Choice of home blood pressure monitoring device: the role of device characteristics among Alaska Native and American Indian peoples

Ashley F. Railey1,2*, Denise A. Dillard3, Amber Fyfe-Johnson2, Michael Todd3, Krista Schaefer3 and Robert Rosenman2

Abstract

Background: Home blood pressure monitoring (HBPM) is an effective tool in treatment and long-term management of hypertension. HBPM incorporates more data points to help patients and providers with diagnosis and management. The characteristics of HBPM devices matter to patients, but the relative importance of the characteristics in choosing a device remains unclear.

Methods: We used data from a randomized cross-over pilot study with 100 Alaska Native and American Indian (ANAI) people with hypertension to assess the choice of a wrist or arm HBPM device. We use a random utility framework to evaluate the relationship between stated likely use, perceived accuracy, ease of use, comfort, and participant characteristics with choice of device. Additional analyses examined willingness to change to a more accurate device.

Results: Participants ranked the wrist device higher compared to the arm on a 5-point Likert scale for likely use, ease of use, and comfort (0.3, 0.5, 0.8 percentage points, respectively). Most participants (66%) choose the wrist device. Likely use (wrist and arm devices) was related to the probability of choosing the wrist (0.7 and −1.4 percentage points, respectively). Independent of characteristics, 75% of participants would be willing to use the more accurate device. Ease of use (wrist device) and comfort (arm device) were associated with the probability of changing to a more accurate device (−1.1 and 0.5 percentage points, respectively).

Conclusion: Usability, including comfort, ease, and likely use, appeared to discount the relative importance of perceived accuracy in the device choice. Our results contribute evidence that ANAI populations value accurate HBPM, but that the devices should also be easy to use and comfortable to facilitate long-term management.

Keywords: Blood pressure, Home blood pressure monitoring, Preferences, Alaska Native, American Indian

Background

Home blood pressure monitoring (HBPM) is an effective tool in the treatment and long-term management of hypertension [1]. Incorporating regular monitoring of blood pressure at home into treatment plans may help improve hypertension control by increasing the number of readings, reducing white-coat and masked hypertension, facilitating patient understanding of blood pressure,
of either an arm or a wrist HBPM device, coupled with limited patient experience with HBPM devices at Southcentral Foundation, prompted us to use a random utility framework to evaluate tradeoffs between the two devices [26, 31]. The findings from our analysis directly inform the provision of either an arm or wrist HBPM device at Southcentral and suggest potential barriers to long-term use.

Methods

Setting and study sample

The data used for this analysis come from a randomized cross-over pilot study at Southcentral Foundation (SCF). SCF provides primary care services to over 65,000 ANAI adults living in Southcentral Alaska, including Anchorage, the rural Matanuska Susitna Borough, and 55 remote villages [32]. SCF services are “prepaid” based on legislative agreements between the United States and tribes.

SCF conducted a 2-week cross-over study to evaluate the preferences and performance of a wrist (Omron Series 7, BP654) and an arm (Omron Series 10, BP786N) HBPM device in a sample of 100 ANAI adults with hypertension. At baseline, research staff measured arm and wrist circumference. Participants then had their blood pressure measured with both HBPM devices and from a calibrated aneroid sphygmomanometer. The order of devices was randomized across participants and device readings were not blinded. Following the blood pressure measurements, participants received a questionnaire containing information on basic demographics and responses to the arm and wrist cuff devices, including likely use at home, perceived device accuracy, ease of use, and comfort. Participants finished by stating their choice for either the arm or the wrist device to use at home and whether they would change to the other device if it was found to be more accurate (see Fig. 1 for data collection order). For this pilot study, participants then took each device home for a 1-week trial, with the order randomized across participants. This study was approved by the Alaska Area Institutional Review Board and tribal leadership of Southcentral Foundation and the Alaska Native Tribal Health Consortium.

