Surgeproofing the Hot Zone

Preparing for a Second Wave of COVID-19

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As the front line of the American health care system's defense against the novel coronavirus SARS-CoV-2 and the associated coronavirus disease 2019 (COVID-19), emergency departments (EDs) have borne the brunt of the initial onslaught since the global pandemic reached the United States last winter. The very novelty of COVID-19, in multiple senses—immunologic novelty for a population lacking herd immunity, clinical novelty in its diversity of presentations, and sociocultural novelty in that it has appeared amid nationwide tumult and institutional distrust—makes it a perfect storm. It has caught much of the United States unprepared. Yet despite the many uncertainties about COVID-19, emergency physicians have gained critical practical knowledge. When the second wave strikes, it is imperative to apply what they have learned from recent experience and from epidemiologic history.

The concept of a second wave is a matter for debate because much of the country is by no means past the first one. (The "wave" metaphor itself can be misleading, said epidemiologist Marc Lipsitch, DPhil, of Harvard's T. H. Chan School of Public Health in a *New Yorker* interview, because of its implication that case and mortality figures ebb and flow naturally and symmetrically, rather than as consequences of policies, interventions, and behavioral decisions. The image of a forest fire, prone to sudden instability when sparks meet tinder, struck Dr. Lipsitch as more appropriate.[1])

At this writing, the national epicenter of COVID-19, the New York City metropolitan area, has succeeded in flattening its new-case[2] and mortality[3] curves since their spring peaks through lockdowns, social distancing, masking, and first-responder resilience. Concern that businesses and activities may be reopening too quickly drives predictions that the fall and winter will see deadly resurgences.[4] "I do think a second wave is coming; it's just a matter of when, and how big is that wave going to be," said Nancy Conroy, MD, associate chief of service in the ED at New York University Langone Hospital–Brooklyn and clinical associate professor at New York University Grossman School of Medicine.

A focus on the epicenter alone can be misleading. "Most of the country did not have the experience that New York, Chicago, Detroit, New Orleans, [and] even Seattle had," observed Donald M. Yealy, MD, chair of the Department of Emergency Medicine at the University of Pittsburgh School of Medicine. "Much of the country looks more like western Pennsylvania, where there was an increase in activity, but it was accommodated within the health care system."

In some locations, however, that slower-breaking first wave, combined with uneven test availability, may have contributed to a false sense of security: areas where the populace has adopted preventive practices less rigorously have seen new cases begin to soar. The Johns Hopkins Coronavirus Research Center's daily case report[5] indicates the sharpest rises in Arizona, Texas, and Florida at this writing, with several other Sunbelt states' data also looking alarming. By publication, other locations may be the hottest of this disease's diverse hot zones.

Dr. Yealy provides historical perspective. "The timing of the peak, the intensity and height of the peak, and then how long that stayed really vary," he noted. "That's been true of viral pandemics since the beginning of time. They do not enter every geographic location at the same time with the same intensity, and they respond differently for reasons that we don't really understand."

DIAGNOSTIC WHACK-A-MOLE

Precautions, Dr. Yealy has found, do not require predictions. "I think you should be probabilistically aware but respond to the realities. I think fear is a great motivator for both patients and health care providers." The practical questions, he suggested, include "What's the infection going to look like? How many people are going to be sick enough to require hospital care, and maybe to have interventions to prevent bad outcomes? And will we be able to do all those things?"

Thomas Spiegel, MD, MS, associate professor of emergency medicine at the University of Chicago, described a common adaptation that aids both transmission control and triage: early in the pandemic, his ED

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separated its space, including waiting rooms, into 2 zones. "We essentially have 2 EDs within any 1 ED," Dr. Spiegel said. "We have [one for] influenza-like illness and a COVID-like illness—most places, I think, refer to it as the hot zone—and then the cold zone, which is the non–[influenza-like] illnesses."

