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Rapid Deployment of a Mobile Medical Clinic During the COVID-19 Pandemic: Assessment of Dyadic Maternal-Child Care

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Abstract

Objectives To describe demographic characteristics and health-related social needs of families who accessed maternal-infant care through a mobile medical clinic (MMC) during the COVID-19 pandemic and to explore feasibility, acceptability, perceived benefits, and barriers to care.

Methods In this mixed-methods observational study, chart reviews, telephone surveys, and qualitative interviews in English and Spanish were conducted with caregivers who accessed the MMC between April and November 2020. Qualitative interviews were analyzed with the constant comparative method alongside descriptive chart and survey data analyses.

Results Of 139 caregiver-infant dyads contacted, 68 (48.9%) completed the survey; 27 also completed the qualitative interview. The survey participants did not differ from the larger sample; most (86.7%) were people of color (52.9% identified as Latino and 33.8% as Black). Health-related social needs were high, including food insecurity (52.9%), diaper insecurity (44.1%), and anxiety (32%). Four women (6.1%) were diagnosed with hypertension requiring urgent evaluation. Nearly all (98.5%) reported being very satisfied with the services. Major themes from qualitative interviews included (1) perceived patient- and family-centered care, (2) perceived safety, and (3) perceived benefits of dyadic mother-infant care.

Conclusions for Practice In this assessment of caregivers who accessed the MMC—a rapidly-developed COVID-19 pandemic response—insights from caregivers, predominantly people of color, provided considerations for future postpartum/postnatal service delivery. Perceptions that the MMC addressed health-related social needs and barriers to traditional office-based visits and the identification of maternal hypertension requiring urgent intervention suggest that innovative models for postpartum mother-infant care may have long-lasting benefits.

Keywords Dyadic care · Mobile medical clinic · COVID-19 Pandemic · Postpartum care

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Significance

These findings support the need for innovative models for postpartum mother-infant care during and beyond the pandemic to provide dyadic care and material support. Ongoing studies of community outreach efforts like the MMC, which focus on dyadic care, can evaluate comparative effectiveness of maternal and infant outcomes.

Introduction

Postpartum maternal and neonatal health care schedules, endorsed by American College of Gynecology (ACOG) and American Academy of Pediatrics (AAP) guidelines, respectively, promote the health and well-being of birthing persons and the nearly 4 million infants born annually in the US ("ACOG Committee Opinion No. 736," 2018; Hagan et al., 2017; Martin et al., 2019; McInerny et al., 2016). Assessments of mothers and infants provide critical opportunities to screen for and detect postpartum depression and health-related social needs (HRSN) affecting families ("ACOG Committee Opinion No. 736," 2018; McInerny et al., 2016).

In 2018, the ACOG Committee on Obstetrics Practice substantially shifted its recommendations for maternal postpartum care from a single visit at 4–6 weeks to earlier, frequent, individualized care during the first 12 weeks postpartum—"the fourth trimester"—a period that lays the groundwork for healthier futures for women and families. These recommendations evolved from the United States' unacceptably high maternal mortality rate, which has more than doubled since 1990 (World Health Organization, 2019). For women with pregnancy complications, short-interval follow-up can mitigate the risk of postpartum pregnancy-related deaths, 35% of which occur between 24 h to 6 weeks postpartum ("ACOG Committee Opinion No. 736," 2018; Kassebaum et al., 2014) and can address the higher lifetime risk of developing cardiovascular disease associated with adverse pregnancy outcomes (Canoy et al., 2016; Grandi et al., 2019; Parikh et al., 2021; Riise et al., 2019; Theilen et al., 2018).

Despite the public health importance of postpartum care for women and infants, there are substantial and longstanding barriers to and disparities in accessing regular and recommended postpartum care. Even though frequent care is indicated for at-risk women, about 40% do not attend the six-week postpartum visit. Attendance rates are lower among women with limited resources, lack of insurance or underinsurance, or individuals with difficulty communicating with their healthcare providers ("ACOG Committee Opinion No. 736," 2018; Bennett et al., 2014; Bryant et al., 2006; Danilack et al., 2019; Daw et al., 2020). These disparities extend to stark gaps in maternal and infant health outcomes in the US, with significantly high morbidity and mortality among Non-Latino Black women and infants (CDC Infant Mortality, 2020; CDC Pregnancy Mortality Surveillance System, 2020; Howell & Zeitlin, 2017).

As with other disaster-related events (DeYoung & Mangum, 2021), the COVID-19 pandemic exacerbated existing challenges in postpartum care, including economic challenges and interrupted support structures for perinatal care (Barbosa-Leiker et al., 2021; Kinser et al., 2021). Because of uncertainties about transmission and hospital burdens of caring for COVID-19 patients, postpartum stays were shortened, and other services, such as depression screening and lactation support, were limited (DeYoung & Mangum, 2021; Hendrix et al., 2021).

Mobile medical clinic (MMC) strategies can bridge community and medical systems and decrease barriers to accessing care, especially for patients from racial and ethnic minority groups disproportionately impacted by health inequities (Hendel, 2022; Yu et al., 2017). For women who are pregnant or who have recently given birth, MMCs have been associated with improved hypertension management, decreased emergency care utilization, lower cost, and earlier initiation of prenatal care with fewer preterm births (Edgerley et al., 2007; O'Connell et al., 2010; Song et al., 2013).

In light of the many challenges related to accessing care during the COVID-19 pandemic, primary care clinicians at our institution re-purposed an MMC to provide medical care to newborns and women near or outside their homes. The MMC was deployed to respond to both pandemic concerns (related to community transmission of COVID-19 and heightened transportation barriers) and to provide patient- and family-centered postpartum and neonatal care to narrow pandemic-generated health disparities. In this mixed methods study, we describe demographic characteristics and HRSN of families (caregivers and infants) who accessed maternal-infant care through the MMC and explore intervention feasibility (Lancaster & Thabane, 2019), acceptability, perceived benefits, and barriers to care.

