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The COVID-19 pandemic and primary care appointment availability by physician age and gender

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Abstract

Using data generated through simulated patient calls to a national random sample of primary care physicians between February and July 2020, we examine the effects of the first wave of COVID-19 on the availability of the U.S. primary care physician workforce for routine new patient appointments. As states enacted stay-at-home orders, physicians overall became less selective by insurance, and there was a 7 percentage-point increase in acceptance of patient insurance. Telemedicine appointment offers increased 10.2 percentage points from near zero. However, relative to younger counterparts, physicians older than the sample mean (53.1 years) became 18.1 percentage points less likely to offer appointments and decreased their estimated appointment duration by 7.1 min. Compared to male physicians, female physicians became 10 percentage points more likely to accept new patients. These insights into appointment offers during the first wave of COVID-19 may help policymakers seeking to ensure an adequate physician workforce during future crises.

KEYWORDS

COVID-19, field experiment, physician demographics, physician workforce, primary care

JEL CLASSIFICATION
C93, I11, J49

1 | INTRODUCTION

The first case of COVID-19 in the United States was confirmed on January 20, 2020 (Holshue et al., 2020). By March 31, the number of confirmed cases had risen to over 160,000 (Lutton, 2020). In response, 45 states and the District of Columbia issued stay-at-home orders between March 19 and April 6, 2020 (Financial Industry Regulatory Authority, 2020). These orders varied by state but, generally, closed schools and businesses and required residents to shelter in place, only leaving home for essential needs. At the suggestion of the Surgeon General, many states prohibited nonessential surgeries to conserve beds and supplies for COVID-19 patients (Ambulatory Surgery Center Association, 2020). At the same time, physicians rapidly ramped up the use of telemedicine, with one health system reporting a 683% increase in urgent care telemedicine visits between March 2 and April 14, 2020 (Mann et al., 2020). This article analyzes data from a February through July 2020 national audit of physicians to assess the impact of the first wave of the pandemic on the availability of the U.S. primary care physician workforce for routine, new-patient appointments.

Sustained availability of the physician workforce is a crucial component of a resilient healthcare system. The World Health Organization defines resilience as "the ability to prepare for, manage (absorb, adapt, and transform) and learn from shocks" (World Health Organization, 2000). A resilient health system is especially critical during a public health crisis, and continuity in access to care during a crisis is a key measure of health system resilience (Nemeth et al., 2008). Furthermore, as 14% of adults in the United States report not having a primary care physician (Kaiser Family Foundation, 2021), it is important to monitor availability of new patient appointments during a time when clinics may retrench or even close, and people who do not usually use medical services are more likely to need them. In addition to overall resilience, it is also important to monitor equity within the health system during times of crisis to determine whether inequities are being created or perpetuated by the disaster or through the response (Matin et al., 2018). In this article, we examine how U.S. primary care appointment availability responded to the first wave of the pandemic, and how physician demographics affected the response. Understanding how individual physicians and the healthcare system are affected by a shock, including one that presents potential risks and costs that differ by provider demographics, can inform preparedness for future shocks (Matin et al., 2018; Thomas et al., 2020).

COVID-19 and its fallout have presented safety, logistic, and financial challenges to physicians and their practices. Early consequences included loss of income, practice shut-downs, layoffs, and acceleration of physician retirements (California Medical Association, 2020; Merritt-Hawkins, 2020). Age is a major risk factor for severe COVID-19 (Fauci et al., 2020), which exacerbated challenges for older physicians. Similarly, female physicians may have faced different challenges than their male counterparts due to gender differences in roles both inside and outside of the workplace (Arora, 2016; Sevilla & Smith, 2020). During the early weeks of the U.S. experience with COVID-19, patient visits to ambulatory care practices dropped considerably, before recovering to levels that were below the pre-pandemic normal (Mehrotra et al., 2020, 2021). A survey of primary care physicians conducted in March 2020 found that 90% of physicians reported that their practice had limited well patient visits and 83% were offering telemedicine visits (Primary Care Collaborative, 2020). While these sources quantified the physician-side response, they did not measure the degree to which primary care availability changed for patients who sought it out, nor were their findings nationally-representative.

We analyze data collected prior to and during the early months of the COVID-19 crisis in the United States through a nationwide audit of primary care physicians. An audit (field experiment or simulated patient study) has advantages over both survey and administrative studies. Audits elicit the usual business response from office staff thereby avoiding the social desirability biases found in surveys (Prince, 2012; Shapiro, 2001). The response rate is often 100% for reachable and eligible participants for many audit methodologies since subjects respond as they would to potential customers. Unlike administrative studies, which do not fully control for differences in health and treatment preferences (Institute of Medicine, 2002), simulated patient characteristics are part of the experimental design for an audit.

Despite these advantages, audits of the availability of medical care remain rare. To the best of our knowledge, the only other audit of U.S. physicians during the COVID-19 pandemic was conducted September 10 through 14, 2020 (Kyle et al., 2021). It found that primary care practices in four geographically dispersed states were offering timely new patient appointments and direct COVID-19 care during that period. Our research is the first audit to examine the nationwide effects of the onset of COVID-19 on the availability of new-patient primary care appointments, as well as the effect of physician demographics on the willingness to provide primary care during the crisis. Information collected in our study included whether and when an appointment was offered, the type of appointment (telemedicine or in-person), and the estimated appointment duration. This article therefore provides novel, field experiment-generated evidence regarding the response of U.S. primary care physicians to the first wave of a major health crisis.

We find that while overall appointment availability for new patients remained stable with the onset of the pandemic, making the appointments required more effort by prospective patients as their phone calls became more likely to encounter voicemail messages and closed offices. There was a substantial shift to telemedicine as well as substitution between older and younger physicians. Relative to younger counterparts, older physicians decreased their willingness to accept new patients and offered shorter appointments to those they did accept. Likely in response to the decrease in demand for routine care during the first wave of the pandemic which may have reduced practice revenue, physicians became less selective based on the patient's insurance type. Female physicians became more likely to accept new patients relative to their male counterparts. As the first wave of the pandemic plateaued, physicians reverted to being more selective based on the patient's insurance. The remainder of the article is organized as follows: The next section describes the audit study used to collect physician availability data. Section 3 provides a conceptual framework for examining such data. Section 4 lays out our empirical approach and Section 5 describes the empirical findings. The last section provides a discussion of our findings and concludes the article.

2 | PHYSICIAN SAMPLE AND AUDIT METHODS

Data comes from a national audit assessing access to primary care appointments in the United States. The sampling framework was the American Medical Association's Physician Masterfile (Masterfile), a comprehensive list of Doctors of Medicine (MDs) and Doctors of Osteopathic Medicine (DOs) which is often used in analyses of physician availability in the United States (American Medical Association, 2020; Association of American Medical Colleges, 2020). We drew an unstratified national random sample from the Masterfile that included physicians with primary specialties in family medicine (47%), internal medicine (49%), general practice (3%), general preventive medicine (1%), and urgent care medicine (0.3%). These specialties were chosen because they are most likely to provide primary care to adults. We verified that the demographic characteristics of our physician sample are similar to those of actively licensed U.S. physicians (Young et al., 2019), and that the geographic distribution of physicians in our sample (Figure A4) approximates that of primary care physicians across the United States (Kaiser Family Foundation, 2022).

The original objective of the study was to examine racial/ethnic, insurance, and gender-based disparities in access to primary care physicians. The unanticipated onset of the pandemic during data collection allowed us to leverage our audit data to assess how physicians' characteristics affected their availability for patient care during the first wave of COVID-19 in the United States. Each physician was randomly assigned a simulated patient profile with a male or female name developed from the literature on racially and ethnically distinctive first and last names for Black, White, and Hispanic individuals (Bertrand & Mullainathan, 2004; Lavender, 1988), as well as an insurance type (private insurance through an employer, Medicaid, traditional Medicare, or self-pay). Trained undergraduate student research assistants (RAs) made up to four attempts to reach each physician's office by telephone. They left a generic voicemail message requesting a call back regarding appointment information if the fourth attempt was unsuccessful at reaching a person able to provide such information. A fifth and final attempt was made to contact the physician's office if they responded to the voicemail message.

Calls employed the script described by Sharma et al. (2015). RAs made one inquiry per physician about the availability of an appointment for a physical exam, saying that they were helping a recently relocated aunt or uncle (the simulated patient) find a doctor. If the physician's office asked about the health of the prospective patient, the RAs reported that the aunt/uncle was "generally healthy," but that it was time for a checkup. The protocol used creates a degree of separation that allows callers to represent patients with demographic characteristics different from their own, and reduces expectations that the RAs would have detailed health and insurance information about the prospective patient. If an appointment was offered, RAs responded saying that they would call back to make the appointment after checking with the aunt/uncle. If the physician's office did not ask about insurance prior to offering an appointment, RAs followed up by inquiring whether plans from the simulated patient's insurance type were accepted by the offered provider. If an appointment was offered, RAs also asked about the amount of time that the physician typically spent with a patient for a physical exam.

We attempted to contact 1704 physicians' offices between February 13th and July 3rd 2020 at either the phone number listed in the Masterfile or one obtained through a systematic internet search if the number in the Masterfile was incorrect or missing. We regard a physician as unreachable if we could not find a practice phone number that was reachable within four call attempts. Of the 1342 reachable physicians, 525 were ineligible for inclusion in our study because they did not provide primary care to the general adult population. In this article, we analyze the outcomes of calls to the 817 reachable and eligible physicians. As with many prior audits, the response rate was 100% for reachable and eligible physicians (Coffman et al., 2016; Sharma et al., 2017).

RAs recorded the date and time of each call, the date and estimated duration of an offer of appointment, and any questions or remarks by the scheduler, including reasons for rejecting the patient. We recorded offers of alternate providers and telemedicine appointments if this information was volunteered by schedulers. Offers are defined as the provision of an appointment date, or date range, with confirmation that at least one plan from the patient's insurance type is accepted. In the analysis that follows, start dates of states' stay-at-home orders ("closures") are from the Financial Industry Regulatory Authority (Financial Industry Regulatory Authority, 2020), and data for state COVID infection and mortality rates are from the New York Times (New York Times, 2020).

The study was approved and overseen by the Institutional Review Board at the corresponding author's institution. The study protocol was assessed to create no more than minimal risk and the requirement for informed consent was waived. We minimized risk to physicians, their office staff, and patients by requesting appointment information without making actual appointments. We further reduced the burden on practices by determining appointment availability and physician eligibility and reachability in a single call.

3 | CONCEPTUAL FRAMEWORK

3.1 | Basic model of physician acceptance of new patients

Sloan et al. (1978) provide the classic framework for analyses of physician acceptance of different types of patients. In their framework, patients with different types of insurance impose different marginal costs and yield different marginal revenue for physicians. Consequently, physician willingness to provide care varies across patients based on insurance type. Our focus in this article is on heterogeneity in physician responses to the initial shock created by the COVID-19 pandemic. We rely on a simple extension of that model (Sloan et al., 1978) to posit that the pandemic may have differentially affected the marginal cost of providing care for physicians based on personal characteristics (age and gender), and that this will lead to differential effects on physician availability for patient care. In this framework, physician heterogeneity can be an important moderator of the response of a health care system to a shock.

