SPECIFIC AIMS

In March of 2020, the COVID-19 pandemic was declared a national public health emergency (PHE) and upended the U.S. health care system, as providers rapidly shifted focus and resources towards managing the surge in COVID-19 patients who were hospitalized. Due to recommendations from the Centers for Disease Control and Prevention (CDC), providers curtailed in-person care, delayed elective procedures and surgeries, and where possible, shifted to providing telehealth services. In response to stay-at-home orders implemented in many states and counties and to minimize COVID exposure, patients avoided in-person visits.[11] The Centers for Medicare & Medicaid Services (CMS) and private payers rapidly pivoted, changing payment policies for telehealth services during the COVID-19 PHE. These factors led to substantial declines in total health service utilization and associated revenues for providers,[12-18] and changes in care delivery with rapid shift to telehealth modalities,[19,20] with expected but unknown effects on quality of care and patient outcomes.[21] Less is known about how the COVID-19 pandemic impacts providers, and in turn, the patients who receive care from providers adversely impacted by the pandemic. **Provider responses to the COVID-19 PHE likely differed across providers and for subgroups of patients given variation across physician organizations (POs) in patient characteristics,[22-24] organizational structures, provider capabilities,[25-29] pre-existing resources, and reimbursement arrangements with payers, and will have long-lasting impacts to the efficiency and equity of the U.S. health care delivery system.**

While several studies examined healthcare utilization during the COVID-19 pandemic, there remain unanswered questions including: whether unmet care is skipped or delayed in the following years, and how the immense shock to the delivery system will change patient access to providers in coming years. The COVID-19 shock to providers could exacerbate existing disparities in access to care for vulnerable patient populations. Less-resourced POs may be less able to invest in telehealth services. Their patients may lose access to care during the pandemic, but also may also face long-run care disruptions if these POs are not able to stay in business. Additionally, the unprecedented shock of COVID-19 on POs has led to concerns about smaller, independent providers, and rural practices exiting the market altogether, reducing access to care, or being acquired by larger health systems.[17] Patients who receive care from POs that close or join new systems may experience gaps in care continuity, be forced to find new POs, or travel further to receive care. Federal support to providers during the pandemic has been disproportionally allocated towards large systems and away from counties with a larger representation of racial minorities.[30] While the COVID-19 pandemic is slowing, the impacts of the pandemic to the health care delivery system and vulnerable patients will have long-lasting effects. Over a five-year period, the proposed study seeks to evaluate the impacts of the direct effects of the COVID-19 pandemic and policy response to the pandemic on health outcomes among the Medicare population, and in particular, among vulnerable patient populations, and how changes in patient volume impact providers. To inform policies that ensure access to health services in the years following the COVID-19 pandemic and in order to prepare for the next PHE, it is vital to understand how the "natural experiment" of the COVID-19 pandemic changed health care delivery and the long-run impacts of patient access to providers, and whether access barriers disproportionately impact vulnerable patient populations.

Aim 1: Examine changes in the use of health care services by Medicare beneficiaries during the COVID-19 pandemic, how policy responses impact care use, and how these changes affected patients who are clinically vulnerable and with high social risk factors).

Aim 2: Estimate the extent of closures and consolidation of POs due to COVID-19 and assess the impacts of provider closures and consolidation on patient continuity of care, access to providers, disparities in access, and unmet patient care needs, both during and in the years following the COVID-19 pandemic, and if outcomes differed for vulnerable patient populations.

RESEARCH STRATEGY

The COVID-19 pandemic has created unprecedented disruptions to care patterns and use of important services. The COVID-19 pandemic has placed tremendous pressure on patients and providers, both in the U.S. and worldwide.[12,14,15,17,18] U.S. health care providers have reported significant decreases in non-COVID related health care use since the beginning of the pandemic.[13,16,31] Estimates from CDC and others suggest a decline in emergency department (ED) visits and outpatient visits associated with the pandemic.[16,21,26] The reduction in visits stemmed from several factors including patient fears of infection, CDC recommendations, [32] and reduced access to traditional in-person health care due to public health regulations that restricted elective procedures.[13,25] While studies have documented reductions in utilization, estimates of how reductions differ among vulnerable patient populations remain limited.[27-29] Reductions in patient use of care during the COVID-

19 pandemic will financially impact providers, which could in turn impact the long-run viability of providers to continue to provide care, particularly for medically and socially vulnerable patient populations.

