Impact of Remote Blood Pressure Monitoring Device Connectivity on Engagement Among Pregnant Individuals Enrolled in the Delfina Care Platform: Observational Study

Mia Charifson1,2, BA, MA; Timothy Wen1,3, MPH, MD; Bonnie Zell1, MD; Priyanka Vaidya1, MBA; Cynthia I Rios1,4, MD; C Funsho Fagbohun1,4, MD, PhD; Isabel Fulcher1, PhD

1Delfina Care Inc, San Francisco, CA, United States
2Department of Population Health, New York University, New York, NY, United States
3Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California San Francisco, San Francisco, CA, United States
4Center for Women’s Health, Richmond, TX, United States

Abstract

User engagement with remote blood pressure monitoring during pregnancy is critical to optimize the associated benefits of blood pressure control and early detection of hypertensive disorders of pregnancy. In our study population of pregnant individuals, we found that connected blood pressure cuffs, which automatically sync measures to a monitoring platform or health record, increase engagement (2.13 [95% CI 1.36-3.35] times more measures per day) with remote blood pressure monitoring compared to unconnected cuffs that require manual entry of measures.

Methods

Study Population

The study population consisted of pregnant individuals enrolled in Delfina Care [10], a comprehensive pregnancy care platform, at a community practice in Texas, USA, between January and July 2023. Initially, these users were provided with unconnected BP devices at their provider’s discretion, with a recommendation to record 2 BP measures a day. The goal of this study was to compare user engagement with RBPM between connected and unconnected BP devices among users of a pregnancy care platform.

Introduction

Hypertensive disorders of pregnancy affect 5%-10% of pregnancies and increase the risk of adverse pregnancy and postpartum outcomes [1,2]. Typically, management of these disorders involves blood pressure (BP) monitoring and initiation of antihypertensive therapy. Remote BP monitoring (RBPM) enables at-home BP monitoring to inform clinical decision-making in a timely manner [2-4]. Previous studies have shown that RBPM facilitates earlier detection of elevated BP and reduces prenatal hospitalizations and clinic visits [2,3]. Despite studies establishing feasibility and patient acceptability of RBPM [4-9], best practices for integrating RBPM within prenatal care have not yet been established. One open question is whether connected BP cuffs, which automatically sync measures to a health record, improve data quality and frequency over standard BP cuffs, which require users to manually enter measures [3-8].
the connected and unconnected device groups are further described in Multimedia Appendix 1.

The outcome of interest was user engagement, defined as the number of daily BP measures taken, and as a binary indicator of completing the daily recommended BP measures (ie, 2 distinct BP measures per day). Analogous engagement outcomes at the weekly level were also reported. To avoid inflated differences due to repeated measures from connected device users, we considered multiple entries within 1 hour as a single measurement (Multimedia Appendix 2). The exposure of interest was receiving a connected versus unconnected device. Clinical and demographic characteristics were collated from user-reported questionnaire data and electronic health records.

**Statistical Analysis**

Poisson and logistic regressions were fit for the daily number of BP measures and ≥2 daily BP measures, respectively. Both models controlled for relevant confounders (ie, age, parity, weeks since enrollment, primary clinic, and preferred language) and included a random effect for users across enrollment days.

**Ethical Considerations**

The study team received an institutional review board exemption waiver of HIPAA (Health Insurance Portability and Accountability Act) authorization on August 22, 2022, from WIRB-Copernicus Group (WCG) Institutional Review Board (protocol number 202208-001).

**Results**

During the study period, 164 users with BP cuffs were enrolled in the Delfina Care platform. Restricting to those with covariate data, the analytic sample consisted of 163 users (97 unconnected device users and 66 connected device users). Users with connected devices had more mean BP measure entries per day (0.51 vs 0.32) and a higher proportion completed the recommended ≥2 daily BP measures (12% vs 7%) compared to users with unconnected devices (Table 1). At the weekly level, the mean entries per week (3.37 vs 2.07) and the proportion of users who completed the recommended ≥1 weekly BP measure (63% vs 47%) were higher for connected users than for unconnected device users (Table 1).

Adjusting for confounders, users with connected devices had 2.13 (95% CI 1.36–3.35) times more measures per day and 5.62 (95% CI 2.28–13.83) times the odds of meeting the recommendation of ≥2 daily BP measures than unconnected device users (Table 2).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overall (n=163)</th>
<th>Unconnected device users (n=97)</th>
<th>Connected device users (n=66)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in years, mean (SD)</strong></td>
<td>28.73 (6.02)</td>
<td>28.71 (5.61)</td>
<td>28.76 (6.61)</td>
<td>.96</td>
</tr>
<tr>
<td><strong>Language, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td>.32</td>
</tr>
<tr>
<td>English</td>
<td>139 (85.3)</td>
<td>80 (82.5)</td>
<td>59 (89.4)</td>
<td></td>
</tr>
<tr>
<td>Spanish</td>
<td>24 (14.7)</td>
<td>17 (17.5)</td>
<td>7 (10.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Parity, mean (SD)</strong></td>
<td>1.37 (1.44)</td>
<td>1.36 (1.32)</td>
<td>1.38 (1.60)</td>
<td>.99</td>
</tr>
<tr>
<td><strong>Primary clinic, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td>.07</td>
</tr>
<tr>
<td>A</td>
<td>35 (21.5)</td>
<td>20 (20.6)</td>
<td>15 (22.7)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>71 (43.6)</td>
<td>49 (50.5)</td>
<td>22 (33.3)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>57 (35.0)</td>
<td>28 (28.9)</td>
<td>29 (43.9)</td>
<td></td>
</tr>
<tr>
<td><strong>User engagement</strong>, mean (SD)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly entries</td>
<td>2.59 (3.02)</td>
<td>2.07 (2.78)</td>
<td>3.37 (3.20)</td>
<td>.007</td>
</tr>
<tr>
<td>Daily entries</td>
<td>0.40 (0.46)</td>
<td>0.32 (0.42)</td>
<td>0.51 (0.49)</td>
<td>.008</td>
</tr>
<tr>
<td>Proportion ≥1 weekly entries</td>
<td>0.53 (0.35)</td>
<td>0.47 (0.35)</td>
<td>0.63 (0.33)</td>
<td>.003</td>
</tr>
<tr>
<td>Proportion ≥2 daily entries</td>
<td>0.09 (0.17)</td>
<td>0.07 (0.15)</td>
<td>0.12 (0.19)</td>
<td>.048</td>
</tr>
</tbody>
</table>

