



Remote Maternal Blood Pressure Monitoring in A Predominantly Black, Rural, Medicaid Population: A Feasibility Study at the University of Mississippi Medical Center

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Disclaimer

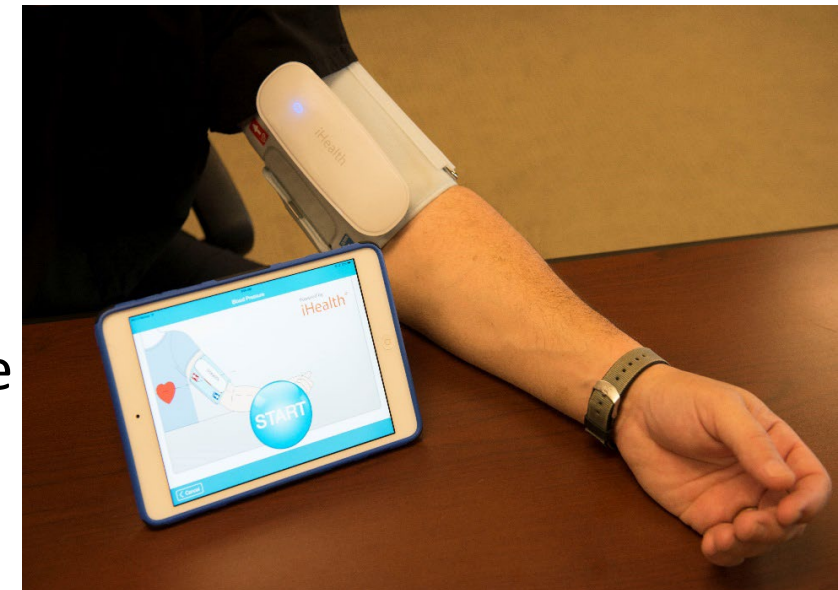
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Background

