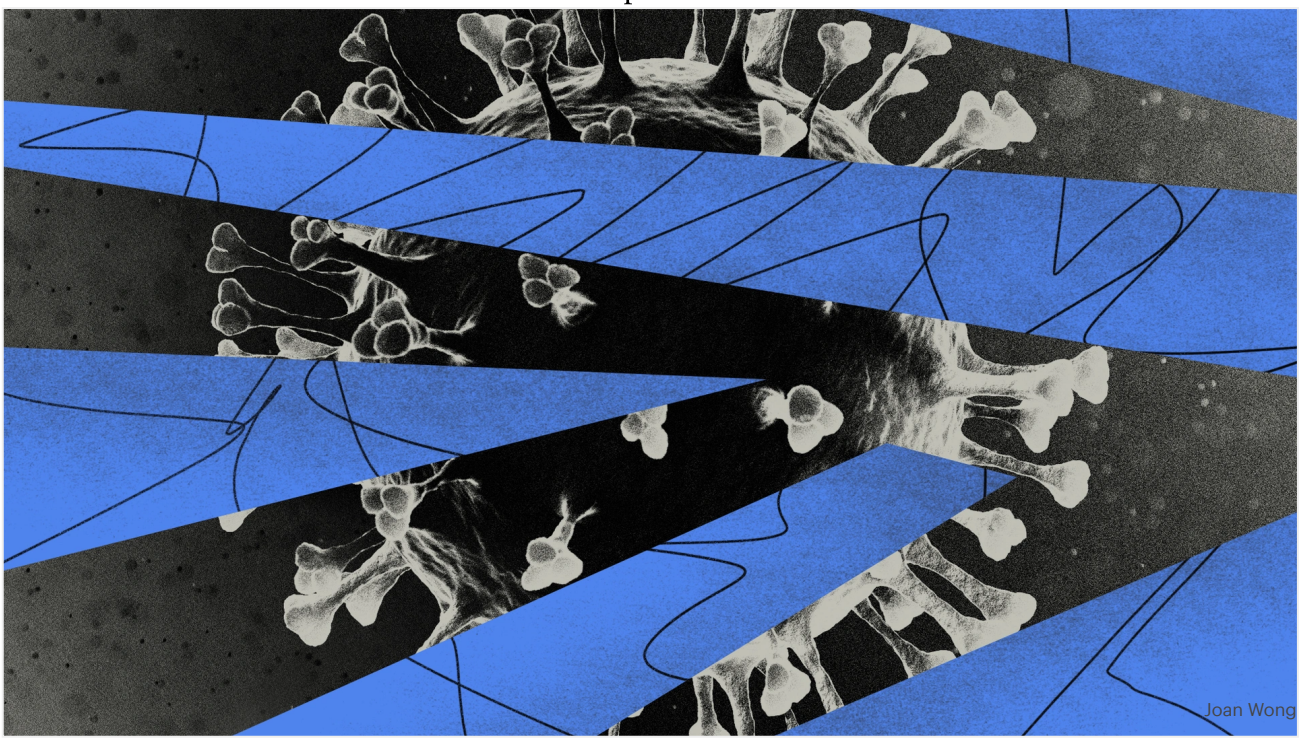
The Atlantic

Why the Coronavirus Is So Confusing

A guide to making sense of a problem that is now too big for any one person to fully comprehend



Story by Ed Yong

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On March 27, as the U.S. topped 100,000 confirmed cases of COVID-19,

flu, you can call it a virus. You know, you can call it many different names. I'm not sure anybody even knows what it is."

That was neither the most consequential statement from the White House, nor the most egregious. But it was perhaps the most ironic. In a pandemic characterized by extreme uncertainty, one of the few things experts know for sure is the identity of the pathogen responsible: a virus called SARS-CoV-2 that is closely related to the original SARS virus. Both are members of the coronavirus family, which is entirely distinct from the family that includes influenza viruses. Scientists know the shape of proteins on the new coronavirus's surface down to the position of individual atoms. Give me two hours, and I can do a dramatic reading of its entire genome.

But much else about the pandemic is still maddeningly unclear. Why do some people get really sick, but others do not? Are the models too optimistic or too pessimistic? Exactly how transmissible and deadly is the virus? How many people have actually been infected? How long must social restrictions go on for? Why are so many questions still unanswered?

