going to increase the density control today. No more than 25% of people can be in the workforce. Yesterday it was 50%. We're reducing it again, except the essential services that we spoke about yesterday. That means 75% of the workforce must stay at home and work from home [Cuomo 2020, March 19].

The next day Cuomo crystallized his data-driven strategy in a phrase – flattening the curve – that became the State's mantra for how to combat an otherwise steep and exponential increase in cases:

> The number one opportunity to make a difference here is to flatten the curve, flatten the increase in the number of cases, as we've talked about. …. You look at those numbers and you understand why. Look at the increase in the number of cases. Sixteen days ago, we were at zero. Today, we are at 2,900. Those numbers are why we're taking these actions. Just increase that curve, and you will see it more than doubles our health care system capacity. It more than triples the number of ICU beds with ventilators that we could possibly arrange. That's why we're taking these actions [Cuomo 2020, March 20]_.

Interestingly, Cuomo did not shrink from describing the complexities of drawing conclusions from data projections. Approximately 2 weeks later, as New Yorkers anxiously pondered when the apex of the curve would be reached, he explained how data projections change on the basis of assumptions about prevailing conditions:

> We follow the projection model. Every day you get additional data, they run that data into the model, and they refine the model. Basically, we then have a composite model, because you have many different people out there with many different models. … [E]ven more maddening, the model changes the more data that comes in. Because they started with assumptions and presumptions. Then the

> more data that comes in either affirms or discounts their presumptions that they started with. They refine the model over time. The model changes, and the numbers change. But what we're looking at now is the apex, top of the curve, roughly at the end of April,which means another month of this [Cuomo 2020, April 1]

One of the most important assumptions about prevailing conditions, Cuomo argued, involved the extent to which New Yorkers changed their personal behavior, for example, with regard to social distancing:

> One of the great variables is, how effective is the social distancing? Are people doing it? Are they complying with it? To what extent, and how effective is it? Nobody knows that answer. They do different projections depending on how well social distancing works. How well people comply with it, and then how effective it is. ..... If you have high compliance, you're down to 75,000 COVID beds, 25,000 ventilators. Less, it goes up to 110 and 37. .... Both models say you apex at the end of April, just a lower need at that apex. That is what we want. Because this all comes down to, at the apex, can your hospital system manage the volume of people coming into the hospital system? That's all this is about at the final analysis [Cuomo 2020, April 1].

While it is true that Cuomo's data presentations also served the goal of correcting misinformation circulated by the press and through social media, one can see that Cuomo goes beyond simple data presentations to take on the task of showing how data can be used to model the natural phenomenon of virus transmission, which then guides his administration in choosing and evaluating policy actions. Cuomo's motivation can be seen as a desire to assure his audience that his decisions are driven by what is scientifically known about the novel coronavirus and what mitigates it, and not by politics. His appeals to data, modeling, and science are intended to convey that there are natural principles that logically lead to particular actions. The assumption that underlies his presentation is that reliance on the data creates a level playing field for decision making, and decisions made in this way serve no particular sets of interests or populations but indeed create "policies that assure uniform safety for everyone."

The Frailty of Data

The supposition that data can be used in a simple and unbiased way to select among policy options is appealing, but those who study data know that issues about its adequacy and its uses inevitably complicate data-driven decision making [Harrison et al. 2019; Matheus et al. 2018; Lepri et al. 2017]. In the context of this pandemic we can see that making data available, ensuring that it is fit to be used in analyses, and deploying it in public discourse illustrate several problems we will continue to experience in the absence of more robust data-based scaffolding upon which public health decision making takes place.

