

Group #1 Question: Salma, Amy, Jeeleta, Sirat, Saima

You've just attended a dinner sponsored by a company that makes home blood pressure monitors for telehealth applications. It sounds interesting, but you want more information. What is the evidence that telehealth blood pressure monitoring improves blood pressure control in urban populations?

Author (Date)	Level of Evidence	Sample/Setting (# of subjects/ studies, cohort definition etc.)	Outcome(s) studied	Key Findings	Limitations and Biases
Tucker et al. (2017)	Level I (Systematic review + Individual Patient Data Meta-analysis of RCTs)	25 randomized controlled trials; 7,138 adult hypertensive patients; outpatient/ primary care settings	Change in systolic/ diastolic BP at 12 months; BP control rates; subgroup effects	Self-monitoring & co-interventions like telemonitoring, medication adjustment, and lifestyle support significantly reduced systolic BP by ≈ -4.7 mmHg vs usual care. Self-monitoring alone showed little/no improvement. The greatest benefit was seen in patients with higher baseline BP or those needing changes to their treatment regimen, indicating that these groups responded most strongly to telemonitoring- supported self-management.	Limitations: 1. Interventions were not uniform (different devices, reporting schedules, and co-interventions), which limits comparability. 2. Few studies focused specifically on urban populations , so results may not fully generalize to your target PICO population. 3. Short follow-up durations in many trials (6–12 months), making long-term effectiveness uncertain. Bias: 1. Selection bias: Studies mainly included tech-savvy patients which does not accurately represent the general urban hypertensive population 2. Performance bias: Patients knew they were being monitored, so they may have tried harder.
Park S-H, Shin J-H, Park J, Choi W-S (2021)	Systematic Review & Meta-analysis of RCTs- Level 1	32 randomized controlled trials 48 total comparisons Urban-dwelling hypertensive adults (≥ 18 years) RBPM group: 5,729 participants Usual care group: 5,666 participants Intervention duration: 2–18 months Settings included: - Primary care clinics - Community health centers - Hospitals/tertiary centers - All studies conducted in urban areas; rural or mixed excluded	Primary Outcomes: Change in systolic blood pressure (SBP) Change in diastolic blood pressure (DBP) Secondary Outcome: BP control rate (proportion of patients reaching BP goal)	- SBP decreased by ~ 4.5 mmHg with remote monitoring - DBP decreased by ~ 2.1 mmHg - BP control rate improved by $\sim 24\%$ vs usual care (RR 1.226) Stronger effect in: - Large cities (≥ 1 million population) - Daily monitoring (daily > weekly > monthly) - Non-medically underserved areas - Shorter interventions (≤ 3 months)	Limitations: - High heterogeneity across studies - Monitoring methods varied (app, phone, web, Bluetooth, SMS) - Different BP targets used over time - Some studies had missing or imputed data - Short follow-up durations - Limited long-term cardiovascular outcome data Potential Biases: - Selection bias: tech-capable urban patients overrepresented - Performance bias: monitoring itself may improve adherence (Hawthorne effect) - Attrition bias: some incomplete outcome reporting - Publication bias: Egger's test significant, suggesting small-study effects - Reporting bias: BP measurement methods differed between studies

