Appendix 1

This appendix has been prepared by the authors to provide readers additional information about their work.

Supplement to: Aiken ARA, Starling JE, Gomperts R, Garcia Tec M, Scott JG, Aiken CE. Demand for Self-Managed Online Telemedicine Abortion in the United States during Coronavirus Disease 2019 (COVID-19).

Introduction

On March 13th 2020, the US declared COVID-19 a national emergency.[3] Over the subsequent weeks, most states enacted social distancing requirements, including business closures designed to slow the spread of the virus. Many states also suspended the provision of "non-essential healthcare services", including many elective procedures and non-time-sensitive surgeries. Some states specifically included abortion services under this definition. States implemented these abortion restrictions in many different ways. Some restrictions only applied to certain types of abortion (mainly surgical), and some were in effect for only a few days. But one state, Texas, effectively suspended all abortions, both medication and surgical, for approximately 4 weeks.[4]

Abortion care is difficult for many to access in the US even under normal circumstances.[5] But COVID-19 has raised yet more potential barriers—including the fear of attending clinics due to infection risk, adjustments to service availability to maintain social distancing, the affordability of care during an economic crisis, and state policies that disrupt or suspend in-clinic services. These new barriers raise the possibility that during the COVID-19 pandemic, people may increasingly seek self-managed abortion from sources outside the formal healthcare system.

Prior studies have shown that people in the US may consider or try self-managed abortion using a variety of methods, including misoprostol from markets, shops, or online pharmacies; botanicals; menstrual extraction; and self-harm.[6,7] But the landscape of options for self-management has recently changed in the US due to the availability of mifepristone and misoprostol via online telemedicine.[8]

Using data from the only online medication abortion telemedicine service in the US, we compared trends in requests for abortion before and after states issued business closure orders and (where applicable) orders to suspend abortion services. Our aims were: 1) to assess the impact of the emergence of COVID-19 on US demand for self-managed medication abortion, by quantifying changes in requests relative to baseline trends; and 2) to examine variation in these changes at the state level, since there is considerable heterogeneity among states in both the burden of COVID-19 and the policy response.

Methods

We examined data from Aid Access, a non-profit organization that provides self-managed medical abortion services in the US up to 10 weeks' gestation via online telemedicine.[9] The service has operated since March 2018 and is accessed through an online consultation form, which is screened by a doctor. If clinical criteria are met, the person requesting abortion medications makes a $90 donation to support the service, a doctor provides a prescription, and mifepristone and misoprostol are dispatched by a partner organization. Real-time instruction and follow-up are conducted through email by a multilingual, specially trained helpdesk team. Those who cannot afford the full donation can donate a smaller amount or in some cases forego the donation. The WHO recommends that it is safe and effective to use mifepristone and misoprostol without direct supervision from a provider up to 12 weeks' gestation,[10] and previous evaluation of similar online telemedicine services has demonstrated their high levels of safety, effectiveness, and acceptability.[11,12]

We obtained the daily number of online requests from each US state between January 1st, 2019 and April 11th, 2020. We excluded any requests that came from a US overseas territory, a military post office, a test source such as a reporter, and any duplicates (defined as ≥1 request with the same information and location made within 12 hrs).

We analyzed trends in these requests using a regression-discontinuity design. This approach requires choosing a "before" and "after" period for each state, so that we can establish whether trends in requests changed significantly at the discontinuity. We chose January 1st 2019 as the start date for the "before" period, to allow baseline trends in requests to stabilize after Aid Access's first year in operation (2018). We defined the end of each state's "before" period as the date of its state-wide business closure order,[13] with the "after" period beginning on the subsequent day. We chose business-closure orders to define the "before and after" thresholds because these orders were generally among the first coordinated actions taken by states to slow the spread of COVID-19, and because almost all states implemented them. We also compiled information on any state-level COVID-19-related restrictions on abortion provision, including the scope of the policy and its date of implementation.[4]

To test whether the rate of Aid Access requests increased after business-closure orders, we first fit separate generalized linear models (GLMs) to each state's daily requests from January 1st, 2019 to April 11th, 2020. Each state's model incorporated a dummy variable taking the value 1 for days in that state's "after" period (as defined above), representing a possible discontinuity in the daily rate of requests. States with a COVID-19 related abortion restriction also had an additional dummy variable in their models, taking the value 1 on days when such restrictions were active. For a single state, our Poisson GLM can be formalized as

$$\log(cases_t) \sim t + ban_t + closure_t + \epsilon_t, \;\; \epsilon_t \sim N(0, \sigma^2)$$

while the corresponding null model is written as

$$\log(cases_t) \sim t + , \;\; \epsilon_t \sim N(0, \sigma^2)$$

where t represents days, $cases_t$ is the number of Aid Access requests on day t, and ban_t and $closure_t$ take values of 0 or 1, depending on whether abortion restrictions and business closures are in place on day t.