Measures

The device choice was between a wrist or arm cuff. The characteristics assessed included likely use at home, perceived accuracy, ease of use, and comfort ranked on a 5-point Likert scale. We retained the full Likert scale responses specified as a linear relationship to maintain degrees of freedom, as well as to model the decision between cuff devices on a continuum. Ease of use and comfort were assessed given their frequent citation as the distinguishing features of blood pressure monitoring...
devices [10, 11]. Perceived accuracy was elicited as a measure of perceived quality after the participants had their blood pressure taken on the three devices [33–35]. The stated likelihood of use reflects the participants’ perceived self-motivation to routinely use the chosen device to measure blood pressure over an extended amount of time [36, 37]. After choosing the preferred device, the participants were asked their willingness to change to the other device if the other proved more accurate. The question intended to evaluate the stability of preferences in the presence of additional information. We assess the choice to change as a binary outcome between those who were ‘very willing’ to change devices from those who were ‘unwilling or willing but hesitant’. In all analyses, we controlled for age as a continuous variable, gender (woman/men), whether a participant has any college education as a dichotomous variable, annual household income across three categories (< $35,000; $35–59,999; $60,000+), and device fit (arm and wrist circumference).

Statistical analysis
We employed summary statistics and logistic regressions to evaluate the relationships between each device’s characteristics, likelihood of using each device, participant demographics, and the choice of device. Following the ordering of questions and random utility framework, we separately evaluated the choice of the wrist device and the willingness to change devices if the other cuff device was more accurate [38]. Non-response on any of the variables was treated as missing values and excluded from the analysis (n = 19) after assessing for non-randomness. Less than 10% of any one variable exhibited missing values. All analyses were performed in Stata 16.

Results
Table 1 outlines the summary statistics for the participant demographics and select device characteristics. The average participant age was 51 years old and 60% were women. Most of the participants reported some college/college education (64%) compared to less than college. Fewer than 10% had upper arm or wrist circumferences that exceeded the manufacturer’s recommended size (≤ 43.2 cm and ≤ 21.5 cm, respectively). The wrist device on average read higher than the arm and with greater variation (for full details on device performance see [39]). Of the two devices, 66% initially chose the wrist and 34% chose the arm. When asked if the participant was willing to take home the other, non-preferred device if it was more accurate, 75% were very willing to change and 25% were unwilling or willing but hesitant.

Table 2 shows the ranking of device characteristics on a continuous scale. The full distribution of the rankings appears in Additional file 1: Table S1. Overall, participants ranked the wrist device higher compared to the arm on likelihood of use (2.8 vs. 2.5), ease of use (3.6 vs. 3.1), and comfort (3.6 vs. 2.8). The participants ranked the arm device higher for perceived accuracy (2.7 vs. 2.4). These trends remain when comparing the difference in device rankings and by choice of device (Additional file 1: Table S2).

The results on participant choice of the wrist cuff appear in Table 3. The likelihood of using the wrist and arm devices were associated with choosing the wrist device (0.7 percentage point and − 1.4 percentage points, respectively). For example, ‘not at all likely’ to use the wrist device was associated with a 0.4 probability of choosing the wrist and ‘extremely likely’ was associated with a 0.9 probability of choosing the wrist device. Similarly, ‘not at all likely’ to use the arm device was related to a 0.9 probability of choosing the wrist device while ‘extremely likely’ to use the arm device was related to a 0.2 probability of choosing the wrist device. Income was marginally associated with choice of wrist device. Additional specifications supporting the strength of relationship between likelihood of use, the device characteristics, and probability of choosing the wrist device appear in the
Table 1  Selected characteristics of HBPM device preference study participants, n = 100

| Variable                                                | n = 100 |
|---------------------------------------------------------|---------|
| Age, mean (SD)                                          | 51 (12) |
| Gender                                                  | 40      |
| Men                                                     |         |
| Income                                                  | 44      |
| $0–34,999                                               |         |
| $35–59,999                                              | 32      |
| $60,000+                                                | 24      |
| Education                                               | 64      |
| Some college/college                                    |         |
| Device choice                                           | 66      |
| Wrist                                                   |         |
| Willingness to change                                   | 75      |
| Yes                                                     |         |
| Wrist circumference in cm, mean (SD)                    | 18 (2)  |
| Arm circumference in cm, mean (SD)                      | 35 (6)  |
| Sphygmomanometer blood pressure in mmHg                 | 133/80 (14/11) |
| Wrist cuff device blood pressure in mmHg, mean systolic/diastolic (SD) | 139/85 (20/15) |
| Arm cuff device blood pressure in mmHg, mean systolic/diastolic (SD) | 131/84 (17/12) |