Methods

Setting

New Haven, Connecticut, with a population of 130,000, is disproportionately impacted by poverty, unemployment, an elevated infant mortality rate, substance use, and HIV (Data Haven, 2016). To address the HIV and substance use epidemics, a 40-foot MMC has provided free healthcare since 1993 (Gibson et al., 2014; Morano et al., 2013a, 2013b;

Morano et al., 2014a, 2014b). Redeployed in April 2020 for maternal-infant care during the COVID-19 pandemic, the MMC, staffed by a Family Nurse Practitioner and a Medical Assistant, offers clinical assessments of newborns (vital signs, growth, limited physical exam, transcutaneous bilirubin when needed) and women (vital signs, wound healing, mood) in safe, accessible, physically distanced, community settings.

Sample Population

Of the 170 caregivers who attended MMC appointments during this period, eight were excluded because a language other than Spanish or English was listed as their primary language in the electronic health record (Fig. 1). Purposive sampling for the concurrent surveys and interviews preferentially included (1) recent attendees and (2) attendees who listed Spanish as their primary language. The study was exempt by our institution's Internal Review Board, and all respondents provided verbal informed consent to participate and for collection of deidentified chart data.

Study Design

We used a convergent mixed methods design (Curry & Nunez-Smith, 2015; Fetters et al., 2013) to conduct and analyze a telephone survey (all respondents) and interview (until thematic saturation) with caregivers whose preferred language in the electronic health records was English and/or Spanish and who received care at the MMC between April and November 2020. Surveys/interviews occurred one to nine months after the MMC encounter.

Survey and Semi-Structured Interview Development

The survey and semi-structured interview guide (Supplemental Table 1), developed and iteratively refined by our research team, included demographic components modeled from the American Community, National Health and Education, and National Immunization Surveys (*National Immunization Surveys | CDC*, 2021; *NHANES—National Health and Nutrition Examination Survey Homepage*, 2021; US Census Bureau, 2021) and previously-validated instruments to assess COVID-19 symptoms and exposures, food insecurity, diaper insecurity, anxiety, and means of transportation (Hager et al., 2010; Nelson et al., 2020; Silver et al., 2012; Smith et al., 2013; Spitzer et al., 2006).

Telephone Interviews and Chart Data Collection

Following recruitment and verbal informed consent, English- and/or Spanish-speaking members of the research team conducted both a structured survey and semi-structured qualitative interview with participants. A three-person coding team of a health services researcher, a primary care pediatrician, and a medical student (JR, LS, MB) independently developed codes and created a codebook by consensus. We recorded survey responses in Qualtrics® (Qualtrics, Provo,

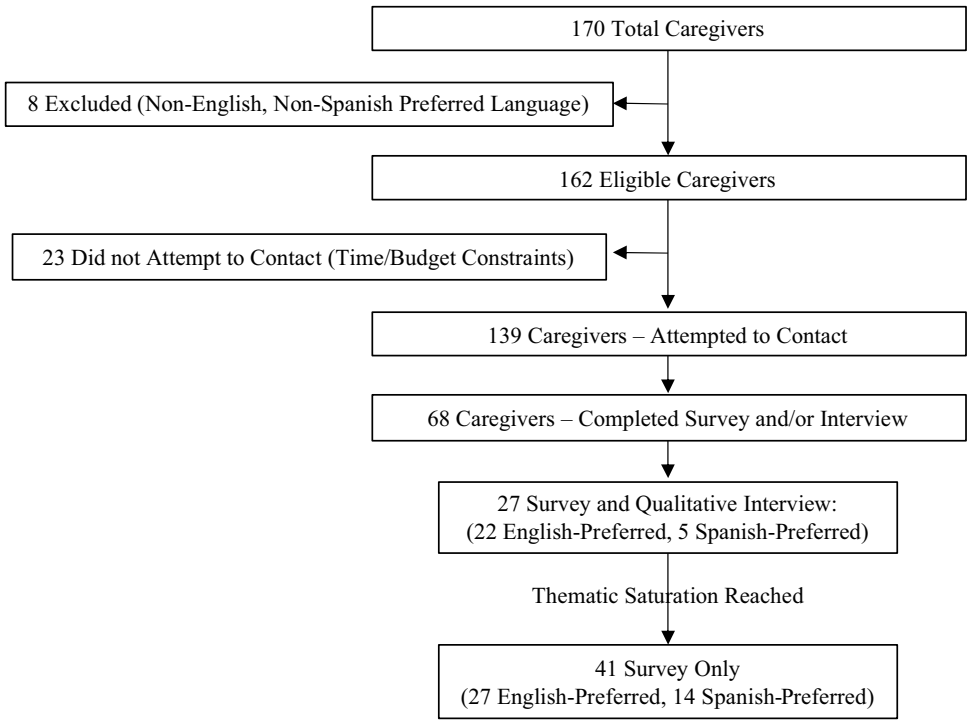

Fig. 1 Caregivers who received care at the mobile medical clinic and completed surveys/interviews

Utah) and, separately, we recorded contact information to send participants a $20 gift card. All respondents were provided information about additional services and resources for mental health, nutrition, and medical resources at the conclusion of the survey. Semi-structured interview components were audio-recorded, transcribed with the automatic transcription software Trint®, and manually edited. Once we reached thematic saturation, we continued to administer the structured telephone survey without the semi-structured interview components. Full surveys with semi-structured qualitative interviews ranged from approximately 20 to 40 min in duration, while structured surveys alone ranged approximately 10 to 30 min. For all caregiver-infant dyads who consented to participate in the study, we collected the following infant data via medical chart review: number of MMC visits, bilirubin assessments, COVID-19 test results, and vitamin D prescriptions (Supplemental Table 2). For the 66 of 68 postpartum women who were evaluated on the MMC, maternal blood pressure evaluations, maternal follow-up appointment data, and COVID-19 test results were also collected via chart review. Survey data and chart review data were linked and subsequently de-identified.