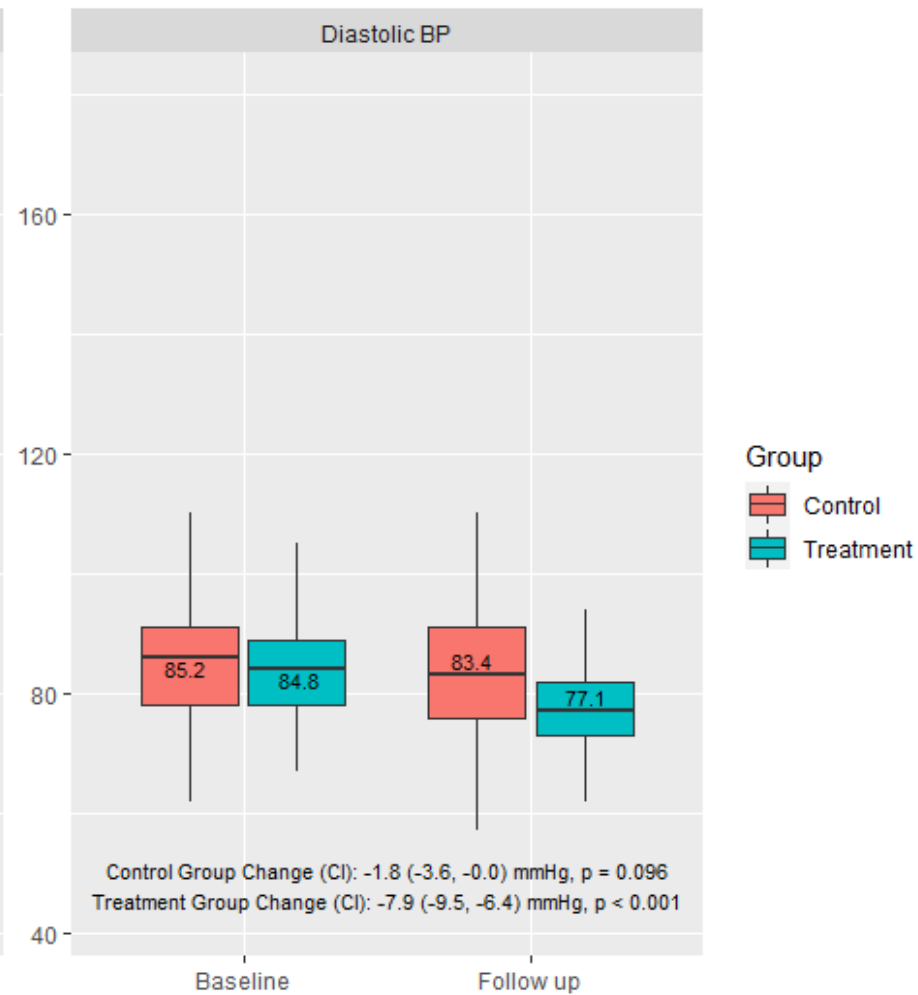
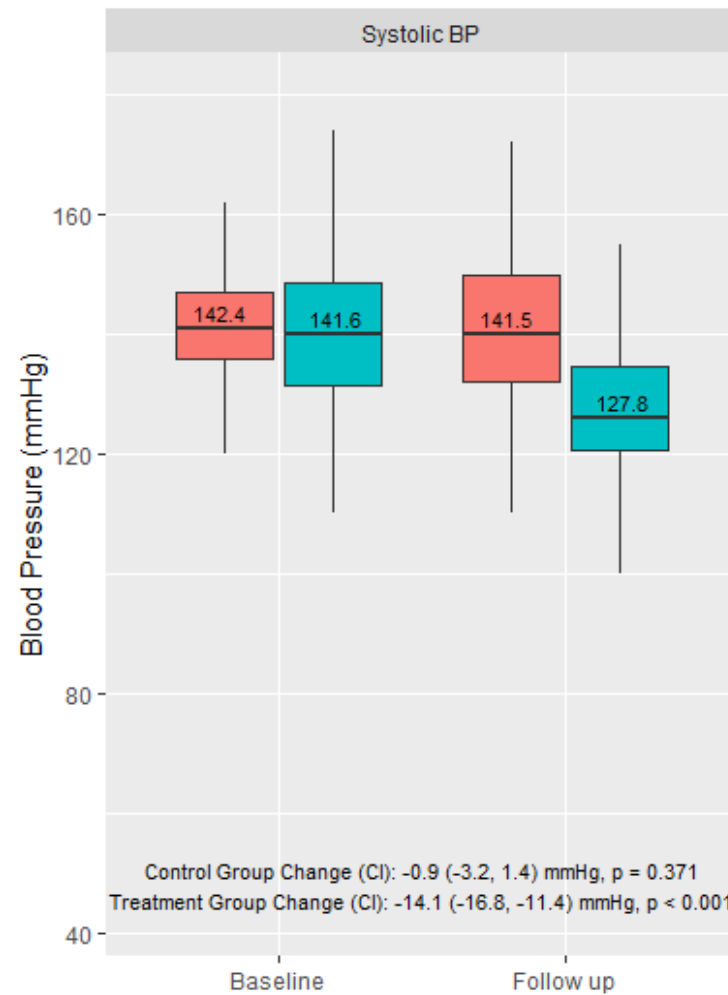
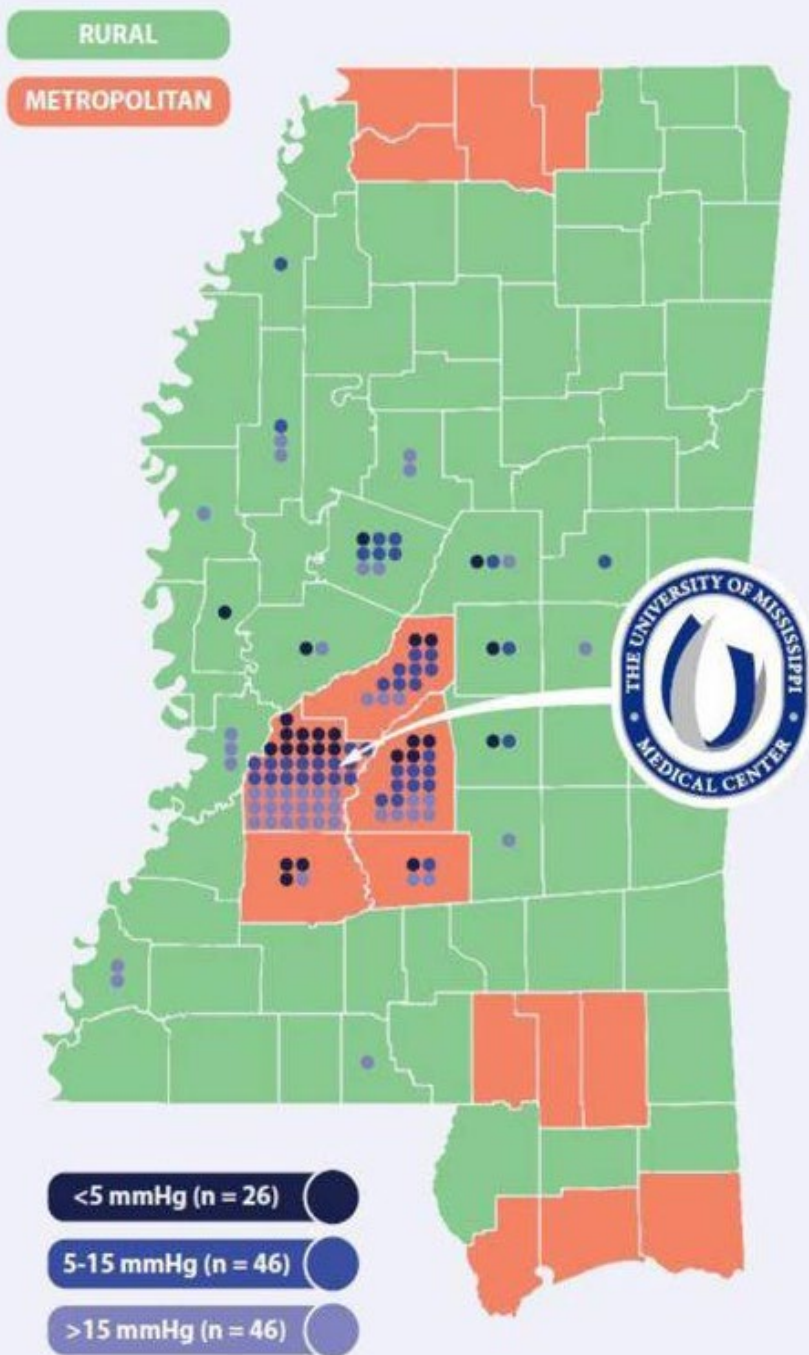
Remote Patient Monitoring

- Chronic disease management
- Integrated with technology for data transmission
- Patients to collect their data at home through personal health devices
- Healthcare providers monitor patient health status at the point of care
- Can be combined with behavioral and medication management



RPM Program at University of Mississippi Medical Center (UMMC) – Hypertension Management

- **Study design:** Prospective cohort study
- **Participants:** Hypertension patients with uncontrolled BP
- **Intervention:** BP monitoring daily, patient education, medication management every 3 week
- **Outcome:** Blood pressure
- **Study period:** September 4, 2018 – June 15, 2020.