Katz et al., 2024	Level I (Systematic Review + Meta-Analysis)	28 studies included (27 RCTs, 1 cohort) Total participants: 8,257 adults with hypertension Mean age: ~57 years Populations: - Black and Hispanic adults (majority) - Low-income, uninsured, or underinsured groups Cohort definition: → Adults with diagnosed hypertension OR taking antihypertensive meds, with studies specifically enrolling populations experiencing health disparities (racial/ethnic minorities, low SES, limited English proficiency)	Primary outcome → Change in Systolic BP at 3, 6, and 12 months Secondary outcomes: → Change in Diastolic BP (DBP) → BP follow-up values (SBP & DBP)	Digital health interventions lowered BP more than standard care SBP reduction: - 6 months: -4.24 mmHg greater decrease vs control - 12 months: -4.30 mmHg greater decrease vs control Most effective interventions combined: - Remote BP monitoring - Coaching (nurse/CHW) - Culturally tailored messaging (ex. language) Benefits were consistent across diverse racial/ethnic and socioeconomic groups	Limited long-term data - Only 4 studies reported outcomes beyond 1 year Inconsistent reporting - Sociodemographic details and definitions of "disparities" varied Complex interventions - Multicomponent designs made it impossible to isolate which component caused improvement Cost and sustainability not evaluated - High resource needs (community staff, devices, coaching) Heterogeneity across studies (different populations, tools, monitoring frequency) Bias concerns: - Missing follow-up data - Engagement bias (intervention group received more attention) - Publication bias difficult to assess (few studies for many outcomes)
Margolis KL, Bergdall AR, Crain AL, et al., (2022)	Level I (randomized controlled trial)	3,071 adult patients in 21 primary care clinics (12 telehealth, 9 clinic based)	Primary: Change in systolic BP over 12 months. Secondary: patient reported outcomes over 6 months	- SBP declined significantly by a similar amount (18–19 mm Hg) in both groups from a baseline of 157 to 139 mm Hg over 12 months of follow-up, with no significant difference between groups in SBP change over time (-0.76 [95% CI, -2.84 to 1.32] mm Hg). - Similarly, DBP declined significantly by 10 mm Hg in both groups (from 93 mm Hg in clinic-based care and 90 mm Hg in telehealthcare) with no significant differences between groups in DBP change over time (0.3 [95% CI, -1.0 to 1.5] mm Hg).	Limitations: - Clinicians and participants were not blinded. - The patients were not limited to the urban population. - Limited protocol adherence - only 27% of telehealth care patients completed the follow ups with the pharmacist within 4 weeks, which could affect the difference in the results between the two groups. - Cost-effectiveness is not addressed - the study did not analyze long term sustainability of the telehealth pharmacist model, reimbursement policies, or cost effectiveness Bias: Attention bias: telehealth patients had structured follow-ups but clinic based patients had different amounts of provider contact.
Smith et al., 2024	Level III- Retrospective Cohort study	6,595 patients enrolled in the remote patient monitoring - 4,370 participants (66.3%) had uncontrolled HTN - 2,476 (37.5%) had stage 2 HTN	Primary: Change in systolic and diastolic BP over an average 298 day duration Secondary: program duration and change in MAP	The baseline SBP for the entire cohort of 6595 patients was 135 mmHg and improved by 7.3 points to reach an average of 127.8 mmHg. In the uncontrolled HTN group, the average SBP decreased by -11.9 mmHg. In the stage 2 HTN subset, the systolic pressure decreased by -16.7mmHg. The change in average DBP from baseline to end of analysis period among all patients was -4.4 mmHg. The uncontrolled hypertensive	Limitations • No Control Group for Comparison: improvements in blood pressure cannot be attributed solely to the RPM program. • Residual Confounding from other factors such as medication changes, lifestyle changes, and increased provider attention • Limited generalizability: Participants were drawn from clinics already using the RPM platform Potential bias

				group decreased by -6.8 mmHg, and stage 2 hypertensives decreased by -9.0 mmHg. RPM improved SBP, DBP, PP, and MAP across all users and especially those with uncontrolled or stage 2 HTN.	<u>Selection bias:</u> The participants that were referred to the RPM program were part of Health Snap. The study was only conducted in Florida, the results are not a national representation <u>Confounding bias:</u> other factors driving blood pressure improvements, like: changes in medication or dosing, lifestyle modifications, and better follow-up or more attention from care navigators.
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Sirat's article: **PUBMED** Meta-analysis.

- ☐ 1 Self-monitoring of blood pressure in hypertension: A systematic review and individual patient data meta-analysis.