Mixed Methods Analyses

Descriptive analyses of survey data and chart review using proportions were analyzed using Stata (StataCorp, 2017). Transcripts were analyzed with grounded theory methodology using the constant comparative method in Dedoose® (Corbin & Strauss, 2008). The coding team analyzed all transcripts (with two coders—JR and MB—analyzing Spanish-language transcripts) and discrepancies were resolved through an iterative process. Codes were then sorted into emerging themes and reviewed and modified with the larger research team. Representative Spanish-language quotations were translated after analysis, and original Spanish-language quotations can be found in the Supplement. We used an intervention mixed methods framework to perform connected integration of qualitative and quantitative results (Curry & Nunez-Smith, 2015; Fetters et al., 2013). We followed the COREQ criteria for reporting qualitative research (Tong et al., 2007).

Results

Of the 162 eligible caregivers, we attempted to reach 139 (97 English-preferred and 42 Spanish-preferred) and successfully completed 68 surveys, 27 of which also included qualitative interviews, of caregivers of 69 children (one set of twins) with a 48.9% response rate (Fig. 1).

Sociodemographic Characteristics

Nearly all caregiver respondents were mothers (91.2%). Over half (52.9%) identified as Latino and 33.8% as Non-Latino Black (Table 1). Nearly half (44.1%) lived in multilingual

Table 1 Respondent characteristics (N = 68 parents/guardians, N = 69 infants)

	n	(%)
Relationship to infant		
Mother	63	(92.6%)
Father	3	(4.4%)
Aunt	1	(1.5%)
Foster parent	1	(1.5%)
Race/ethnicity of respondent		
Latino	36	(52.9%)
Non-Latino Black	23	(33.8%)
Non-Latino white	7	(10.3%)
Non-Latino Asian	2	(2.9%)
Languages spoken at home		
English only	29	(42.6%)
Spanish only	9	(13.2%)
English and Spanish	23	(33.8%)
English and another language	7	(10.3%)
Language of survey		
English	49	(72.1%)
Spanish	19	(27.9%)
Highest grade level of respondent		
$< 12^{th}$ grade	12	(17.6%)
High school graduate	26	(38.2%)
Some college or technical School	24	(35.3%)
College graduate and/or postgraduate training	6	(8.8%)
Marital status		
Never married	28	(41.2%)
Married or living with a partner	36	(52.9%)
Separated or divorced	4	(5.9%)
Household size		
2	7	(10.3%)
3–4	35	(51.5%)
5–7	26	(38.2%)
Infant sex–female	38	(55.1%)
Infant gestational age at birth		
< 37 weeks	6	(8.7%)
≥ 37 and < 40 weeks	42	(60.9%)
≥ 40 weeks and < 42 weeks	21	(30.4%)
Number of mobile medical clinic visits		
1	30	(43.5%)
2	32	(46.4%)
3	6	(8.7%)
≥ 4	1	(5.8%)

households, 44.1% had education beyond high school, and just over half (52.9%) were married or living with a partner. Most (89.9%) made one or two visits to the MMC (Table 1). Most women had public insurance (63.3%), and many (22.7%) were uninsured (Table 2).

Infant and Maternal Health Characteristics

Four caregivers (5.9%) reported contact with someone who tested positive for SARS-CoV2, and two mother-infant dyads (2.9%) tested positive after discharge. No women or infants tested positive for SARS–CoV2 during their birth admissions. We found no cases of hyperbilirubinemia requiring phototherapy. Although most (89.9%) reported ever breastfeeding, nearly all (94.2%) had fed formula, and only half (49.3%) were still breastfeeding at the time of the survey (Table 2).

According to chart review, two-thirds of women who were evaluated on the MMC attended an in-person or telehealth postpartum visit, and 16.7% had a documented missed postpartum visit. All women evaluated on the MMC had blood pressure evaluated. Over two-thirds (69.7%) had at least one postpartum blood pressure reading > 120/80 mmHg, and 19.6% had readings elevated enough to require contact with the obstetric provider for further guidance. Follow-up visits with either an outpatient or obstetric provider regarding blood pressure then occurred in 15.2% of mothers, and four (6.1%) required emergent treatment and/or readmission to the hospital for postpartum hypertension detected on the MMC (Table 2).

Table 2 Characteristics of women and infants and services received on the mobile medical clinic and in the community (N = 66 mothers, N = 69 infants)

Maternal evaluations and characteristics		
Mother's insurance type		
Public	42	(63.6%)
Private	9	(13.6%)
Uninsured	15	(22.7%)
Postpartum visit, n (%)		
Scheduled and attended	44	(66.7%)
Scheduled but not yet attended	8	(12.1%)
Scheduled but missed	11	(16.7%)
Not scheduled per chart	3	(1.5%)
Blood pressure evaluation, n (%)		
Blood pressure measured on mobile medical clinic	66	(100%)
Any elevated postpartum blood pressure (> 120/80)	46	(69.7%)
Obstetrician contacted for elevated blood pressure	9	(19.6%)
Outpatient or ED evaluation for elevated blood pressure	10	(15.2%)
Emergent treatment and/or admission for postpartum hypertension	4	(6.1%)
COVID-19 evaluations and exposures		
Tested positive for COVID-19, n (%)		
Mother (after discharge)	2	(2.9%)
Infant (after discharge)	2	(2.9%)
COVID-19 risks in prior 4 weeks, n (%)		
Contact with someone who tested positive	4	(5.9%)
Cold or flu-like symptoms	2	(2.9%)
Infant evaluations and characteristics		
Bilirubin evaluations, n (%)		
Transcutaneous checked on mobile medical clinic	3	(4.3%)
Serum checked in office	4	(5.8%)
Re-admitted for phototherapy	0	(0%)
Breastfeeding, n (%)		
Ever breastfed	62	(89.9%)
Still breastfeeding	34	(49.3%)
Ever had formula	65	(94.2%)
Received vitamin D prescription	59	(85.5%)

Health-Related Social Needs (HRSN) of Caregivers

About half of caregivers screened positive for food insecurity (52.9%), diaper insecurity (44.1%), and use of Supplemental Nutritional Assistance Program (SNAP) (55.9%). About one-third of respondents screened positive for mild (16.2%), moderate (8.9%), or severe (1.5%) anxiety. Most respondents were somewhat and/or very worried about contracting COVID-19 and about finances related to COVID-19 (69.1% for both) (Table 3).