The confusion partly arises from the pandemic's scale and pace. Worldwide, at least 3.1 million people have been infected in less than four months. Economies have nose-dived. Societies have paused. In most people's living memory, no crisis has caused so much upheaval so broadly and so quickly. "We've never faced a pandemic like this before, so we don't know what is likely to happen or what would have happened," says Zoë McLaren, a health-policy professor at the University of Maryland at Baltimore County. "That makes it even more difficult in terms of the uncertainty."

But beyond its vast scope and sui generis nature, there are other reasons the pandemic continues to be so befuddling—a slew of forces scientific and societal, epidemiological and epistemological. What follows is an analysis of those forces, and a guide to making sense of a problem that is now too big for any one person to fully comprehend.

Because *coronavirus* wasn't part of the popular lexicon until SARS-CoV-2 ran amok this year, earlier instances of the term are readily misconstrued. When people learned about a meeting in which global leaders role-played through a fictional coronavirus pandemic, some wrongly argued that the actual pandemic had been planned. When people noticed mentions of "human coronavirus" on old cleaning products, some wrongly assumed that manufacturers had somehow received advance warning.

[Read: Why the coronavirus has been so successful]

There isn't just one coronavirus. Besides SARS-CoV-2, six others are known to infect humans—four are mild and common, causing a third of colds, while two are rare but severe, causing MERS and the original SARS. But scientists have also identified about 500 other coronaviruses among China's many bat species. "There will be many more—I think it's safe to say tens of thousands," says Peter Daszak of the EcoHealth Alliance, who has led that work. Laboratory experiments show that some of these new viruses could potentially infect humans. SARS-CoV-2 likely came from a bat, too.

It seems unlikely that a random bat virus should somehow jump into a susceptible human. But when you consider millions of people, in regular contact with millions of bats, which carry tens of thousands of new viruses, vanishingly improbable events become probable ones. In 2015, Daszak's team found that 3 percent of people from four Chinese villages that are close to bat caves had antibodies that indicated a previous encounter with SARS-like coronaviruses. "Bats fly out every night over their houses. Some of them shelter from rain in caves, or collect guano for fertilizer," Daszak says. "If you extrapolate up to the rural population, across the region where the bats that carry these viruses live, you're talking 1 [million] to 7 million people a year exposed." Most of these infections likely go nowhere. It takes just one to trigger an epidemic.

Once that happens, uncertainties abound as scientists race to characterize the new pathogen. That task is always hard, but especially so when the pathogen is a coronavirus. "They're very hard to work with; they don't grow very well in cell

the world who specialize in coronaviruses, which have attracted comparatively little attention compared with more prominent threats like flu. The field swelled slightly after the SARS epidemic of 2003, but then shrunk as interest and funding dwindled. "It wasn't 'til MERS came along [in 2012] that I even thought I could have an academic career on coronaviruses," Menachery says.

The tight group of coronavirologists is now racing to make up for years of absent research—a tall order in the middle of a pandemic. "We're working as hard as possible," says Lisa Gralinski, a virologist at the University of North Carolina. "Our space is so intermingled that we can't socially distance among ourselves much."

One small mercy, she notes, is that SARS-CoV-2 isn't changing dramatically. Scientists are tracking its evolution in real time, and despite some hype about the existence of different strains, the virologists I've spoken with largely feel that the virus is changing at a steady and predictable pace. There are no signs of "an alarming mutation we need to be worried about," Gralinski says. For now, the world is facing just one threat. But that threat can manifest in many ways.

II. The Disease

SARS-CoV-2 is the virus. COVID-19 is the disease that it causes. The two aren't the same. The disease arises from a combination of the virus and the person it infects, and the society that person belongs to. Some people who become infected never show any symptoms; others become so ill that they need ventilators. Early Chinese data suggested that severe and fatal illness occurs mostly in the elderly, but in the U.S. (and especially in the South), many middle-aged adults have been hospitalized, perhaps because they are more likely to have other chronic illnesses. The virus might vary little around the world, but the disease varies a lot.

[Read: The coronavirus's unique threat to the South]

This explains why some of the most important stats about the coronavirus have

frustrating to not have a firm number, but also unrealistic to expect one. “Folks are talking about CFR as this unchangeable quantity, and that is not how it works,” says Maia Majumder, an epidemiologist at Harvard Medical School and Boston Children’s Hospital.