COVID-19's long asymptomatic or presymptomatic carrier state expands uncertainties and complicates triage. Centers for Disease Control and Prevention data from COVID-19 antibody tests in patients undergoing routine screening for other purposes (eg, cholesterol testing) at 6 sites around the country indicate that estimates based on seroprevalence and catchment-area populations far outstrip the known cases.[6] "For every case reported," Centers for Disease Control and Prevention director Robert Redfield, MD, told reporters, "there were actually 10 other infections."[7]

New York University Langone epidemiologist Stephanie Sterling, MD, credits isolation measures with damping the initial surge in the Northeast but warns against complacency. "The risk is much lower now, but it's going to creep up," she said. "As people start getting more comfortable being more social, especially in the fall when we have to start maybe coming indoors more, that's the biggest concern: that we've pushed the virus down to very low rates of transmission [but] we haven't gotten rid of it, and if we have a number of days where we are not respecting how bad this virus is, it's just going to come back and bite us in the butt."

Although the classic COVID-19 clinical presentation involves fever and respiratory distress (sometimes upper, sometimes lower, and not always a conventional upper-to-lower progression), the virus has also produced atypical effects that are only beginning to be understood. New York University Langone–Brooklyn is a Level I trauma center, Dr. Sterling noted, and "we saw a number of people coming in with falls—no other symptoms whatsoever—and then because we had the capacity at some point to test everyone coming into the hospital, we started seeing a lot of people [for whom] that was their presenting symptom for COVID." These patients did not have fevers and upper respiratory infections that were missed on the initial history, she noted; "It really was 'I was fine and then just fell.'"

ROCK-BOTTOM BASICS AND VENTILATOR BLUES

Certain precautions for either a resurgent or a continued wave are accepted universally. Personal protective equipment (PPE) was in notoriously short supply in the early stage of the outbreak. Ensuring adequate PPE and adapting facilities in ways that conserve this resource by reducing repeated donning and doffing will be essential to safeguard staff before waves of new cases again become overwhelming.

Dr. Choe returned from Los Angeles to the site of her residency at New York–Presbyterian Hospital when she heard about New York's spring outbreak. She currently practices bicoastally, maintaining voluntary affiliations with Columbia and Cornell, as well as UCLA (both the quaternary hospital and a community clinic in downtown Los Angeles that serves an underserved population); she vividly recollects how practice atmospheres evolved since early reports arrived from Wuhan and Italy. "Essentially, all the other patient populations were disappearing from the patient list," she said; patients would arrive "with oxygen saturations that were not sustainably low and were ultimately intubated and placed on ventilators, and I would hear these stories over and over again that 20 to 30 ventilated patients on breathing machines were in our ED, just coming in [in] droves, and the hospital continued to try to find room for them…at a faster pace than there were ventilators, as well as providers and space."

Work conditions could be primitive as well as stressful. At the height of the pandemic, she recalled, "the [Centers for Disease Control and Prevention] had made an announcement that bandannas or handkerchiefs could be [used] as a substitute for high-grade PPE, and there were pictures of people wearing trash bags as gowns." As a part-time MBA student at UCLA Anderson School of Management, Dr. Choe helped organize PPE drives and raise funds to help alleviate these shortages in clinics, hospitals, and communities around LA. In New York, she has seen disturbing inequalities in supply distribution: "I think it should not have required a social media presence of health care workers, and for health care workers to get sick and themselves die from coronavirus, in order for hospitals to have received the standard equipment that they deserve."

Testing remains essential to COVID-19 management, although serologic tests may not be all that informative until more is known about the duration of immunity. Timing affects the accuracy of both serologic tests and polymerase chain reaction–based diagnostic tests. A Cochrane Library review of 38 antibody-test studies[8] found a sensitivity of only 30% during the first week of symptoms, increasing to 91% during the third week, with overall specificity of 98%; another review of 7 studies of polymerase

chain reaction tests found false-negative rates of 38% on the day of symptom onset, 20% on day 8, and 66% on day 21.[9] Waiting for test results as long as a week, Dr. Conroy noted, can make them clinically irrelevant—"A lot can change in 6 to 7 days"—and she believes rapid-turnaround tests will be indispensable when influenza and other seasonal viral illnesses begin to complicate the differential diagnosis. Still, the false-negative rates remain a cause for concern.

Other pointers worth emulating are relatively low tech. Positioning patients prone has improved outcomes, Dr. Spiegel noted, and the literature supports this simple intervention.[10,11] Dr. Conroy's ED had "teams that would go around the hospital on shifts to turn patients over to help recruit additional lung tissue, and we found that that was actually very beneficial."