One-quarter of respondents reported missing an office appointment because of transportation problems. About

Table 3 Health-related social needs and characteristics of caregivers who visited the mobile medical clinic (N = 68)

Health and social needs		
Food insecure,[a] n (%)	36	(52.9%)
Diaper insecure,[b] n (%)	30	(44.1%)
Supplemental nutritional assistance program in past year, n (%)	38	(55.9%)
Anxiety,[c] n (%)		
Minimal	46	(67.6%)
Mild	11	(16.2%)
Moderate	6	(8.9%)
Severe	1	(1.5%)
Worried about contracting COVID, n (%)		
Not at all worried	8	(11.8%)
Not too worried	13	(19.1%)
Somewhat worried	33	(48.5%)
Very worried	14	(20.6%)
Worried about finances with COVID, n (%)		
Not at all worried	9	(13.2%)
Not too worried	12	(17.6%)
Somewhat worried	27	(39.7%)
Very worried	20	(29.4%)
Transportation needs		
Typical means of transportation to office, n (%)		
Drive (self)	40	(58.8%)
Drive (ride from family/friend)	20	(29.4%)
Uber/lyft/cab	4	(5.9%)
Bus	3	(4.4%)
Walk	1	(1.5%)
Time for transportation, median (range) in minutes		
Time to get to office	12	(3–60)
Time to park at office	3	(0–15)
Time go get to mobile medical clinic	5	(0–60)
Time to park at mobile medical clinic	2	(1–5)
Pay for parking at office, n (%)	12	(17.5%)
Ever missed appointment because of transportation problems, n (%)		
Office	18	(26.5%)
Mobile medical clinic	3	(4.4%)
How challenging to get to doctor office, n (%)		
Very challenging	8	(11.8%)
Somewhat challenging	14	(17.6%)
Neutral	16	(23.5%)
Somewhat easy	8	(11.8%)
Very easy	20	(29.4%)

[a]Answered "sometimes true" or "often true" to either of the two Hunger Vital Signs (Hager et al., 2010)

[b]Answered "sometimes true" or "often true" to not changing diapers as often as would like (Smith et al., 2013)

[c]According to GAD-7 (Generalized Anxiety Disorder Scale) (Spitzer et al., 2006)

one-third (29.4%) reported that they found it "somewhat" or "very" challenging to get to the doctor's office (Table 3). When asked about transportation, most reported that they typically traveled by driving themselves or obtaining a ride with family and/or friends, while 5.9% reported taking a taxi-like service, 4.4% reported using a bus, and 1.5% reported walking.

Acceptability and Satisfaction

Table 4 demonstrates satisfaction measures from survey responses. Nearly all caregivers reported they were very satisfied and very likely to recommend the MMC to friends (98.5% and 94.1%, respectively), with responses like: "They exceeded my expectations," and "It was better than expected" (*Respondents #4 and #5*, respectively). Most (85.3%) had no suggestions for improvement, although some requested additional resources and space ("I'm kind of claustrophobic and it was kind of tight." –*Respondent #2*).

About two-thirds (66.2%) preferred the MMC for future visits over the office location, 7.3% preferred the office, and 26.5% expressed no location preference.

As we discussed the acceptability and satisfaction with caregivers, perceived patient- and family-centered care and respectful interactions were common threads through many responses, with many expressing a desire to expand services.

Table 4 Satisfaction of caregivers who visited the mobile medical clinic (N = 68 parents/guardians)

Satisfaction with mobile medical clinic, n (%)	
Very satisfied	67 (98.5%)
Somewhat satisfied	1 (1.5%)
Neutral	0 (0%)
Somewhat dissatisfied	0 (0%)
Very dissatisfied	0 (0%)
Likelihood to recommend to friend, n (%)	
Very likely	64 (94.1%)
Somewhat likely	4 (5.9%)
Neutral	0 (0%)
Somewhat unlikely	0 (0%)
Very unlikely	0 (0%)
Areas for improvement, n (%)	
Nothing to improve	58 (85.3%)
Provide vaccines	3 (4.4%)
More space	2 (2.9%)
Better parking at location	2 (2.9%)
Provide diapers	1 (1.5%)
Preference for future visit location, n (%)	
Mobile medical clinic	45 (66.2%)
Clinic	4 (5.9%)
No preference	18 (26.5%)

> "Even like if they have this when I was pregnant too. It would have been nice to be able to go down and talk to somebody in a in a situation like this instead of having to go all the way down there, you know, nine months pregnant, you know, risking getting sick and everything. So if you guys have a possibility to expand this, I would go for it." – *Respondent #18*

Themes from Qualitative Interviews

Major themes from the qualitative analysis of interviews included (1) patient- and family-centered care, (2) perceived safety, and (3) perceived benefits of dyadic mother-infant care (Table 5).

Patient- and Family-Centered Care

Perceived delivery of patient- and family-centered care, in which patient/family goals, values, and preferences guide provision of healthcare, was evident in several subthemes related to the patient experience on the MMC. This included patient- and family-centeredness around aspects of convenience, communication, privacy, continuity of care, acceptability and intervention feasibility, and resources provided to address HRSN.