We enrolled 120 patients. 118 had at least 1 follow-up visit, and 103 completed a 6-month follow-up.

RPM for Cardiovascular Disease (CVD) – Systematic Review

- Review questions:
 1. **Cost:** Does CVD managed by RPM have lower costs compared with usual care in the U.S.?
 2. **Cost-effectiveness:** How is the cost of RPM associated with CVD patient outcomes compared with usual care in the U.S.?

Zhang, Y., Pena, M. T., Fletcher, L. M., Swint, J. M., & Reneker, J. C. (2022). Cost of remote patient monitoring for cardiovascular disease: a systematic review protocol. *JB1 Evidence Synthesis*, 20(6), 1585-1592.

Zhang, Y., Peña, M. T., Fletcher, L. M., Lal, L., Swint, J. M., & Reneker, J. C. (2023). Economic evaluation and costs of remote patient monitoring for cardiovascular disease in the United States: A systematic review. *International journal of technology assessment in health care*, 39(1), e25.

RPM for Cardiovascular Disease (CVD) – Systematic Review

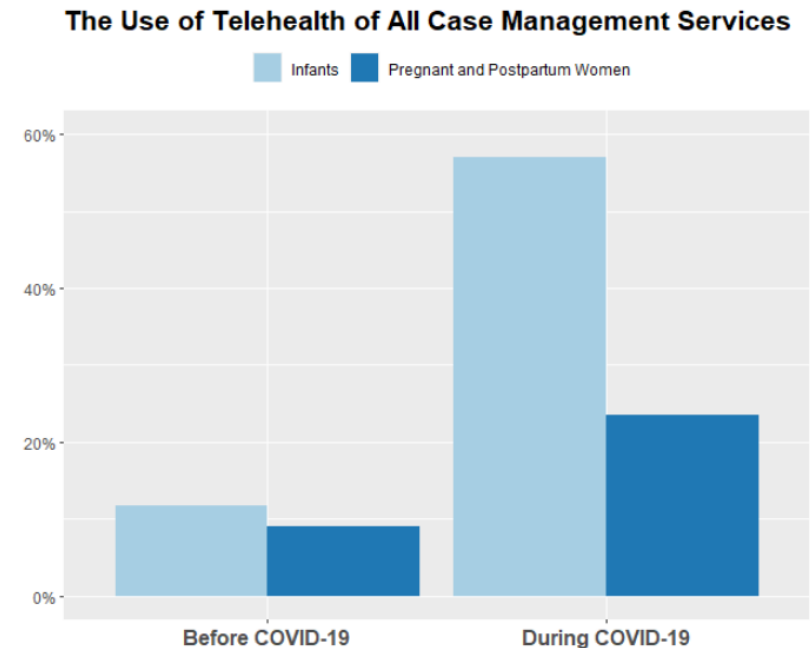
- PICO (Participants, Intervention, Context, Outcomes):
 - Studies involved **a chronic CVD patient population** in the **U.S.**, comparing **RPM**, or similar health delivery models, with **usual care** in terms of **costs** or in conjunction with other **health benefit outcomes**.
- We consider both partial and full economic evaluations (EEs).
- Assessment of methodological quality: JBI critical appraisal instruments for Economic Evaluation.

Cost and Cost-effectiveness of RPM for CVD management

- Studies from the **provider** perspective identified higher costs and similar effectiveness for the RPM group relative to the usual care group.
- Studies from **payer and healthcare** sector perspectives indicate better clinical effectiveness of RPM relative to usual care.
- **Full economic evaluations** identified RPM as a cost-effective tool, particularly for long-term CVD management.
- Future efforts should seek to investigate the economic sustainability of RPM for CVD management, considering **broader and varying perspectives** with a longer-term view.

Telehealth Services for Prenatal Care in Mississippi

- Limited access to maternal-fetal medicine subspecialists in Mississippi
 - UMMC is the state's only Regional Perinatal Health Care Center
- Telehealth is a viable solution to the limited access to care and specialty provider shortage.
- Use cases for telehealth increased to avoid COVID-19 exposure.
 - MSDH Prenatal High Risk Management/Infant Services System (PHRM/ISS)



Comparison of pre-COVID-19 pandemic and pandemic obstetric management

1. Describe prenatal care practices during the height of the COVID-19 pandemic, compared to the immediate pre-pandemic time period
2. Explore maternal and birth outcomes during these time periods

Key Findings of the Comparison

- During the COVID-19 pandemic, a majority pregnancies were considered
 - **High-risk pregnancy**
 - **Hypertension during pregnancy**
 - Infectious disease
- The **incidence of neonate** or infant death **increased** from 3.23% to 5.42% within the sample.
- No significant differences in any maternal pregnancy-related outcomes between the pre-COVID-19 and COVID-19 pandemic time periods examined.