We also repeated this model-fitting process for the U.S. as a whole in order to estimate a nationwide average change in daily requests for the "after" period. In this case, we let i index states and t index days, and write our Poisson GLM as

$$\log(cases_{it}) \sim t + ban_{it} + closure_{it} + \epsilon_t, \;\; \epsilon_t \sim N(0, \sigma^2)$$

so that the ban and closure model coefficients estimate average impact of bans and closures across all states.

We assessed the significance of each state's discontinuity using a likelihood ratio test versus a null model that lacked a dummy variable for the "after" period but was otherwise identical. To determine the functional form of each state's GLM, we first fit a Poisson model with a log link and assessed goodness of fit using a chi-squared test. For any states with a poor Poisson model fit ($p<0.05$), we refit a Negative Binomial GLM to account for over-dispersion, and we reassessed fit. This gave well-fitting models ($p \geq 0.05$) for all states. We also repeated this process for the US as a whole, to estimate a nationwide average change in requests for the "after" period.

To visualize results for each state, we generated Monte Carlo simulations from each state's null model, without a discontinuity for the "after" period. These draws show the probability distribution for expected requests under the assumption that the daily rate of requests remained at its prior level. We also calculated the percentage difference between actual requests and expected requests under the null model in the "after" period. To allow sufficient power to detect before-and-after differences, our analysis includes only states that had at least ten expected requests in the "after" period, resulting in an analytic sample of 37 states.

To assess the possibility that any increases in requests to Aid Access were related to behavioral changes in response to COVID-19, we also compared social-distancing data for states with and without significant changes in requests during the "after" period. We obtained social distancing data from SafeGraph from January 1st, 2020 through April 11th, 2020.[14] This data consists of aggregated, anonymized GPS traces from mobile devices, and it measures time spent at home as a proxy for social distancing behavior. SafeGraph infers a home location for each device based on its night-time location. It then calculates time spent at home by summing home minutes for each device and then taking the median across devices for each day over a large geographic area (in our case, a state). We received the data in this highly aggregated and anonymized form, and we computed relative home time for each state as daily median home minutes relative to its historical average for January and February, where the historical average value was normalized to zero. To enhance privacy, census block group information is excluded if fewer than five devices visited an establishment in a month from a given census block group. SafeGraph calculates the time spent at home (each anonymized device's most common night-time location) by summing home minutes for each device, then taking the median across devices for each day across states. The median home time data exhibited strong weekend/weekday seasonality, and we de-trend the data using the **forecast** R package[15] and then compute relative home time for each state as daily median home minutes divided by the historical average of this quantity for January and February. We then subtracted one from this quantity, so that the historical average corresponded to zero.

We used a difference-in-difference approach, comparing home time during the “before” versus “after” periods for states with and without significant increases in requests to Aid Access. Let i index states and $t \in \{0,1\}$ index before/after periods. Let y_{it} be the median home dwell time for state i averaged over the “before” $(t = 0)$ and “after” $(t = 1)$ periods respectively. Let s_i indicate whether state i experienced a significant change in Aid Access requests compared to the baseline trend. We formulate our model as

$$y_{it} = \gamma_{s(i)} + \lambda_t + \delta I + \epsilon_{it}$$

such that γ_s are intercepts for each group (significant request change versus not), λ_t is the time trend shared by both groups, and δ is the difference in slopes for the significant versus not-significant groups.

