

VITAL SIGNS OF SATISFACTION

The Role of Remote
Monitoring in Patients'
Perceptions of
Telehealth



Connected Nation explores how experiences with different telehealth modalities, particularly remote patient monitoring technologies, affect attitudes about telehealth and make a case for building more IXP.

During the COVID-19 pandemic, many patients had to rely on telehealth services for medical visits. While its use has declined since the height of the pandemic, telehealth has become an increasingly common health care modality in the United States.

While several studies have assessed patients' perceptions of that care, few have paid particular attention to one of telehealth's most promising innovations: remote monitoring. Remote patient monitoring technologies (RPM) are data-driven solutions to resolving patients' health issues by transmitting health information to providers in real time. They can offer numerous benefits to patients, including saving them time and money, as well as being more convenient, especially for patients in rural areas.

But how do rural telehealth patients' perceptions of their care vary depending on the types of services they can access?

Rural Americans tend to have reservations about utilizing telehealth for virtual appointments. One review emphasizes three key themes to explain why: the importance of familiar relationships, concerns about privacy, and acceptance of limited access to care¹. Rural Americans value familiarity with their medical providers, as these repeated interactions help foster trust. With respect to virtual appointments, this population often feels that it can be difficult to establish those kinds of relationships without meeting with a provider in person².

¹ Pullyblank, Kristin. 2022. "A Scoping Literature Review of Rural Beliefs and Attitudes Toward Telehealth Utilization." *Western Journal of Nursing Research* 45 (4): 375–84. <https://doi.org/10.1177/01939459221134374>

² Lindberg, Jens, Robert Bhatt, and Anton Ferm. 2021. "Older People and Rural eHealth: Perceptions of Caring Relations and Their Effects on Engagement in Digital Primary Health Care." *Scandinavian Journal of Caring Sciences* 35 (4): 1322–31. <https://doi.org/10.1111/scs.12953>

Residents of rural areas also worry about the privacy of their information while engaging in telehealth. They express concerns that the conversations could be recorded, or someone could be listening in³. Difficulty accessing the internet only exacerbates these concerns. While rural residents appreciate familiar relationships, they also value confidentiality and would be hesitant to access telehealth services from community locations where others could be listening⁴.

Finally, rural Americans embody a sense of self-reliance and recognize the limitations of living where they do; as a result, many patients already satisfied with their health

care cannot imagine how telehealth could improve their care⁵. They accept what they have and take pride in meeting their own needs, despite limited resources.

While much of this literature emphasizes the difficulties of implementing telehealth solutions in rural areas, other studies suggest that telehealth could appeal to this population with the right information. Given that telehealth can reduce travel time and costs for patients and alleviate transportation barriers (thereby promoting autonomy and flexibility), some research suggests that rural residents endorse the use of telehealth when these benefits are emphasized⁶.

³ Sundstrom, Beth, Andrea L. DeMaria, Merissa Ferrara, Ellie Smith, and Stephanie McInnis. 2020. "People Are Struggling in This Area:' a Qualitative Study of Women's Perspectives of Telehealth in Rural South Carolina." *Women & Health* 60 (3): 352–65. <https://doi.org/10.1080/03630242.2019.1643814>

⁴ Alexander, Dayna S., Stephanie Kiser, Steve North, Courtney A. Roberts, and Delesha M. Carpenter. 2021. "Exploring Community Members' Perceptions to Adopt a Tele-COPD Program in Rural Counties." *Exploratory Research in Clinical and Social Pharmacy* 2 (May): 100023. <https://doi.org/10.1016/j.rcsop.2021.100023>

⁵ Rush, Kathy L., Linda Hatt, Nicole Gorman, Louann Janicki, Petr Polasek, and Matt Shay. 2018. "Planning Telehealth for Older Adults with Atrial Fibrillation in Rural Communities: Understanding Stakeholder Perspectives." *Clinical Nursing Research* 28 (2): 130–49. <https://doi.org/10.1177/1054773818758170>

⁶ Rasekaba, Tshepo, Helen Nightingale, John Furler, Wen Kwang Lim, Jessica Triay, and Irene Blackberry. 2021. "Women, Clinician and IT Staff Perspectives on Telehealth for Enhanced Gestational Diabetes Mellitus Management in an Australian Rural/Regional Setting." *Rural and Remote Health*, January. <https://doi.org/10.22605/rrh5983>



Telehealth can take one of four forms: virtual appointments, “store-and-forward,” mobile health (mHealth), or remote patient monitoring (RPM)⁷.