Responses from baseline survey at Southcentral Foundation
SD standard deviation

Table 2  Average rank of device characteristic, stratified by device

| Variable                          | Wrist | Arm | P value |
|-----------------------------------|-------|-----|---------|
| Overall rank (scale 1–5)          |       |     |         |
| Likelihood of use (n = 98)         | 2.8   | 2.5 | 0.05    |
| Perceived accuracy (n = 91)        | 2.4   | 2.7 | < 0.01  |
| Ease of use (n = 96)               | 3.6   | 3.1 | < 0.01  |
| Comfort (n = 96)                   | 3.6   | 2.8 | < 0.01  |

Participants provided responses for both devices. Responses from baseline survey at Southcentral Foundation. Two-sided t tests. Rankings based on a 5-point Likert scale, where 1 = “not at all likely,” “completely inaccurate,” or “very dissatisfied” and 5 = “extremely likely,” “completely accurate,” or “very satisfied.”

Table 4 presents the results on the characteristics associated with the willingness to change to the other device if it was found to be more accurate. The ease of using the wrist device and the comfort of the arm device were associated with the probability of changing devices. Being ‘very dissatisfied’ with the ease of use and comfort was associated with a 0.9 and 0.5 probability, respectively, of being willing to change devices. The comfort of the arm device had the largest association with the probability of changing devices among the arm characteristics (0.5 percentage point). The likelihood of using either device appeared to be minimally associated with the willingness to change devices. Age was associated with the willingness to change to the more accurate device (− 0.9 percentage point).

Discussion

Our study evaluated the role of preferences for HBPM device characteristics in the choice of either a wrist or an arm cuff device. We found that the likelihood of use at home was strongly associated with choice of device. Likelihood of use may reflect perceptions of future self (i.e., self-efficacy, motivation, self-control, executive function) [40], which would lend support to extant studies that cite the burden of taking blood pressure readings over an extended amount of time as a determinant of use [41]. Age and income may likewise be capturing self-management constraints through a potential relationship with the portability of the arm cuff [10]. Our results accord with the literature on blood pressure management decisions [42] and long-term use [26, 43] to suggest that patient constraints will likely influence choosing the most accurate device and willingness to change devices despite the substantial reductions in structural barriers from shifting to home monitoring.
Device usability has been cited as a significant barrier to choosing the more accurate arm cuff [10]. Our study further suggests that the tangible measures of usability (ease of use and comfort) may influence long-term use through the willingness to change cuffs [41]. Similar to comparisons between ambulatory and home blood pressure monitoring [12, 44], the more comfortable and easier to use wrist device was preferred to the arm device despite lower accuracy. A clear tradeoff in the decision to change to the more accurate device occurred between not wanting to change from the ease of using the wrist device to the (dis)comfort of the arm device. This occurs regardless of device cuff fit based on arm and wrist circumference. With respect to facilitating long-term use, increasing the comfort of the arm device jointly with increased information on the accuracy of the arm device may help reduce the relative importance of easy use in the HBPM decision.

Participants appeared to discount their perceptions of accuracy in the choice of device. Perceived accuracy was not the strongest or most consistent factor to influence choice of device. Accuracy and reliability reflect the essential metrics of quality from a clinical perspective [1] but user perceptions of quality may vary from clinical standards due to instances of inaccurate or unreliable HBPM blood pressure readings. This occurs in the absence of opportunities to learn about product quality [45–47], or in the case of the choice between an arm or a wrist cuff device, when the choices are substitutes to collect clinical data. Over time, a higher than expected reading may lead to increased patient use of the HBPM device either to continually reassess the accuracy of the reading [48] or because the patient believes the reading is true and sees a need for