We hypothesized that states that experienced either a high burden of COVID-19 or longer-lasting and more restrictive limitations on in-clinic abortion services (as described above) would see greater increases in requests to Aid Access. We measured the burden of COVID-19 on the day that state business closures went into effect using the *New York Times* daily cumulative case data.[16]

All data analysis was conducted using the R statistical package version 3.6.2.[17] Findings were considered statistically significant at an alpha level of 0.05. Fully de-identified data were provided to us by Aid Access and SafeGraph. Those requesting medication abortion through Aid Access gave permission for their data to be used anonymously for research purposes at the time of the request. The study was approved by the University of Texas at Austin Institutional Review Board.

Results

Between January 1st, 2019 and April 11th, 2020, Aid Access received 49,935 requests for abortion medications. Between March 20th 2020, and April 11th 2020 (the "after" period), there was a 27% increase in requests across the US as a whole ($p<0.001$).

At the individual state level, eleven states showed significant increases in requests in the "after-" period, one state showed a significant decrease, and 25 states showed no significant change in requests. We first focus on the illustrative example of Texas, the state with the largest increase in requests, before presenting results by state.

Texas announced initial business closures on March 21st, 2020, and restrictions on abortion on March 23rd, 2020. The left panel of Appendix 2 shows the number of daily requests for Texas. Requests in the "before" versus "after" periods are in black and orange, respectively. Vertical dashed lines show dates when Texas's abortion ban and business closure were announced. The blue line shows the model without any discontinuities (the null model), and the green line shows the model fit with discontinuities for the abortion ban and business closure. The right panel shows the same data, in terms of cumulative requests since January 1st, 2019. The pink lines are the 250 Monte Carlo simulations from the null model, which support the likelihood ratio test's finding that the model with discontinuities is a significantly better fit than the null model. There were 94% more requests from Texas after March 21st, 2020, and the increase is highly statistically significant (p-value <0.001).

Appendix 3 shows the cumulative requests for the eleven states with significant increases in Aid Access requests (Texas, California, New York, New Jersey, Massachusetts, Washington, Illinois, Louisiana, Ohio, Oklahoma, Tennessee) and the one state with a significant decrease in requests (Kentucky). Appendix 4 shows observed versus expected cumulative requests for states without significant increase in Aid Access requests after implementing COVID-19 measures.

States with significant increases in requests had either a high burden of infection at the time business closures went into effect (with the exception of California, where high prevalence was intensely feared but largely avoided) or had enacted more restrictive and longer lasting limitations on abortion care (Appendix 5). States with a significant increase in requests also had, on average, a 5% larger increase in time spent at home, compared to states showing no significant change in requests (p=0.037) (Appendix 6).

Discussion

Requests for medication abortion using online telemedicine increased significantly in the US after the implementation of measures to slow the spread of COVID-19. Of the 37 states in our sample, 11 showed significant increases in requests, along with a concurrent rise in social distancing behavior. These states tended to have either: 1) longer and more severe restrictions on in-clinic abortion access, or 2) higher burdens of COVID-19 and thus higher risks associated with in-person care.

Our results may reflect two distinct phenomena. First, some states may see more people seeking abortion through all channels. The decision to end a pregnancy during the pandemic could be due to the perception of risk posed by COVID-19, reduced access to pre-natal care, and limited social support during lockdowns.[18] Additionally, decision-

making could be influenced by the economic downturn COVID-19 has precipitated, with many people facing unemployment or financial losses.[19] It has also been suggested that social distancing policies may increase rates of unintended pregnancy due to increased time spent at home with a partner or reduced access to contraception.[20] Since our study period ends less than 4 weeks after social distancing policies were put in place, the impact of any changes in unintended pregnancy rates is minimized, since resulting pregnancies would likely not yet have been apparent.

Second, the observed increases in requests may represent a shift in demand from in-clinic abortion to self-managed abortion. In states with high burdens of COVID-19, including New York, New Jersey, Massachusetts, Washington, and Louisiana, people may have turned to online telemedicine due to fear of the infection risk associated with in-person care. With the exception of Louisiana, these states have enacted few barriers to in-clinic abortion; some have even implemented measures to support access during COVID-19, including explicitly deeming abortion an essential healthcare service.[4] Other potential drivers of interest in online telemedicine may also play a role—for example, the infection risk associated with public transport, inability to escape surveillance from a controlling partner, difficulty finding child-care while daycares and schools are closed, and reduced ability to pay for in-clinic care. In support of these possibilities, we observed higher levels of stay-at-home behavior in states with significant increases in requests.

