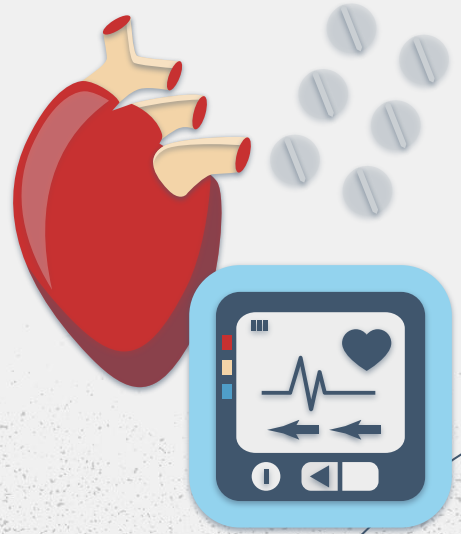
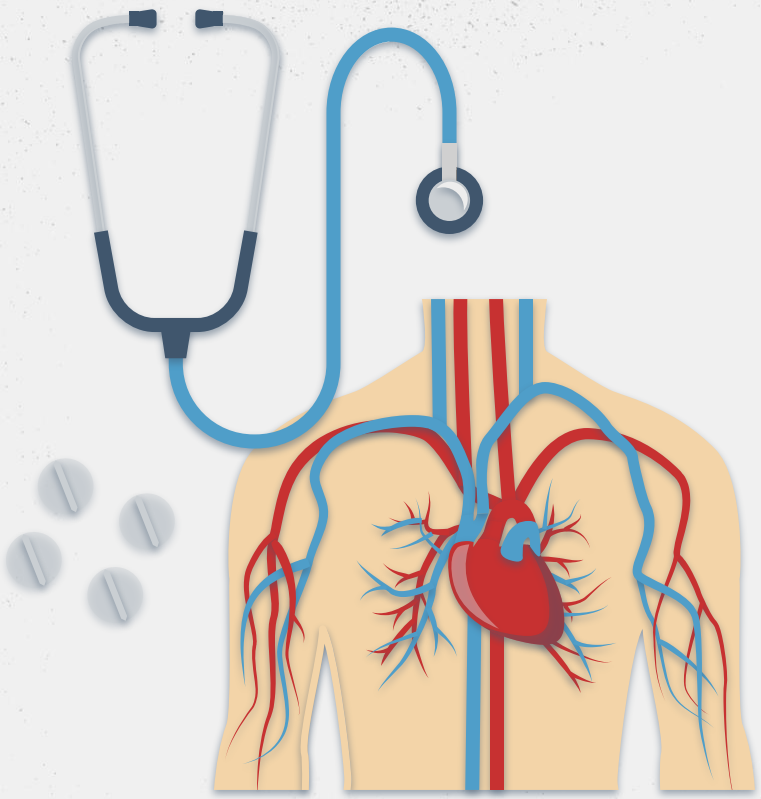
You've just attended a dinner sponsored by a company that **makes home blood pressure monitors for telehealth applications.** It sounds interesting, but you want more information. **What is the evidence that telehealth blood pressure monitoring improves blood pressure control in urban populations?**

Presented by: Saima Afrin, Salma Benitez, Amy Dong, Jeleeta Jolly, Sirat Zafar





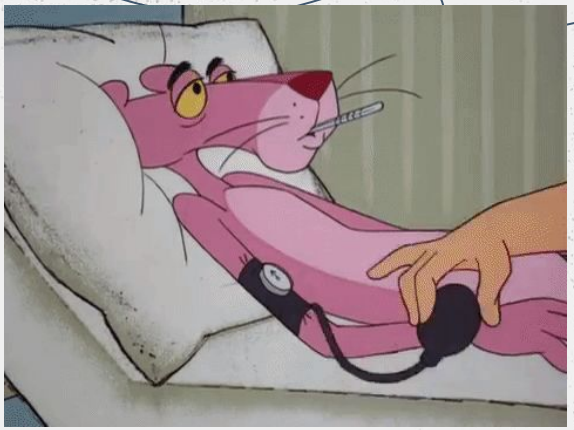
Clinical Question

Does telehealth blood pressure monitoring improve BP control in urban adults with hypertension compared to those receiving only usual care?