3.2 | Physician availability and observed characteristics of appointments

The characteristics of appointments (e.g., whether one was offered, wait time, and duration) observed in an audit of physicians reflect equilibrium outcomes affected by the choices of both patients and physicians. Since the COVID-19 pandemic likely affected the behavior of both physicians and patients, changes in observed appointment characteristics cannot entirely be ascribed to changes in physician availability. Therefore, we interpret empirically observed changes in appointment characteristics due to COVID-19 to represent the comparative static effects of a shock that affects both the demand for, and the supply of, routine physician services.

To illustrate how one key outcome—the observed probability that a patient who requests an appointment is offered one—relates to the availability of physicians in an environment with potentially reduced demand due to the pandemic, consider a representative physician i. Assume that physician i was available for $A_i^{pre} > 0$ weekly appointments for routine, new-patient primary care prior to the pandemic. Let $A_i^{post} > 0$ denote analogous availability after the onset of the pandemic. Also, let $D_i^{pre} > 0$ and $D_i^{post} > 0$, respectively, denote the number of patients who seek such care from physician i before and after the onset of the pandemic. If we assume for simplicity that pre- and post-pandemic patients are homogenous, then the probability of an appointment offer for a patient who requests an appointment with physician i before and after the onset of the pandemic is, respectively, $\frac{A_i^{pre}}{D_i^{pre}}$ and $\frac{A_i^{post}}{D_i^{post}}$.

Abstracting away from the situation where either of these probabilities is 1, the probability of an appointment offer would decrease if physician availability decreased proportionately more than patient demand (i.e., $\frac{A_i^{post}}{D_i^{post}} < \frac{A_i^{pre}}{D_i^{pre}}$ only if $\frac{D_i^{post}}{D_i^{pre}} > \frac{A_i^{post}}{A_i^{pre}}$). Therefore, when a shock leads to a decrease in demand, the change in the observed probability of an appointment offer for a patient will tend to overestimate physician availability. A similar logic applies to other important measures of appointment availability such as appointment duration and wait times.

3.3 | Sources of physician heterogeneity

In practice, physician heterogeneity may result from differences in training and work settings (e.g., access to equipment and support staff), the size and characteristics of the current panel of patients, and physician demographics and preferences. Audited physicians in our study are heterogenous with respect to the increased practice costs/risks they face from COVID-19 along both observable (e.g., age, gender, and community COVID infection/mortality rates) and unobservable (e.g., pre-existing conditions, availability of childcare for physicians who are parents) dimensions. We focus on the age and gender of physicians as potentially important sources of physician heterogeneity in the case of the COVID-19 pandemic. It quickly became apparent early in the pandemic that age is a risk factor for serious disease which meant that older physicians would potentially bear a higher cost if they came into contact with infected patients (Fauci et al., 2020). Due to traditional gender roles, mothers with paid employment likely bore the brunt of school closings and the loss of informal sources of care, such as grandparents, due to social distancing measures (Collins et al., 2021; Sevilla & Smith, 2020). Our focus on routine new patient appointments is important because such appointments may be particularly sensitive to cutbacks since physicians often prioritize established patients and acute care in a crisis.

4 | EMPIRICAL APPROACH

The first wave of the pandemic hit different U.S. regions at different times. We employ the start dates for closures (see Table A1 in the Appendix) as an indicator of when COVID-19 first came to be regarded as a serious threat in a state. Case rates and death rates strongly correlate with the start dates for closures as both measures increased dramatically in the post-closure observations in our sample (Table 1). The mean daily case rate of 0.000315% of the state population in pre-closure observations increased nearly 30-fold to 0.008945% in post-closure observations. The mean daily death rate similarly increased from 0.000005% of the state population in pre-closure observations to 0.000511% post-closure.

To examine the impact of the first wave of the pandemic on physician availability (Figure A1), we estimate the relationships between closures and the following call outcomes: (1) the patient's insurance was accepted; (2) the physician was not accepting new patients; (3) a telemedicine appointment was offered; (4) an appointment with the requested physician was offered; and (5) an appointment with any provider (the requested physician or an alternate in the same practice) was offered. When an appointment was offered, we also analyzed appointment duration in minutes, and the wait time to an appointment in days.

TABLE 1 Mean COVID-19 case and death rates for pre and post closure observations.

	Pre-closure (%)[a]	Post-closure (%)[a]	N[b]
Case rate[c]	0.000315 (0.001775)	0.008945 (0.009847)	817
Death rate[d]	0.000005 (0.000029)	0.000511 (0.000735)	817
N[b]	437	380	

[a]Standard deviations in parentheses. See Table A1 for state closure data. Strictness of orders varied by state.
[b]N = number of audited physicians in each group.
[c]Daily case rates = daily cases divided by total state population multiplied by 100. Data is from the New York Times.
[d]Daily death rates = daily deaths divided by total state population multiplied by 100. Data is from the New York Times.

We first analyze associations between call outcomes for all physicians in the closure period compared to the pre-closure period by estimating the differential impact of being in a state with a stay-at-home order. We specify the model as follows:

$$Y_{ij} = \alpha + \beta \, \text{Post} + \varphi \, \text{Covariates}_i + \varepsilon_{ij}, \tag{1a}$$

where, Y_{ij} is the call outcome varying by physician i in state j. The estimate β captures the effect of the indicator variable Post for calls made after the imposition of stay-at-home orders. The intercept is α, and φ covers the effects of other covariates that may affect the outcome of the call to physician i (day of week the call was made, the research assistant making the call, state fixed effects, the race/ethnicity and gender of the simulated patient assigned to the physician, age and gender of the physician, and whether the physician was a medical doctor [MD] or doctor of osteopathy [DO]). Finally, ε_{ij} is the robust error term clustered by state.

We also analyze the association between call outcomes in the closure compared to pre-closure period based on whether physicians are older or younger than the mean age of the sample physicians (53.1 years), and whether physicians are female or male. We specify these models as follows:

$$Y_{ij} = \alpha + \beta \, \text{Post}^* \, \text{Group}_i + \tau \, \text{Post} + \lambda \, \text{Group}_i + \varphi \, \text{Covariates}_i + \varepsilon_{ij}, \tag{1b}$$

where, variable Group_i distinguishes between older and younger physicians, or between female and male physicians. Other elements of model (1b) are identical to those of model (1a), except that the regression comparing younger and older physicians does not control for physician age and the regression comparing male and female physicians does not control for physician gender. To examine whether insurance or practice type affected call outcomes, we estimated models based on (1b) where the Group variable was used to indicate either simulated patient insurance (Medicaid, Medicare, private insurance, and self-pay) or the physician's practice size (group practice vs. solo or two-physician). Finally, as an assessment of changes in the difficulty of contacting physicians' offices in the early phase of the pandemic, we estimated the likelihood that a caller encountered voicemail or a closed office using models based on (1a) and (1b). Results from these analyses are reported in Appendix Tables A2-A4.

To assess the timing of effects on call outcomes, we conducted event study analyses to estimate the association of each outcome variable with each month between March and June in comparison to February with the following specification:

TABLE 2 New patient experience and physician characteristics before and after COVID-19 closures.

	Pre-closure[a]		Post-closure[a]		
	Number (% total)	Std. dev.	Number (% total)	Std. dev.	Total physicians
Physician characteristics					
Female	167 (38.2)	48.6	148 (39.0)	48.8	817
Age (years)	52.9	11.5	53.3	12.2	817
Older (age > 53.1)	211 (48.2)	49.8	196 (51.6)	50.0	817
Patient experience					
Insurance accepted[b]	285 (85.3)	35.4	236 (89.1)	31.3	599
No new patients	129 (29.5)	45.7	101 (26.6)	44.2	817
Telemedicine available	1 (0.2)	4.8	44 (11.6)	32.0	817
Requested physician offered[c]	220 (50.3)	50.1	181 (47.6)	50.0	817
Any provider offered[d]	265 (60.6)	48.9	226 (59.5)	49.2	817
Wait to requested appointment (days)	35.3	58.1	29.2	31.9	401
Wait to any appointment (days)	36.0	57.8	32.6	36.6	491
Appointment duration[e] (minutes)	38.6	15.3	39.5	13.0	448
Total physicians	437		380		

[a]Closure defined as the date of state-issued stay at home order (Table A1). Strictness of orders varied by state.
[b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).
[c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.
[d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.
[e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

$$Y_{ijt} = \alpha + \sum_{t=\text{March}}^{\text{June}} \{\alpha_t * \text{Month}_t\} + \varphi\,\text{Covariates}_i + \varepsilon_{ijt}, \tag{2a}$$

where, α_t is a vector of estimates for the effect of individual months. Other terms in this analysis are as specified for model (1a). The state clustered standard errors are used to account for any serial correlation within states.

The estimation of parameters associated with Group variables in (1b) comprises a difference-in-differences analysis that is potentially affected by the fact that the timing of the closures varied across states in our sample. Corrections for staggered timing, such as those described in Callaway and Sant'anna (2021), are challenging in our data due to the very the small sample of "untreated" observations (there were only three female and five younger physicians among 22 observations across five states which implemented no closures). To circumvent this problem, as well as to provide a more nuanced view of changes in appointment availability over time, we conducted event study analogues of (1b). In these analyses, we assessed whether physicians who are older (compared with younger) or female (compared with male) responded differently through time by interacting these variables with the vector of monthly indicators variables from the following specification:

TABLE 3 COVID-19 and changes in the experience of seeking new patient appointments.[a]

	Insurance accepted[c]	No new patients	Telemedicine available	Requested phys. offered[d]	Any provider offered[e]	Appt duration[f]
Post-closure[b]	6.97** (1.09, 12.84)	−3.94 (−11.92, 4.04)	10.24*** (6.69, 13.78)	1.77 (−6.64, 10.19)	3.44 (−6.48, 13.36)	0.70 (−3.84, 5.24)
p-value	.02	.33	<.01	.67	.70	.76
Pre-closure mean	85.3%	29.5%	0.2%	50.3%	60.6%	38.6
N	599	817	817	817	817	448

$^*p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage-point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

[c]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[d]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[e]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[f]Amount of time (minutes) the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

$$Y_{ijt} = \alpha + \sum_{t=\text{March}}^{\text{June}} \{\alpha_t * \text{Month}_t * \text{Group}_i\} + \varphi\,\text{Covariates}_i + \varepsilon_{ijt}, \tag{2b}$$

where all variables are as defined in Equations (1b) and (2a). In Appendix Figures A5-A7, we additionally report analyses that assessed time variation at the weekly (instead of monthly) level. These weekly analyses are potentially useful in assessing a rapidly evolving situation, but small sample sizes result in noisy estimates with wide confidence intervals.

5 | EMPIRICAL FINDINGS

Our sample comprises 437 physicians reached before and 380 reached after the first round of COVID-19 closures (Table 2). There were no statistically significant differences in the demographic characteristics of physicians in the two groups. Changes to most outcome variables in the raw data were not statistically significant, but offers of telemedicine increased from 0.2% to 11.6% ($p < .01$) following the closures.