The CFR’s denominator—total cases—depends on how thoroughly a country tests its population. Its numerator—total deaths—depends on the spread of ages within that population, the prevalence of preexisting illnesses, how far people live from hospitals, and how well staffed or well equipped those hospitals are. These factors vary among countries, states, and cities, and the CFR will, too. (Majumder and her colleagues are now building tools for predicting regional CFRs, so local leaders can determine which regions are most vulnerable.)

The variability of COVID-19 is also perplexing doctors. The disease seems to wreak havoc not only on lungs and airways, but also on hearts, blood vessels, kidneys, guts, and nervous systems. It’s not clear if the virus is directly attacking these organs, if the damage stems from a bodywide overreaction of the immune system, if other organs are suffering from the side effects of treatments, or if they are failing due to prolonged stays on ventilators.

[Read: Why some people get sicker than others]

Past coronavirus epidemics offer limited clues because they were so contained: Worldwide, only 10,600 or so people were ever diagnosed with SARS or MERS combined, which is less than the number of COVID-19 cases from Staten Island. “For new diseases, we don’t see 100 to 200 patients a week; it usually takes a whole career,” says Megan Coffee, an infectious-disease doctor at NYU Langone Health. And “if you see enough cases of other diseases, you’ll see unusual things.” During the flu pandemic of 2009, for example, doctors also documented heart, kidney, and neurological problems. “Is COVID-19 fundamentally different to other diseases, or is it just that you have a lot of cases at once?” asks Vinay Prasad, a hematologist and an oncologist at Oregon Health and Science University.

situation of fear, uncertainty, and hype, and it's not surprising that there's almost a folk medicine emerging." Already, there are intense debates about giving patients blood thinners because so many seem to experience blood clots, or whether ventilators might do more harm than good. These issues may be important, and when facing new diseases, doctors must be responsive and creative. But they must also be rigorous. "Clinicians are under tremendous stress, which affects our ability to process information," McLaren says. "'Is this actually working, or does it seem to be working because I want it to work and I feel powerless?'"

Consider hydroxychloroquine—the antimalarial drug that's been repeatedly touted by the White House and conservative pundits as a COVID-19 "game changer." The French studies that first suggested that the drug could treat COVID-19 were severely flawed, abandoning standard elements of solid science like randomly assigning patients to receive treatments or placebos, or including a control group to confirm if the drug offers benefits above normal medical care. The lead scientist behind those studies has railed against the "dictatorship of the methodologists," as if randomization or controls were inconveniences that one should rebel against, rather than the backbone of effective medicine.

[Read: Why does the president keep pushing a malaria drug?]

Larger (but still preliminary) studies from the U.S., France, and China have cast doubt on hydroxychloroquine's effectiveness, and because it can cause heart problems, the National Institutes of Health has recommended against using it outside clinical trials. Those trials will offer clearer answers by the summer, and the drug may yet prove beneficial. For now, doctors are routinely prescribing it without knowing if it works or, crucially, if it does more harm than good. Meanwhile, people with lupus and rheumatoid arthritis, who actually need hydroxychloroquine, can't get it. It is not the case that every new study contributes to our understanding of COVID-19. Sloppy ones are a net negative, adding to the already considerable uncertainty by offering the illusion of confidence where none exists.

Since the pandemic began, scientists have published more than 7,500 papers on COVID-19. But despite this deluge, "we haven't seen a lot of huge plot twists," says Carl Bergstrom, an epidemiologist and a sociologist of science at the University of Washington. The most important, he says, was the realization that people can spread the virus before showing symptoms. But even that insight was slow to dawn. A flawed German study hinted at it in early February, but scientific opinion shifted only after many lines of evidence emerged, including case reports, models showing that most infections are undocumented, and studies indicating that viral levels peak as symptoms appear.

This is how science actually works. It's less the parade of decisive blockbuster discoveries that the press often portrays, and more a slow, erratic stumble toward ever less uncertainty. "Our understanding oscillates at first, but converges on an answer," says Natalie Dean, a statistician at the University of Florida. "That's the normal scientific process, but it looks jarring to people who aren't used to it."