PICO Search Terms:

Population	Intervention	Comparison	Outcome
Urban population	Blood pressure monitoring	Usual care	Improved blood pressure control
Hypertension	Telehealth monitoring		
	Digital health		

Search Strategy Summary



Terms Used

- Telehealth in the urban AND hypertensive patients
- Telehealth for high blood pressure
- Remote blood pressure monitoring

Database searched

- Pubmed: Search criteria gave **123 results,** after applying the filters it narrowed down to **40**- selected the ones most relevant to our clinical question
- Cochrane: Search criteria gave **40 results**, after applying filters it narrowed to **1**
- Trip database: Search criteria gave **18 results**, none were applicable to our clinical question

Articles used

- Choose studies that were based on recent findings, involved a form of telehealth (remote or digital subset), appropriate sample size and duration of the study to measure the effects of telehealth on blood pressure
    - **Pubmed- 5 articles**

Appraised Articles

1. Self-monitoring of blood pressure in hypertension: A systematic review and individual patient data meta-analysis. [Tucker et al., 2017]
2. Comparing Pharmacist-Led Telehealth Care and Clinic-Based Care for Uncontrolled High Blood Pressure: The Hyperlink 3 Pragmatic Cluster-Randomized Trial. [Margolis et al., 2022]
3. An Updated Meta-Analysis of Remote Blood Pressure Monitoring in Urban-Dwelling Patients with Hypertension. [Park et al., 2021]
4. Digital Health Interventions for Hypertension Management in US Populations Experiencing Health Disparities: A Systematic Review and Meta-Analysis. [Katz et al., 2024]
5. Remote Patient Monitoring Is Associated with Improved Outcomes in Hypertension: A Large, Retrospective, Cohort Analysis [Smith et al., 2024]

1. Self-monitoring of blood pressure in hypertension: A systematic review and individual patient data meta-analysis. [Tucker et al., 2017]

CRITERIA

- Adults with hypertension
- 25 RCTs pooled
- Home BP self-monitoring ≥24 weeks
- Uncontrolled or elevated baseline BP

METHODS

- Individual patient data meta-analysis
- Adjusted for age, sex, baseline BP, comorbidities
- Subgroups: high baseline BP, need for med change, co-interventions

PROCEDURE

Intervention:

- Home BP self-monitoring
- Telemonitoring in many trials
- Some lifestyle or medication-support components

Control:

- Usual care with routine office visits

Article #1 Results

RESULTS

- Self-monitoring + telemonitoring → ↓ SBP by ~4–5 mmHg
- Self-monitoring alone → **minimal effect**
- DBP changes were minimal
- **Greatest benefit**: high baseline BP or med adjustment needed

LIMITATIONS

- Interventions varied across studies
- Few trials in urban populations
- Short follow-up (6–12 months)

BIAS

- **Selection bias**: tech-savvy patients overrepresented
- **Performance bias**: behavior changed due to monitoring

2. Comparing Pharmacist-Led Telehealth Care and Clinic-Based Care for Uncontrolled High Blood Pressure: The Hyperlink 3 Pragmatic Cluster-Randomized Trial. [Margolis et al., 2022]

CRITERIA

- Adults ages 18-85
- Moderately severe uncontrolled hypertension defined as BP > 150/95
  - > 2 HTN related visits within past 24 months
  - Saw their PCP in past 12 months
  - Current visit with PCP at same clinic
  - Current BP > 150/95 twice

METHODS

- Randomized controlled trial
- 21 primary care clinics in an integrated health system (HealthPartners)
- Randomization based on age, sex, race
- Excluded if pregnant, Stage 5 CKD, in hospice care or nursing home

PROCEDURE

Telehealth Care Group:

- BP monitored via home devices. Follow ups with pharmacist every 2 to 4 weeks.

Clinic Based Care Group:

- Face to face visits with PCP for BP monitoring, treatment adherence, and regular follow ups at 2 to 4 week intervals until BP was controlled.

Article #2 Results

RESULTS

- 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
- DBP declined significantly by **10 mm Hg** in both groups (from **93 mm Hg** in clinic-based care and **90 mm Hg** in telehealth care)
- No significant change in BP reduction overall between the two groups (**-0.8 mmHg**).
- Reported a decrease in their sense of burden in caring for their hypertension, and adherent patients reported more burden related to measuring BP, but less time away from work and other responsibilities.

LIMITATIONS

- Clinicians and participants were not blinded.
- The patients were not limited to the urban population.
- Limited protocol adherence
- Cost-effectiveness is not addressed

BIAS

- **Attention Bias:** Telehealth patients had structured follow-ups but clinic based patients had different amounts of provider contact.

3. An Updated Meta-Analysis of Remote Blood Pressure Monitoring in Urban-Dwelling Patients with Hypertension. [Park et al., 2021]

CRITERIA

- **Adults ≥18 years in urban populations** with diagnosed hypertension
- **Duration**: 2–18 months
- **Participants required the ability to:**
  - Measure BP at home
  - Transmit BP readings (phone, web, Bluetooth, mobile app, etc.)
- **Excluded:**
  - Studies were excluded for acute illness, unclear location, unusable BP data, or non-urban samples.

