Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Pregnancy Watch: remote monitoring of pregnant and postpartum patients with suspected or confirmed COVID-19

OBJECTIVE: With the emergence of the COVID-19 pandemic in the United States in 2020, the providers for pregnant individuals rapidly developed internal guidelines to care for such patients.[1] Consensus among perinatal societies encouraged transition to telehealth when clinically feasible, even though guidance on how to effectively implement outpatient surveillance was limited, particularly in settings with a large patient volume and high disease prevalence, which necessitated significant resource allocation.[2,3]

To facilitate symptom monitoring for nonpregnant patients with COVID-19 in our health system, Penn Medicine developed an automated, text-based surveillance program (COVID WATCH) and paired it with full-time clinician support, similar to a previous automated bidirectional text messaging program developed by our group to monitor postpartum hypertension, while reducing healthcare resource utilization.[4,5] We concurrently developed a companion program called "Pregnancy Watch" for the obstetrical population. The objective of this study was to describe the implementation of this remote COVID-19 symptom monitoring program.

STUDY DESIGN: This was a retrospective cohort study of pregnant or newly postpartum (<2 weeks) patients with suspected or confirmed COVID-19 enrolled in Pregnancy Watch from March 23, 2020 to December 31, 2020 at the Hospital of the University of Pennsylvania. The individuals received inpatient, outpatient, or emergency room care within Penn Medicine and were deemed stable for outpatient surveillance. The postpartum patients diagnosed on delivery admission were included on discharge. Pregnancy Watch runs through Way to Health, a Penn-based research platform that supports text-based clinical programs and is linked to the electronic medical record (EMR) for patient enrollment and provider escalation.

The Figure demonstrates the pathways for patient flow and provider response. Patients receive automated, twice-daily text messages to assess their health status (comparing symptoms to the previous 12 hours) for 14 days. Escalations are routed through the EMR to a Maternal-Fetal Medicine physician, prompting phone triage by the provider to determine whether in-person evaluation or continued remote monitoring is appropriate. Patients with a negative test result, or any patients on request, are unenrolled.

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The demographic and clinical information were obtained through chart abstraction and were managed using Research Electronic Data Capture application. The text-message symptom responses were abstracted from Way to Health. Standard analytical approaches were performed using STATA/IC version 16 (StataCorp LLC, College Station, TX) to establish significance ($P<.05$). The institutional review board at the University of Pennsylvania reviewed the program and deemed it as quality improvement.

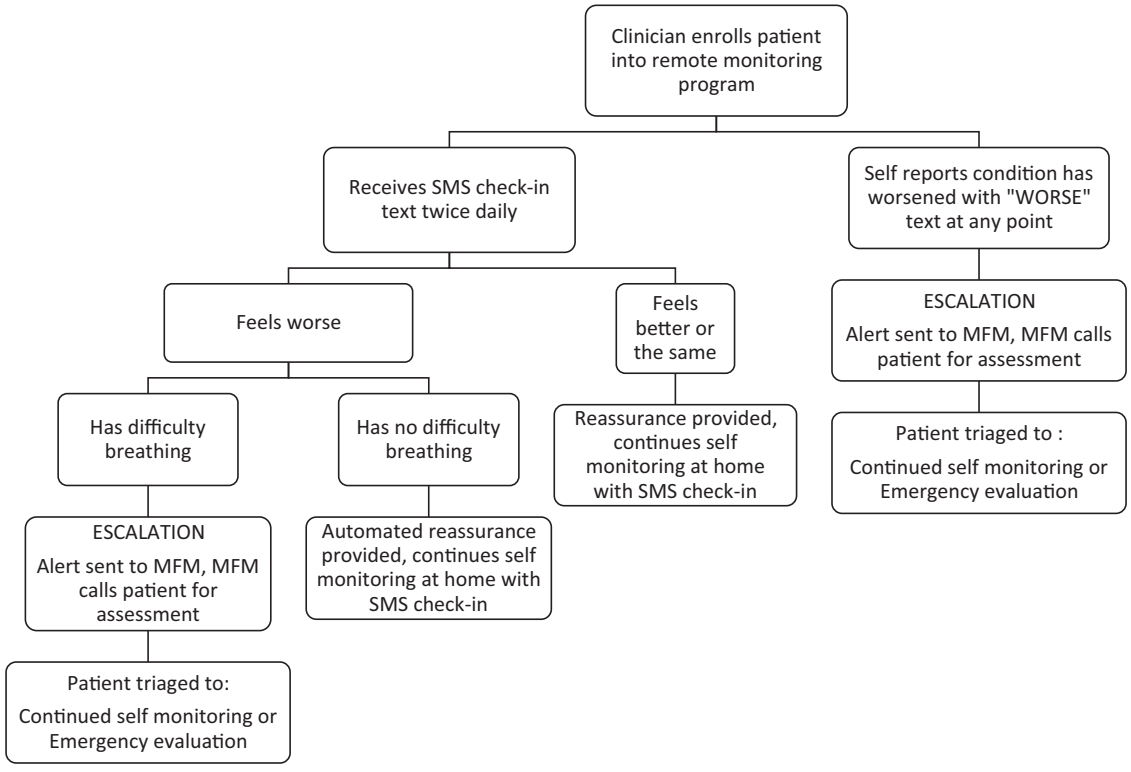
RESULTS: Patient Characteristics: A total of 261 patients (239 pregnant and 22 postpartum) enrolled in the Pregnancy Watch program. The patient characteristics are reported in the Table. Most of the participants (71.6%) were self-reported Black, and 67.4% of the participants had tested positive for COVID-19.