For example, Stanford University researchers recently made headlines after testing 3,330 volunteers from Santa Clara County for antibodies against the new coronavirus. The team concluded that 2.5 to 4.2 percent of people have already been infected—a proportion much higher than the official count suggests. This, the authors claimed, means that the virus is less deadly than suspected, and that severe lockdowns may be overreactions—views they had previously espoused in opinion pieces. But other scientists, including statisticians, virologists, and disease ecologists, have criticized the study's methods and the team's conclusions.

One could write a long article assessing the Santa Clara study alone, but that would defeat the point: that individual pieces of research are extremely unlikely to single-handedly upend what we know about COVID-19. About 30 similar "serosurveys" have now been released. These and others to come could collectively reveal how many Americans have been infected. Even then, they would have to be weighed against other evidence, including accounts from doctors and nurses in New York or Lombardy, Italy, which clearly show that SARS-CoV-2 can crush health-care systems. The precise magnitude of the virus's

The scientific discussion of the Santa Clara study might seem ferocious to an outsider, but it is fairly typical for academia. Yet such debates might once have played out over months. Now they are occurring over days—and in full public view. Epidemiologists who are used to interacting with only their peers are racking up followers on Twitter. They have suddenly been thrust into political disputes. "People from partisan media outlets find this stuff and use a single study as a cudgel to beat the other side," Bergstrom says. "The climate-change people are used to it, but we epidemiologists are not."

In an earlier era, issues with the Santa Clara study would have been addressed during peer review—the process in which scientific work is assessed by other researchers before being published in a journal. But like many COVID-19 studies, this one was uploaded as a preprint—a paper that hasn't yet run the peer-review gauntlet. Preprints allow scientists to share data quickly, and speed is vital in a pandemic: Several important studies were uploaded and discussed a full month before being published.

Preprints also allow questionable work to directly enter public discourse, but that problem is not unique to them. The first flawed paper on hydroxychloroquine and COVID-19 was published in a peer-reviewed journal, whose editor in chief is one of the study's co-authors. Another journal published a paper claiming that the new coronavirus probably originated in pangolins, after most virologists had considered and dismissed that idea.

[Read: Don't believe the COVID-19 models]

Meanwhile, scientists are poring over preprints in open online spaces: The Santa Clara study may not have been formally peer-reviewed, but it has very much been reviewed by peers. It is easier than ever for journalists to assess how new research is being received, but only some are presenting these debates to their audience. Others are not. Some are even reporting on press-released research that hasn't been uploaded as a preprint. "The rules for reporting on preprints shouldn't be any different from reporting on journal articles," the journalist Ivan Oransky told the media watchdog Health News Review. "Everything needs to be

Such scrutiny will become ever more necessary as the pandemic wears on. Julie Pfeiffer of UT Southwestern, who is an editor at the *Journal of Virology*, says that she and her colleagues have been flooded with submitted papers, most of which are so obviously poor that they haven't even been sent out for review. "They shouldn't be published anywhere," she says, "and then they end up [on a preprint site]." Some come from nonscientists who have cobbled together a poor mathematical model; others come from actual virologists who have suddenly pivoted to studying coronaviruses and "are submitting work they never normally would in a rush to be first," Pfeiffer says. "Some people are genuinely trying to help, but there's also a huge amount of opportunism."

IV. The Experts

Last month, the legal scholar Richard Epstein claimed that "the current organized panic in the United States does not seem justified" and that as the pandemic continued, "good news is more likely than bad." His piece was widely circulated in conservative circles and the Trump administration. When asked about his lack of epidemiological training in an interview with *The New Yorker*'s Isaac Chotiner, Epstein responded, "One of the things you get as a lawyer is a skill of cross-examination. I spent an enormous amount of time over my career teaching medical people about some of this stuff." His essay initially speculated that 500 Americans would die from COVID-19. He later updated that estimate to 5,000. So far, the death toll stands at 58,000, and is still rising.