METHODS

- **Systematic review + meta-analysis**
- **Outcomes analyzed:**
  - Primary: Change in office SBP and DBP
  - Secondary: BP control rate (proportion reaching target BP)

PROCEDURE

Intervention:

- **Patients used home BP monitors and transmitted readings via**: Bluetooth devices, Mobile phone apps, or Web portals

Control:

- **Standard in-person office-based hypertension management with clinic BP checks**

Article #3 Results

RESULTS

- RBPM → ↓ **SBP by ~4.5 mmHg**
- RBPM → ↓ **DBP by ~2.1 mmHg**
- BP control rate ↑ **by ~24% vs usual care**
- **Stronger effect in:**
  - Larger cities (≥1 million population)
  - More frequent BP transmission (daily > weekly > monthly)
  - Non-medically underserved areas
- **Greatest benefit** with short-duration interventions (≤3 months)

LIMITATIONS

- Differences in monitoring methods, care settings, and BP targets across studies

BIAS

- **Selection bias:**
  - Only urban-accessible populations studies
  - More tech-comfortable patients included
- **Performance bias:**
  - BP monitoring itself may improve adherence (Hawthorne effect)
  - Increased contact may influence behavior

4. Digital Health Interventions for Hypertension Management in US Populations Experiencing Health Disparities: A Systematic Review and Meta-Analysis. [Katz et al., 2024]

- **Systematic review and meta-analysis that examined 28 studies**
  - Evaluated whether digital blood pressure monitoring improve BP control in underserved, urban U.S. populations

- **CRITERIA for 28 studies**
  - **Adults ≥18 years old** with hypertension or taking antihypertensive medication
  - Focus on **medically underserved groups** from **urban communities**
    - Black, Hispanic, low-income, uninsured
    - NYC, Chicago, Houston, Newark, Minneapolis, LA — all urban areas
  - **Digital health/telehealth BP intervention strategies** that were culturally/linguistically **tailored** to the populations

- **Methods & Outcomes Studied:**
  - **Databases searched:** Cochrane, Embase, MEDLINE, PubMed, Scopus, Web of Science, Google Scholar
    - Study types included: **RCTs & Cohort studies**
  - **Baseline and follow-up SBP and DBP levels at 3, 6, 12, 18, or 24 months**
  - **Difference in BP between telehealth/digital intervention groups and usual care**
    - Interventions include remote BP monitoring, text reminders, mobile apps, telehealth coaching

Article #4 Results

- **Digital health interventions significantly improved systolic BP compared with usual care**
  - **6 months: ↓ 4.24 mmHg (p = .01)**
  - **12 months: ↓ 4.30 mmHg (p = .04)**
- **DBP changes** were smaller and not statistically significant overall
- **Remote BP monitoring was the primary driver**
- High engagement and adherence were reported when **digital tools were paired with ongoing support**

LIMITATIONS

- **High heterogeneity** across studies
  - Different digital tools, frequencies of BP monitoring, coaching styles, and cultural tailoring
- **Few long-term studies** – only 4 studies reported outcomes beyond 1 year
- Cost and sustainability were **not assessed**

BIAS

- **Publication Bias**
  - Studies showing no benefit may be less likely to be published, meaning the review could **overestimate the effectiveness** of telehealth BP interventions

5. Remote Patient Monitoring Is Associated with Improved Outcomes in Hypertension: A Large, Retrospective, Cohort Analysis [Smith et al., 2024]

CRITERIA

Population / Participants

- **Adult patients with diagnosed HTN** referred to a RPM (remote patient monitoring) program by their healthcare providers
- Received at least one year of conventional **(non-RPM)** treatment for HTN before enrollment
- **Duration**: 90 days–298 days
- **Participants required the ability to:**
  - Measure BP at home
  - Transmit BP readings

Excluded: Patients who

- Did **not** remain in RPM for at least 90 days, **or**
- Transmitted BP readings for **<30% of the days**

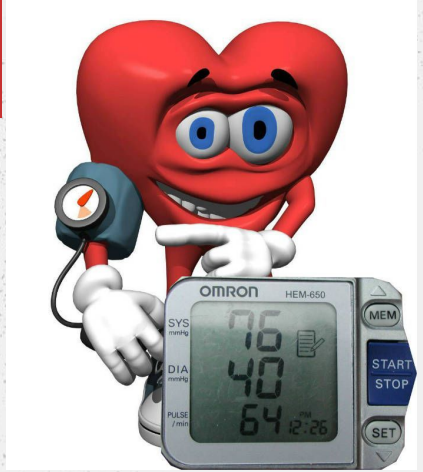
METHODS

- **Retrospective cohort study with 6,595 Participants**
- **Outcomes analyzed:**
  - Primary: Change in SBP, DBP and pulse pressure
  - Secondary: Duration of RPM with decrease in MAP

PROCEDURE

Intervention:

- **A cellular-enabled home blood pressure cuff.** Automatically transmitted BP readings to the healthcare providers
- **Clinical follow-up based on transmitted BP** – Abnormal or elevated readings triggered alerts.
  – Providers could adjust medications, schedule follow-ups, or intervene remotely.