Key Findings (Continued)

- Telehealth visits accounted for less than 1% of all visits.
 - This is being interpreted as a positive finding, as it indicates that maternal care needs, necessitating in-person examination, were prioritized over the desire to limit in-person contact.
- What about using RPM for obstetric management?



RPM – Maternal Hypertension

Maternal Hypertension in Mississippi: A call for Equity

- In the United States, preeclampsia affects ~4% of pregnancies, disproportionately impacting Black women with a **threefold** higher case fatality rate compared to White women.
- This disparity can be attributed to multiple factors, such as **lack of access to health care, systemic racism, and inequitable care**, influencing Black maternal health experiences.
- In Mississippi, severe maternal hypertension from preeclampsia and cardiovascular disease is the leading cause of pregnancy-related deaths, with up to **80% of fatalities** occurring among Black mothers.
- Those in **rural areas** further encounter challenges in accessing adequate health care services, exacerbating existing health inequities.

Study Aim

- To investigate the **feasibility**, **acceptability**, and **safety** of integrating home BP monitoring for early intervention during pregnancy
- The innovative nature and unique implementation of RPM for maternal BP management hold the potential to address the limited access to care, especially in underserved areas.

Zhang, Y., Lin, Y. Y., Lal, L., Swint, J. M., Tucker, T., Ivory, D. M., ... & Collier, C. (2024). Feasibility of Remote Blood Pressure Monitoring for Detection and Management of Maternal Hypertension in a predominantly Black, Rural and Medicaid Population in Mississippi. *Telemedicine and e-Health*.

Study Design

- A prospective cohort study was conducted from July 19, 2021, to February 23, 2023.
- **Participants:** Adult patients with an intrauterine pregnancy, receiving prenatal care at the UMMC and affiliated clinics, proficient in English, having reliable internet access, and diagnosed with moderate to high risk of developing a hypertensive complication in pregnancy as defined by the U.S. Preventive Task Force.

Program Setup and Patient Education

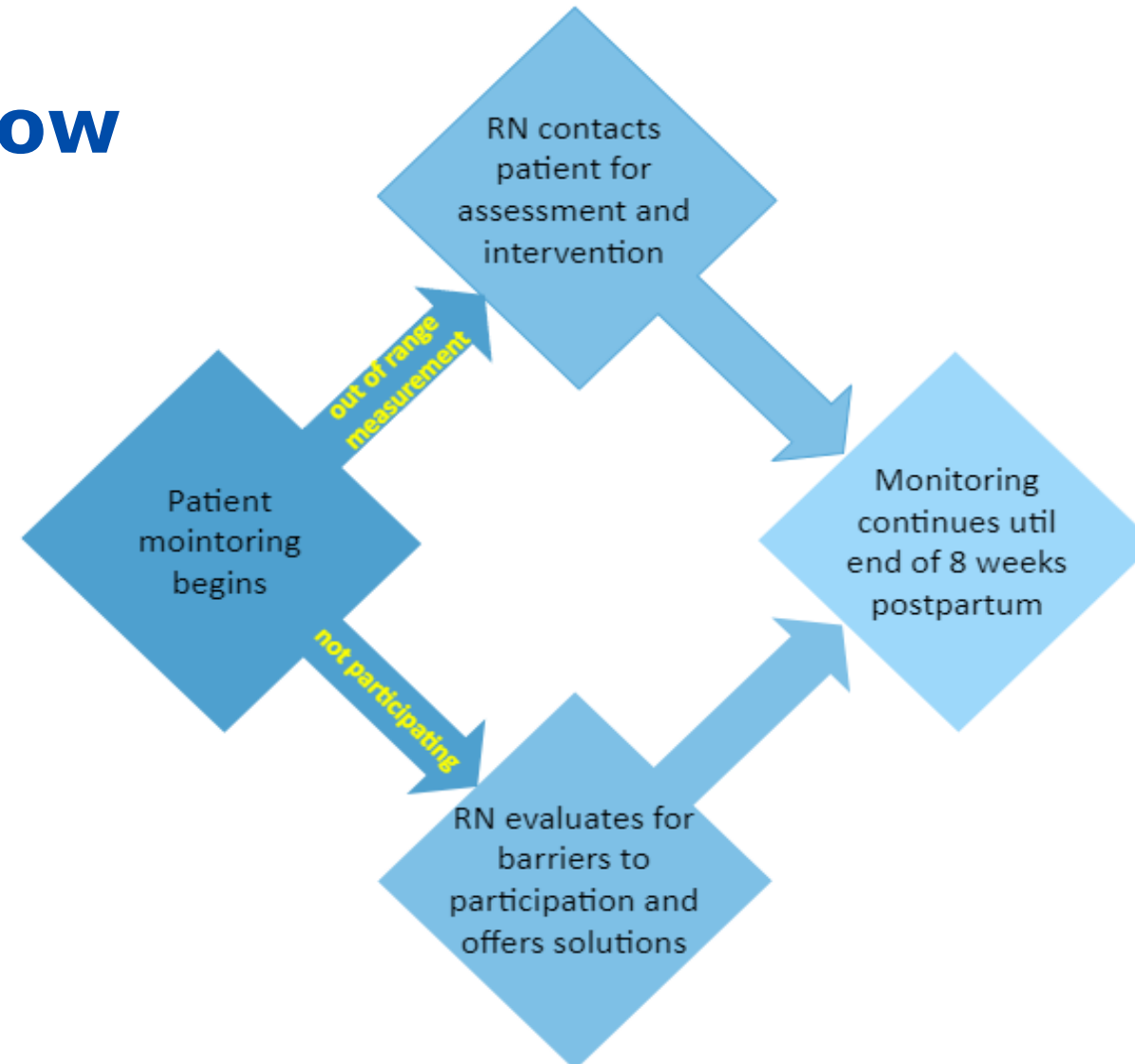
- Sent a telemonitoring kit within 3–5 days that included an iPad tablet equipped with a cellular chip and a Bluetooth-enabled BP cuff.
- Contacted by a nurse coordinator through secured audio/video connections to confirm informed consent.
- Patient education on proper BP measurement techniques
 - E.g., sit quietly for 5 minutes with feet flat on the floor, supported back and arms
 - Avoid caffeine, exercise, and having a full bladder within the last 30 minutes