Many other non-epidemiologists seem to have similarly accrued expertise in the field. The military historian Victor Davis Hanson proffered the widely shared idea that the coronavirus has been spreading in California since last fall—a claim disproved by genetic studies showing that the earliest U.S. case likely arrived in January. During a White House meeting, the economist Peter Navarro reportedly pointed to a pile of hydroxychloroquine studies and said, "That's science, not anecdote" to Anthony Fauci, who has worked in public health for five decades and directs the National Institute of Allergy and Infectious Diseases. The Silicon

[Read: We are living in a failed state]

Expertise is not just about knowledge, but also about the capacity to spot errors. Ginn couldn't see them in his own work; Bergstrom could. The rest of us are more likely to fall in the former group than the latter. We hunger for information, but lack the know-how to evaluate it or the sources that provide it. "This is the epistemological crisis of the moment: There's a lot of expertise around, but fewer tools than ever to distinguish it from everything else," says Zeynep Tufekci, a sociologist at the University of North Carolina and an *Atlantic* contributing writer. "Pure credentialism doesn't always work. People have self-published a lot of terrible pieces on Medium, but some of the best early ones that explained stuff to laypeople were from tech guys."

Bergstrom agrees that experts shouldn't be dismissive gatekeepers. "There's a lot of talent out there, and we need all hands on deck," he says. For example, David Yu, a hockey analyst, created a tool that shows how predictions from the most influential COVID-19 model in the U.S. have changed over time. "Looking at that thing for, like, an hour helped me see things I hadn't seen for three weeks," Bergstrom says.

A lack of expertise becomes problematic when it's combined with extreme overconfidence, and with society's tendency to reward projected confidence over humility. "When scientists offer caveats instead of absolutes," Gralinski says, "that uncertainty we're trained to acknowledge makes it sound like no one knows what's going on, and creates opportunities for people who present as skeptics." Science itself isn't free from that dynamic, either. Through flawed mechanisms like the Nobel Prize, the scientific world elevates individuals for work that is usually done by teams, and perpetuates the myth of the lone genius. Through attention, the media reward voices that are outspoken but not necessarily correct. Those voices are disproportionately male.

The idea that there are no experts is overly glib. The issue is that modern expertise tends to be deep, but narrow. Even within epidemiology, someone who studies infectious diseases knows more about epidemics than, say, someone who

to public-health experts; to work out if widespread testing is possible, listen to supply-chain experts. To determine if antibody tests can tell people if they're immune to the coronavirus, listen to immunologists; to determine if such testing is actually a good idea, listen to ethicists, anthropologists, and historians of science. No one knows it all, and those who claim to should not be trusted.

In a pandemic, the strongest attractor of trust shouldn't be confidence, but the recognition of one's limits, the tendency to point at expertise beyond one's own, and the willingness to work as part of a whole. "One signature a lot of these armchair epidemiologists have is a grand solution to everything," Bergstrom says. "Usually we only see that coming from enormous research teams from the best schools, or someone's basement."

V. The Messaging

In the early months of the pandemic, while the coronavirus blazed through China, even veteran disease experts seemed to misjudge the odds that the epidemic would become a full-blown pandemic. On January 26, Fauci himself said the virus posed a "very, very low risk to the United States" and was a concern for public-health officials, but not the public. Many journalists offered similar reassurances, and frequently compared the coronavirus threat with the allegedly greater danger of flu.

Some officials may have been motivated to avoid disproportionate panic, of the kind that gripped the U.S. during the Ebola outbreak of 2014. The instinct to be calm and measured is laudable—until it isn't. "Alarmism is equated with misinformation, and a lot of it is misinformation. But when you do have something coming, no one feels empowered to say: 'This one isn't alarmism,'" Tufekci, the sociologist, says. "There's a cultural script that we play, and when the script changes, it takes time to shift to a new one."

The narrative that experts underplayed the risks isn't fully correct, though. On January 26, Thomas Inglesby of Johns Hopkins Bloomberg School of Public

communication—the U.S. is still struggling to meet. Four days later, Scott Gottlieb, the former FDA commissioner, and Luciana Borio, who was part of the National Security Council's now-dissolved pandemic-preparedness office, similarly urged the government to "act now" to prevent an American epidemic. "I hope the lesson people take from this is not 'Experts were wrong,'" Tufekci says. "If you followed the right people, they were overwhelmingly right. We just didn't put them in the right place so we could hear them."

The World Health Organization has also come under fire for hewing too closely to China's position in January, and being too slow to confirm that the coronavirus was spreading among people, or to finally describe the situation as a pandemic. These issues should not detract from all that the WHO has done to contain the crisis. Nor should they provide cover for leaders who still failed to prepare their countries after the risks became clearer, and after being exhorted to act "aggressively" and "swiftly" by, well, the WHO. But the agency's missteps do offer lessons for communicating in an emergency. In mid-January, it sent a now-infamous tweet describing "no clear evidence of human-to-human transmission of the novel #coronavirus" without clearly discussing other important details, such as a new case in Thailand and warnings from Taiwan and Hong Kong. "They didn't give the world the tells," Tufekci says.