Article #5 Results

RESULTS

- RPM → ↓ **SBP by 7.3 mmHg overall**
  - **uncontrolled HTN: 11.9 mmHg**
  - **Stage 2 HTN: 16.7 mmg hg**
- RPM → ↓ **DBP by ~4.4 mmHg overall**
  - **uncontrolled HTN group: 6.8 mmHg**
  - **stage 2 HTN group: 9.0 mmg hg**

Duration of RPM had a direct relationship on the decline of MAP

- Patients who participated in the program for more than 155 days achieved greater reductions in MAP compared to those who were involved for only 90–154 days

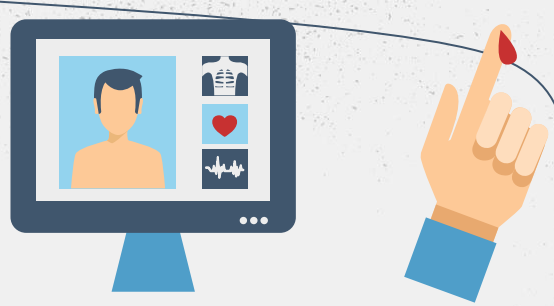
LIMITATIONS

- **No Control Group for Comparison:** improvements in blood pressure cannot be attributed solely to the RPM program.
- **Device-Dependent Measurement:** BP readings relied on correct use of a single cellular-enabled cuff.
- **Limited generalizability:** Participants were drawn from clinics already using the RPM platform

BIAS

- **Selection bias:** The participants that were referred to the RPM program were part of Health Snap and chosen by their clinician to participate
- **Confounding bias:** other factors driving blood pressure improvements, like: changes in medication, lifestyle,or more attention from providers

Summary of Mini-CAT Grid



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:
Telehealth & BP Control in Urban Populations

- After appraising each of the articles, we found that the strongest and most persuasive articles drew these conclusions

Katz et al., 2024 — Strongest for Urban Populations

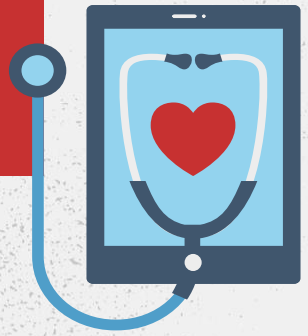
- Digital intervention lowered SBP 4.24–4.30 mmHg at 6 & 12 months.
- Focused on underserved Black & Hispanic urban adults.
- Real-world study with meaningful BP improvement.

Park et al., 2021 — Strongest Overall Evidence

- Meta-analysis of 32 urban RCTs.
- Remote BP monitoring reduced SBP 4.46 mmHg and DBP 2.08 mmHg.
- Consistent benefit across diverse urban populations.

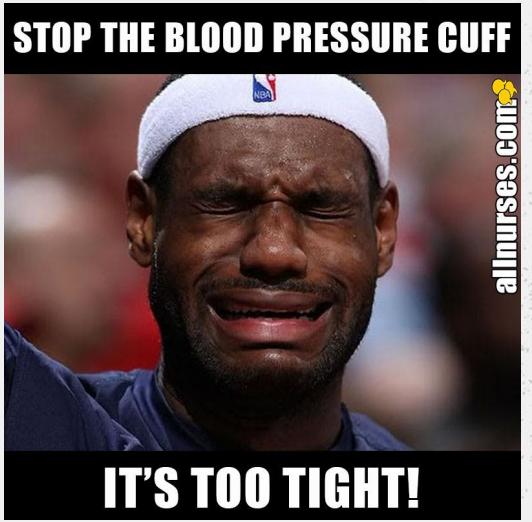
Tucker et al., 2017 — Strong RCT with Clear Mechanism

- Telemonitoring improved BP control by providing continuous feedback and clinician support.
- Self-monitoring alone was not effective without guided care.
- Individual patient data increased the study's reliability



HOWEVER ,

1. **Urban populations were not consistently studied** across all trials; some findings must be cautiously generalized.
2. **Interventions varied widely** (different devices, transmission frequency, coaching styles, digital tools), reducing comparability.
3. Many studies had **short follow-up durations** (3–12 months), limiting evidence for long-term BP control.
4. Bias concerns:
    a. **Selection bias:** participants were often tech-comfortable or already engaged in care.
    b. **Performance bias**: frequent monitoring itself may improve adherence (Hawthorne effect).
5. **Cost-effectiveness and sustainability** were rarely evaluated, especially in underserved urban settings.



RESOURCES

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THANK YOU!


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