Early concerns about ventilator shortages may have been limited to the hardest-hit cities. Dr. Yealy noted that "at the peak of the pandemic, we never used more than 5% of our ICU or ventilator capacity specifically for COVID-19 patients. That's in part because our experience was different than many places like New York or Detroit or Chicago, but we prepared and asked, 'How can we deploy resources? How can we make sure that anything that could be also used like a ventilator was available?' The other thing that changed is our knowledge about how to treat COVID-19 evolved over 3 months. So this is a virus no one knew anything about before December/January, and in the beginning, we thought that if you waited too long to begin ventilator therapy that people would do worse, and so in the first month of the experience, we had a very low threshold to begin people on mechanical ventilation. Then we learned that maybe that wasn't the best answer, so we got better at it at the same time that things were beginning to peak."

Given the high mortality with mechanical ventilation, alternatives are attractive. Dr. Spiegel reported that noninvasive ventilation by high-flow nasal cannula outperforms ventilators, and "prevent the vent" has become his department's byword. "There is literature out there," he said, supporting the high-flow nasal cannula approach[12,13] despite concerns over aerosolization, droplet transmission, and viral exposure to staff.[14,15] His ED limits high-flow nasal cannula use to "rooms that have negative pressure and have an anteroom, so that we have an area to safely don and doff our PPE without spreading that virus." Beginning with 2 anterooms, the facilities group doubled this capacity within 24 hours, along with adding negative-pressure rooms on 2 floors.

Regarding space constraints making zone separation difficult, Dr. Spiegel pointed to outside-the-box improvisations. "Waiting rooms in an outdoor setting would be ideal ventilationwise"; tents as a COVID/influenza-like illness waiting area combine shade and fresh air. Some spaces can be repurposed: "We've converted our ambulance bay into one of our hot treatment zones, and then we set up tents for the ambulance arrivals out on the street, so basically the ambulances are pulling over to the curb, taking patients out, and then bringing them to us underneath canopies." Administrative hallways have served as waiting rooms when air flow is appropriate.

LOWER-VOLUME, HIGHER-ACUITY, SYSTEMIC VULNERABILITY

Telehealth, several commentators agree, is a timely technology for screening patients and making sure ED visits are essential ones. Dr. Spiegel's hospital is launching a telehealth service; Dr. Conroy's has a virtual urgent care system in place for face-to-face evaluation and consultation. Dr. Yealy noted that at his institution, a few months into their telehealth operation, "we had a decade of growth happen in weeks once COVID-19 happened, because people…had few other real options outside of coming to the ED. The regular channels were off, and they had a lot of fear about it. Our telehealth volumes, whether they're scheduled or unscheduled visits, went up multiple orders of magnitude, and it's come off from the peak, but it hasn't gone back to the pre-COVID era, and I don't think it ever will."

The pandemic is likely to transform patterns of resource use, admission, and other system variables in unforeseen ways. ED visits declined significantly throughout the health care system during the spring peak,[16-18] and Dr. Spiegel cautioned against a response that might make sense managerially but not medically. "I think most EDs did see a decline of volume, and then we had a corresponding increase in acuity, so as the volumes went down, the patients that were presenting seemed to be sicker," he observed. "In terms of being prepared, cutting staff and reducing shifts may seem like the obvious thing to do with the simple decrease of volume, but I think that EDs need to take into consideration the acuity, because as that acuity (at least in our shop) increased, the workload didn't change significantly as you would have expected."

Volumes have begun returning to the University of Chicago's ED. Whether COVID-19 will augment them with a second wave is uncertain, but seasonal respiratory problems are inevitable, with obvious consequences for the influenza-like illness/COVID

hot zone if the wave appears. "Especially later this year, as influenza resurges, that's probably the worst-case scenario, having multiple highly contagious respiratory illnesses," Dr. Spiegel said. "We may have put our rifles on safety, but we're not putting them away right now."

Still, the suspicion that too many exhausted, frustrated people will rush back to places of assembly, imprudent, proximate, and unmasked—in other words, that deferred gratification, trust in the scientific process, and regard for the greater good are relatively scarce concepts in current American culture[19]—is hard to dismiss. The nation's emergency physicians and other acute care providers have stepped up courageously enough in the initial wave of COVID-19, Dr. Yealy pointed out, that "if you were looking for [something] positive, I think the public has a new and deeper understanding of what the challenges are for people who choose as a career to see anybody, any time, with any need.... People like that run *to* risk. They don't run away from it."

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