Cite Tucker KL, Sheppard JP, Stevens R, Bosworth HB, Bove A, Bray EP, Earle K, George J, Godwin M, Green BB, Hebert P, Hobbs FDR, Kantola I, Kerry SM, Leiva A, Magid DJ, Mant J, Margolis KL, McKinstry B, McLaughlin MA, Omboni S, Ogedegbe O, Parati G, Qamar N, Tabaei BP, Varis J, Verberk WJ, Wakefield BJ, McManus RJ.

PLoS Med. 2017 Sep 19;14(9):e1002389. doi: 10.1371/journal.pmed.1002389. eCollection 2017 Sep.

PMID: 28926573 [Free PMC article.](#)

BACKGROUND: Self-monitoring of blood pressure (BP) appears to reduce BP in hypertension but important questions remain regarding effective implementation and which groups may benefit most.

...Results for diastolic blood pressure (dBp) wer ...

Abstract:

This individual patient data meta-analysis evaluated the effectiveness of self-monitoring of blood pressure in adults with hypertension by pooling data from 25 randomized controlled trials (7,138 participants). Self-monitoring alone produced little to no reduction in systolic blood pressure, while self-monitoring combined with co-interventions, such as telemonitoring, medication-titration support, or lifestyle counseling, led to significantly greater BP reductions, averaging 3-6 mmHg depending on intervention intensity. Benefits were strongest in patients with higher baseline BP and those requiring medication adjustment. Ambulatory BP data showed similar patterns. Findings were limited by inconsistency in devices, monitoring frequency and co-intervention types. Overall, self-monitoring is effective **only when paired with clinical support**, highlighting the importance of integrated care modules for hypertension management.

Tucker, K. L., Sheppard, J. P., Stevens, R., Bosworth, H. B., Bove, A., Bray, E. P., Earle, K., George, J., Godwin, M., Green, B. B., Hebert, P., Hobbs, F. D. R., Kantola, I., Kerry, S. M., Leiva, A., Magid, D. J., Mant, J., Margolis, K. L., McKinstry, B., McLaughlin, M. A., ... McManus, R. J. (2017). Self-monitoring of blood pressure in hypertension: A systematic review and individual patient data meta-analysis. PLoS medicine, 14(9), e1002389.

<https://doi.org/10.1371/journal.pmed.1002389>

Jeleeta's article: Clinic Based Care vs. Telehealth Care Monitoring Uncontrolled High Blood Pressure

Comparing Pharmacist-Led Telehealth Care and Clinic-Based Care for Uncontrolled High Blood Pressure: the Hyperlink 3 Pragmatic Cluster-Randomized Trial

KL Margolis, AR Bergdall, AL Crain, MM JaKa, JP Anderson, LI Solberg, J Sperl-Hillen, M Beran, BB Green, P Haugen, CK Norton, AJ Kodet, R Sharma, D Appana, NK Trower, PA Pawloski, DJ Rehrauer, ML Simmons, ZJ McKinney, TE Kottke, JY Ziegenfuss, RA Williams, PJ O'Connor

Hypertension (dallas, tex. : 1979), 2022, 79(12), 2708-2720 | added to CENTRAL: 30 November 2022 | 2022 Issue 11

Abstract:

A team-based approach is effective for managing uncontrolled hypertension, but different care models have not been directly compared. In this pragmatic, cluster-randomized trial of adults with moderately severe hypertension (BP $\geq 150/95$ mm Hg), clinic-based care was compared with telehealth based care incorporating home blood pressure monitoring and management by a pharmacist or nurse practitioner. Over 12 months, both groups achieved significant and similar reductions in systolic blood pressure, with no meaningful difference between interventions. However, telehealth care patients reported greater use of home monitoring, higher satisfaction, and improved convenience, supporting telehealth based team care as an effective and patient-centered alternative to traditional clinic-based management.