Among states that restricted access to in-clinic abortion during the pandemic, we observed larger increases in requests in states with the most severe and longest-lasting bans. Texas, the state with the most restrictive measures, showed the largest increase in requests despite a relatively low burden of COVID-19. In states where restrictions were in place for shorter periods (e.g. Alabama), or enacted near the end of the study period (e.g. Mississippi), or where measures were narrower in scope (e.g. West Virginia), we did not observe significant changes in online

requests. In the only state where we observed a significant decrease in online requests during the pandemic (Kentucky), the number of abortion clinics in the state doubled (from one to two) in March 2020,[21] increasing the state's capacity for in-person care.

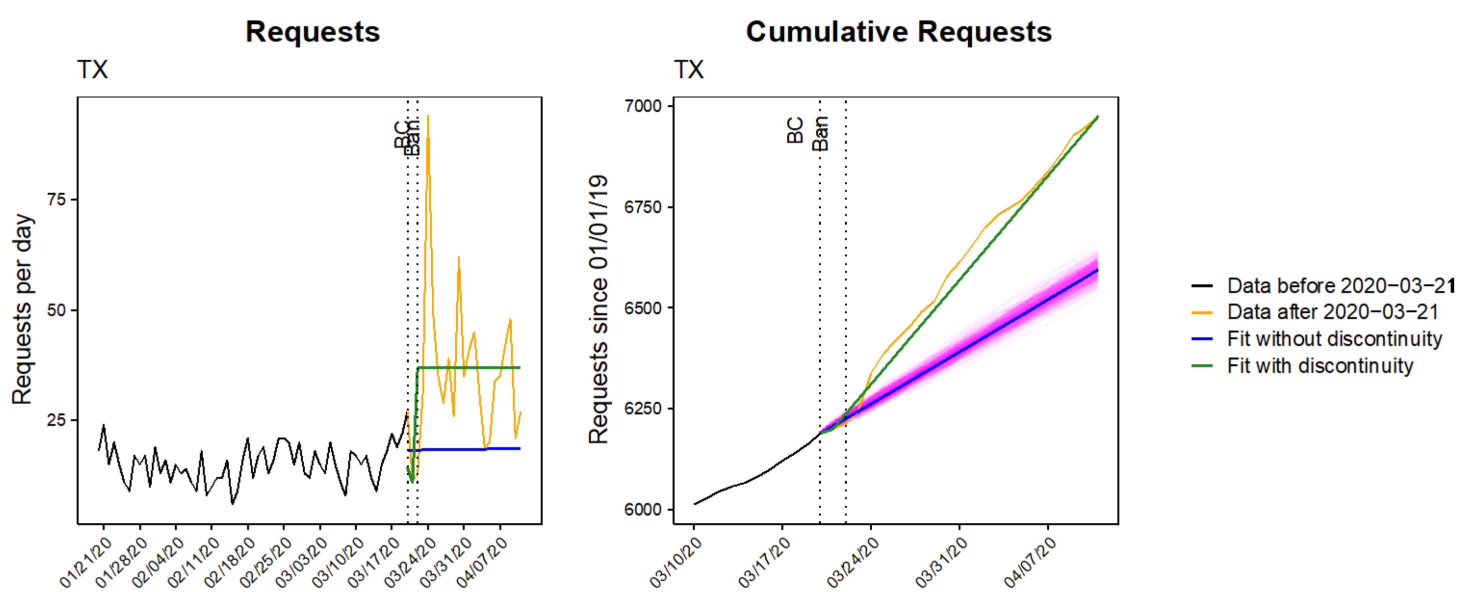
We use a unique source of data to capture requests for medication abortion using online telemedicine in the US. While these data provide a vital window into demand for self-managed abortion during COVID-19, an important limitation is that there are other pathways to abortion outside the formal healthcare setting in the US. Thus, we cannot measure full demand for self-managed abortion during the COVID-19 pandemic. Additionally, we were unable to observe any changes in requests that might have occurred in the latter half of April, when Aid Access was forced to pause service provision due to restrictions on international shipping. We also lack insight into the reasons why a few states with relatively high infection rates or with less severe COVID-related restrictions on abortion did not show increases in requests. In some states, where abortions restrictions were implemented towards the end of the study period, demand for self-managed abortion may have increased even though Aid Access was no longer able to accept requests for medications. Future qualitative research might explore in depth the state-level variation in challenges faced both by those seeking abortion and by clinics endeavoring to maintain operations during the pandemic.