Research published by members of the study team in *JAMA Network Open* and the *Journal of General Internal Medicine* has quantified the drastic changes in use of health care services during the initial phase of the COVID-19 pandemic among privately insured individuals.[33,31] We document over 70% reductions in the use of colonoscopies and mammograms for adults ages 46 to 64, a 67% reduction in HbA1c tests, a 51% reduction in HbA1c tests, and a 22% reduction in vaccination rates. However, less information exists to understand whether similar patterns exist for the 65 and older population and how utilization varied based on patient characteristics including race/ethnicity, socioeconomic status, comorbidity burdens, and urban/rural residence. More importantly, how these patterns evolve over the course of the COVID-19 pandemic and whether unmet care is delayed for a period or skipped in the following years remains unclear. The proposed study will examine health care utilization during the COVID-19 pandemic, how changes in use of important health care services impact health outcomes and health disparities among the elderly population, and how gaps in care are met in the years following the COVID-19 pandemic.

Disparities in access to telehealth can exacerbate health disparities among vulnerable patient populations. During some of COVID-19, the primary method of delivering care relied on access to smartphones, computers, and internet access. Many patient populations may lack these tools, and thus may not have access to critical care modalities. Patients with chronic conditions, cognitive limitations (e.g., Alzheimer's or dementia), or in areas without robust internet access may face both larger health impacts of reductions in care use and barriers in using telemedicine. For example, 33% of rural Americans do not have access to high-speed broadband internet that can support video-based telehealth visits.[37] There also are differences in broadband by race and ethnicity that limit access to telehealth.[38,39] As a result, the reduction in care may be largest for vulnerable patient populations. Our research in the *American Journal of Preventive Medicine* documents differential increase in use of telehealth among higher-income, and metropolitan patient populations.[40]

Declines in patient visits and associated revenues place POs at risk for closure, dramatically cutting services needed by patients in the communities they serve, or consolidating, and many patients may experience COVID-related gaps in care, even in the years after the COVID-19 pandemic subsides. Preliminary studies that have used limited data sets have begun to reveal COVID-19's financial impacts on providers.[11,12,14,17] The proposed study will consider the important role POs play in the delivery of care, which is challenged during the COVID-19 pandemic. We will use a model that attributes patients to primary care providers for 92% of Medicare FFS beneficiaries to examine how COVID-19's effect on POs has in turn impacted the health of patients served by these POs.[44] The impacts of COVID-19 on PO exit and consolidation will likely unfold over the coming years. Our five-year project horizon will allow us to measure these dramatic longer-run changes to the health care delivery system and how these changes impact patient's access and continuity of care. Deferring routine care could force patients and providers to miss opportunities for management of chronic conditions and avoiding complications associated with their disease, receipt of routine vaccinations, or early detection of new conditions, which might worsen outcomes.[41] While the COVID-19 pandemic has subsided, the direct and indirect effects of the pandemic on patients and the delivery system will have long-last impacts. The results of the proposed study will inform policies that maintain the resiliency of the delivery system and address disparities exacerbated by the COVID-19 pandemic.

Overview of Approach

We will use empirical methods to understand how the COVID-19 pandemic affected changes in patient use of important services, PO utilization of telemedicine, and continuity of care. In **Aim 1**, we will track trends in use of non-COVID services, and quantify how changes in use vary among vulnerable patient populations. In **Aim 2**, we will estimate how provider closures/consolidation due to COVID-19 impact continuity of patient care and health outcomes from disrupted care patterns. For both aims, we will leverage existing experience with Medicare FFS claims data. In all Aims, we will conduct descriptive analyses that highlight changes in trends during the COVID-19 pandemic and multivariable regression models that adjust for patient, PO, market, and COVID-19 characteristics. In each aim, we will test for differences among medically/socially vulnerable and NIA-priority patient populations.