Data Availability and Suffiency. Timely, transparent, and accessible data is an absolute pre-condition for data-driven decision making; without it, Governor Cuomo's strategy could not be executed. A closely related concern focuses on the general availability and sufficiency of relevant data. Do we have data that decision makers need in order to understand situations as they unfold? This cannot be taken for granted. For example, early in April in New York City, it was apparent that there were disproportionate health impacts of the coronavirus on minority communities. At that time, Governor Cuomo turned to President Havidán Rodríguez of the University at Albany to commission research addressing these issues. Why do black New Yorkers comprise 28 percent of the deaths in New York City, despite being only 22 percent of the population? Why do they comprise 18 percent of deaths in the rest of New York, despite being 9 percent of the population [Budryk 2020]? But while health care providers collected ethnicity data related to deaths, they did not routinely collect ethnicity data related to infections, diagnoses, and hospitalization. Led by the American Medical Association, seven national physician associations have since appealed to the U.S. Department of Health and Human Services to routinely collect race, ethnicity, and patients' preferred spoken and written language data in relationship to testing status, hospitalization, and mortality

[AMA 2020]. In the absence of such data (or valid estimates) one cannot determine where policy interventions earlier in the disease progression might best be directed in order to reduce fatality rates [Holtgrave et al. 2020].

Data Accuracy. One hopes of course that the data faithfully represent the characteristics of a phenomenon, but whether or not it accurately does so leads directly to questions about what constitutes an accurate count. The data register a case once users define what "counts" as a case. Our experience with COVID-19 once again illustrates why this may be a complicated issue. In one briefing, a reporter asked the Governor what he had to say about President Trump's accusation that New York City's fatality numbers were inflated: "So now they're saying [we] added something like 3,800 new deaths based on in-home deaths." Gov. Cuomo replied:

> The CDC put out different guidelines about what numbers you must report. We've always said, "All we really know are deaths in a hospital or deaths in a nursing home." Could people be dying at home because of the coronavirus and we're not counting them? Yes. Was this a rough estimate? Yes. So now we're trying to refine the estimate, other categories, other possibilities. I think that's what it is more than anything. It's more of a reporting process. [April 16, 2020].

Subsequent interactions clarified that the Centers for Disease Control and Prevention (CDC) had begun to require that "probable deaths" from COVID-19 be reported with counts that could not necessarily be precise and that were not originally included in the City's death count numbers but were subsequently added. This example shows that it's possible to differ markedly over data that should be taken as "fact," with implications for what policy makers may take as objectively true.

Contested Data. Finally, although we hope and trust that the data always present an accurate and sufficient view of reality, we must recognize that once it becomes clear that decisions hinge on data analytics, then data itself may become contested, by which we mean that it can be argued about, questioned, or competed for. One common example in the current pandemic is the distrust of data representations supplied, or not, by certain countries; China [Fish and Sinclair 2020] and Tanzania [Ng'Wanakilala 2020] are prominent illustrations.

In the United States, we now find arguments over who controls the representation and collection of data. In Florida, state employees have contested their Administration's instructions for performing data-related duties for state government. One state employee was fired, ostensibly because she refused to manipulate data intended for public consumption, such as the number of positive coronavirus cases, so that it would appear to support the case for economic reopening [Martin 2020]. She has since mounted her own website presenting Florida's coronavirus data [Iati 2020]. In April 2020, Florida's Medical Examiners Commission, which had historically been responsible for tracking deaths from natural disasters and diseases, were told, to their dismay, by the DeSanctis administration that they could no longer release publicly their counts of COVID-19 deaths. Their fatality counts were greater than those compiled by Florida's Department of Health [Allen 2020].

At the federal level, substantial concern was expressed when the Department of Health and Human Services (HSS) created a new coronavirus reporting system in July that bypassed the Centers for Disease Control and Prevention and required hospitals to file their data directly with an untested contractor supervised by the federal HSS or with their state. One immediate result was that data disappeared from a CDC dashboard, which had reported on infections, hospitalizations, and ICU bed capacity with information obtained directly from hospitals. Given that it was no longer directly receiving this data, the CDC declined to offer that dashboard, much to the consternation of the National Governors Association who wanted it back [Sun and Goldstein 2020]. Additionally, some states complained that the new reporting requirements, for which they received little notice, included types of data that they are not equipped to handle [Sun and Goldstein 2020]. Two weeks after its start, the new reporting system was receiving substantial criticism for its data omissions, inaccuracies, significant anomalies, and revised promises [Huang and Simmons-Duffin 2020].