### Table 3  Device and participant characteristics associated with choosing the wrist cuff device among HBPM study participants (n = 81)

| Characteristic   | Marginal effects | [95% conf. interval] |
|------------------|------------------|----------------------|
| Wrist ranking    |                  |                      |
| Likelihood of use| 0.7              | [0.2 1.2]            |
| Perceived accuracy| 0.6              | [−0.2 1.5]          |
| Ease of use      | −0.1             | [−1.4 1.3]          |
| Comfort          | 0.6              | [−0.6 1.9]          |
| Arm ranking      |                  |                      |
| Likelihood of use| −1.4             | [−2.5 0.4]          |
| Perceived accuracy| −0.1             | [−1.1 0.9]          |
| Ease of use      | −0.8             | [−2.4 0.9]          |
| Comfort          | 0.3              | [−0.6 1.1]          |
| Age              | 0.1              | [−0.9 1.2]          |
| Education        |                  |                      |
| Some college/college| 0.0              | [−0.2 0.2]          |
| Income           |                  |                      |
| 35–59,999        | −0.0             | [−0.2 0.2]          |
| 60,000+          | −0.2             | [−0.4 0.0]          |
| Gender           |                  |                      |
| Men              | −0.1             | [−0.3 0.1]          |
| Circumference    |                  |                      |
| Wrist            | 1.9              | [−2.2 6.0]          |
| Mid-upper arm    | 0.0              | [−3.1 3.1]          |

Responses from baseline survey at Southcentral Foundation. Binary outcome logit model where wrist device = 1 and arm device = 0. Estimated with robust standard errors

* Marginal effects are interpreted for continuous regressors as elasticities at the mean where the dependent, outcome variables and independent variables change at a constant rate. The categorical variables are the marginal values taken as an approximate percentage effect of the variable in response to a discrete change from zero to one, while holding all other parameters constant.

### Table 4  Device and participant characteristics associated with willingness to change to a more accurate device among HBPM study participants (n = 81)

| Characteristic   | Marginal effects | [95% conf. interval] |
|------------------|------------------|----------------------|
| Wrist ranking    |                  |                      |
| Likelihood of use| 0.2              | [−0.2 0.6]          |
| Perceived accuracy| 0.1              | [−0.4 0.5]          |
| Ease of use      | −1.1             | [−2.1 0.0]          |
| Comfort          | 0.7              | [−0.2 1.5]          |
| Arm ranking      |                  |                      |
| Likelihood of use| 0.1              | [−0.4 0.5]          |
| Perceived accuracy| 0.2              | [−0.4 0.8]          |
| Ease of use      | −0.5             | [−1.2 0.3]          |
| Comfort          | 0.5              | [0.1 1.5]           |
| Choice of wrist cuff| 0.2              | [−0.1 0.5]          |
| Age              | −0.9             | [−1.7 0.0]          |
| Education        |                  |                      |
| Some college/college| 0.0              | [−0.2 0.2]          |
| Income           |                  |                      |
| 35–59,999        | 0.0              | [−0.2 0.2]          |
| 60,000+          | −0.1             | [−0.3 0.2]          |
| Gender           |                  |                      |
| Men              | 0.0              | [−0.2 0.2]          |
| Circumference    |                  |                      |
| Wrist            | −0.5             | [−3.3 2.2]          |
| Mid-upper arm    | −0.5             | [−2.7 1.7]          |

Responses from baseline survey at Southcentral Foundation. Binary outcome logit model where willingness to change = 1 and ‘unwilling/willing but hesitant’ = 0. Estimated with robust standard errors

* Marginal effects are interpreted for continuous regressors as elasticities at the mean where the dependent, outcome variables and independent variables change at a constant rate. The categorical variables are the marginal values taken as an approximate percentage effect of the variable in response to a discrete change from zero to one, while holding all other parameters constant. More accurate defined as the opposite of the chosen device. For example, for those who chose the wrist device, the more accurate device was presented as the arm.
continual monitoring [33, 49]. Conversely, patients have been shown to prefer devices that report lower than expected readings [34], which would have the opposite effect on long-term use. Thus, the relationship between perceived device accuracy and adherence over time warrants further investigation.

Relationships with providers influence perceptions of quality and can be especially important in traditionally disadvantaged and at-risk populations [50]. In the case of choosing between an arm or a wrist device, information on the actual device accuracy was limited during the baseline visit, such that participants would have to infer the quality of the two devices based on previous experiences with high quality care at SCF. Patients at SCF can expect exceptional access and availability to primary healthcare services [32], but both the arm and the wrist were new devices which may have signaled uniform quality, especially in the absence of price. The ambiguous effect of perceived device accuracy on long-term outcomes offers the potential for long-term feedback about HBPM from providers or treatment modifications to adjust for HBPM reading trends [51]. The negative impact of choosing a less accurate device on clinical outcomes may be minimal when coupled with the standard of patient care that is found at SCF.