Margolis KL, Bergdall AR, Crain AL, JaKa MM, Anderson JP, Solberg LI, Sperl-Hillen J, Beran M, Green BB, Haugen P, Norton CK, Kodet AJ, Sharma R, Appana D, Trower NK, Pawloski PA, Rehrauer DJ, Simmons ML, McKinney ZJ, Kottke TE, Ziegenfuss JY, Williams RA, O'Connor PJ Hypertension (dallas, tex. : 1979), 2022, 79(12), 2708-2720 | added to CENTRAL: 30 November 2022 | 2022 Issue 11

<https://doi.org/10.1161/HYPERTENSIONAHA.122.19816>

Saima's article: Systematic review and meta-analysis that evaluates whether remote (telehealth) blood pressure monitoring helps improve blood pressure control in urban adults with hypertension

☐ 1 **An Updated Meta-Analysis of Remote Blood Pressure Monitoring in Urban-Dwelling Patients with Hypertension.**

Cite Park SH, Shin JH, Park J, Choi WS.

Int J Environ Res Public Health. 2021 Oct 9;18(20):10583. doi: 10.3390/ijerph182010583.

PMID: 34682329 **Free PMC article.** [Review.](#)

Following the coronavirus disease-2019 pandemic, this study aimed to evaluate the overall effects of remote **blood pressure monitoring** (RBPM) for **urban-dwelling** patients with hypertension and high accessibility to healthcare and provide updated q ...

Abstract:

Park et al. (2021) made a meta-analysis with 28 RCTs with adults with hypertension to evaluate whether or not interventions like mobile apps or telemonitoring can improve BP control compared to usual care. The authors found that these interventions led to a reduction in systolic BP with a decrease of around 4-5 mmHg and a smaller improvement in diastolic BP. They also reported that at-home monitoring was more likely to achieve target BP goals quicker. Overall, the study concludes that these interventions are effective in improving BP control depending on how intense the intervention is.

Park S-H, Shin J-H, Park J, Choi W-S. An Updated Meta-Analysis of Remote Blood Pressure Monitoring in Urban-Dwelling Patients with Hypertension. International Journal of Environmental Research and Public Health. 2021;18(20):10583. doi:10.3390/ijerph182010583.

Amy's article: **PUB MED**

☐ **Digital Health Interventions for Hypertension Management in US Populations Experiencing Health Disparities: A Systematic Review and Meta-Analysis.**

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Cite Katz ME, Mszar R, Grimshaw AA, Gunderson CG, Onuma OK, Lu Y, Spatz ES.

JAMA Netw Open. 2024 Feb 5;7(2):e2356070. doi: 10.1001/jamanetworkopen.2023.56070.

PMID: 38353950 **Free PMC article.**

While advances in **digital health** technologies have increased individuals' access to care for **hypertension**, few studies have analyzed the use of **digital health** interventions in vulnerable populations. ...The findings suggest that tailored initiat ...

Abstract

This systematic review and meta-analysis examined whether telehealth and digital health interventions, particularly remote blood pressure (BP) monitoring, improve BP control compared with usual care among adults with hypertension living in urban and underserved settings. Across 28 randomized and cohort studies including over 8,000 participants, most interventions combined home BP monitoring with telehealth support, culturally tailored education, and care team follow-up. Compared with usual care alone, telehealth-based BP monitoring was associated with significantly greater reductions in systolic blood pressure at both 6 and 12 months, demonstrating improved BP control in populations experiencing health disparities. These findings suggest that telehealth BP monitoring is an effective strategy for improving hypertension management in urban adults and may help reduce persistent inequities in cardiovascular outcomes

Katz, M. E., Mszar, R., Grimshaw, A. A., Gunderson, C. G., Onuma, O. K., Lu, Y., & Spatz, E. S. (2024). Digital Health Interventions for Hypertension Management in US Populations Experiencing Health Disparities: A Systematic Review and Meta-Analysis. JAMA network open, 7(2), e2356070.

<https://doi.org/10.1001/jamanetworkopen.2023.56070>

Remote Patient Monitoring Is Associated with Improved Outcomes in Hypertension: A Large, Retrospective, Cohort Analysis.

Smith W, Colbert BM, Namouz T, Caven D, Ewing JA, Albano AW.

Healthcare (Basel). 2024 Aug 9;12(16):1583. doi: 10.3390/healthcare12161583.