5.1 | New patient appointments

Following the closures, physicians' offices became 10.2 percentage points (95% CI: 6.7, 13.8; $p < .01$) more likely to say that a telemedicine appointment was available (Table 3). Physicians' offices also became 7 percentage points (95% CI: 1.1, 12.8; $p = .02$) more likely to say that they

TABLE 4 COVID-19 closures and changes in wait time to appointment.[a]

	Requested physician[c]	Any provider[d]
Post-closure[b]	−1.79 (−12.57, 8.99)	−2.16 (−9.95, 5.63)
p-value	.74	.58
Pre-closure mean	35.3	36.0
N	401	491

*$p < .10$; **$p < .05$; ***$p < .01$.
[a]Wait time is in days. 95% confidence intervals are in parentheses. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as state fixed effects, individual RAs, and the day of the week when the call was made. Robust standard errors are clustered by state.
[b]See Table A1 for state closure data. Strictness of orders varied by state.
[c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.
[d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

TABLE 5 Change in COVID-19 case rate and call outcomes.[a]

	Insurance accepted[d]	No new patients	Telemedicine available	Requested phys. offered[e]	Any provider offered[f]	Appt duration[g]
Daily case rate[b]	0.03* (<0.01, 0.07)	−0.01 (−0.05, 0.03)	0.02*** (0.01, 0.04)	−0.03 (−0.08, 0.01)	−0.02 (−0.07, 0.03)	1.78* (−0.27, 3.83)
p-value	.08	.63	<.01	.13	.38	.09
Pre-closure[c] mean	85.3%	29.5%	0.2%	50.3%	60.6%	38.6
N	599	817	817	817	817	448

*$p < .10$; **$p < .05$; ***$p < .01$.
[a]All estimates are percentage point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, individual RAs, and the day of the week the call was made. Robust standard errors are clustered by state.
[b]Daily case rate = daily cases divided by total state population multiplied by 100, therefore estimates from the regression show the effect of a 1 percentage point change in the daily case rate. Case rate data is from the New York Times.
[c]See Table A1 for state closure data. State orders varied in strictness.
[d]Not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).
[e]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.
[f]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.
[g]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not offer an appointment.

accepted the patient's insurance. The increase in telemedicine availability is a well-documented response to the danger of contagion presented by COVID-19 (Mann et al., 2020; Zachrison et al., 2021). In contrast, the increase in physicians' acceptance of insurance has not been documented previously. Increased insurance acceptance likely reflects a decrease in physician selectivity towards patients in response to the demand shock created by the pandemic. There were no statistically significant changes in the probability of an appointment offer with the requested

TABLE 6 Change in the COVID-19 death rate and call outcomes.[a]

	Insurance accepted[d]	No new patients	Telemedicine available	Requested phys. offered[e]	Any provider offered[f]	Appt duration[g]
Death rate[b]	0.57** (0.02, 1.11)	0.18 (−0.50, 0.85)	0.81*** (0.57, 1.05)	−0.04 (−0.93, 0.84)	0.19 (−0.71, 1.10)	28.71* (−2.99, 60.40)
p-value	.04	.60	<.01	.92	.67	.08
Pre closure mean[c]	85.3%	29.5%	0.2%	50.3%	60.6%	38.6
N	599	817	817	817	817	448

$^*p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, MD/DO), as well as fixed effects for state, individual RAs, and the day of the week when the call was made. Robust standard errors are clustered by state.

[b]Daily death rates = daily deaths divided by total state population multiplied by 100, therefore estimates from the regression show the effects of a 1 percentage point change in the death rate. Death rate data is from the New York Times.

[c]See Table A1 for state closure data. Strictness of orders varied by state.

[d]Not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[e]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[f]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[g]Amount of time the physician or alternate provider typically spends with patients for a physical exam. Not requested from physicians' offices that did not offer an appointment.

physician or with any provider in the practice. However, callers' encounters with voicemail messages increased by 13 percentage points (95% CI: 9.7, 16.4; $p < .01$) and those with closed offices increased by 21 percentage points (95% CI: 12.8, 29.1; $p < .01$) indicating that it did become more difficult to contact physicians' offices (Table A2, Basic Models). There was no statistically significant change in appointment wait times following the implementation of stay-at-home orders (Table 4).

Analyses using case rates and death rates as alternative measures of the timing of COVID-19 impacts are shown in Tables 5 and 6. These analyses yield results that are generally consistent with those that use state closures as indicators of the timing of COVID-19 impacts. Higher COVID-19 case rates and death rates were both associated with greater acceptance of patients' insurance and increased availability of telemedicine.

Figure 1 and Table 7 present the results of event studies using the formulation in Equation (2a). We found that insurance acceptance was statistically significantly higher in April than in February but had reverted to February levels by June. The availability of telemedicine was significantly higher in April, peaked in May, and fell in June, while remaining significantly above February levels. Estimates for changes in the acceptance of new patients, appointment offers, and appointment duration are not statistically significant for any month.

5.2 | Appointment availability by physician age and gender

Table 8 shows that, prior to closure, older physicians' offices offered appointments that were 8.6 min (95% CI: 2.9, 14.4; $p < .01$) longer than the 35.3-min average for younger physicians.

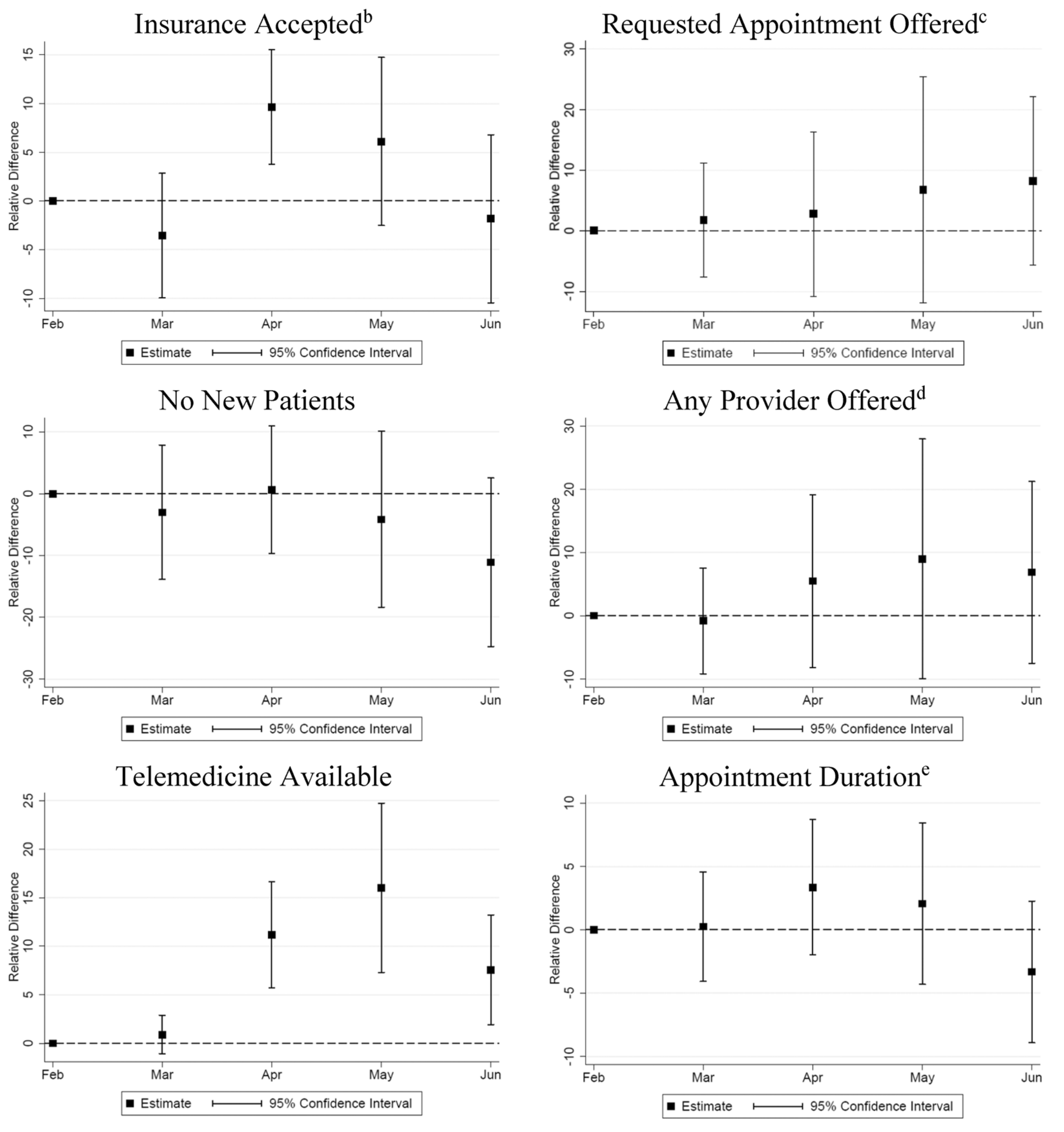

FIGURE 1 Timing of COVID-19 impacts (monthly).[a] ([a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (10 observations from early July were omitted). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).

TABLE 7 Timing of COVID-19 impacts (monthly).[a]

	Insurance accepted[b]	No new patients	Telemedicine available	Requested phys. offered[c]	Any provider offered[d]	Appt duration[e]
February	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
March	−3.55 (−9.94, 2.84)	−3.01 (−13.88, 7.86)	0.90 (−1.06, 2.86)	1.74 (−7.71, 11.18)	−0.81 (−9.16, 7.53)	0.25 (−4.08, 4.57)
p-value	.27	.58	.36	.71	.85	.91
April	9.64*** (3.76, 15.52)	0.62 (−9.70, 10.94)	11.18*** (5.70, 16.65)	2.78 (−10.76, 16.31)	5.50 (−8.19, 19.18)	3.36 (−1.98, 8.70)
p-value	<.01	.90	<.01	.68	.42	.21
May	6.11 (−2.53, 14.74)	−4.15 (−18.41, 10.11)	16.02*** (7.30, 24.74)	6.74 (−11.91, 25.40)	9.00 (−9.94, 27.95)	2.06 (−4.30, 8.43)
p-value	.16	.56	<.01	.47	.34	.52
June	−1.82 (−10.45, 6.82)	−11.10 (−24.76, 2.55)	7.56*** (1.89, 13.22)	8.23 (−5.69, 22.14)	6.88 (−7.49, 21.24)	−3.33 (−8.91, 2.26)
p-value	.67	.11	.01	.24	.34	.24
February Mean (SD)	85.5 (35.3)	31.0 (46.4)	0.0 (0.0)	47.7 (50.1)	58.3 (49.4)	38.6 (16.1)
N	593	807	807	807	807	444

[a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (10 observations from early July were omitted). Robust standard errors were clustered by state.
[b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).
[c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.
[d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.
[e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

Older physicians' offices were also 14.6 percentage points (95% CI: −1.1, 30.3; $p = .07$) more likely to offer an appointment with either the requested provider or an alternate.