Strengths and limitations
Our study benefited from occurring alongside a clinical trial in which participants use a HBPM device in a healthcare center that intends to offer HBPM to its patients. The consequentiality of their responses provided a strong incentive to reveal true preferences [52]. Beyond the trial setting, the choice between an arm or a wrist device appropriately reflects the current decision environment for HBPM devices [53]. Our subsequent ability to assess device choice following a random utility framework gave us the advantage of defining the importance of device characteristics and demographics in the decision.

The primary limitation of using pilot data for secondary, exploratory analyses is sample size. This included confining our ability to explore how ranking perceptions of accuracy and actual accuracy interact to influence the choice of device or using traditional mixed, latent class models in the random utility framework to retrieve clinically meaningful changes in device characteristics [54]. Omitted variable bias presents the greatest threat to our identification strategy by not capturing additional variables related to the participant, device portability, [44] or previous experience [55]. Finally, while trial protocols attempted to reduce social desirability bias in responses and researchers’ influence on perceptions of accuracy, we cannot know the extent of variation in conversations between researchers and participants, including whether participants saw baseline blood pressure measurements.

Conclusions
The results from this study help demonstrate to providers that ANAI populations recognize the need for accurate blood pressure monitoring, but device usability cannot be sacrificed. Particularly considering the patient burden of repeated measurements per day, over multiple months, or years, underestimating the prominence of device usability is problematic. Improving the comfort of the arm device to reduce pinching or ensuring the correct device size may address initial hesitations toward the device. Devising plans between the patient and provider to alleviate the burden of use over time is an initial approach in the absence of device improvements. Importantly, relationships with providers influence perceptions of quality and can be leveraged to emphasize the subtleties in accuracy and reliability, which may impact treatment outcomes. This holds true in our ANAI sample and provides encouragement for broader acceptance of HBPM among people in traditionally underserved locations.

Abbreviations
ANAI: Alaska Native and American Indian; HBPM: Home blood pressure monitoring; SCF: Southcentral foundation.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s12872-021-02449-w.

Additional file 1. Additional summary statistics and alternative model specifications.

Acknowledgements
The authors thank the Alaska Native and American Indian participants in the study. The authors are grateful to the members of the Southcentral Foundation and Alaska Native Tribal Health Consortium research review committees for their continued review of research at the Alaska Native Medical Center campus and to the Community Advisory Board for their guidance on this study. The authors are also thankful for helpful comments from members of NCHART Methodology Core and Thomas L. Marsh.

Authors’ contributions
Conceptualization—(paper) AFR, RR, (study) AFJ, DAD, MT, KS; Methodology—AFR, RR; Formal analysis and investigation-AFR, RR; Writing-review and editing—AFR, AFJ, KS, DAD, MT, RR; Funding acquisition-DAD; Supervision-RR, AFJ. All authors have read and approved the manuscript.

Funding
This work was supported by the National Institute on Minority Health and Health Disparities of the National Institutes of Health (U54MD011240). The funding agreement ensured the authors’ independence in designing the study, interpreting the data, writing, and publishing the report. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.
Availability of data and materials

The datasets generated during and/or analyzed during the current study are not publicly available due to tribal sovereignty over research data.

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the Alaska Area Institutional Review Board, the Alaska Native Tribal Health Consortium and Southcentral Foundation’s research review bodies. In addition, the Alaska Native Tribal Health Consortium and Southcentral Foundation’s research review bodies reviewed the manuscript. Written informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

No known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Author details

1Department of Sociology, Indiana University, Bloomington, IN, USA. 2Institute for Research and Education to Advance Community Health (IREACH), Elson S. Floyd College of Medicine, Washington State University, Seattle, WA, USA. 3Southcentral Foundation, Anchorage, AK, USA.