While we cannot disambiguate the possible causes of increased requests for online telemedicine abortion during COVID-19, our findings provide important insight into how the pandemic—and the subsequent state-level policy responses—have affected access to in-clinic abortion. The significant increases in demand we observed likely reflect barriers to clinical care. A joint statement from ACOG and other relevant professional bodies makes clear that abortion services should not be halted or delayed during the COVID-19 pandemic, and should be regarded as "an essential component of comprehensive health care".[22] While medication abortion provided via online telemedicine is

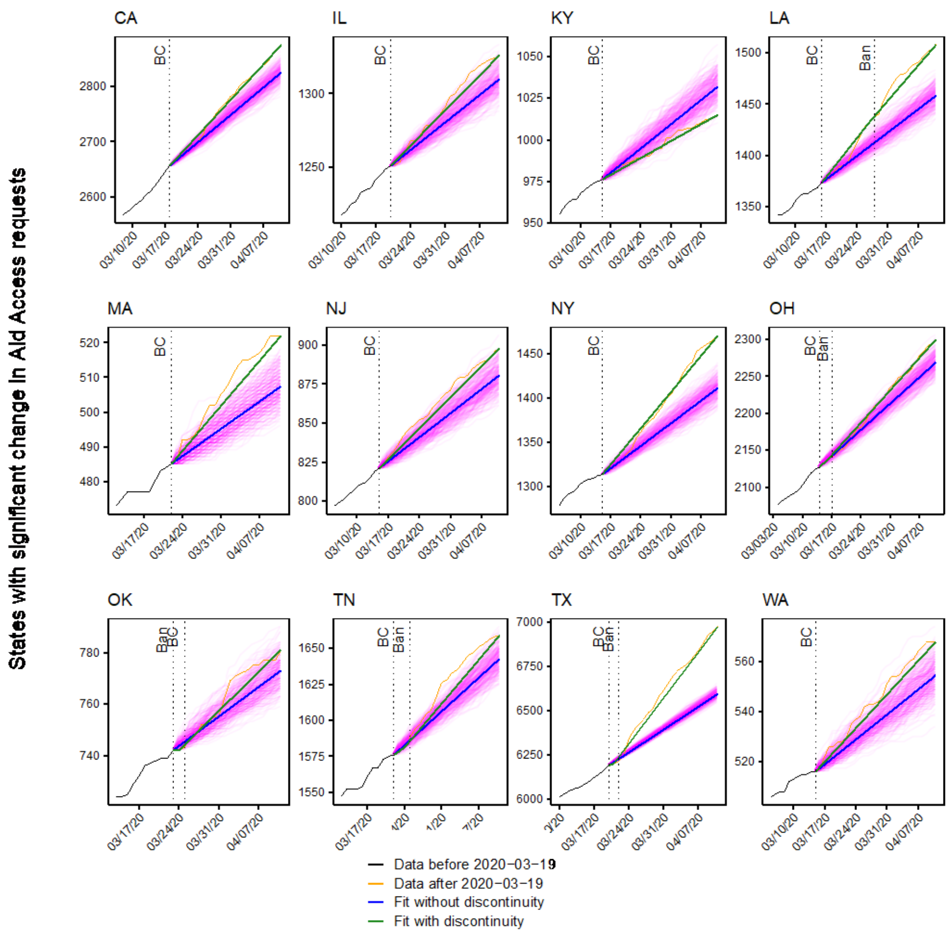
known to be a safe and effective option[23], it is not without legal risks.[24] Its safety also depends on access to the formal healthcare system when necessary, which is not guaranteed during a pandemic. Additionally, while some people may prefer self-managed medication abortion, others may experience it as fraught and isolating, and may have preferred in-clinic care but were unable to access it, or were unable to rely on others for support at home.[25]