Following closure, appointment offers with older physicians decreased 18.1 percentage points relative to younger physicians (95% CI: −30.6, −5.6; $p < .01$). Their offices became 14.9 percentage points less likely to offer an appointment with any provider (95% CI: −27.4, −2.5; $p = .02$). Appointments with older physicians relative to younger physicians became 7.1 min (95% CI: −14.1, −0.14; $p = .05$) shorter. Similarly, older physicians' offices became 18.7 percentage points more likely to report that they were not taking new patients (95% CI: 6.0, 31.3; $p < .01$) and 5.8 percentage points less likely to offer telemedicine (95% CI: −11.1, −0.4; $p = .04$) relative to younger physicians. In contrast, we observed increased appointment offers, longer duration appointments, increased acceptance of new patients, and increased acceptance of insurance by younger physicians. There were no statistically significant differences between older and younger physicians in how closures affected the likelihood that callers encountered voicemail or closed offices (Table A2).

Event studies (Figure 2 and Table 9) generally confirm these findings, and highlight that differences in appointment offers and acceptance of new patients were greatest in May. The event studies also show that older physicians offered longer duration appointments in February and

TABLE 8 COVID-19 and changes in physician availability by age of requested physician.[a]

	Insurance accepted[d]	No new patients	Telemedicine available	Requested phys. offered[e]	Any provider offered[f]	Appt duration[g]
Older physician[b] * post-closure[c]	−4.27 (−14.83, 6.29)	18.66*** (6.04, 31.28)	−5.76** (−11.09, −0.43)	−18.09*** (−30.55, −5.64)	−14.91** (−27.35, −2.47)	−7.13** (−14.12, −0.14)
p-value	.42	<.01	.04	<.01	.02	.05
Post-closure[c]	9.05** (1.29, 16.81)	−13.18** (−23.79, −2.56)	13.13*** (8.40, 17.85)	10.72* (−0.35, 21.79)	10.74* (−2.29, 23.78)	4.15* (−0.01, 8.30)
p-value	.02	.02	<.01	.06	.10	.05
Older physician	1.31 (−9.60, 12.22)	−12.48 (−28.85, 3.89)	1.83 (−3.47, 7.14)	12.93 (−3.11, 28.97)	14.61* (−1.05, 30.27)	8.62*** (2.89, 14.36)
p-value	.81	.13	.49	.11	.07	<.01
Pre-closure mean younger physician	85.7%	31.9%	0.0%	49.1%	59.3%	35.3
N	599	817	817	817	817	448

$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage-point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The reference group is pre-closure younger physicians. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (gender, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Older physician defined as age greater than the full sample mean of 53.1.

[c]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

[d]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[e]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[f]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[g]Amount of time (minutes) the physician or alternate provider offered typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

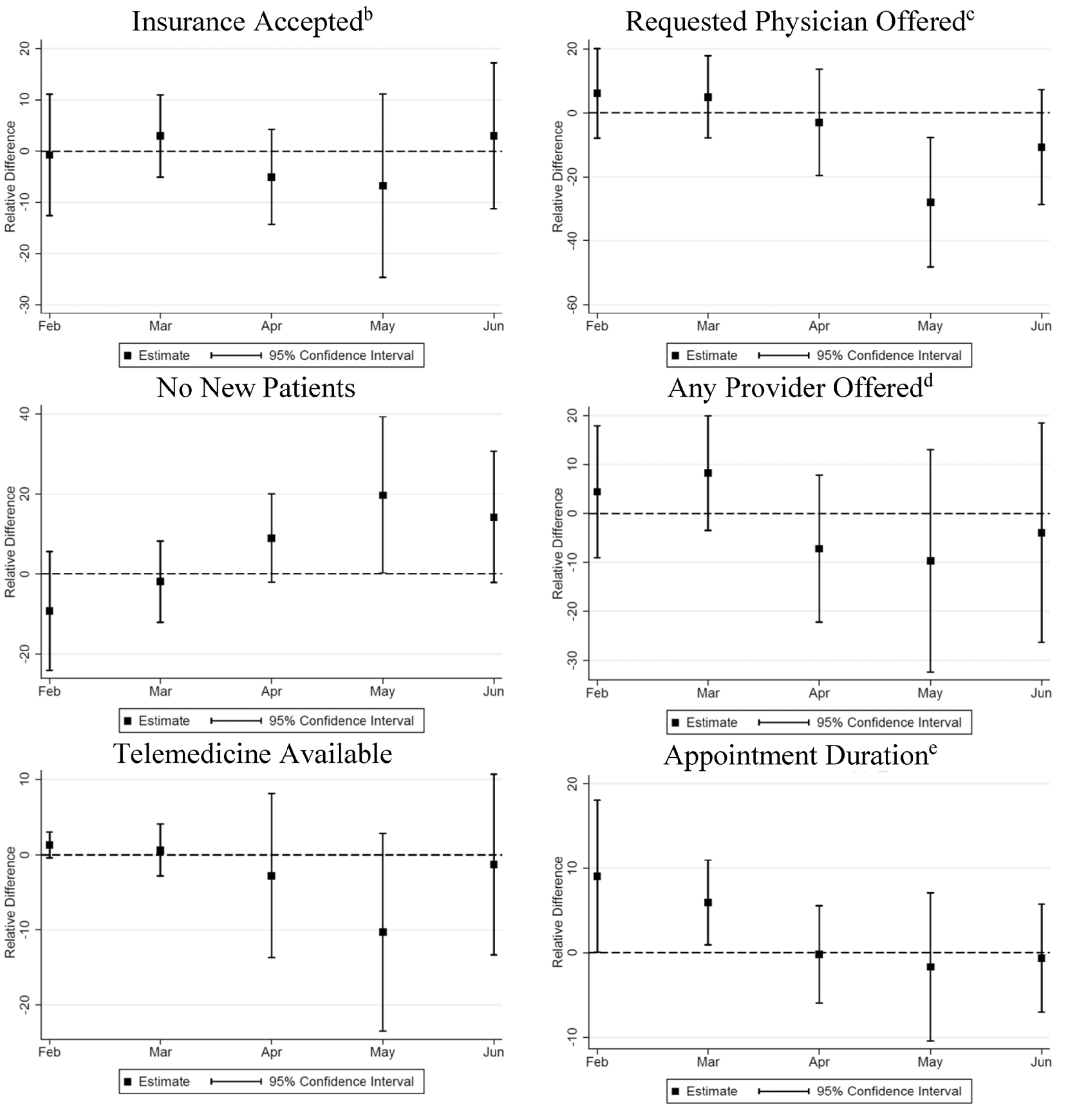

FIGURE 2 Timing of COVID-19 impacts (by provider age, older vs. younger).[a] ([a]Older physician defined as age greater than the full sample mean of 53.1). All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (10 observations from early July were omitted). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).

TABLE 9 Timing of COVID-19 impacts (by provider age, older vs. younger).[a]

	Insurance accepted[b]	No new patients	Telemedicine available	Requested phys. offered[c]	Any provider offered[d]	Appt duration[e]
February * Old[f]	−0.80 (−12.66, 11.06)	−9.22 (−24.01, 5.57)	1.31 (−0.38, 3.00)	6.08 (−7.95, 20.12)	4.40 (−9.06, 17.85)	9.06** (0.06, 18.06)
p-value	.89	.22	.13	.39	.51	.05
March * Old	2.90 (−5.09, 10.89)	−1.91 (−12.07, 8.25)	0.63 (−2.81, 4.07)	4.97 (−7.84, 17.78)	8.22 (−3.49, 19.93)	5.95** (0.92, 10.97)
p-value	.47	.71	.71	.44	.17	.02
April * Old	−5.07 (−14.34, 4.20)	9.00 (−2.09, 20.09)	−2.79 (−13.67, 8.09)	−2.98 (−19.58, 13.62)	−7.20 (−22.19, 7.80)	−0.20 (−5.98, 5.58)
p-value	.28	.11	.61	.72	.34	.94
May * Old	−6.79 (−24.67, 11.09)	19.71** (0.22, 39.2)	−10.31 (−23.43, 2.82)	−27.99*** (−48.25, −7.72)	−9.69 (−32.34, 12.96)	−1.67 (−10.42, 7.08)
p-value	.45	.05	.12	.01	.39	.70
June * Old	2.92 (−11.33, 17.17)	14.21* (−2.17, 30.60)	−1.31 (−13.33, 10.70)	−10.71 (−28.59, 7.18)	−3.98 (−26.34, 18.39)	−0.65 (−7.05, 5.75)
p-value	.68	.09	.83	.24	.72	.84
March	−5.48 (−13.90, 2.94)	−6.31 (−22.22, 9.60)	1.13 (−1.92, 4.18)	1.83 (−13.35, 17.01)	−2.97 (−15.52, 9.58)	1.67 (−3.71, 7.05)
p-value	.20	.43	.46	.81	.64	.54
April	11.60** (2.26, 20.93)	−8.54 (−21.08, 4.01)	13.16*** (3.77, 22.55)	6.93 (−9.38, 23.23)	11.59 (−5.76, 28.94)	7.62** (1.02, 14.22)
p-value	.02	.18	.01	.40	.19	.03
May	8.61 (−4.71, 21.92)	−17.93* (−36.85, 0.98)	21.52*** (11.24, 31.79)	22.91* (−0.71, 46.54)	15.81 (−9.27, 40.89)	7.27* (−0.84, 15.39)
p-value	.20	.06	<.01	.06	.21	.08

TABLE 9 (Continued)

	Insurance accepted[b]	No new patients	Telemedicine available	Requested phys. offered[c]	Any provider offered[d]	Appt duration[e]
June	−3.63 (−14.26, 7.00)	−22.67** (−41.26, −4.08)	8.87** (0.54, 17.19)	16.58* (−2.12, 35.27)	10.95 (−7.97, 29.88)	1.35 (−4.69, 7.39)
p-value	.50	.02	.04	.08	.25	.66
February Mean (SD)	85.5 (35.3)	31.0 (46.4)	0.0 (0.0)	47.7 (50.1)	58.3 (49.4)	38.6 (16.1)
N	593	807	807	807	807	444

[a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (gender, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

[f]Older physician defined as age greater than the full sample mean of 53.1.