Engagement and Disease Course: Overall, 207 (79.3%) patients responded to at least 1 check-in. Fifty-one (24.6%) responded daily and 64 patients (30.9%) answered the maximum number of text messages. The patients responded on an average of 8 out of 14 days. Patient engagement did not differ by race ($P=.56$), insurance type ($P=.12$), parity ($P=.79$), or symptom status ($P=.12$). When restricting to patients who tested positive for COVID-19, they responded on an average of 9 of 14 days.

One hundred and sixty-six (80.2%) patients were managed by the automated program without escalation in care. Of the 42 (19.8%) patients who escalated, 9 of them were directed to obstetrical triage (1 could not be reached), and 3 admitted with hypoxia. The mean day of escalation from the start of the program was Day 3. Sixteen patients escalated more than once during monitoring, of whom 3 were triaged to in-person assessment and none required admission. Of the 54 patients who did not respond to any text messages, 2 presented to the emergency department for worsening symptoms, and neither were admitted. No postpartum patients worsened after discharge. When comparing the early (first peak, April 2020−May 2020) and late (second peak, November 2020−December 2020) phases of the pandemic, the patient engagement and median number of responses did not differ ($P=.31$ and $P=.88$, respectively).

CONCLUSION: The implementation of an automated text messaging system for the remote symptom monitoring of COVID-19 in the obstetrical population was easily adopted with high patient engagement. Most of the individuals were successfully monitored as outpatients for worsening clinical

FIGURE
Pregnancy Watch COVID-19 symptom remote monitoring program: patient flow and response algorithm



MFM, maternal-fetal medicine; *SMS*, short message service.

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TABLE 1
Participant characteristics and engagement

Demographic characteristic	Total (n=261)	SARS-CoV-2 Test Positive (n=176)	
		Symptomatic (n=140)	Asymptomatic (n=36)
Age (years)	28 ± 6	28 ± 6	26 ± 6
Race			
Black/African American	187 (71.6)	107 (76.4)	32 (88.9)
White	55 (21)	27 (19.3)	3 (8.3)
Asian	10 (3.8)	1 (0.7)	1 (2.8)
Other/Not documented	9 (3.6)	5 (3.6)	0
Ethnicity			
Hispanic or Latino	17 (6.5)	11 (7.9)	0
Non-Hispanic or Latino	243 (93.1)	128 (91.4)	36 (100)
Other/Not documented	1 (0.4)	1 (0.7)	0
Insurance Status			
Private	108 (41.4)	55 (39.3)	9 (25)
Government Assisted	149 (57.1)	81 (57.9)	27 (75)

(continued)

TABLE 1
Participant characteristics and engagement *(continued)*

Demographic characteristic	Total (n=261)	SARS-CoV-2 Test Positive (n=176)	
		Symptomatic (n=140)	Asymptomatic (n=36)
None/Self-pay	4 (1.5)	4 (2.8)	0
Parity			
Nulliparous	55(21)	25(17.9)	8(22.2)
Gestational Age at Diagnosis, median (IQR)	25.6 (18.5-33.4)	36.4 (29.3-39)	23 (17.4-30.4)
Pregnancy status at enrollment			
Pregnant	239 (91.6)	118 (84.3)	36 (100)
Postpartum (< 2 weeks)	22 (8.4)	22 (15.7)	0

Data are mean ± SD or n(%) unless otherwise specified.

IQR, interquartile range; *SD*, standard deviation.

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disease during their surveillance period. Our program appropriately identified patients with progressive disease warranting in-person evaluation. Similar surveillance programs can support home isolation while reducing the exposures and resources needed for follow-up and provide patients with reassurance. Although continued vaccination efforts will decrease the volume of patients at risk for COVID-19, thereby reducing the need for large-scale surveillance, the recent uptick in COVID-19 cases coupled with the emergence of the highly infectious Delta variant underscore the clinical potential of this type of surveillance strategy in the obstetrical population.

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