Related to patient- and family-centered convenience, caregivers discussed transportation, childcare, and scheduling as typical burdens and inconveniences of in-person office visits eased by the MMC. One participant noted the convenience of not needing to coordinate travel or childcare for other children while home schooling during COVID-19:

> "Because I have two other kids that are toddlers and they do virtual school, so it's hard to go all out once over there. And then also taking the baby out." – *Respondent #11*

Many respondents reflected that, in contrast to prior in-office experiences, they faced fewer barriers to communication with MMC staff and had positive interactions during the scheduling process, appointment confirmations, and discussing care for themselves and their newborns:

> "I spoke with a person directly and they would always arrange the arrival time and call a day ahead of time to confirm that they were coming, to see if everything was okay with me, and that I didn't have COVID symptoms and that everything was good." – *Respondent #24*

Table 5 Themes, sub-themes, and representative quotations from qualitative discussions

Theme	Representative quotations:
Patient- and Family-Centered Care	
Patient- and Family-Centered Care: convenience (transportation, child care, and scheduling conveniences)	"Oh, it was just much easier and much, much more pleasant and quicker and just easier. Much more relaxed and less stressful." – Respondent (English-Language) #1
	"I like it better than going to the hospital. It was faster. There was no waiting I guess that's why. They were nice I guess, but it's faster that's what I like about it the most." – Respondent (English-Language) #7
	"Because I have two other kids that are toddlers and they do virtual school, so it's hard to go all out once over there. And then also taking the baby out." – Respondent (English-Language) #11
	"It's just with the weather changing it's getting cold. I have to, like, bundle him up, put them in the car, put him in the car, to bring him to go to a warm place. And he's only under two months old, so it's better, I could just bundle him up, take him straight to the [MMC] and bring him right back inside. – Respondent (English-Language) #16
	"I was surprised with how convenient it was really. I appreciate the fact that I only have to go downstairs." –Respondent (English-Language) #18
Patient- and Family-Centered Care: Quality and ease of communication (clear communication, positive interactions with staff, continuity of care)	"It compares because of the friendliness. I feel that I'm getting used to the [physician's assistant] and the [medical assistant]. And it's the same team, which is always nice, to where in the clinic it's always different faces and the hospitality is definitely warm in the in the in the [MMC] than in the clinic." – Respondent (English-Language) #5
	"See, [the medical assistant] called me and he told me about it and how it was and how they were going to work it. And he explained everything to me. And he told me that he was going to call a day before the appointment. And he called and told me that they were going to come around some time. And they did come a little bit early because of a cancelation. So he told me about that, too. So it's a great two-way communication." – Respondent (English-Language) #12
	"Oh, my God, I wish I could continue with the [MMC] visit, to be honest. I love it. Because the nurses you have on the [MMC], the white coats you guys have on the [MMC], they're so respectful, they communicate with you. They're like they communicate with you, they ask you questions, like ask you questions like "How you feel? How's the baby doing? And how you doing?" Like they ask you lots of questions and then they explain it to you in a way that, you satisfied with them." – Respondent (English-Language) #13
	"It was good, because I spoke with a person directly and they would always arrange the arrival time and call a day ahead of time to confirm that they were coming, to see if everything was okay with me, and that I didn't have COVID symptoms and that everything was good." – Respondent (Spanish-Language)* #24

Table 5 (continued)

Theme	Representative quotations:
Patient- and Family-Centered Care: private and individualized care in COVID-19 and beyond	"I mean I just like it because you're by yourself. It's private, you're by yourself. Just you and the staff which is nice. You don't have to worry about everybody around you." – Respondent (English-Language) #3
	"So you don't have to worry about driving anywhere and there's not a lot of people in the waiting room, it's just you and the staff, so you don't have to worry about checking and checking out, you just, you know? Step outside and step into the ambulance." – Respondent (English-Language) #17
	"Oh, oh, like I said, just more less of bringing her out in front of everyone, with everything that is going on right now. Just everyone leaves the [MMC], everything's disinfected. And–not that the doctor's office doesn't do that. There's just a lot more people to be around. Got to walk through the hallways with her, and I don' know, it just felt a little safer." – Respondent (English-Language) #22
	"They looked after me very well, they even gave me diapers for the baby. It's very nice for that, and I like it because they take care of one individual, only one person, no? Well, there are not many people there." – Respondent (Spanish-Language)* #26
Patient- and Family-Centered Care: resources provided and financial considerations	"Well they helped out with it, they gave me masks for my kids and myself and then a pack of diapers. And the people are very nice." – Respondent (English-Language) #11
	"I didn't expect them to have like Pampers diapers and cream for the baby. They were so caring of baby too. They were really nice." – Respondent (English-Language) #12
	"So with the [MMC], it's free. I don't have to worry. They even have like free diapers. They help out with [daughter]. She had a rash and they gave me cream for the rash. So I feel like it's just so helpful in so many ways." – Respondent (English-Language) #18
	"With the diaper situation, the fact that I mean, I like I said, I don't know if you guys do this for everybody, but I am a single mother. The fact that they have free diapers while I still have some left from, you know, from the last visit and it eliminates a lot of, well money and also getting ahold of diapers, you know, having to go to the store and get them." – Respondent (English-Language) #18
Perceived safety	
Perceived safety: in COVID-19 and beyond	"Honestly, the [MMC] is just better, with no other patients on the [MMC]. So I just you know, I'm just scared because people start coughing, don't cover their mouth. At the clinic, that's what I'm worried about. But the [MMC] is literally just you so you don't have to worry about much." – Respondent (English Speaking) #3
	"Just the elimination of the fear of having to take the taxi and taking off work, I would hands down rather have that bus come down my house any day of the week than having to go to the doctor's office" – Respondent (English-Language) #18
	"For now it is much safer and much more, safe from COVID, I believe." –Respondent (Spanish-Language)* #23
	"Yes, I would recommend it because in these times of the pandemic nobody wants to go and expose their baby to the hospital, where there are people who have different types of diseases. And I would recommend it, since newborn babies leave the hospital without vaccines and are low in defenses and, well, we can avoid exposure for them." –Respondent (Spanish-Language)* #24

Table 5 (continued)