Received: 17 August 2021 Accepted: 28 December 2021

Published online: 28 January 2022

References

1. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Denicek Himmelfarb C, et al. 2017 ACC/AHA/ABC/ACPM/AGS/APHA/ASH/ASC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: executive summary. Hypertension. 2018;71:1269–324. https://doi.org/10.1161/HYP.0000000000000686.

2. Physician HC, Unit MM, Hospital N. The use of home blood pressure monitoring. Eur Cardiol Rev. 2015;10:95–101.

3. Melville S, Teskey R, Philip S, Simpson JA, Lutchmedial S, Brunnt KR. A comparison and calibration of a wrist-worn blood pressure monitor for patient management: assessing the reliability of innovative blood pressure devices. J Med Internet Res. 2018;20(4):e111.

4. Cao X, Song C, Guo L, Yang J, Deng S, Xu Y, et al. Quality control and validation of oscillometric blood pressure measurements taken during an epidemiological investigation. Medicine (United States). 2019;98(37):e1475.

5. Kikuy M, Chonan K, Imai Y, Goto E, Ishii M. Accuracy and reliability of wrist-cuff devices for self-measurement of blood pressure. J Hypertens. 2003;20(4):629–38.

6. Roberts MC, Ferrer RA, Rendle KA, Kobrin SC, Taplin SH, Hesse BW, et al. Lay beliefs about the accuracy and value of cancer screening. Am J Prev Med. 2018;54(5):699–703.

7. Lindheim O, Bennett CB, Trentacosta CJ, Mclear C. Client preferences affect treatment satisfaction, completion, and clinical outcome: a meta-analysis [Internet]. Vol. 34. Clinical Psychology Review. Pergamon, 2014 [cited 2019 Aug 13]. p. 506–17. https://www.sciencedirect.com/science/article/pii/S0272773514000494v?via%3Dihub.

8. Rabi DM. Barriers to patient-centered care in hypertension. Can J Cardiol. 2017;33(5):586–90. https://doi.org/10.1016/j.cjca.2017.03.003.

9. Glenn L, Casey M, Walsh J, Hayes PS, Harte RP, Heaney D. Patient’s views and experiences of technology based self-management tools for the treatment of hypertension in the community: a qualitative study. BMC Fam Pract. 2015;16(1):119. https://doi.org/10.1186/12875-015-0337-3.

10. Palacholda RS, Fischer N, Coleman A, Agboula S, Kirley K, Felsted J, et al. Provider- and patient-related barriers to and facilitators of digital health technology adoption for hypertension management: scoping review. J Med Internet Res. 2019;21(3):e11951.

11. Abdullah A, Liew SM, Hanafi NS, Ng CJ, Lai PSM, Chia YC, et al. What influences patients’ acceptance of a blood pressure telemonitoring service in primary care? A qualitative study. Patient Prefer Adherence. 2016;10:99–106.

12. Tompson AC, Ward AM, McManus RJ, Perera R, Thompson MJ, Henehan CJ, et al. Acceptability and psychological impact of out-of-office monitoring to diagnose hypertension: an evaluation of survey data from primary care patients. Br J Gen Pract. 2019. https://doi.org/10.3399/bjgp19X702211.

13. Jennigaran VKB, Duran B, Ahr D, Winkleby M. Changing patterns in health behaviors and risk factors related to cardiovascular disease among American Indians and Alaska natives. Am J Public Health. 2010;100(4):677–83.

14. Redwood DG, Laniar AP, Johnston JM, Asay ED, Slattery ML. Chronic disease risk factors among Alaska Native and American Indian People, Alaska, 2004–2006. Prev Chronic Dis. 2010;7(4). www.cdc.gov/pcd/issues/2010/jul/09_0168.htm.

15. Hutchinson RN, Shin S. Systematic review of health disparities for cardiovascular diseases and associated factors among American Indian and Alaska native populations. PLoS ONE. 2014;9(1):e80973.

16. Wood S, Greenfield SM, Haque MS, Martin U, Gis PST, Mant J, et al. Influence of ethnicity on acceptability of method of blood pressure monitoring: a cross-sectional study in primary care. Br J Gen Pract. 2016;66(663):1–10.

17. Harmon Still C, Jones LM, Moss KO, Variath M, Wright KD. African American older adults’ perceived use of technology for hypertension self-management. Res Gerontol Nurs. 2018;11(5):249–56.

