Title: Learning by Doing: Quality of Care and Health Outcomes for COVID-19 and Non COVI19-Patients During and After the COVID-era

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Description: Healthcare providers, hospitals in particular, came under intense pressure during the COVID-19 pandemic in the US. Some learned quickly to treat patients suffering from the novel pathogen. Others experienced intense distress, particularly financial distress from the loss of non COVID patients which lead to closure.

Previous research has explored learning by doing in healthcare in non-pandemic conditions. What is the shape of the learning trajectory for COVID-19 and how does it differ by hospital vs by clinical providers? Under what circumstances do hospital learn the most? What experiences characterize hospitals that close, and what then happens to health outcomes of patients in the hospital's market areas in the following nearterm years? What types of patients' health outcomes improve the most from this learning (patient heterogeneity by race, comorbidities, community characteristics, etc.)? What was the impact of this pressure the forced learning, and the concentration of resources towards COVID-19 on non-COVID-19 wards and patient outcomes? How do hospitals learn to treat "long covid", and do patient who were treated for COVID later in a hospital's health production timeline fare better? How do hospitals (and the treating physicians) who experience high COVID hospitalizations caseloads and in-hospital mortality change their treatment of nonCOVID-19 patients in the future? Do they treat non COVID-19 patients with standard diagnoses more intensively and how do health outcomes fare (after vs before the COVID era) if they experienced a severe COVID caseload in 2020/2021? Given greater mortality rates for racial and ethnic minority populations in the US, we also will test whether intensity of treatment increased moreso for Black and Hispanic populations relative to white, depending on that hospital and that physician's experience during the COVID era, interacted with the amount of community activism supporting racial equity (such as BLM demonstration activities)?

Emerging studies have found wide variations in in-hospital mortality rates related to COVID-19 across time, geography, racial/ethnic categories, expected payers, rural/urban areas, and community income-levels (Bravata et al 2021, Asch et al 2021 Rosenthal et al 2020). However, they have been conducted with convenience samples of hospitalizations. The purpose of this study is to understand how covid patient's health fared at different points in the hospital's community COVID timeline and potential mechanisms for such variations in quality, using the universe of 35 states hospitalizations data. We supplement the hospital analysis by also studying physicians in a non-hospital setting, using electronic health records from HealthJump, available through the COVID19ResearchDatabase: This teaches us about what ways patient health is affected by the learning process and by responses to emergency situations. We are especially interested in how hospital and patient outpatient outcomes may have improved over time ("learning by doing"), how crowding affected quality, and whether pre-pandemic hospital quality in general explains the quality of COVID care. We will also explore how these factors impacted the quality of care for non-COVID patients admitted to hospitals during COVID outbreaks and hospital responses more generally, including hospital closures. We are interested in understanding these determinants of quality directly and in understanding the extent to which they explain disparities in outcomes across various dimensions.

The lives of 600,000 people in the U.S. have been lost due to COVID-19 as of writing this proposal, and understanding how hospitals responded to the pandemic in ways that had implications for patient health, and how the quality of care evolved are essential as policy makers and as hospitals prepare for future pandemics and other crises. Given that the pandemic impacted different groups disproportionately, understanding the determinants of disparities in quality of care is critical to improve equity in healthcare.

Data:

The main dataset we will use is the 2019-2020 (and beyond) Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID). As of May 2021, internally available SID data included data from 4 states until June 2020, data from 12 states until September 2020, data from 1 state until December 2020.
We will begin our analysis with states that currently have 2020 data available through our internal collaborator and will add states to our analysis as they become available. We will use the 2019 data to obtain baseline quality of care of each hospital. Our budget contains funds for purchasing X years, Y states; over time we expect the number of states and number of years we can purchase to grow so we get to look at more states and longer follow up periods.

We will use a sample of adults aged 19+, and our main outcome related to COVID-19 will be inpatient death due to COVID-19. We will also examine other outcomes such as length of stay, costs, and charges as well as procedures such as ventilator use during COVID-19 admissions. Outcomes of the analysis of spill-over effects include inpatient death due to other conditions, such as heart attacks, and AHRQ's Patient Safety Indicators. We will construct measures of crowding based on admission and discharge dates of COVID and non-COVID patients.[6]

We will merge data on hospital characteristics, including measures of finance and care quality, obtained from American Hospital Association (AHA), CMS's Healthcare Cost Report Information System (HCRIS) and Hospital Compare. We will also merge 5-digit zip-code level data from CDC's COVID total cases and deaths and other characteristics obtained from AHRQ's Social Determinants of Health database (or its sources if the data for 2020 is not available).

To identify learning by doing, we will estimate regressions of outcomes on the number of cumulative COVID patients treated at the hospital, controlling for hospital and time fixed effects. We face a challenge in measuring severity on admission to the hospital. Research suggests that patient selection is a concern (Kelly et al 2021). This will be mostly unobserved to us and probably to some extent endogenous to the stage of the pandemic and hospital capacity. We will conceptualize learning (or exposure to opportunities to learn) in two ways. 1) number of past covid patients or 2) outcomes of past covid patients. The first is more traditional learning by doing, the second is more like learning from past "mistakes" eg Manasvini Singh). But both are probably correlated in complicated ways with current covid patient severity. We plan to use hospital (or physician) fixed effects, but the dynamics still pose a challenge for identification.

We will identify crowding effects by estimating regressions of outcomes on the number of COVID patients currently being cared for in the hospital, again controlling for hospital and time fixed effects. Finally, we will explore how COVID mortality outcomes are correlated with baseline hospital quality measures. We will then explore whether these factors have heterogeneous effects on outcomes by geographic area, race/ethnicity, etc. and decompose how much of these disparities can be explained by learning, capacity, and pre-determined hospital quality.

We also will assemble a panel of providers of nonhospital care from the HealthJump database. measuring severity on admission to the hospital. This will be mostly unobserved to us and probably to some extent endogenous to the stage of the pandemic and hospital capacity.

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