Theme	Representative quotations:
Perceived benefits of dyadic care for infants and women	
Perceived benefits of dyadic care: infant benefits monitoring infant growth easily, a way to encourage breastfeeding	"They're very nice and I think they were very good at handling my son. And they got like little pictures, like he gets entertained while he gets weighed and like little things that they don't have in the hospital where they keep him calm." – Respondent (English-Language) #11
	"Because I can keep track on his weight because I have mastitis. So I was worried he wasn't getting enough nutrients and enough milk, but everything was all good. That's how I can keep track, with the [MMC]." – Respondent (English-Language) #12
	"That they measured her, they weighed her, they did everything that a regular doctor's office does, so it just like, you know, that was amazing." – Respondent (English-Language) #14
	"Her main focus was making sure that my physical and mental strength were met as well as my baby. He was following up regularly with his body size and his eating schedule, his stool progress, like everything was. It was nice to have someone come and check on us every week to make sure that things were running as they should be. I can't complain." – Respondent (English-Language) #16
Perceived benefits of dyadic care: mother-infant dyad benefits holistic care of the mother-infant dyad, with opportunity to care for both woman and infant	"With the [MMC], you get out and go. With the hospital you have to walk all the way across the street or have to wait outside. Just get in your car and just go. And they help me all the way to the car so I like that. I had a C-section so I couldn't carry the baby, and they gave me a box of diapers, and they carried the diapers for me all the way to the car, so I liked that." – Respondent (English-Language) #7
	"Because of I had a C-section…I was told not to pick up anything bigger than the baby. I couldn't pick up the car seat, I really had door to door service, they came to the door, grabbed the baby, helped me in the [MMC], and you know, helped me out. It was completely, it was a relief…I'm literally in front of my house, we're going in and out, and I don't have to carry a car seat, I can just carry my child. And the nurse and the guy in the [MMC] that was assisting was very nice and very helpful. It felt very genuine compared to at the office." – Respondent (English-Language) #10
	"And I was glad that they had that because I couldn't I can't drive right now because I had a C-section with the boys. So they give me time to get behind everything, when they offer that to me, it was like a relief for me. You know, I'm going there all the time when they have visits that they have to come over there. And I just put them steps from my house and meet with them. And I go downstairs from my house and meet with them. So I was glad when they told me about the [MMC] doing home visits, I was really glad that they had that service available." – Respondent (English-Language) #13
	"Yes, the doctor was very nice. She helped me a lot. She reassured me be patient with breastfeeding. And the translation service was good."– Respondent (Spanish-Language)* #25

Table 5 (continued)

Theme	Representative quotations:
Perceived benefits of dyadic care: maternal benefits: important health interventions	"Oh, it was good for me. The first time when they came over, Angel helped me with [child 1] and I had [child 2] in my hand. And then we went and met the nurse. They had the stool that you had to step over when getting in the [MMC]. And then when I went in they took the baby, they took the first one for me. Weighed him, checked his height, and then after that, they took my blood pressure, and it was a little bit high because I had issues with my blood pressure when I was pregnant with them, so that was reason why they came out early, before their due date." – Respondent (English-Language) #13
	"Because I thought it was only for [my daughter], they were going to check her up and then I realized it was also for me. So when they checked me, I found out that I was with high blood pressure. So then I went back to the hospital for two days with my magnesium and everything." – Respondent (English-Language) #15
	"It was OK, because one of the times, my pressure, it was high and they checked it and they told me, but I didn't call. And then they keep up with me, they call the hospital. And I had to rush in because my pressure was way, way high. So that was good for them to have my pressure done and keep up with me so I could get further medication and further assistance." – Respondent (English-Language) #20

*Original Spanish quotations in supplement

Privacy was appreciated as a component of patient- and family-centered care for providing respectful, personalized interactions with the MMC staff:

> "I mean I just like it because you're by yourself. It's private, you're by yourself. Just you and the staff which is nice." – *Respondent #3*

Perceived Safety

Perceived safety from exposure to communicable diseases, especially related to COVID-19, was a major theme that emerged from discussions with many caregivers. There was often overlap with patient- and family-centered care and convenience, as the components of the MMC model which provided convenience for transportation, childcare, privacy, ease of scheduling and communication also allowed many caregivers physical space and reassurance around COVID-19 safety during the height of the pandemic in 2020:

> "Honestly, the [MMC] is just better, with no other patients on the [MMC]. So I just you know, I'm just scared because people start coughing, don't cover their mouth. At the clinic, that's what I'm worried about. But the [MMC] is literally just you, so you don't have to worry about much." – *Respondent #3*
> "I would recommend it, since newborn babies leave the hospital without vaccines and are low in defenses and, well, we can avoid exposure for them." –*Respondent #24*

Perceived Benefits of Dyadic Care

The final theme reflected the perceived benefits of dyadic care, in which participants expressed how engaging the mother-infant dyad in care together provided opportunities for improved health for both caregivers and their infants.

One woman discussed how the MMC evaluation provided her confidence as she continued to breastfeed:

> "Because I can keep track on his weight because I have mastitis. So I was worried he wasn't getting enough nutrients and enough milk, but everything was all good. That's how I can keep track, with the [MMC]." – *Respondent #12*

This woman, like many, often mentioned her own health as secondary to the health of her child. Similarly, when asking about care for themselves, caregivers would often respond in the context of caring for their children, especially for women recovering from Caesarean sections who had added barriers to care:

> "And I was glad that they had that because I can't drive right now because I had a C-section with the boys…It was like a relief for me. You know, I'm going [to the office] all the time…So I was glad when they told me about the [MMC] doing home visits, I was really glad that they had that service available." – *Respondent #13*

Furthermore, as noted above, many women had not yet attended a postpartum visit, and yet the MMC clinicians

detected many instances of elevated blood pressure and several instances of hypertension requiring urgent or emergent medical management. For one woman who was admitted, her focus remained on her child, only disclosing her own admission after being explicitly asked about her experience with blood pressure checks:

> "Because I thought it was only for [my daughter], they were going to check her up and then I realized it was also for me. So when they checked me, I found out that I was with high blood pressure. So then I went back to the hospital for two days with my magnesium and everything." – *Respondent #15*

Discussion

In this mixed methods evaluation of a MMC that was emergently repurposed to provide postpartum/postnatal care for women and neonates during the early COVID-19 pandemic, findings suggest high acceptability especially related to perceived safety and feelings that certain transportation and social needs were addressed. Respondents found services acceptable, feasible, and, importantly, patient- and family-centered. In addition, 15% of women had instances of maternal hypertension requiring follow-up with an obstetrician, and 6% of women required emergent evaluation and treatment. The MMC, deployed during the COVID-19 pandemic to address COVID-19 safety concerns, could be one of many dyadic outreach interventions to help to improve patient- and family-centered care and reduce disparities in access to postpartum and neonatal care for underserved populations.

From both qualitative and quantitative responses, we found high levels of satisfaction related to patient- and family-centeredness. Patient-centered care is defined by the Institute of Medicine as, "providing care that is respectful and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions" (Institute of Medicine (US) Committee on Quality of Health Care in America, 2001). Patient- and family-centered care emphasizes "collaborating with people of all ages, at all levels of care, and in all health care settings" according to the Institute for Patient- and Family-Centered Care (Institute for Patient & Family Centered Care, 2021).

Elements of the six domains of patient- and family-centeredness, described in a 2019 Academy Health report (Sinaiko et al., 2019) and modified in Fig. 2, were addressed through the MMC. The domains include (1) addressing caregiver and provider goals, (2) adjusting to life circumstances, including COVID-19 modifications, (3) respecting values and culture, (4) allowing options for provider care preference, (5) addressing health status and symptoms, and (6) promoting equitable access. All six of these domains were reflected in the qualitative responses, especially as patients shared their experiences with the MMC related to convenience, communication, and privacy. This respectful and responsive care was appreciated by families and, for some, contrasted with the patient experience in usual clinic-based care. Focusing on patient values through patient- and family-centered care must guide initiatives aimed at improving equitable access to health care and decreasing the significant inequities in US maternal and infant health outcomes (CDC Infant Mortality, 2020; CDC Pregnancy Mortality Surveillance System, 2020; Howell & Zeitlin, 2017).

Beyond offering patient- and family-centered care, the MMC provided hypertension screening for postpartum women. The MMC's linkage to primary provider and/or specialist referrals resulted in follow-up for many, and in emergent treatment for 6% of women in our study. The US has the highest rate of maternal mortality among high-income countries, with Non-Latino Black women at disproportionately high risk of dying from a pregnancy-related complications (World Health Organization, 2019). Cardiovascular disease and hypertensive disorders of pregnancy are leading causes of maternal mortality (Petersen et al., 2019). One of the greatest shortcomings in the current health system, especially in light of the fractured care and missed visits that have occurred during the pandemic, is a safe transfer of care between the obstetrician and primary care provider for women with known risk (Hendrix et al., 2021; Parikh et al., 2021). The MMC is one possible model to provide frequent and individualized postpartum care that can help identify women with high-risk conditions and facilitate potentially life- and cost-saving follow up during the twelve week postpartum period ("the fourth trimester") and beyond (World Health Organization, 2019).

Approximately half of the respondents reported HRSNs of food insecurity, diaper insecurity, and/or use of the Supplemental Nutrition Assistance Program. Consistent with prior research, caregivers also expressed substantial anxiety and stress related to the COVID-19 pandemic (Basu et al., 2021; Boekhorst et al., 2021; Chmielewska et al., 2021; Hessami et al., 2020; Liu et al., 2021; Mariño-Narvaez et al., 2021; Mayopoulos et al., 2021; Silverman et al., 2020). Worldwide, the pandemic has been associated with worsened maternal and infant outcomes, including significant increases in stillbirth, maternal death, and postnatal depression (Chmielewska et al., 2021). This pandemic has also worsened many material hardships, with rates of food insecurity doubling nationwide and tripling in families with children (Keith-Jennings et al., 2021). Multiple studies have found maternal stress, anxiety, and loneliness have worsened since the onset of the pandemic, although studies have found varying changes in depression scores (Basu et al., 2021; Boekhorst et al., 2021; Chmielewska et al., 2021; Hessami et al., 2020; Liu et al., 2021; Mariño-Narvaez et al., 2021;