[Read: The WHO shouldn't be a plaything for great powers]

The same could be said of the White House and other U.S. officials who repeatedly assured Americans in January, February, and even March that their risk was low. That might have initially been true, Inglesby says, but officials should have noted that the true extent of the disease was unknown; that there wasn't a way of measuring it, because tests weren't in place; that the virus had already spread globally; and that control measures such as airport screening and travel bans have historically been unsuccessful. "The fuller statements take longer to explain, but that's how it is in outbreaks." Inglesby says. "There's a lot of uncertainty, and we shouldn't try to tidy it up."

In late February, Nancy Messonnier, the respiratory-disease chief of the Centers

Messonnier urged the nation to prepare for possible school closures, loss of work, "disruption to everyday life that may be severe," and "the expectation that this could be bad." The next day, Trump asserted that cases were "going to be down to close to zero." The day after, CDC Director Robert Redfield reiterated that "the risk is low," and said that Messonnier could have been more articulate. Shortly after, Redfield said, "The American public needs to go on with their normal lives." Of late, CDC officials, who were constant authoritative voices during past epidemics, have been mostly silent.

The impulse to be reassuring is understandable, but "the most important thing is to be as accurate as possible," Inglesby says. "We should give people information so they can do what they think is right. We should tell people what we don't know and when we'll know more." (The WHO is learning: On April 25, after wrongly tweeting that "there is currently no evidence that people who have recovered from COVID-19 and have antibodies are protected from infection," they offered a longer and more accurate explanation.)

If officials—and journalists—are clear about uncertainties from the start, the public can better hang new information onto an existing framework, and understand when shifting evidence leads to new policy. Otherwise, updates feel confusing. When the CDC suddenly reverses its position on wearing masks, without having previously clarified why the issue was so divisive, it seems like an arbitrary flip-flop. "That's a dangerous way to communicate," says Kate Starbird at the University of Washington, who studies how information flows during a crisis. "It contributes to diminishing trust in organizations. And when people don't have a place they can go for trusted information, it makes them vulnerable to disinformation."

VI. The Information

During news events like Trump's impeachment trial, people mostly share information to signal their beliefs, says Renée DiResta of Stanford, who studies how narratives spread online. But in a disaster, people tend to share information

uncertainty. “But when an earthquake happens, you talk to your neighbors and in a few days, you’ve figured out what’s going on,” Starbird says. “For COVID-19, the uncertainty is persistent.”

The pandemic’s length traps people in a liminal space. To clarify their uprooted life and indefinite future, they try to gather as much information as possible—and cannot stop. “We go seeking fresher and fresher information, and end up consuming unvetted misinformation that’s spreading rapidly,” Bergstrom says. Pandemics actually “unfold in slow motion,” he says, and “there’s no event that changes the whole landscape on a dime.” But it feels that way, because of how relentlessly we quest for updates. Historically, people would have struggled to find enough information. Now people struggle because they’re finding too much.

[Read: Trump’s dangerously effective coronavirus propaganda]

It does not help that online information channels are heavily personalized and politicized, governed by algorithms that reward certain and extreme claims over correct but nuanced ones. On Twitter, false information spreads further than true information, and at six times the speed. But “this is not just a problem of the internet,” DiResta says. “For a lot of people, what is true is what the people I’ve chosen to trust in my community say is true.” Those dynamics meant that, at least initially, liberal and conservative Americans had very different understandings of the pandemic.

As the reality of the pandemic becomes clearer, the partisan gap is rapidly closing. But as time passes, misinformation, which refers to misleading stories that are circulated in good faith, will give way to disinformation—falsehoods deliberately seeded “to leverage the disaster for political power,” Starbird says. Amid the psychological loam of fear and uncertainty, conspiracy theories are germinating like weeds.

The daily briefings from the White House have only exacerbated the confusion. Trump has repeatedly tried to downplay the pandemic and rewrite his role in mishandling it. His playbook is his usual one: Deny responsibility, find a

promotion of hydroxychloroquine led to shortages of the drug. His false claim that anyone who wants a test can get one sent droves of worried well to already-stretched hospitals.