One potential policy solution is to expand remote provision of medication abortion up to 10 weeks' gestation. Clinic-based telemedicine—where consultations are done via phone or video link, and medications are mailed to the patient at home[26]—circumvents infection risks for patients and providers, requires no personal protective equipment, and would lower out-of-pocket costs to the patient. Follow-up care can be provided in the clinic if necessary, and the patient has clear continuity of care in the rare instance where an adverse event occurs. The WHO recommends the use of telemedicine and self-management care models during COVID-19, and the United Kingdom has already temporarily implemented clinic-based telemedicine services where no ultrasound is required and abortion medications are provided by mail in direct response to the pandemic.[27,28] Authorization for such services across the US would depend in part on administrative action from the FDA to remove the Risk Evaluation and Mitigation Strategy (REMS) that requires patients to pick up mifepristone in person at a hospital or medical facility.[29] Indeed, ACOG, along with several other organizations, recently petitioned a federal court to require the FDA to lift the REMS restrictions on mifepristone during the pandemic.[30] Our findings suggest that when in-clinic abortion services are not accessible, people are seeking alternative ways of accessing the time-sensitive care they need.

Appendix 2. Requests and model forecasts for Texas. Left panel: The daily number of requests for Texas since January 1, 2019. Requests in the "before" period are *black*; requests "after" are *orange*. *Vertical dashed lines* show the dates when the business closure (BC) and abortion restrictions (Ban) were announced. The *blue line* shows the model fit without discontinuities (the null model), and the *green line* shows the model fit with discontinuities for the abortion ban and business closure. Right panel: The same data, shown in terms of cumulative requests since January 1, 2019. The *pink lines* are 250 Monte Carlo simulations from the null model. These corroborate the likelihood-ratio test and suggest the observed rate of requests in Texas is inconsistent with the null model. The model with a discontinuity fits the data well, as measured by a chi-squared goodness-of-fit test (*P*>.05).