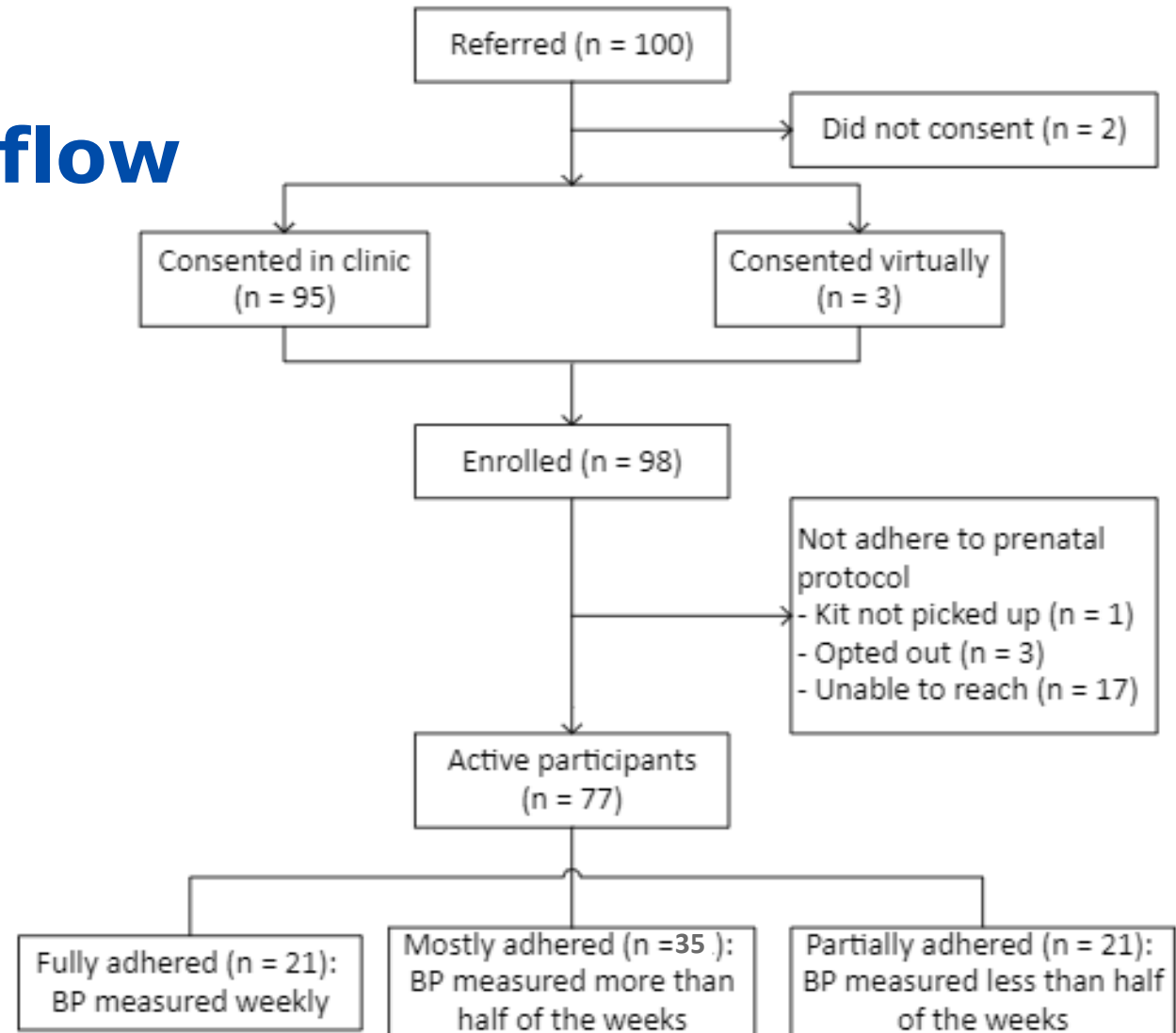
Monitoring Schedule

- Measurement frequency:
 - Weekly in antenatal
 - Daily for 1 week postpartum
 - Weekly until 8-week postpartum.
- Automatic medical guidance for BP $\geq 140/90$ mmHg
- Alerts for BP $\geq 155/90$ mmHg
- Each BP measurement was reviewed daily by a nurse
 - Elevated readings prompting contact, timely assessment, intervention recommendations, messaging maternal fetal providers, and triage instructions if needed