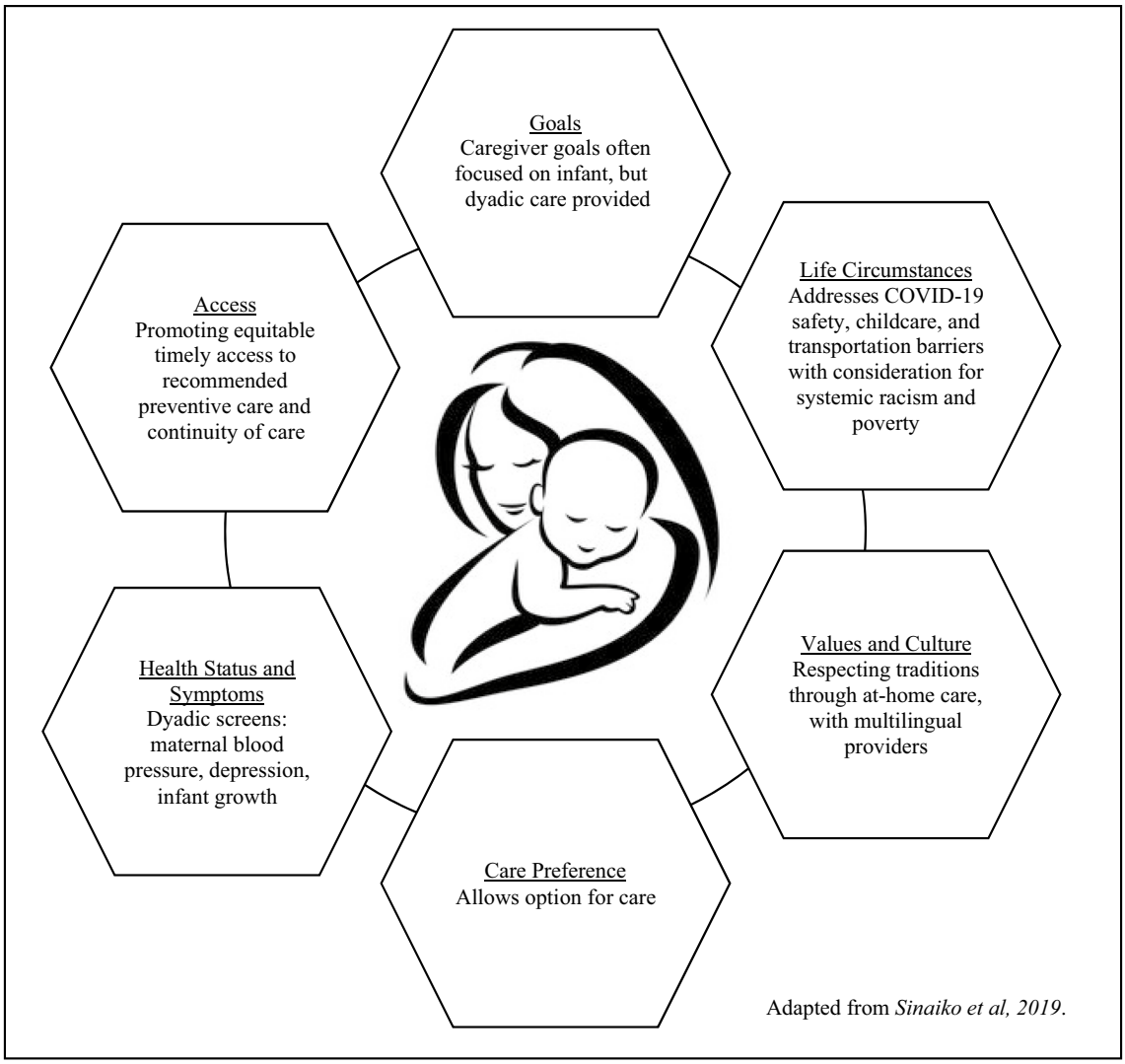

Fig. 2 Achieving domains of patient- and family-centeredness on the mobile medical clinic

Mayopoulos et al., 2021; Silverman et al., 2020). Allaying material hardships such as diaper insecurity is one way to reduce caregiver stress (Smith et al., 2013), and many caregivers we surveyed expressed appreciation for the material items—including diapers and creams—that were provided as part of the MMC outreach efforts. Thus, direct material support through provision of items including diapers and food may continue to be key interventions for health providers' community outreach efforts, not only to alleviate these direct material hardships but also to mitigate caregiver anxiety and stress.

A key element of this MMC iteration was the provision of dyadic mother-infant care provided by a Family Nurse Practitioner. As highlighted in a framework for maternal-infant dyad care model developed and described by Glazer, et al., applying a dyadic approach is a crucial paradigm shift which can break down silos to address the multifactorial maternal-infant health disparities and accompanying lifelong health outcomes (Glazer et al., 2021). As was noted by the multiple instances of maternal hypertension that were detected and treated through the MMC, even when caregivers were focused on their children, dyadic care offers opportunities for maternal evaluations during the "fourth trimester." These evaluations, which may have otherwise been missed, may help to meet the mutual goals of both AAP and ACOG postpartum care schedules and reduce morbidity and mortality ("ACOG Committee Opinion No. 736," 2018; McInerny et al., 2016).

Limitations included a small clinical sample further reduced by time and budgetary restraints which restricted the ability to contact all participating families. Social desirability bias and recall bias may have affected responses, as some respondents were surveyed months

after their MMC visit. We tried to minimize social desirability bias by using an independent interviewer and to minimize recall bias by asking questions in a variety of ways to approach the constructs of interest. Furthermore, we conducted this study in English and Spanish, but respondents who spoke other languages were excluded, which constrained the evaluation of language barriers.

Conclusions for Practice

Many caregivers who accessed care on a mobile medical clinic during the COVID-19 pandemic reported a high level of satisfaction, especially related to patient- and family-centered care, and, importantly, the mobile medical clinic clinicians detected multiple instances of maternal hypertension requiring emergent treatment and care. Caregivers identified health-related social needs including food insecurity, diaper insecurity, and use of SNAP and significant anxiety related to COVID-19 transmission. These findings support the need for innovative models for postpartum mother-infant care during and beyond the pandemic to provide dyadic care and material support. Ongoing studies of community outreach efforts like the MMC, which focus on dyadic care, can evaluate comparative effectiveness of maternal and infant outcomes. Sustainability of such programs will require support from hospitals and community-based pediatric practices to support increased patient- and family-centered care initiatives for maternal-infant dyads.

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Data Availability Available at: https://dataverse.harvard.edu/dataverse/MMC

Code Availability N/A.

Declarations

Conflict of interest This research was supported by the Yale Pediatric Scholar Program in the Department of Pediatrics at Yale University. The Mobile Medical Clinic was supported by funding from New Haven Healthy Start, March of Dimes, The Community Foundation *for* Greater New Haven, Yale University Office of New Haven Affairs, the Gilead Foundation, and the Yale New Haven Hospital Medical Staff Fund. Mobile Medical Clinic funders had no role in the study design, collection, analysis, interpretation of data, writing of the report, or decision to submit the report. All authors have declared that they have no conflicts of interest.

Ethical Approval The study was exempt by the Yale IRB (Study #2000028292, Modification #00035287).

Consent to Participate All persons gave their verbal informed consent prior to their inclusion in the study.

Consent for Publication N/A

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