18. Clark MD, Determann D, Petrov S, Mio R, de Bekker-Grob EW. Discrete choice experiments in health economics: a review of the literature [Internet]. Vol. 33. PharmacoEconomics. PharmacoEconomics; 2014 [cited 2020 Mar 24]. p. 883–902. http://www.ncbi.nlm.nih.gov/pubmed/25050924.

19. Soekhai V, de Bekker-Grob EW, Ellis AR, Vass CM. Discrete choice experiments in health economics: past, present and future [Internet]. Vol. 37. PharmacoEconomics. 2019 [cited 2020 May 1]. p. 201–26. http://go.ncsu.edu/ellis.

20. Fiebig DG, Knox S, Viney R, Haas M, Street DJ. Preferences for new and existing contraceptive products. Health Econ. 2011;20(Suppl. 1):35–52. https://doi.org/10.1002/hec.1686.

21. Angell B, Laba T, Lukaszycz C, Coombes J, Eades S, Keay L, et al. Participant preferences for an aboriginal-specific fall prevention program: measuring the value of culturally-appropriate care. PLoS ONE. 2018;13(8):e0203264.

22. Jan S, Mooney G, Ryan M, Bruggemann K, Alexander K. The use of conjoint analysis to elicit community preferences in public health research: a case study of hospital services in South Australia. Aust N Z J Public Health. 2000;24(1):64–70.

23. Becker F, Douglass S. The ecology of the patient visit. J Ambul Care Manag. 2008;31(2):28–41.

24. Hanson K, McPake B, Nakamba P, Archard L. Preferences for hospital quality in Zambia results from a discrete choice experiment. Health Econ. 2005;14(7):687–701.

25. Hanson K, Yip WC, Hsiao W. The impact of quality on the demand for outpatient services in Cyprus. Health Econ. 2004;13(12):1167–80.

26. Holmes EAF, Morrison VL, Hughes DA. What influences persistence with chronic care patients. Br J Clin Pharmacol. 2016;82:522–31.

27. Rothney C, Claxton K, Palmer S, Epstein D, Tarricone R, Sculptur M. Characterising uncertainty in the assessment of medical devices and determining future research needs. Health Econ (United Kingdom). 2017;26:109–23.

28. Hwang KO, Thomas EJ, Petersen LA. Use of home blood pressure results for assessing the quality of care for hypertension. JAMA J Am Med Assoc. 2018;320(17):1753–4. https://doi.org/10.1001/jama.2018.12365.

29. Padival RS, So H, Wood PW, Mcalister FA, Siddiqui M, Norris CM, et al. Cost-effectiveness of home blood pressure telemonitoring and case management in the secondary prevention of cerebrovascular disease in Canada. J Clin Hypertens. 2019;21(2):159–68.