TABLE 10 COVID-19 and changes in physician availability by gender of requested physician.[a]

	Insurance accepted[c]	No new patients	Telemedicine available	Requested phys. offered[d]	Any provider offered[e]	Appt duration[f]
Female physician * post-closure[b]	−7.91 (−18.37, 2.55)	−10.04* (−21.81, 1.73)	5.99 (−2.88, 14.87)	−3.39 (−16.85, 10.07)	−9.94 (−22.28, 2.41)	−1.31 (−8.97, 6.35)
p-value	.14	.09	.18	.62	.11	.73
Post-closure[b]	10.05*** (3.60, 16.51)	−0.23 (−9.34, 8.88)	8.02*** (3.94, 12.11)	3.03 (−8.00, 14.05)	7.11 (−4.24, 18.46)	1.23 (−3.73, 6.19)
p-value	<.01	.96	<.01	.58	.21	.62
Female physician	−0.06 (−7.22, 7.10)	3.85 (−7.28, 14.97)	−0.04 (−1.30, 1.21)	4.47 (−5.53, 14.46)	10.28* (−0.81, 21.37)	2.12 (−2.60, 6.85)
p-value	.99	.49	.94	.37	.07	.37
Male physician pre-closure mean	85.3%	29.3%	0.4%	47.4%	56.3%	37.9
N	599	817	817	817	817	448

$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The reference group is pre-closure male physicians. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

[c]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[d]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[e]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[f]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

TABLE 11 Timing of COVID-19 impacts (by provider gender, female vs. male).[a]

	Insurance accepted[b]	No new patients	Telemedicine available	Requested phys. offered[c]	Any provider offered[d]	Appt duration[e]
February * Female	3.40 (−7.33, 14.13)	4.34 (−10.40, 19.07)	0.16 (−1.21, 1.53)	7.08 (−6.42, 20.58)	10.94 (−6.09, 27.97)	5.96 (−2.37, 14.29)
p-value	.53	.56	.82	.30	.20	.16
March * Female	−3.58 (−15.7, 8.55)	4.79 (−8.43, 18.02)	−1.01 (−3.70, 1.68)	0.76 (−13.45, 14.97)	9.00 (−4.97, 22.96)	−2.06 (−8.88, 4.77)
p-value	.56	.47	.45	.92	.20	.55
April * Female	−12.10** (−24.17, −0.03)	−2.68 (−20.44, 15.09)	5.41 (−7.24, 18.06)	−10.54 (−26.73, 5.64)	−12.78 (−28.94, 3.38)	3.59 (−3.06, 10.24)
p-value	.05	.76	.39	.20	.12	.28
May * Female	−3.18 (−18.00, 11.64)	−21.51* (−44.32, 1.30)	1.52 (−19.08, 22.11)	10.26 (−12.87, 33.39)	9.50 (−11.80, 30.80)	−0.48 (−10.28, 9.31)
p-value	.67	.06	.88	.38	.37	.92
June * Female	−0.85 (−19.39, 17.69)	−1.32 (−15.63, 12.98)	10.48 (−2.3, 23.25)	12.47 (−5.20, 30.14)	15.02 (−3.64, 33.68)	2.64 (−5.62, 10.90)
p-value	.93	.85	.11	.16	.11	.52
March	−0.90 (−8.35, 6.56)	−3.33 (−14.65, 7.99)	1.42 (−1.28, 4.11)	3.89 (−7.25, 15.02)	−0.44 (−11.21, 10.33)	3.44 (−3.24, 10.11)
p-value	.81	.56	.30	.49	.94	.31
April	15.05*** (7.29, 22.81)	2.91 (−10.39, 16.21)	9.65*** (4.01, 15.29)	8.66 (−7.77, 25.10)	13.20 (−2.76, 29.16)	4.75 (−1.55, 11.06)
p-value	<.01	.66	<.01	.30	.103	.14
May	8.53 (−5.86, 22.93)	7.45 (−9.26, 24.17)	15.80* (4.01, 27.58)	4.63 (−18.25, 27.50)	8.86 (−12.88, 30.60)	5.09 (−2.78, 12.95)
p-value	.24	.37	.01	.69	.42	.20

(Continues)

TABLE 11 (Continued)

	Insurance accepted[b]	No new patients	Telemedicine available	Requested phys. offered[c]	Any provider offered[d]	Appt duration[e]
June	−0.46 (−14.35, 13.43)	−9.20 (−23.55, 5.15)	3.52 (−1.98, 9.02)	5.71 (−11.03, 22.45)	4.71 (−12.57, 21.99)	−1.88 (−7.35, 3.60)
p-value	.95	.20	.20	.50	.59	.49
February Mean (SD)	85.5 (35.3)	31.0 (46.4)	0.0 (0.0)	47.7 (50.1)	58.3 (49.4)	38.6 (16.1)
N	593	807	807	807	807	444

[a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

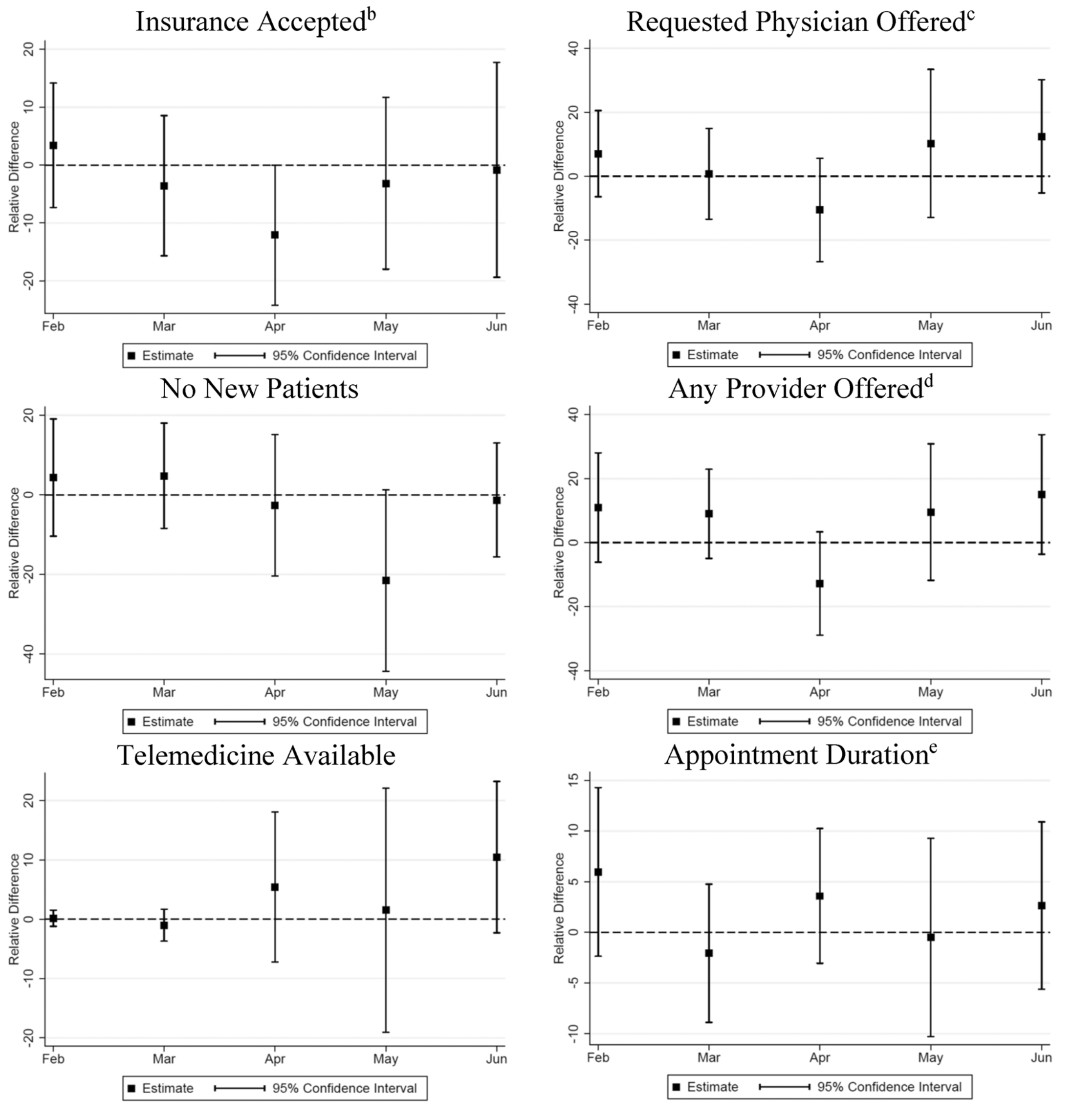

FIGURE 3 Timing of COVID-19 impacts (by provider gender, female vs. male).[a] ([a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (10 observations from early July were omitted). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).

March, but that this difference had largely disappeared in April, May, and June as physicians in different age groups responded differently to COVID-19.

Pre-closure appointment availability was similar between female and male physicians on most measures (Table 10). However, offices of female physicians were 10.3 percentage points (95% CI: −0.8, 21.4; $p = .07$) more likely to offer an appointment with any provider (requested physician or alternate) than offices of male physicians.

After closure, male physicians' offices became 8.0 percentage points (95% CI: 3.9, 12.1; $p < .01$) more likely to offer telemedicine, and 10.1 percentage points (95% CI: 3.6, 16.5; $p < .01$) more likely to accept patients' insurance. Female physicians' responses on these measures were not statistically significantly different than for male physicians. However, relative to male physicians, female physicians did become 10.0 percentage points (95% CI: −21.8, 1.7; $p = .09$) less likely to say that they were not accepting new patients. We found no statistically significant differences between male and female physicians in how closures affected the likelihood that callers encountered voicemail or closed offices (Tables A2).

Event studies (Table 11) highlight large changes in insurance acceptance and telemedicine availability by physicians in April. Female physicians were less likely to accept patient insurance in April and more likely to accept new patients in May relative to male counterparts (Figure 3 and Table 11).

6 | DISCUSSION AND CONCLUSIONS

This article employs a unique audit data set that spans the onset of the first wave of COVID-19 in the United States and assesses its impact on the availability of the primary care physician workforce for routine new-patient appointments. The pandemic resulted in a deferral of health services that were unrelated to COVID-19, some of which may be related to supply-side reductions (Blecker et al., 2021; Centers for Disease Control and Prevention, 2020). Prior research has identified the multi-faceted challenges that the pandemic has posed to the medical workforce. The commitment and sacrifice of health workers during the early days of the pandemic as they endured well-documented threats to safety and logistical issues, as well as decreased demand for routine care, is unquestionable (Mehta et al., 2021; Pandey & Sharma, 2020). However, the ways in which the pandemic impacted primary care physicians' availability for new patient appointments, and whether this differed based on physicians' age and gender, has not been examined previously.

While our finding that the availability of telemedicine expanded dramatically (10 percentage-point increase) during the first U.S. wave of COVID-19 is consistent with previous reports (Mehrotra et al., 2020; Zachrison et al., 2021), several of our findings add new detail to our understanding of physician availability. In absolute terms, the 18-percentage-point relative decrease in appointment offers by older physicians that we find is larger than the widely reported surge in telemedicine. The 7-min relative decrease in the duration of appointments offered by older physicians—who tended to offer longer appointments before the closures—is another indicator of their retreat from patient care. The finding that physicians became more willing to accept insurance as COVID-19 impacted their states indicates that the decrease in selectivity regarding insurance was a response to the decreased demand for routine care early in the pandemic.

In an environment of reduced demand for routine care due to COVID-19, the overall availability of primary care appointments for new patients actively seeking such care did not fall because younger physicians mostly offset the decrease in supply from older physicians. We also did not find that wait times to appointments changed significantly. However, the persistence and effort required to schedule the appointments did increase as prospective patients became more likely to encounter voicemail and closed offices in the post-pandemic period.

