Covid-19 X-Curves: Illness Hidden, Illness Deferred

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NYC Health + Hospitals has played a crucial role in New York City's response to Covid-19. In this work, we investigated the striking X-curve of ICU utilization: a surge in Covid-19 patients accompanied with dramatic drop in non-Covid-19 patients. We found there was an 88% drop in non-Covid-19 ICU volume within the period from February 15 to April 15, 2020. The changing distribution of ICU patients' diagnoses across the study period raises the specter of illness hidden and illness deferred. Illness hidden could represent patients who would have otherwise been hospitalized for another condition being hospitalized for Covid-19 instead of, or in addition to, that condition. Illness deferred could represent patients experiencing symptoms of serious conditions choosing not to seek care, perhaps due to stay-at-home orders or fear related to contagion.

As an $8 billion public health care system with 11 acute-care hospitals and five post-acute care facilities, New York City Health + Hospitals (H+H) has played a vital role in responding to the city’s Covid-19 outbreak, particularly for low-income New Yorkers. On April 15, H+H had 2,559 Covid-19 patients in its hospitals as well as other sites, including 712 patients in intensive care. Leading up to that date, while the intensive care units (ICUs) surged with Covid-19 patients, the number of non-Covid-19 patients dropped precipitously, resulting in a striking X-curve of utilization (Figure 1).
We examined daily patient census in adult and surge-specific ICUs (ad hoc spaces created to expand critical care capability as traditional ICUs reached maximum capacity) across our facilities and departments by Covid-19 status from February 15 to April 15, 2020. Patients were categorized as confirmed (positive Covid-19 PCR result or infection status), suspected (Covid-19 or pneumonia ICD-10 diagnosis upon hospital admission or in their problem list, or pending Covid-19 PCR result), or negative (no evidence of Covid-19 infection via diagnosis, Covid-19 PCR result, or pending test). We also tracked grouped, co-occurring non–Covid-19 diagnoses over time.\textsuperscript{1} Data from Epic Clarity was analyzed using SQL Server Management Studio and visualized with Tableau 2019.\textsuperscript{4} ICU departments were identified based on a department grouper created and maintained specifically to keep track of departments undergoing shifts to incorporate additional ICU beds during the Covid-19 surge.
At the start of the analyzed period, adult and surge ICU departments were caring for 420 negative or untested patients and 21 patients whose subsequent Covid-19 tests were positive. Within two months, these same departments served a total of 775 patients, the vast majority of them Covid-19-positive. Covid-19 patient volume began to grow in mid-March, cresting at 712 patients in mid-April. Some Covid-19 patients who would have otherwise been in an ICU did receive intensive care on hospital wards, making this a conservative estimate of Covid-19 patients with critical illness. Contemporaneously, Covid-19-negative ICU volume began to decline on March 9, reaching a low of 49 patients on April 4, a census decrease of 88%.

What was happening to these “missing” non-Covid-19 patients?

To elucidate, we visualized the changing distribution of ICU patients’ diagnoses across the study period (Figure 2a, Figure 2b, Figure 2c).
FIGURE 2A

Changes in Diagnosis Groups of ICU Patients, February 15 to April 15, 2020

These charts depict changes in diagnosis groups of patients in Intensive Care Units at NYC H+H from February 15 to April 15, 2020. Respiratory diagnoses increased markedly, and diabetes and kidney-related diagnoses also increased. Several other diagnosis groups, such as heart failure and stroke, declined in volume.

Circulatory System

Endocrine, Nutritional and Metabolic

Genitourinary System

Source: The authors
NEJM Catalyst (catalyst.nejm.org) © Massachusetts Medical Society
FIGURE 2B

Changes in Diagnosis Groups of ICU Patients, February 15 to April 15, 2020

Source: The authors
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Concomitant with the sharp rise in respiratory system diagnoses driven by Covid-19, diagnoses of hypertension, diabetes, and chronic kidney disease more than doubled from baseline levels and renal failure tripled. However, there was a greater than 50% drop in other conditions compared to baseline, raising the specter of illness hidden or illness deferred.

Illness hidden could represent patients who would have otherwise been hospitalized for another condition being hospitalized for Covid-19 instead of, or in addition to, that condition. For example, ICU patients with myocardial infarction dropped over the early weeks of the pandemic. However, in late March through early April, the number of patients with myocardial infarction rose back up to about two-thirds of the initial volume — and most of these were Covid-19–positive or –suspected. (Figure 3).
FIGURE 3

Weekly Average Count of Patients with Myocardial Infarction, by Covid-19 Status, February 16 to April 15, 2020

While myocardial infarction patients continued to be admitted to the ICU during the coronavirus pandemic, it is notable that such patients without a Covid-19 infection dropped considerably from typical rates; part of that volume was made up by Covid-19 positive patients who were admitted with myocardial infarction.

Chronic obstructive pulmonary disease, venous thromboembolism, and acute kidney injury may represent other “masked” diagnoses accompanying Covid-19 clinical presentations. A more tragic dimension of illness hidden to our hospitals is the possibility that patients who would have otherwise been hospitalized in an ICU were instead dying at home. There was some evidence that this was happening. A preliminary estimate of excess deaths (number of deaths above expected seasonal baseline levels) in New York City during March 11–May 2, 2020 found 5,293 deaths that were not identified as either laboratory-confirmed or probable Covid-19–associated deaths.²

Illness deferred could represent patients experiencing symptoms of serious conditions choosing not to seek care, perhaps due to stay-at-home orders or fear related to contagion.³,⁴ For instance, daily trends of heart failure and stroke patients in intensive care remained relatively consistent from February 16 until March 16, but then declined steeply for the following two weeks (Figure 4).
Social distancing measures in New York included a March 7 state of emergency declaration, increasing restrictions on crowd size starting March 12, school closures on March 15, and additional business closures beginning March 16. A reduction in ST-segment elevation cardiac catheterization laboratory activations has also been seen in other jurisdictions. The most worrisome interpretations of these findings are that patients may be suffering at home, and also may contribute to subsequent surges during the pandemic.

Hospitalizations due to Covid-19 are now declining in New York City, but admissions and ICU utilization for other conditions has not yet returned to baseline levels. These findings have important ramifications for future surge planning. Critical care capacity must be ramped up quickly in the context of a Covid-19 outbreak. We must also pay attention to the pandemic’s reverberating effects, including illness hidden and illness deferred, which are more likely to cause suffering among low-income and marginalized patient populations. Further, a surge of patients who deferred
medical care might be possible when social restrictions are eased. Thousands of people have been directly affected by Covid-19, but these X-curves demonstrate the indirect effects on many more.

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