RPM Workflow



Results: Study Workflow



Patient Characteristics

	All enrollees (N = 98)	Fully adhere (n = 21) ^a	Mostly adhere (n = 35) ^b	Partially adhere (n = 21) ^c	Not adhere (n = 21) ^d	P- value
Age, year, Mean (SD)	30.53 (5.95)	31.19 (5.74)	31.63 (5.75)	29.67 (6.26)	28.90 (6.09)	0.329
Gestational age at enrollment, week, Mean (SD) ^{ab*, ac*}	23.57 (6.91)	27.63 (6.92)	22.27 (5.20)	21.05 (7.22)	24.22 (7.64)	0.008
Race, no. (%)						0.068
Black/African American	84 (86.60)	17 (85.00)	34 (97.14)	17 (80.95)	16 (76.19)	
White/Caucasian	13 (13.40)	3 (15.00)	1 (2.86)	4 (19.05)	5 (23.81)	
BMI at initial prenatal care, no. (%) ^{bc*}						0.016
Normal weight ($18.5 \leq \text{BMI} < 25.0$)	6 (6.38)	1 (4.76)	4 (12.50)	0 (0.00)	1 (4.76)	
Overweight ($25.0 \leq \text{BMI} < 30.0$)	14 (14.89)	1 (4.76)	8 (25.00)	0 (0.00)	5 (23.81)	
Obese ($\text{BMI} \geq 30.0$)	74 (78.72)	19 (90.48)	20 (62.50)	20 (100.00)	15 (71.43)	
Insurance, no. (%)						
Medicaid	89 (90.82)	19 (90.48)	31 (88.57)	19 (90.48)	20 (95.24)	0.962
Commercial	25 (25.51)	6 (28.57)	10 (28.57)	1 (4.76)	8 (38.10)	0.079
Others	6 (6.12)	1 (4.76)	2 (5.71)	2 (9.52)	1 (4.76)	0.942
Rural, no. (%)	57 (58.16)	13 (61.90)	20 (57.14)	10 (47.62)	14 (66.67)	0.633

Pregnancy outcomes

- We investigated pregnancy outcomes:
 - Number of participants with multifetal, gestational age at delivery, induction, mode of delivery, severe maternal morbidity complication, chronic hypertension, length of stay of delivery, diagnosis during the program, readmission, ED utilization, birthweight
- No significance between groups

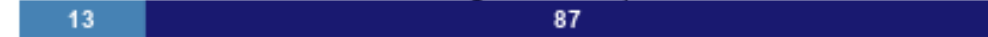
Satisfaction Survey Response

Maternal Hypertension RPM Exit Satisfaction Survey Responses by Questions (%)

Receiving the materials/monitor and tablet by mail.



The education received about using the blood pressure cuff.



The education received about using the tablet.



The quality of the "Health Sessions" on the tablet.



The communication with the program nursing staff.



The frequency of the blood pressure checks.



The accuracy of the blood pressure monitor.



The quality of the prenatal care you received in your clinic.



The quality of the medical care you received at the hospital you gave birth.



The quality of the postpartum care you received after leaving the hospital?



Scale □ 1-Very Unsatisfied □ 2-Unsatisfied □ 3-Neutral □ 4-Satisfied ■ 5-Very Satisfied

Satisfaction Survey Response (More Feedback)

I enjoyed the program n hope to do it Again one day

Absolutely love this program!!

They a very efficient communicators

I was very pleased with the program. I highly recommend it and I was very happy with nurses. They were very courteous and helpful during the program.

I love it! Everyone that's pregnant needs to join.

I already referred the program to a friend.

This Care program is vital and important to maternity health and well-being. I would not have known the severity of my health and having pre-eclampsia with this program! Thank you for this proactive health measure!

Key Findings

- The **high enrollment rate** indicates a strong interest within the study population.
- However, **nonadherence issues** emerged, warranting strategies for patient engagement, such as comprehensive patient education and patient-family advisory councils in future work.
- Demographic profile reflects the challenges faced by **vulnerable** mothers, particularly those who are **Black/African American**, **obese**, covered by **Medicaid**, residing in **rural areas**, contributing to healthcare disparities.
 - The prevalence of previous pregnancy experiences, including **preterm births** and **spontaneous abortions**

Key Findings (Continued)

- Hospital utilization (hospitalization and ED) was similar across adherence groups, but the **timely triage** assisted patients in avoiding unnecessary visits and prompting necessary visits.
- The fully adhered group displayed **higher postpartum visit completion** and telemonitoring use, indicating the potential benefits of consistent adherence in promoting **patient engagement** and facilitating monitoring and detection in postpartum care.
- No maternal or neonatal deaths were identified within 60 days postpartum, highlighting the overall safety and positive outcomes associated with this program.
- The patient satisfaction survey responses echoed a **strong contentment**, reinforcing the value and relevance of the program in improving maternal health and well-being among the vulnerable population.

Conclusion

- Despite some challenges with adherence, the program shows promise in improving maternal health management and receiving positive feedback from participants.
- Overall, this study highlights the potential of RPM programs in enhancing perinatal care for vulnerable mother populations and their newborns.
- Future research should consider addressing barriers to **patient engagement** and further investigating the **clinical and economic impact** of telemonitoring.
- Additionally, it is important to assess the **program sustainability** to optimize its **long-term clinical effectiveness** and its value to patients, the health care system, and society as a whole.