Our event study analyses showed that physicians responded quickly to decreased demand by becoming less selective about patient insurance in April 2020. As states reopened and some interactions resumed in subsequent months (Nguyen et al., 2021), reversion to greater selectivity was equally quick. The primary care system also enacted a rapid and substantial shift from in-person to telemedicine visits during the first 2 months following stay-at-home orders. By June, the system adjusted again, with telemedicine visits decreasing in favor of in-person appointments. Telemedicine may enable medically vulnerable older physicians, or those caring for young children, to practice while COVID-19 is circulating. It may also decrease mortality and hospitalizations by improving access (Chen & Dills, 2022). Our finding that older physicians were less available via telemedicine is troubling and may result from a lower level of comfort with new technologies on the part of older physicians. Alternatively, the significant investment of time and money needed to adopt new workplace technology may be less worthwhile for a physician nearing the end of their career (Smith et al., 2020). Reliance on telemedicine may also negatively impact access for older patients who experience significantly higher barriers to using the technology (Lam et al., 2020). Furthermore, there is evidence that low-income patients have less access to telemedicine (Patel et al., 2021).

Our finding that female physicians did not reduce their participation relative to male physicians during the closures may arise because female physicians who are parents, the group likely to be most subject to pressures at home, are well paid relative to other women workers, and are likely to have a greater capacity to arrange for childcare, including in-home care, when formal sites such as schools shut down. More hopefully, the shift to telemedicine may have increased efficiency by decreasing time spent transitioning between patients (Mullen-Fortino et al., 2018), and has the potential to improve access for patients, especially those in rural areas (Kichloo et al., 2020). While we find no statistically significant difference in telemedicine availability between female and male physicians, research using administrative data from a large New England health care system has found that female physicians from multiple medical and surgical specialties were more likely to be early adopters of telemedicine during the pandemic than male physicians (Zachrison et al., 2021).

This study has several limitations. Our focus on routine appointments for new patients may not represent the experience of established patients or those with urgent needs. It is likely that such patients were given priority. Data is limited to 5 months early in the pandemic, and we are not able to control for seasonality. However, any seasonal effects are likely to have been small relative to the enormous disruption caused by the pandemic. Furthermore, our pre-closure period may include a time when physicians and their office staff were already concerned about and reacting to the risks posed by COVID-19. Offers of telemedicine appear to have been the most sensitive indicators of physician reaction to the early risks of COVID-19. We recorded no such offers in February and only one in pre-closure data. This suggests that our pre-closure (especially February) data provides an accurate measure of appointment availability prior to the pandemic. To the extent that the pre-closure period includes physicians who were already reacting to the pandemic, the true effects of COVID-19 on appointment availability may be larger than those reported in this article. The number of calls completed during various time intervals varied greatly over the duration of this study which could be problematic if the rate of data collection were related to characteristics of physicians being sampled. However, the rate of data collection in this study was largely determined by the rate at which RAs made calls which, in turn, was determined by the rhythms of academic workloads for undergraduates (Figures A2–A3). The weekly event studies included in Appendix Figures A5-A7 rely on small amounts of weekly data and yield noisy estimates and wide confidence intervals. We focus on the results of the difference-in-difference and monthly event study analyses, methodologies with countervailing strengths and weaknesses that yield largely consistent results.

Our findings should be interpreted as changes in equilibrium outcomes resulting from pandemic-induced changes in both demand and supply for routine medical care. Nevertheless, our findings of differences in availability by physician demographics are likely to represent differential supply side responses by different types of physicians if the changes in demand were uniform across physician types. To the extent that the pandemic-induced reduction in demand was endogenous to physician characteristics (e.g., if the decrease in demand was greater for older patients who were at higher risk from COVID-19 and who tend to account for a greater proportion of older physicians' patient panels), our estimates of older physicians' response are likely to underestimate the extent of such physicians' withdrawal from patient care. The analyses of differential availability for older and female physicians rely on difference-in-difference methods that may be susceptible to bias due to the differential timing of closures across states. However, event study analyses that do not suffer from such potential problems yield similar results and provide an assurance that the results from difference-in-difference analyses are generally reliable. Lastly, our observations were limited to the initial U.S. wave of COVID-19 and may not be generalizable to later waves.

Our findings add new insights to physician availability during the first U.S. wave of the pandemic. As COVID-19 remains an important threat to life and health, there are extensive reports of burnout, exasperation, and withdrawal from care among the medical workforce (Galvin, 2021). Under these circumstances, it is unlikely that the substitution among physicians that maintained the availability of routine care amid decreased demand during the first wave of the pandemic is sustainable. However, the new insights that this research offers may help policymakers to better identify and address potential problems with adequate availability of the physician workforce in a crisis.

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APPENDIX

TABLE A1 Stay-at-home (closure) orders start dates.

State	Date	State	Date
Alabama	4/3/2020	Montana	3/26/2020
Alaska	3/27/2020	Nebraska	None
Arizona	3/30/2020	Nevada	3/31/2020
Arkansas	None	New Hampshire	3/26/2020
California	3/19/2020	New Jersey	3/21/2020
Colorado	3/25/2020	New Mexico	3/23/2020
Connecticut	3/20/2020	New York	3/20/2020
Delaware	3/22/2020	North Carolina	3/27/2020
District of Columbia	3/30/2020	North Dakota	None
Florida	4/1/2020	Ohio	3/22/2020
Georgia	4/2/2020	Oklahoma	4/1/2020
Hawaii	3/23/2020	Oregon	3/23/2020
Idaho	3/25/2020	Pennsylvania	4/1/2020
Illinois	3/20/2020	Rhode Island	3/30/2020
Indiana	3/23/2020	South Carolina	4/6/2020
Iowa	None	South Dakota	3/23/2020
Kansas	3/28/2020	Tennessee	3/30/2020
Kentucky	3/22/2020	Texas	3/31/2020
Louisiana	3/22/2020	Utah	3/27/2020
Maine	3/31/2020	Vermont	3/24/2020
Maryland	3/30/2020	Virginia	3/30/2020
Massachusetts	3/23/2020	Washington	3/23/2020
Michigan	3/23/2020	West Virginia	3/23/2020
Minnesota	3/25/2020	Wisconsin	3/24/2020
Mississippi	4/1/2020	Wyoming	None
Missouri	4/3/2020		

TABLE A2 COVID-19 Closures and call placed outcomes by age and gender of requested physician.[a]

	Calls to voicemail			Office is closed		
	Basic model	[Old[b]]	[Female]	Basic model	[Old[b]]	[Female]
Post[c]	13.04*** (9.66, 16.43)	15.20*** (9.94, 20.46)	11.62*** (6.97, 16.27)	20.97*** (12.84, 29.10)	19.38*** (11.38, 27.38)	21.50*** (13.60, 29.40)
p-value	<.01	<.01	<.01	<.01	<.01	<.01
Post * [Attribute]		−4.29 (−10.89, 2.32)	3.85 (−5.43, 13.13)		3.34 (−4.56, 11.24)	−1.43 (−10.29, 7.44)
p-value		.20	.41		.40	.75
[Attribute]		0.90 (−5.72, 7.53)	0.38 (−1.70, 2.46)		−5.82** (−10.79, −0.84)	0.62 (−1.38, 2.62)
p-value		.79	.71		.02	.54
Pre-closure overall mean	0.69%	0.69%	0.69%	0.23%	0.23%	0.23%
N	817	817	817	817	817	817

$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage-point differences 95% confidence intervals are in parentheses. The reference group is pre-closure younger or male physicians. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (gender, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Older physician defined as age greater than the full sample mean of 53.1.

[c]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

TABLE A3 COVID-19 Closures and changes in the experience of seeking new patient appointments, by payer type.[a]

	Insurance accepted[c]	No new patients	Telemedicine available	Requested phys. offered[d]	Any provider offered[e]	Appt duration[f]
Post[a] * Medicaid[b]	10.71 (−3.81, 25.24)	−6.04 (−20.57, 8.50)	9.26** (0.82, 17.71)	9.00 (−3.87, 21.86)	10.84 (−2.92, 24.60)	10.84 (−2.92, 24.6)
p-value	.15	.41	.03	.17	.12	.12
Post * Medicare	9.28*** (2.53, 16.02)	0.81 (−12.4, 14.02)	10.14** (2.41, 17.87)	−0.81 (−15.42, 13.80)	−1.62 (−16.79, 13.54)	−1.62 (−16.79, 13.54)
p-value	.01	.90	.011	.91	.83	.83
Post * Private	5.17 (−2.42, 12.75)	−6.82 (−25.63, 11.99)	15.09*** (8.21, 21.97)	−0.48 (−20.41, 19.46)	5.07 (−14.97, 25.12)	5.07 (−14.97, 25.12)
p-value	.18	.47	<.01	.96	.61	.61
Post * Self	2.98 (−7.18, 13.13)	−4.03 (−14.18, 6.11)	6.44** (0.16, 12.72)	−0.37 (−14.64, 13.90)	−0.12 (−14.32, 14.08)	−0.12 (−14.32, 14.08)
p-value	.56	.43	.05	.96	.99	.99
Pre-closure mean	85.3%	29.5%	0.2%	50.3%	60.6%	38.6
N	599	817	817	817	817	448

$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage-point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

[c]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[d]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[e]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[f]Amount of time (minutes) the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

TABLE A4 COVID-19 and changes in the experience of seeking new patient appointments, by practice size.[a]

	Insurance accepted[d]	No new patients	Telemedicine available	Requested phys. offered[e]	Any provider offered[f]	Appt duration[g]
Group practice[b] * post-closure[c]	−5.53 (−19.28, 8.22)	−11.28 (−27.87, 5.31)	0.01 (−7.90, 7.92)	−3.79 (−22.16, 14.58)	−9.13 (−26.35, 8.09)	2.72 (−5.44, 10.88)
p-value	.42	.18	1.00	.68	.29	.51
Post-closure[c]	0.14** (0.01, 0.26)	0.06 (−0.06, 0.17)	0.10** (0.02, 0.17)	0.06 (−0.10, 0.22)	0.11 (−0.05, 0.27)	−1.81 (−12.05, 8.43)
p-value	.03	.34	.02	.44	.17	.72
Group practice	5.09 (−7.73, 17.91)	14.90** (4.27, 25.54)	0.67 (−2.12, 3.46)	−8.34 (−22.19, 5.50)	2.30 (−10.45, 15.04)	2.10 (−5.04, 9.25)
p-value	.43	.01	.63	.23	.72	.56
Pre-closure small practice mean	75.0%	19.1%	0.0%	51.1%	54.3%	37.7
N	451	615	615	615	615	340

$^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

[a]All estimates are percentage-point differences except for appointment duration which is in minutes. 95% confidence intervals are in parentheses. The reference group is pre-closure younger physicians. The analysis controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (gender, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. Robust standard errors were clustered by state.

[b]Group practice = 1. Self-employed solo or two-physician practices = 0. All other types, including hospital settings, were excluded.

[c]Closure defined as the date of state-issued stay at home order (see Table A1). Strictness of orders varied by state.

[d]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients).

[e]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted.

[f]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted.

[g]Amount of time (minutes) the physician or alternate provider offered typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range.