The Politics of Data

On June 19, speaking on the last of his 111-day streak of daily briefings, Governor Cuomo declared that the "impossible" had been accomplished. "We are controlling the virus better than any state in the country and any nation on the globe. Even more, by reducing the infection rate, we saved over 100,000 people from being hospitalized and possibly dying, just think about that. It is an unimaginable achievement." [Cuomo 2020, June 19]. As we write, the pandemic is still with us and Governor Cuomo continues to count and to present data. But it is nevertheless time to begin to draw some valuable lessons from what is taking place as data-driven decision making enters into public discourse.

To be useful in government policy making, the data must be available and accurately address issues of analytical importance. According to public health scholars (Sittig and Singh [2020]), the pandemic has called our attention specifically to "the need for timely, accurate, and reliable data about the health of the US population" and the same may well be true for other nations. The challenges to realizing this goal are many and varied. Some are fundamental to the form of government and therefore inevitably political, requiring deeper changes than others. One of the fundamental factors impacting the availability of COVID-19 data, along with other important health data, is the practical reality of federalism in the U.S. and perhaps other federalist countries as well. A federal system is one in which two or more governments share powers over the same geographic area. In the United States, the Constitution grants certain powers to the federal government, certain powers to the state governments, and some powers that are shared by both.

In the context of COVID-19 in the United States, federalism matters. Governor Cuomo and New York State benefited from what Gordon et al. [2020], identified as advantages of federalism, including "the flexibility to customize responses to the unique characteristics of a local population, maintain state budgets, and test new policies," while other COVID-19 efforts have struggled, in part due to the fact that the Federal government is "limited in its ability to mandate a centralized course of action." Federalism in the U.S. means that there are more than 2000 state, local, and tribal health departments, according to the Association of State and Territorial Health Officials.[1] Many states of the United States have their own state-funded, locally administered public health model. This means that many public health departments have their own electronic health record systems and design their own unique data collection instruments.

This embarrassment of data and IT riches motivates public health scholars to call for new investments in public health infrastructure; perhaps digital government scholars should lend support to this call. Some argue for changes to "federalist" public health systems that would create uniform data collection across states and for the expansion of data that is collected, including race/ethnicity and income as a way to target resources to those communities disproportionately affected [Gordon et al. 2020]. Others go further, envisioning a more "robust national health IT infrastructure" that might consist of, for example, an interconnected network of health care nodes, each representing a health care organization using the now-common vehicle of electronic medical records; however, at present significant social and legal barriers (such as those protecting privacy) block such development [Sittig and Singh 2020] with political implications of their own.

Regardless of the particular direction ultimately pursued, it is clear that digital government practitioners and scholars, who have thought deeply about how such data infrastructures should be designed, have much to contribute to such an enterprise. Given the increasing use of and demand for data-driven policy decision making, the data-related issues referenced above are likely to become more common and more consequential. Ensuring the accuracy of the data in such an infrastructure is foundational, requiring the creation of widely accepted conventions for data reporting and standards for data management. Every care must be taken in this regard, or one risks the loss of trust and provokes charges of "fake" data. Beyond this, infrastructures must be designed to maximize data availability, sufficiency, and relevance while minimizing the possibility of contested data. This

[1] https://www.astho.org/Research/State-and-Local-Public-Health-Relationships/#:~:text=The%20governmental%20public%20health%20system,in%20assuring%20the%20public's%20health.

requires infrastructures that can facilitate, and manage the interdependencies among, at the very least, health data users with characteristics that are variable and unpredictable, uses for health data that go well beyond what it was originally intended to enable, health data sources and suppliers using records with widely disparate characteristics, and content with varying degrees of sensitivity (see Dawes et al. [2003] for additional dimensions).

Scholars and practitioners speaking and writing about using public health data in decision making seem to agree that to improve our prevention, mitigation, and response efforts for the COVID-19 pandemic, and future pandemics ahead, we must begin to question "the data collection status quo" [Sittig and Singh 2020] in public health and confront the politics of the process. It is not clear which governments, health care providers, and professional associations are in the best position to initiate and participate in the ambitious collaborative enterprise needed. One can only hope that a pandemic responsible for over 200,000 deaths (and counting) might persuade policy makers from a wide range of institutions to work together in accepting this challenge.

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