[Read: The Trump presidency is over]

Several journalists and media critics have urged news networks to stop airing the White House briefings live. That seems extreme, but it's an extreme time when a presidential briefing forces doctors to clarify that people should not consume bleach. "No matter how many tough questions you ask, it really is not possible to prevent him from spreading bad info that could have very serious health effects," says Jay Rosen, a journalism professor at NYU. "People think that more determined journalists can solve the problem—and they can't."

Rosen also argues that the media's default rhythm of constant piecemeal updates is ill-suited to covering an event as large as the pandemic. "Journalists still think of their job as producing new content, but if your goal is public understanding of COVID-19, one piece of new content after another doesn't get you there," he says. "It requires a lot of background knowledge to understand the updates, and the news system is terrible at [providing that knowledge]." Instead, the staccato pulse of reports merely amplifies the wobbliness of the scientific process, turns incremental bits of evidence into game changers, and intensifies the already-palpable sense of uncertainty that drives people toward misinformation.

If the media won't change, its consumers might have to. Starbird recommends slowing down and taking a moment to vet new information before sharing it. She herself is spending less time devouring every scrap of pandemic news, and more time with local sources. It's the equivalent, she says, of "hand-washing for the infodemic." And it might dispel the illusion that the pandemic can be tracked in real time.

VII. The Numbers

The rapid pace of new information creates the sense that we can accurately

the U.S. But it's hard to know for sure. As my colleagues Robinson Meyer and Alexis Madrigal have reported, 20 percent of Americans who are tested for the coronavirus are still getting positive results. This figure is higher than almost every other developed country and has held steady over time. It suggests that the U.S. is still mostly testing people who are very likely to be infected and is still missing the majority of cases. If so, cases could have leveled off because the U.S. has maxed out its ability to find infected people.

This concern complicates the government's plan to start reopening the country after a "downward trajectory of documented cases within a 14-day period." If the case number is illusory, this criterion is meaningless. "I'd want to know that we're doing enough testing to be confident that those numbers really are stabilizing," says Dean, the University of Florida statistician. "I'm still not convinced we're in a good place."

When looking at case counts, remember this: Those numbers do not show how many people have been infected on any given day. They reflect the number of tests that were done (which is still insufficient), the lag in reporting results from those tests (which can be long), and the proportion of tests that are incorrectly negative (which seems high). Likewise, daily death counts do not offer a real-time glimpse at the virus's toll. Because of delays in reporting, they tend to be lower on weekends.

Deaths are hard to tally in general, and the process differs among diseases. The CDC estimates that flu kills 24,000 to 62,000 Americans every year, a number that seems superficially similar to the 58,000 COVID-19 deaths thus far. That comparison is misleading. COVID-19 deaths are counted based either on a positive diagnostic test for the coronavirus or on clinical judgment. Flu deaths are estimated through a model that looks at hospitalizations and death certificates, and accounts for the possibility that many deaths are due to flu but aren't coded as such. If flu deaths were counted like COVID-19 deaths, the number would be substantially lower. This doesn't mean we're overestimating the flu. It does mean we are probably underestimating COVID-19.

or that people can become "reinfected." This really means that patients are testing positive for the virus after having tested negative. But that might have nothing to do with the virus, and everything to do with the test. Diagnostic tests for COVID-19 produce a lot of false negatives, incorrectly telling 15 to 30 percent of infected people that they're in the clear. And even if these tests were better, the viral levels of a recovering patient would eventually fall below their threshold of accuracy. When such patients are sequentially tested, some will toggle between negative and positive results, creating the appearance of reinfection.

False positives are a problem, too. Many companies and countries have pinned their hopes on antibody tests, which purportedly show whether someone has been infected by the coronavirus. One such test claims to correctly identify people with those antibodies 93.8 percent of the time. By contrast, it identifies phantom antibodies in 4.4 percent of people who don't have them. That false-positive rate sounds acceptably low. It's not. Let's assume 5 percent of the U.S. has been infected so far. Among 1,000 people, the test would correctly identify antibodies in 47 of the 50 people who had them. But it would also wrongly spot antibodies in 42 of the 950 people without them. The number of true positives and false positives would be almost equal. In this scenario, if you were told you had coronavirus antibodies, your odds of actually having them would be little better than a coin toss.