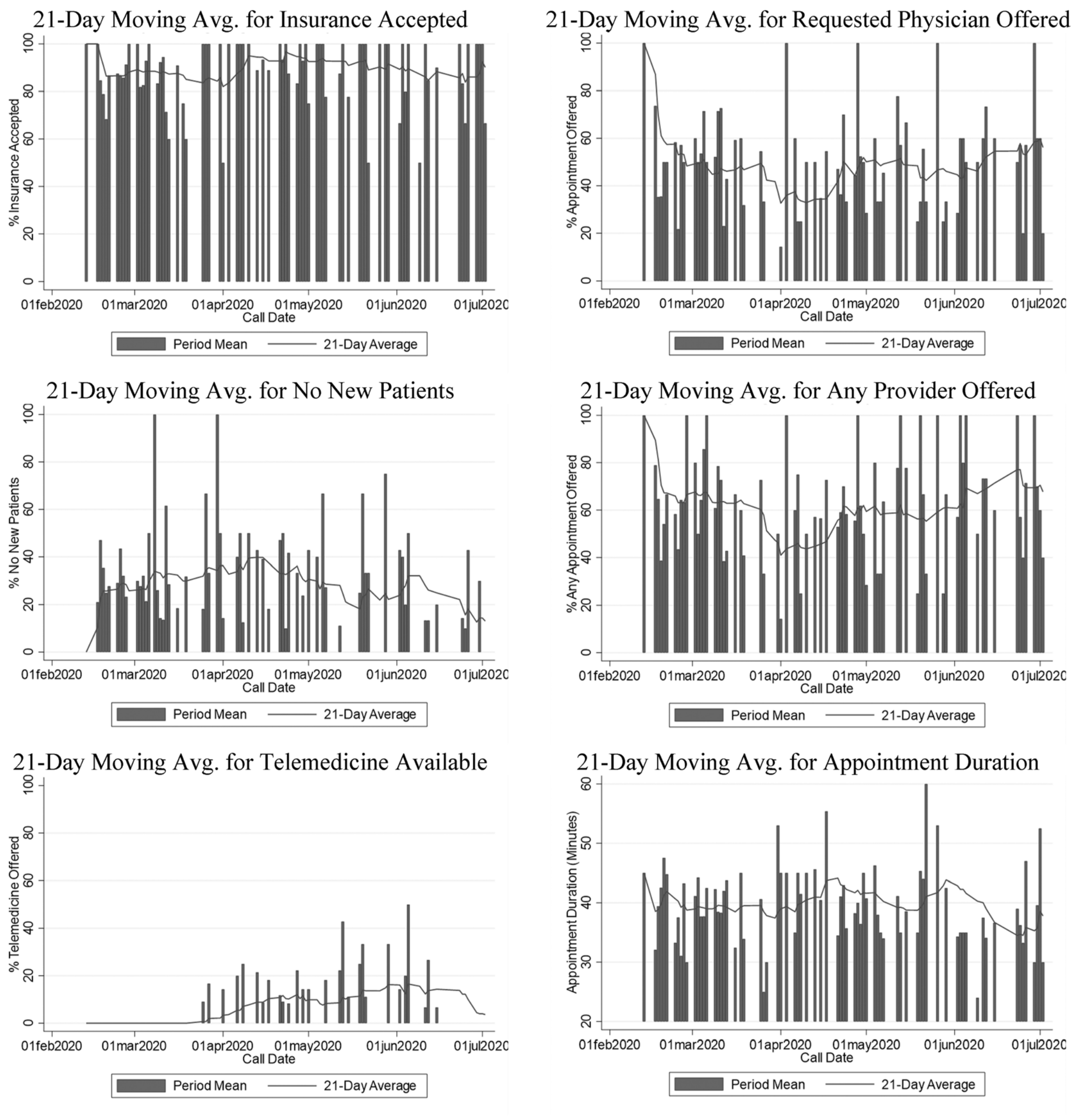

FIGURE A1 Daily mean and 21-day moving average call outcomes. Charts show mean outcome values in the raw data for each date with completed calls, and 21-day look-back moving averages.

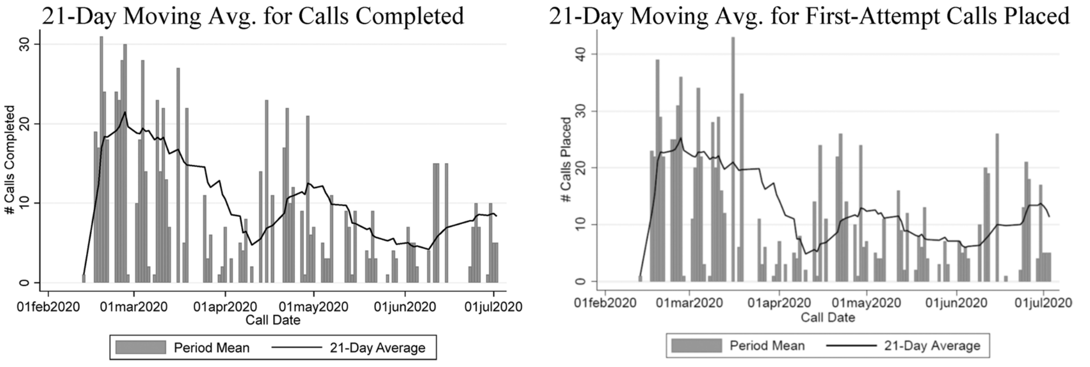

FIGURE A2 Daily mean and 21-day moving average for call activities.

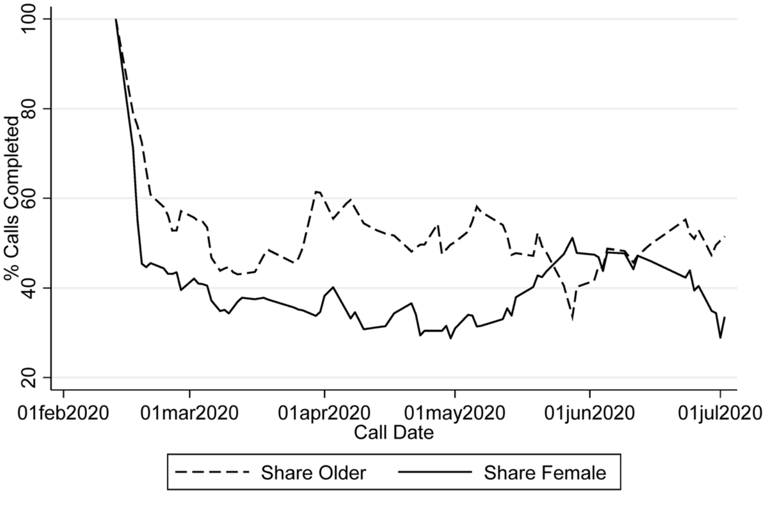

FIGURE A3 Weekly calls successfully placed by provider age and gender.

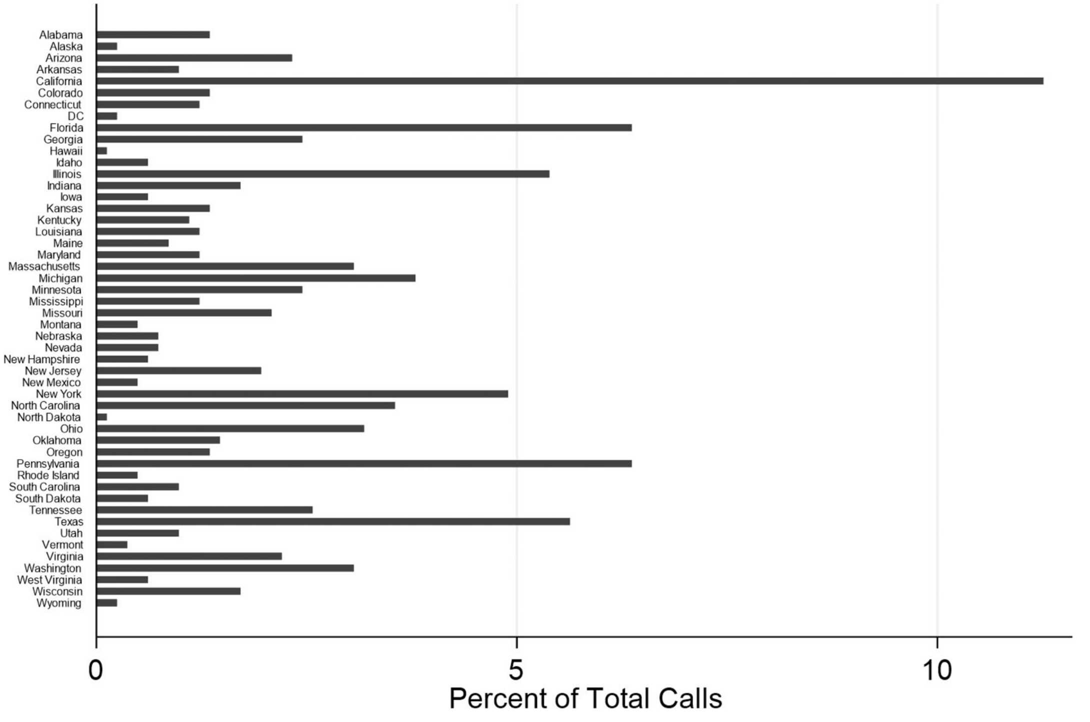

FIGURE A4 Physicians called by state.