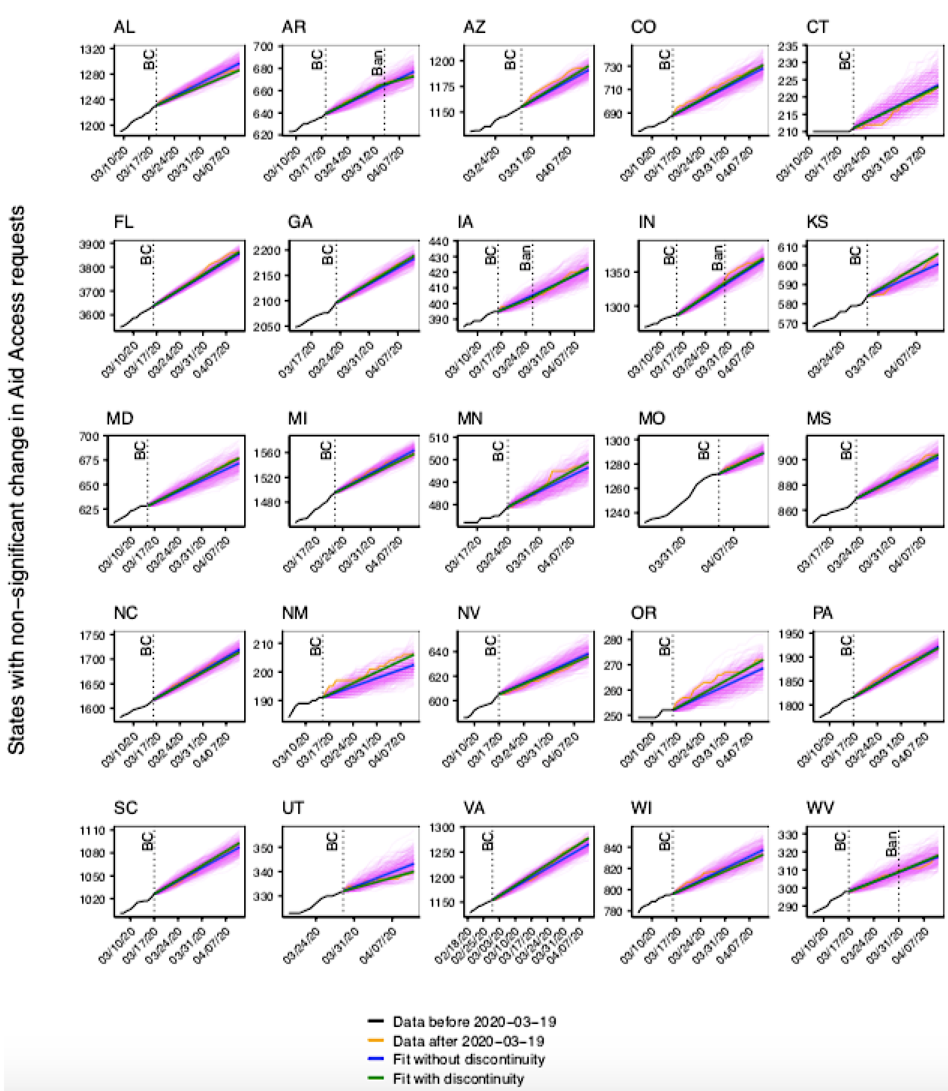


Appendix 3. Observed versus expected requests for all states with significant changes in requests in the "after" period. Observed versus expected cumulative requests for states with significant changes in Aid Access requests. Each panel shows actual cumulative requests prior to the COVID-19 policy measures in *black*, and after COVID-19 policy measures in *orange*. *Vertical dashed lines* show the dates on which business closures (BC) and abortion restrictions (where applicable) (Ban) were announced. The *blue line* shows the forecast for cumulative requests under the null model that there was no discontinuity in the rate of requests on the date of the business closure. In the "after" periods, the *pink lines* show 250 Monte Carlo simulations for visualizing forecasting uncertainty under each country's null model that incorporates the long-term trend, but no discontinuity. For all states, the orange line is noticeably above (or in the case of KY, below) all or most of the pink lines.



Aiken ARA, Starling JE, Gomperts R, Tec M, Scott JG, Aiken CE. Demand for self-managed online telemedicine abortion in the united states during coronavirus disease 2019 (COVID-19). Obstet Gynecol 2020;136.
The authors provided this information as a supplement to their article.

Appendix 4. Observed versus expected cumulative requests for states without significant changes in Aid Access requests. Each panel shows actual cumulative requests prior to the coronavirus disease 2019 (COVID-19) policy measures in *black*, and after COVID-19 policy measures in *orange*. *Vertical dashed lines* show the dates on which business closures (BC) and abortion restrictions (where applicable) (Ban) were announced. The *blue line* shows the forecast for cumulative requests under the null model that there was no discontinuity in the rate of requests on the date of the business closure. In the "after" periods, the *pink lines* show 250 Monte Carlo simulations for visualizing forecasting uncertainty under each country's null model that incorporates the long-term trend, but no discontinuity. For all states, the orange line is not noticeably above or below all or most of the pink lines.



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Appendix 5. Business Closure Implementation Dates, Abortion Limitation Measures, Coronavirus Disease 2019 (COVID-19) Prevalence, and Social Distancing Expressed as Median Time Spent at Home for Each State Included in the Study

Change in Aid Access requests	State	Threshold Date	COVID-related Abortion restrictions type + (period in effect)	COVID-19 cases per 10K on threshold date	Difference in median time at home (mins)
Significant Increase	TX	3/21/20	All med + surgical (19 days)*	38.3	192.1
	MA	3/23/20	None	274.8	263.9
	NY	3/16/20	None	990.0	253.0
	LA	3/17/20	No explicit restrictions†	399.3	160.9
	WA	3/16/20	None	174.9	237.1
	CA	3/19/20	None	58.2	268.1
	NJ	3/16/20	None	606.0	322.3
	IL	3/21/20	None	134.8	197.8
	OK	3/24/20	All med + surgical (10 days)	43.9	152.3
	TN	3/23/20	All surgical (16 days)	76.8	146.0
	OH	3/15/20	All surgical (16 days)	51.9	143.5
Significant decrease	KY	3/16/20	None	36.4	121.8
No significant change	KS	3/30/20	None	35.5	152.3
	NM	3/16/20	None	47.5	91.8
	OR	3/17/20	None	39.3	164.8
	MN	3/25/20	None	25.6	187.3
	MD	3/16/20	None	94.8	229.8
	VA	3/1/20	None	47.7	66.4
	AZ	3/30/20	None	39.6	164.2
	SC	3/18/20	None	60.0	133.8
	MS	3/24/20	All surgical (1 day)	83.0	154.2
	CO	3/17/20	None	129.6	196.4
	GA	3/24/20	None	103.4	194.6
	WV	3/18/20	Delayed med + surgical (10 days)§	28.1	140.6
	IA	3/17/20	All surgical (6 days)	42.7	121.2
	IN	3/16/20	None	95.8	108.4
	FL	3/17/20	None	85.6	155.7
	MO	4/6/20	None	33.3	159.8
	PA	3/18/20	None	133.4	216.4
	CT	3/22/20	None	258.9	248.1
	NC	3/17/20	None	38.5	131.5
	NV	3/18/20	None	93.3	214.1
	MI	3/23/20	None	223.2	247.7
	WI	3/17/20	None	61.3	149.0
	AR	3/19/20	All surgical (8 days)	46.6	99.1
	AL	3/20/20	Med + surgical (3 days)	59.3	133
	UT	3/30/20	None	61.2	171.7