PMCID: PMC11353537

Hypertension (HTN) is a chronic condition that requires careful **monitoring** and management.

...Individuals at cardiac and primary care clinics were prescribed a **remote patient-monitoring** (RPM) program. Patients were sent blood pressure monitors t ...

Abstract:

This retrospective analysis evaluated the impact of remote patient monitoring (RPM) on blood pressure (BP) control among adults with hypertension receiving care in medical clinics. Patients enrolled in an RPM program were provided cellular-enabled BP monitors that transmitted readings automatically. Trends in hypertension management were compared between a year of conventional therapy and a minimum of 90 days of RPM participation. Among 6,595 enrolled patients, the mean duration of RPM participation was 289 days. At baseline, 66.3% of patients had uncontrolled hypertension, including 37.5% with stage 2 hypertension. Following at least 90 days of RPM, the proportion of patients with uncontrolled hypertension decreased to 40.2%, and stage 2 hypertension decreased to 19.1%. Significant reductions in systolic BP were observed, with mean decreases of 7.3 mmHg across all patients and 16.7 mmHg among those with stage 2 hypertension. Mean arterial pressure also improved significantly among patients with uncontrolled hypertension. These findings indicate that RPM is associated with meaningful improvements in BP control and support the use of telehealth-based monitoring as an effective strategy for chronic hypertension management.

Smith, W., Colbert, B. M., Namouz, T., Caven, D., Ewing, J. A., & Albano, A. W. (2024). Remote Patient Monitoring Is Associated with Improved Outcomes in Hypertension: A Large, Retrospective, Cohort Analysis. *Healthcare (Basel, Switzerland)*, 12(16), 1583. <https://doi.org/10.3390/healthcare12161583>

Conclusions:

1. **Tucker et al., 2017**
 - a. Self-monitoring combined with telemonitoring or other support lowered systolic BP by about 4–6 mmHg, while self-monitoring alone showed minimal benefit
2. **Margolis et al., 2022**
 - a. SBP declined by a similar amount (18–19 mm Hg) in both groups from 157 to 139 mm Hg over 12 months of follow-up. DBP declined by 10 mm Hg in both groups (from 93 mm Hg in clinic-based care and 90 mm Hg in telehealth care).
3. **Katz et al., 2024**
 - a. At 6 and 12 months of follow-up, individuals who received a digital health intervention had a 4.24 mm Hg and 4.30 mmHg greater reduction in SBP compared with those in a control group, respectively
4. **Park et al., 2021**

- a. Across 32 urban-based RCTs, individuals using remote blood pressure monitoring achieved a 4.46 mm Hg greater reduction in systolic blood pressure and a 2.08 mm Hg greater reduction in diastolic blood pressure compared with those receiving usual care.

5. **Smith et al., 2024**

- a. Overall, SBP decreased by 7.3mmHg and DBP decreased by 4.4mmHg. RPM improved SBP, DBP, PP, and MAP across all users and especially those with uncontrolled or stage 2 HTN.

Clinical bottom line:

Katz et al., 2024 – Strongest for Urban Populations

- Digital BP intervention reduced SBP by 4.24–4.30 mmHg at 6 & 12 months.
- Directly studied underserved Black & Hispanic adults in urban settings.
- Real-world design showing meaningful BP improvement.

Park et al., 2021 – Strongest Overall Evidence

- Meta-analysis of 32 urban-based RCTs (highest-quality evidence).
- Remote BP monitoring lowered SBP by 4.46 mmHg and DBP by 2.08 mmHg vs usual care.
- Consistent improvement across large, diverse urban groups.

Tucker et al., 2017 was a Strong RCT with Clear Mechanism, showing that

- telemonitoring improves BP control by adding continuous support and feedback
- Self-monitoring alone was not effective, highlighting the need for guided care.
- The use of individual patient data strengthened the reliability of the findings.

Together, these studies show that telemonitoring DOES improves BP control, especially in high-risk urban population