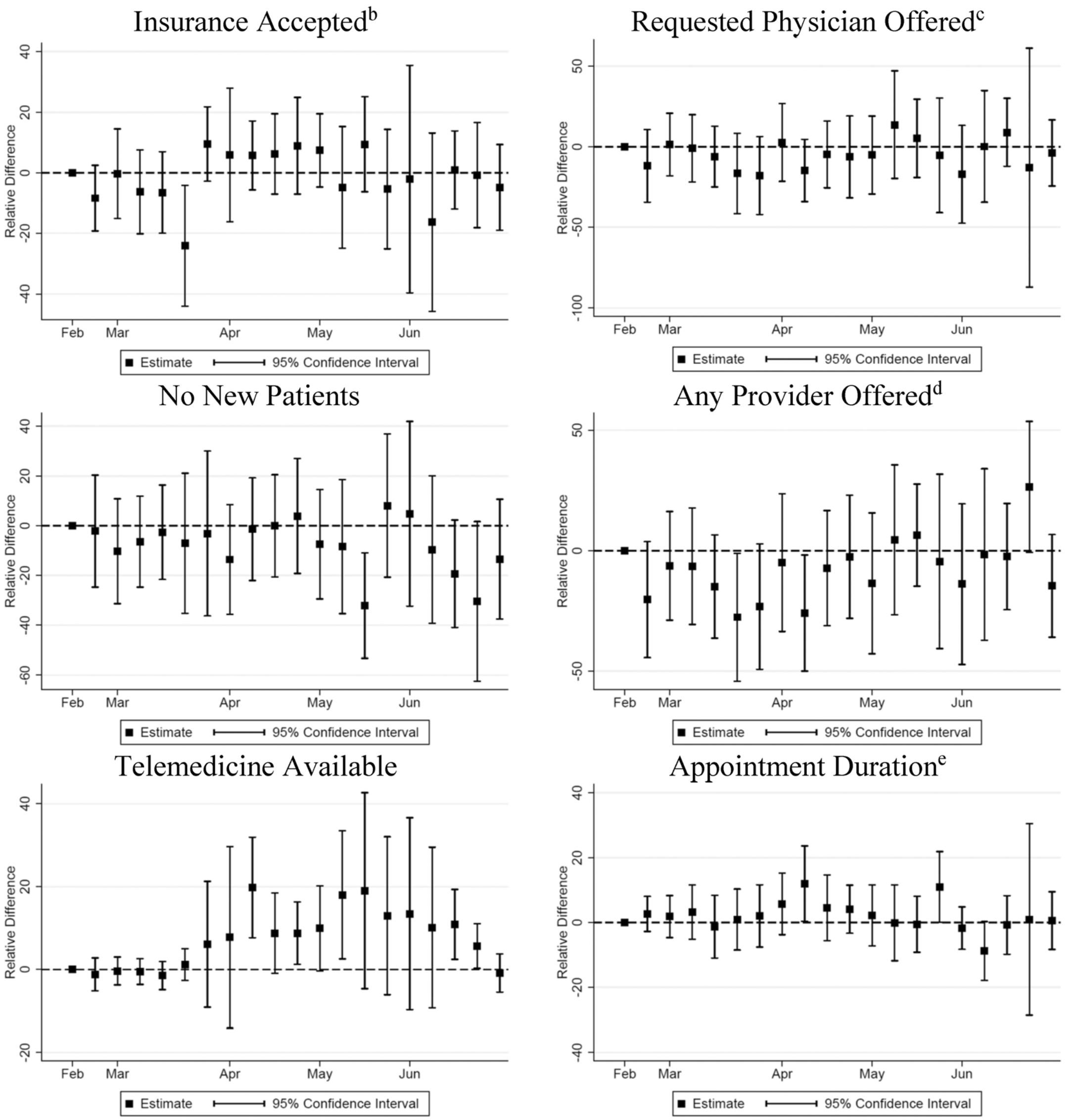

FIGURE A5 Timing of COVID-19 impacts (weekly).[a] ([a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, gender, and MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (10 observations from early July were omitted). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).

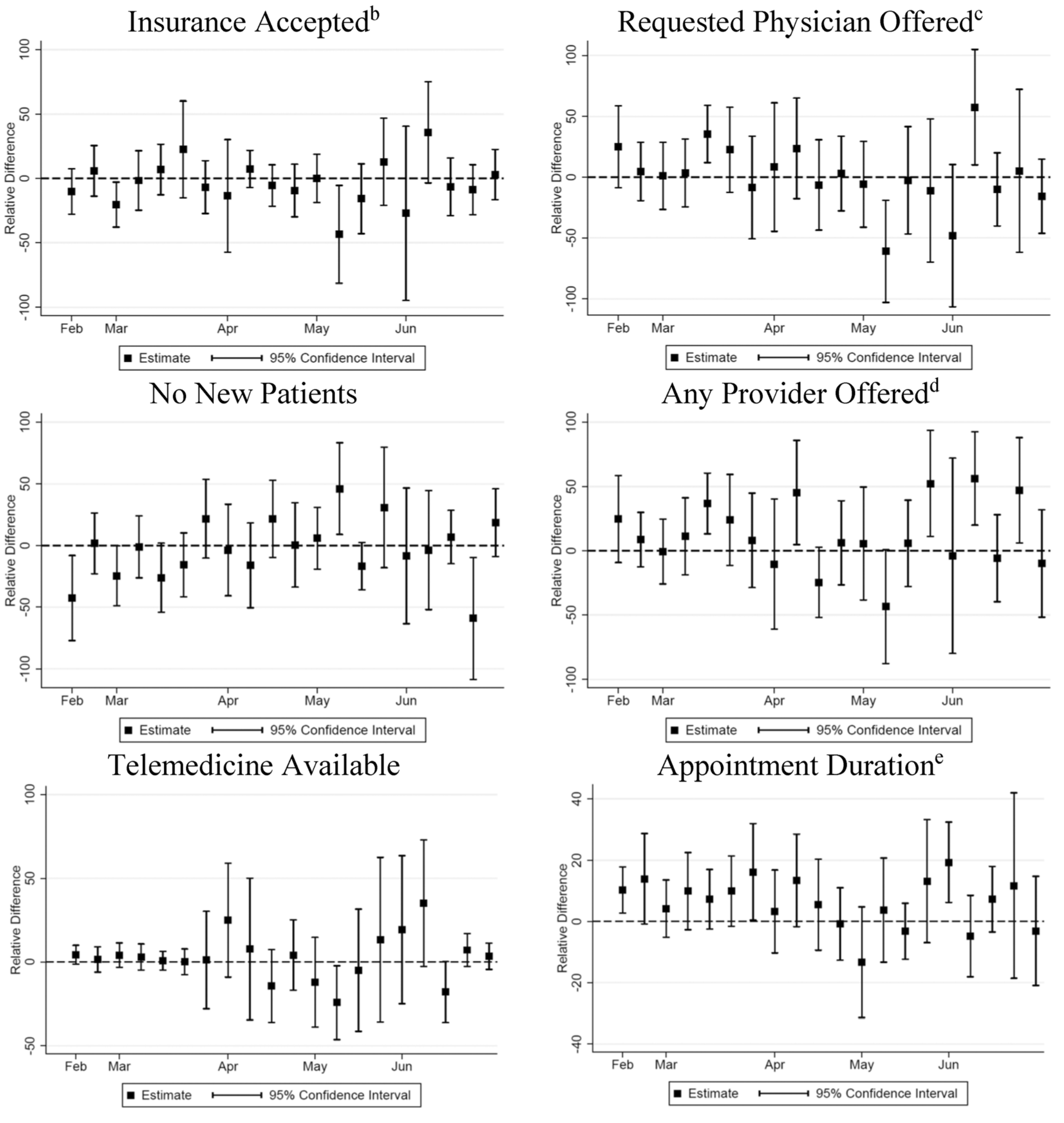

FIGURE A6 Timing of COVID-19 impacts (weekly, by provider age, older vs. younger).[a] ([a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (gender, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (9 observations from early July were omitted from the figure). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).

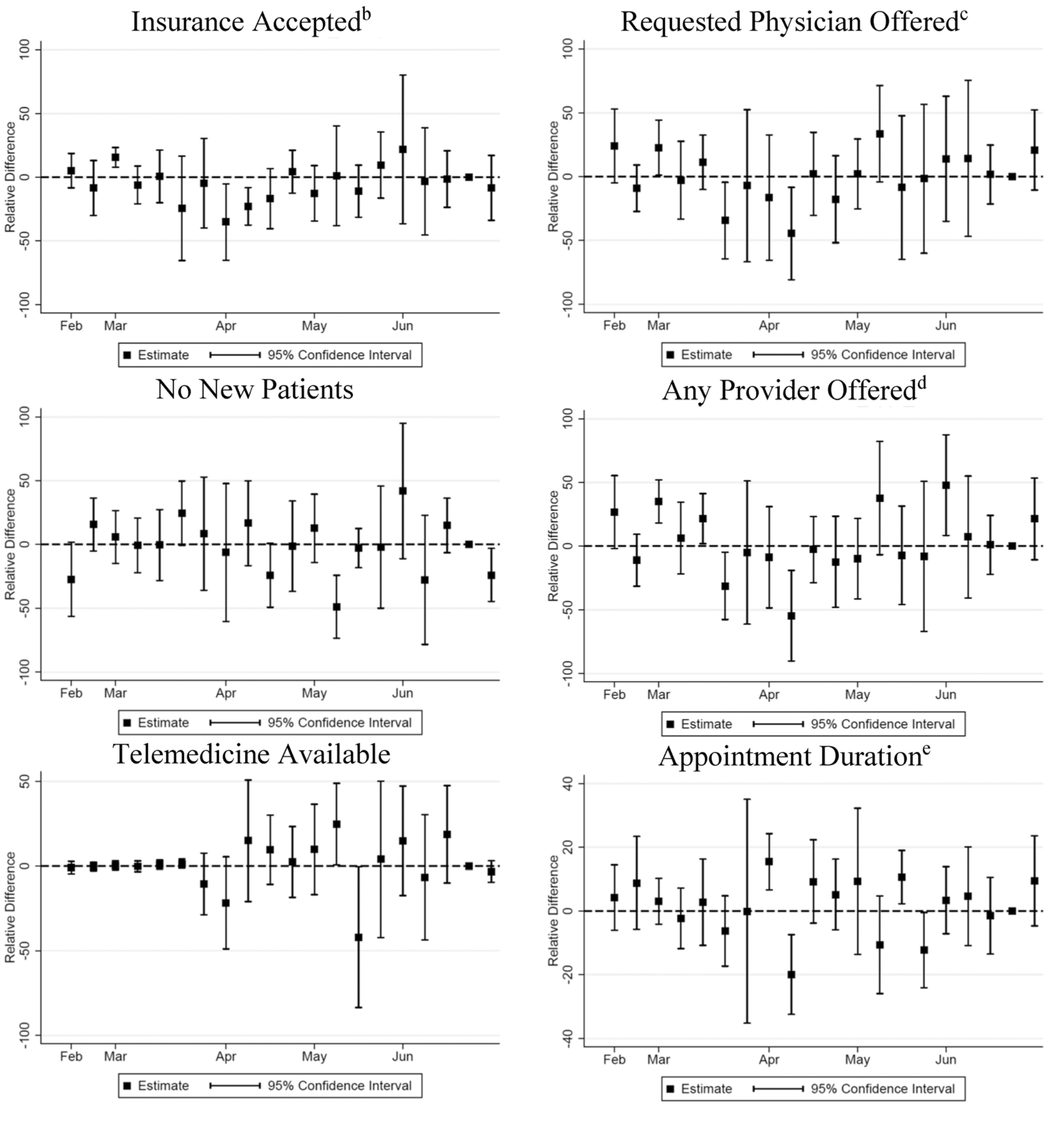

FIGURE A7 Timing of COVID-19 impacts (weekly, by provider gender, female vs. male).[a] ([a]All estimates are percentage point differences except for appointment duration which is in minutes. The analyses controlled for simulated patient characteristics (race/ethnicity, gender, and insurance type), characteristics of the requested physician (age, MD/DO), as well as fixed effects for state, the research assistant making the call, and the day of the week when the call was made. $N = 807$ (9 observations from early July were omitted from the figure). Robust standard errors were clustered by state. [b]Information on insurance acceptance was not requested from physicians' offices that provided insurance-unrelated reasons for lack of appointment availability (e.g., not accepting new patients). [c]Potential appointment date (or date range) offered with requested physician, and at least one plan of the patient's insurance type was accepted. [d]Potential appointment date (or date range) offered with requested physician or alternate provider in the same practice, and at least one plan of the patient's insurance type was accepted. [e]Amount of time the physician or alternate provider typically spends with patient for a physical exam. Not requested from physicians' offices that did not provide a potential appointment date or date range).