Program Sustainability

Program Sustainability

- Dynamic healthcare policy and funding availability
- Program Evaluation
 - Metrics?
 - Analysis?

Framework for Evaluating and Developing Sustainable Telehealth Programs

- Program Implementation
- Clinical Effectiveness
- Economic Sustainability
- Time Horizon
- Health and Digital Equity
- Sustainability within the U.S. Healthcare System

Evaluation Domain: Program Implementation

Evaluation Object/Approach	Metric Example
Patient and provider adoption	Adoption rate
Patient and provider satisfaction survey	Likert scaled answers
Recruitment strategy	Referral and enrollment rates
Patient compliance	Completion rate
	Frequency of home monitoring (RPM)
	Medication compliance

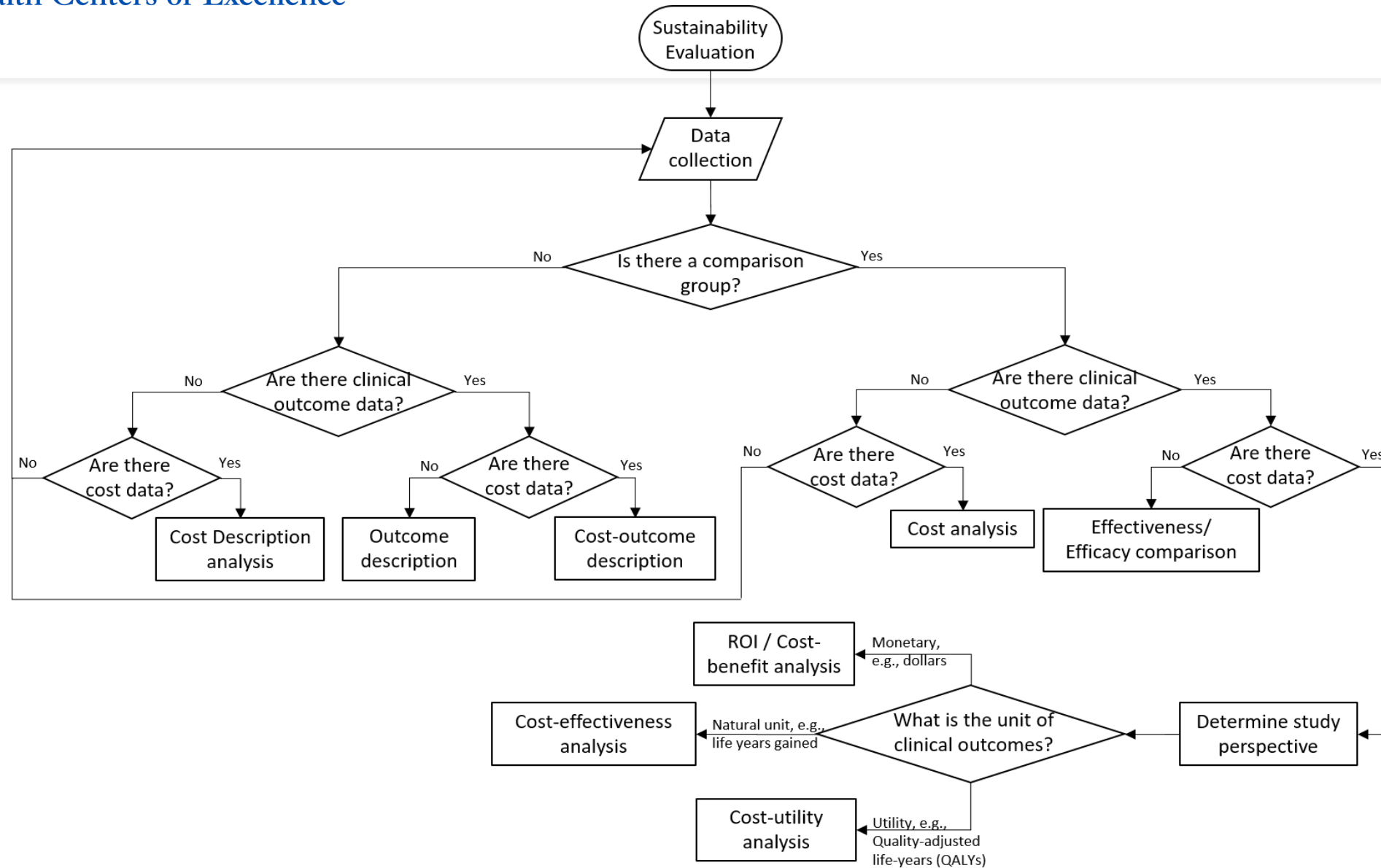
Evaluation Domain: Clinical Effectiveness

Evaluation Object/Approach	Metric Example
Clinical outcome	Outcome measures change from baseline Difference between intervention and comparison groups
Healthcare resource utilization	Hospitalization ED admission Length of stay
Self-reported clinical effectiveness	Surveys for quality of life Ability to work or perform daily tasks with independence Adverse event (Number of adverse events, severity of adverse event)
Health Equity	Outcome difference between subpopulations