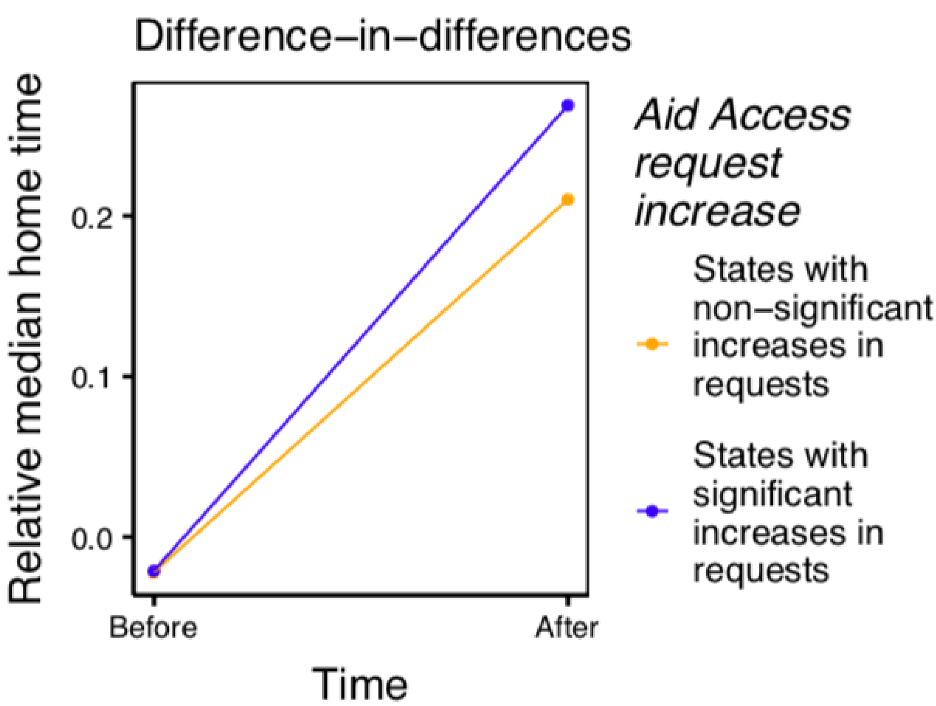
Abortion restrictions include information about the type of abortion that was restricted (medical, surgical, or both), and the time period for which the restrictions were in place during the study period (i.e. up until April 11th 2020). Some restrictions continued past the end of the study.

[*] During the 19-day period in TX, two rounds of litigation occurred with temporary blocking and reinstating of the restrictions. But restrictions were never lifted for more than a day at time.

[†] While no explicit restrictions were put in place in LA, a notice was issued from the health department in late March to suspend all medical and surgical procedures except in emergencies, with the definition of an emergency at the discretion of physicians. The State Governor put intense pressure on the two abortion clinics in LA to close and the number of patients they could see was reduced.[31]

[§] Medical and surgical abortions could not be provided until very close to the gestational limits of 11 weeks for medical abortions and 16 weeks for surgical abortion in WV, since only then could they be considered "essential" medical care.[4]

Appendix 6. Results of the difference-in-differences model for states with versus without significant change in Aid Access requests. Our model averages the relative median home dwell time for each state during the "before" and "after" periods (as defined above), and evaluates the difference in change between the states with versus without significant request increases. The relative median home time in the "before" period is slightly less than zero, as the relative median home time is baselined so that the historical average across January 2020 and February 2020 is zero; slight decreases in home time in early March are reflected in the "before" relative medians. States with a significant increase in requests had a 5% larger increase in time spent at home, compared to states showing no significant change in requests (*P*=.037).



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