*aUser engagement metrics were first averaged within a user and then averaged across users for each device type and overall.*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Number of BP measures per day</th>
<th>Completed ≥2 BP measures per day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incidence rate ratio</td>
<td>95% CI</td>
</tr>
<tr>
<td>Connected versus unconnected device</td>
<td>2.13</td>
<td>1.36-3.35</td>
</tr>
<tr>
<td>Age (years)</td>
<td>1.06</td>
<td>1.02-1.11</td>
</tr>
<tr>
<td>Weeks since enrollment</td>
<td>0.97</td>
<td>0.97-0.98</td>
</tr>
<tr>
<td>English vs Spanish language</td>
<td>1.25</td>
<td>0.66-2.35</td>
</tr>
<tr>
<td>Parity (number of live births)</td>
<td>0.88</td>
<td>0.74-1.05</td>
</tr>
</tbody>
</table>
Number of BP measures per day

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Number of BP measures per day</th>
<th>Incidence rate ratio</th>
<th>95% CI</th>
<th>Completed ≥2 BP measures per day</th>
<th>Odds ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic B vs A</td>
<td></td>
<td>1.44</td>
<td>0.79-2.61</td>
<td>4.18</td>
<td>1.25-14.03</td>
<td></td>
</tr>
<tr>
<td>Clinic C vs A</td>
<td></td>
<td>1.54</td>
<td>0.83-2.86</td>
<td>4.06</td>
<td>1.16-14.20</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

We observed user engagement with RBPM was significantly higher among those with connected devices than those with unconnected devices. Previous studies among pregnant individuals have shown that the recommended frequency of BP measures ranges from several times daily to once weekly [4,7,8,11]. In our cohort, the proportion of users meeting the twice-daily recommendation was low, but the majority of users completed the once-weekly entry at least, and connected device users still had higher utilization than unconnected device users (63% vs 47%; P=.003). Compared to in-clinic BP measures, all users had a higher average number of weekly readings than the in-clinic average (2.59 vs 0.50 BP readings/week). Our study corroborated the feasibility of at-home RBPM during pregnancy and highlights the potential advantages of device connectivity on user engagement.

Limitations

Our findings are limited by the lack of true randomization to device types, which we addressed by controlling for potential confounders. We also addressed potential time-related confounding via a sensitivity analysis with no change in findings (Multimedia Appendix 2).

Conclusion

This study highlights how connected BP devices can improve patient engagement to RBPM during the prenatal period. Other aspects of RBPM, such as recommended frequency and patient education, should be further investigated to ensure users are able to successfully engage with monitoring technologies.

Acknowledgments

This study was supported by grant funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) under grant number R43HD114360.

Conflicts of Interest

MC reports serving as a data science consultant for Delfina, Inc. TW reports serving as the associate chief medical officer for Delfina, Inc. BZ reports serving as the chief medical officer for Delfina, Inc. PV reports serving as the chief product officer for Delfina, Inc. IF reports serving as the chief scientific officer for Delfina, Inc

Multimedia Appendix 1

Additional information on Delfina Care.

[DOCX File (Microsoft Word File), 344 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Additional analyses.

[DOCX File (Microsoft Word File), 16 KB-Multimedia Appendix 2]

References


Abbreviations

BP: blood pressure
HIPAA: Health Insurance Portability and Accountability Act
NICHD: National Institute of Child Health and Human Development
RBPM: remote blood pressure monitoring
WCG: WIRB-Copernicus Group

Edited by Lorraine Buis; peer-reviewed by Benjamin Senst, Chu-Pak Lau; submitted 19.12.2023; final revised version received 03.05.2024; accepted 12.06.2024; published 12.07.2024

Please cite as:
Charifson M, Wen T, Zell B, Vaidya P, Rios CI, Fagbohun CF, Fulcher I
Impact of Remote Blood Pressure Monitoring Device Connectivity on Engagement Among Pregnant Individuals Enrolled in the Delfina Care Platform: Observational Study
JMIR Mhealth Uhealth 2024;12:e55617
URL: https://mhealth.jmir.org/2024/1/e55617
doi: 10.2196/55617

© Mia Charifson, Timothy Wen, Bonnie Zell, Priyanka Vaidya, Cynthia I Rios, C Funsho Fagbohun, Isabel Fulcher. Originally published in JMIR mHealth and uHealth (https://mhealth.jmir.org), 12.07.2024. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR mHealth and uHealth, is properly cited. The complete bibliographic information, a link to the original publication on https://mhealth.jmir.org/, as well as this copyright and license information must be included.