Evaluation Domain: Economic sustainability

Evaluation Object/Approach	Metric Example
Economic benefit relative to investment	Return-on-Investment (ROI)
Cost-avoidance	Cost of avoided events, or resources
Average cost	Cost comparison
Cost-effectiveness	Cost-outcome description Cost per unit of effect for CEA Cost per quality adjusted life years (QALYs) or cost per disability-adjusted life years (DALYs) for CUA Ratio of costs to benefits for CBA

Telehealth Centers of Excellence



Telehealth Centers of Excellence

Cost Components		Payer	Provider	Societal	Data Source
Formal Healthcare Costs					
Program Costs					Institutional finance
	Equipment and supplies		✓	✓	
	Personnel		✓	✓	
	Training of patients and providers		✓	✓	
	Marketing		✓	✓	
	Overhead		✓	✓	
	Medical Costs paid for by third-party payers	✓		✓	Claims data
	Medical Costs paid for by patients out-of-pocket			✓	Institutional finance
Informal Healthcare Costs					Patient survey, Electronic Health Records
	Patient-time costs			✓	
	Unpaid caregiver-time costs			✓	
	Transportation costs	✓		✓	
Non-Healthcare Costs					Patient survey, National Health Interview Survey, American Medical Association Physician Masterfile, and U.S. Census data, etc.
	Productivity				
	Labor market earnings lost			✓	
	Cost of unpaid lost productivity due to illness			✓	
	Cost of uncompensated household production			✓	
	Education				
	Impact of intervention on educational achievement			✓	
	Environment				
	Carbon emissions caused by transportation			✓	
	Other impacts			✓	

Telehealth Evaluation in the United States

- While numerous evaluation frameworks have emerged, crafted by various stakeholders, their comprehensiveness is limited, and the overall state of telehealth evaluation remains unclear.
- We are conducting a scoping review to incorporating perspectives from multiple stakeholder categories. Specifically, we aim to (1) map the existing landscape of telehealth evaluation, (2) identify key concepts for evaluation, (3) synthesize existing evaluation frameworks, and (4) identify measurements and assessments considered in the United States.

Zhang, Y., Lin, Y. Y., Lal, L. S., Reneker, J. C., Hinton, E. G., Chandra, S., & Swint, J. M. (2024). Telehealth Evaluation in the United States: Protocol for a Scoping Review. *JMIR Research Protocols*, 13(1), e55209.

Need RWD and RWE for Telehealth

- Using **Real-World Data (RWD)** to facilitate telehealth-associated research and **Real-World Evidence (RWE)**
- FDA Definition
 - “**Real-world data** are data relating to patient health status and/or the delivery of health care routinely collected from a variety of sources.”
 - Examples of RWD: data derived from electronic health records, medical claims data, data from product or disease registries, and data gathered from other sources

<https://www.fda.gov/science-research/science-and-research-special-topics/real-world-evidence>



BENEFITS

GET DETAILED INFORMATION

The Warehouse will include information from around the United States and include data on patient diagnoses, procedures, medications, medical history, and others

ACCESS PROVIDER AND PAYER DATA

The Warehouse will include data on primary and specialty provider and payers of all types

HIPAA COMPLIANT

The data collected for and stored in the Warehouse is fully compliant with HIPAA privacy and security laws



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The National Telehealth Data Warehouse from the University of Mississippi Medical Center (UMMC) is a groundbreaking resource that provides researchers with unparalleled data on telehealth usage and trends. With its detailed information on reimbursement, policy, and quality metrics, the Warehouse is essential for anyone interested in telehealth research and innovation

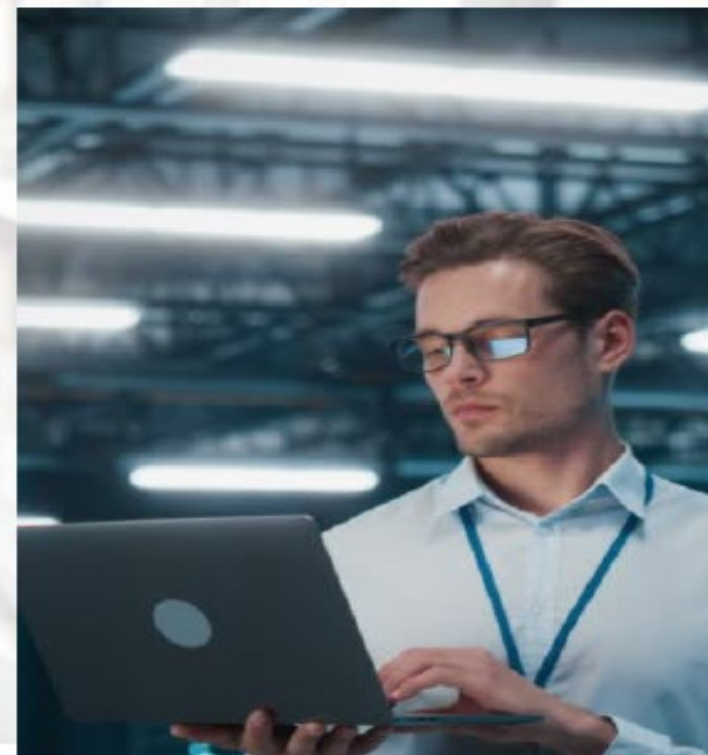


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A NATIONAL TELEHEALTH DATA WAREHOUSE

The most comprehensive resource for telehealth data anywhere



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