30. Stergiou GS, Kario K, Kallias A, McMans R, Ohkubo T, Parati E, et al. Home blood pressure monitoring in the 21st century. J Clin Hypertens. 2018;20(7):1128–32. https://doi.org/10.1111/jch.13284.
31. McFadden D. Conditional logit analysis of qualitative choice behavior. Front Econom. 1973.
32. Gottlieb K. The Nuka system of care: improving health through ownership and relationships. Int J Circumpolar Health. 2013;72(Suppl. 1):1–6.
33. Polonsky WH, Hesdier D. Perceived accuracy in continuous glucose monitoring: understanding the impact on patients [Internet]. Vol. 9, Journal of Diabetes Science and Technology. SAGE PublicationsSage CA: Los Angeles, CA, 2015 [cited 2019 Jul 8]. p. 339–41. http://journals.sagepub.com/doi/10.1177/1932296814539302.
34. Plante TB, O’Kelly AC, Urema B, MacFarlane ZT, Blumenthal RS, Charleston J, et al. User experience of instant blood pressure: exploring reasons for the popularity of an inaccurate mobile health app. NPJ Digit Med. 2018;1(1):1–6.
35. Chorão P, Pereira AM, Fonseca JA. Inhaler devices in asthma and COPD—a assessment of inhaler technique and patient preferences. Respir Med. 2014;108(7):968–75.
36. McAuley E, Jerome GJ, Marquez DX, Elavsky S, Blissmer B. Exercise self-efficacy in older adults: social, affective, and behavioral influences. Ann Behav Med. 2003;25(1):1–7.
37. Tucker KL, Earle K, Bray EP, Tabaei BP, Wakefield BJ, Godwin M, et al. Self-monitoring of blood pressure in hypertension: a systematic review and individual patient data meta-analysis. PLoS Med. 2017;14(9):e1002389.
38. Schmidt P, Maddala GS. Limited-dependent and qualitative variables in econometrics. J Am Stat Assoc. 1984.
39. Schaefer K, Fyfe-Johnson A, Noonan C, Umans J, Rosenman R, Dillard DA, et al. Home blood pressure monitoring devices: device performance in an Alaska Native and American Indian population. J Aging Health. 2021;in press.
40. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. Health Educ Behav. 1988;15(2):175–83.
41. Egan M, Philipson TJ. Health care adherence and personalized medicine. 2014. http://www.nber.org/papers/w20330.
42. Degli Esposti L, Valpiani G. Pharmacoeconomic burden of undertreating hypertension [Internet]. Vol. 22, PharmacoEconomics. 2004 [cited 2019 Sep 23]. p. 907–28. https://link.springer.com/content/pdf/10.2165%2F00019053‑200422140‑00002.pdf.
43. Abebe T, Shehab A, Gbreyehounna EA, Bhagavathula AS, Enour AA. Nonadherence to antihypertensive drugs a systematic review and meta-analysis. Medicine (United States). 2017;96(4):e5641.
44. Nasothimiou EG, Karpettas N, Dafni MG, Stengiou GS. Patients’ preference for ambulatory versus home blood pressure monitoring. J Hum Hypertens. 2014;28(4):224–9.
45. Siam ZA, McConnell M, Golub G, Nyakora G, Rothschild C, Cohen J. Accuracy of patient perceptions of maternity facility quality and the choice of providers in Nairobi, Kenya: a cohort study. BMJ Open. 2019;9(7):29486.
46. Chang JT, Hays RD, Shekelle PG, MacLean CH, Solomon DH, Reuben DB, et al. Patients’ global ratings of their health care are not associated with the technical quality of their care. Ann Intern Med. 2006;144(9):665–72.
47. Isaak T, Zaslavsky AM, Cleary PD, Landon BE. The relationship between patients’ perception of care and measures of hospital quality and safety. Health Serv Res. 2010;45(4):1024–40. https://doi.org/10.1111/j.1475‑6773.2010.01122.x.
48. Lamiraud K, Geoffard P Y. Therapeutic non-adherence: a rational behavior revealing patient preferences? Health Econ. 2007;16;1185–204.
49. Marshall U, Wolfe-CDA, McKevitt C. Lay perspectives on hypertension and drug adherence: systematic review of qualitative research. BMJ. 2012;345(7867):e3953.
50. Glickman SW, Boulding W, Manany M, Staelin R, Roe MT, Woloson RJ, et al. Patient satisfaction and its relationship with clinical quality and inpatient mortality in acute myocardial infarction. Circ Cardiovasc Qual Outcomes. 2010;3(2):188–95.
51. Shahaj O, O’Neill D, Schwappach A, Pearce G, Epiphaniou E, Parke HL, et al. Supporting self-management for people with hypertension: a meta-review of quantitative and qualitative systematic reviews. J Hypertens. 2019;37(2):264–79.
52. Carson RT. Contingent valuation: a practical alternative when prices aren’t available. J Econ Perspect. 2012;26(4):27–42. https://doi.org/10.1257/jep.26.4.27.
53. Munton P, Shimbo D, Carey RM, Charleston JB, Gaillard T, Mista S, et al. Measurement of blood pressure in humans: a scientific statement from the American Heart Association. Hypertension. 2019;73(5):e35‑66. https://doi.org/10.1161/HYP.0000000000000887.
54. Hole AR. Modelling heterogeneity in patients’ preferences for the attributes of a general practitioner appointment. J Health Econ. 2014;26(4):1078–94.
55. Murphy SM, Rosenman R, Yoder JK, Friesner DL. Patients’ perceptions and treatment effectiveness. Appl Econ. 2011;43(24):3275–88.

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