[Read: No testing, no treatment, no herd immunity, no easy way out]

None of this means that all bets are off and the pandemic is unquantifiable. The case count might be wrong, but it's almost certainly too low rather than too high, and it's more likely off by a factor of 10 than 100. The numbers still matter; they're just messy and hard to interpret, especially in the moment. On my phone, I can see weather patterns, the position of every plane in the sky, and the number of people currently reading this article, all in real time. But I cannot get the same immediate information about the pandemic. The numbers I see say as much about the tools researchers are using as the quantities they are measuring. "I

If measuring the present is hard, predicting the future is even harder. The mathematical models that have guided the world's pandemic responses have been often portrayed as crystal balls. That is not their purpose. They instead describe a range of possibilities, and help scientists and policy makers to simulate what might happen pending different courses of action. Models reveal many possible fates, and allow us to choose one. And while distant projections are necessarily blurry, the path ahead is not unknowable. "The long-term is like modeling the trajectory of a falling leaf, but the short-term is like modeling a falling bowling ball," says Dylan Morris, an infectious-disease modeler at Princeton. Uncertainties about the year ahead shouldn't cloud "how devastatingly and terrifyingly certain we can be" about the immediate consequences if the pandemic isn't controlled, he adds.

VIII. The Narrative

In the final second of December 31, 1999, clocks ticked into a new millennium, and … not much happened. The infamous Y2K bug, a quirk of computer code that was predicted to cause global chaos, did very little. Twenty years later, Y2K is almost synonymous with overreaction—a funny moment when humanity freaked out over nothing. But it wasn't nothing. It actually was a serious problem, which never fully materialized because a lot of people worked very hard to prevent it. "There are two lessons one can learn from an averted disaster," Tufekci says. "One is: That was exaggerated. The other is: That was close."

Last month, a team at Imperial College London released a model that said the coronavirus pandemic could kill 2.2 million Americans if left unchecked. So it was checked. Governors and mayors closed businesses and schools, banned large gatherings, and issued stay-at-home orders. These social-distancing measures were rolled out erratically and unevenly, but they seem to be working. The death toll is still climbing, but seems unlikely to hit the worst-case 2.2 million ceiling. That was close. Or, as some pundits are already claiming, that was exaggerated.

The coronavirus is not unlike the Y2K bug—a real but invisible risk. When a

come out. But viruses lie below the threshold of the senses. Neither peril nor safety is clear. Whenever I go outside for a brief (masked) walk, I reel from cognitive dissonance as I wander a world that has been irrevocably altered but that looks much the same. I can still read accounts of people less lucky—those who have lost, and those who have been lost. But I cannot read about the losses that never occurred, because they were averted. Prevention may be better than cure, but it is also less visceral.

The coronavirus not only co-opts our cells, but exploits our cognitive biases. Humans construct stories to wrangle meaning from uncertainty and purpose from chaos. We crave simple narratives, but the pandemic offers none. The facile dichotomy between saving either lives or the economy belies the broad agreement between epidemiologists and economists that the U.S. shouldn't reopen prematurely. The lionization of health-care workers and grocery-store employees ignores the risks they are being asked to shoulder and the protective equipment they aren't being given. The rise of small anti-lockdown protests overlooks the fact that most Republicans and Democrats agree that social distancing should continue "for as long as is needed to curb the spread of coronavirus."

[Read: How the pandemic will end]

And the desire to name an antagonist, be it the Chinese Communist Party or Donald Trump, disregards the many aspects of 21st-century life that made the pandemic possible: humanity's relentless expansion into wild spaces; soaring levels of air travel; chronic underfunding of public health; a just-in-time economy that runs on fragile supply chains; health-care systems that yoke medical care to employment; social networks that rapidly spread misinformation; the devaluation of expertise; the marginalization of the elderly; and centuries of structural racism that impoverished the health of minorities and indigenous groups. It may be easier to believe that the coronavirus was deliberately unleashed than to accept the harsher truth that we built a world that was prone to it, but not ready for it.

In the classic hero's journey—the archetypal plot structure of myths and movies

If such a character exists in the coronavirus story, it is not an individual, but the entire modern world. The end of its journey and the nature of its final transformation will arise from our collective imagination and action. And they, like so much else about this moment, are still uncertain.