Virtual appointments involve meeting with health care providers outside the office using a computer, smartphone, or tablet. While these calls can take place over the phone, many rely on VoIP calls through proprietary software. For these cases, in addition to an internet-enabled device, the user needs internet service with sufficient latency to make these calls (roughly 150 milliseconds)⁸. Latency refers to the time it takes your internet-enabled device, the internet, and everything in between to respond during online activities.

“Store-and-forward” telehealth, also known as asynchronous telehealth, involves communicating health information to a provider who reviews it later. This information could include images, videos, a patient’s medical history, or lab reports. These interactions with providers require internet service, but only to upload the information. For this reason, this form of telehealth is the most insulated from connectivity issues because the uploads do not require a particular speed or latency.

mHealth uses dedicated applications that patients must install to transmit health information. Unlike virtual appointments, this form

of telehealth does not typically involve the patient conveying information; rather, these applications allow the patient to receive information from providers — advice for healthy living, information about disease outbreaks, etc. mHealth requires patients to have mobile internet service and an internet-enabled device on which to receive that information. However, users do not need a specific speed or latency to receive this information.

Remote patient monitoring (RPM) entails transmitting information about vital signs to health care providers in real time. This form of care allows medical professionals to monitor and detect potential issues before they worsen. RPM technologies offer several benefits that other forms of telehealth cannot. They enable older patients and those with mobility challenges to stay in their homes longer without having to relocate to an assisted living facility. Moreover, this technology helps reduce the number of hospitalizations, readmissions, and length of hospital stays, as facilities can monitor patients away from their physical locations.

Unfortunately, RPM technologies also require constant, high-speed internet connectivity with low latency⁹. Providers may not receive information in time to make necessary medical interventions if data are not continuously transferred to them. Therefore, closing the Digital Divide is especially crucial for ensuring access to these groundbreaking medical innovations.

⁷ “Getting Started with Telehealth.” <https://telehealth.hhs.gov/providers/getting-started>

⁸ Jones, Alan, Peter Sevcik, and Rebecca Wetzel. “Internet Connection Requirements for Effective Video Conferencing to Support Work from Home and eLearning.” NetForecast, https://www.netforecast.com/wp-content/uploads/NFR5137-Videoconferencing_Internet_Requirements.pdf

⁹ Vishweshwara, A., and R. Ramya. 2025. “Transforming Telemedicine: Reducing Latency Through Edge Computing and 5G — A Review.” Biomedical Materials & Devices, March. <https://doi.org/10.1007/s44174-025-00312-6>

Drawing on data from a 2024 household phone survey in the Central Upper Peninsula of Michigan (n = 1,800 adults in Alger, Delta, Dickinson, Marquette, Menominee, and Schoolcraft counties), this study explores rural telehealth patients' perceptions about the potential benefits of telehealth depending on

whether they (or someone in their household) have utilized RPM technologies to monitor seizures, heart rate, blood pressure, blood sugar, or other vital signs. Connect Nation (CN) researchers looked at how these rural telehealth patients answered **five important questions** about their telehealth experience:

FIVE MEASURES OF SUCCESS FOR TELEHEALTH SERVICE

1 Did it save time?

2 Did it save money?

3 Was it convenient?

4 Was the service on par with the quality of in-person health care visits?

5 Was the health care provider proficient and knowledgeable with the application being used?

CN compared the responses from remote patients who had used RPM technologies with those who had used other forms of telehealth. We wanted to see

how opinions differed between the two groups and whether RPM users had more positive impressions about their telehealth experiences¹⁰.

¹⁰ The methodology for deriving these results can be found in Appendix A.

'Telehealth saved me time'



Telehealth appointments provide several benefits that save time for patients. By interacting with a health care provider remotely, patients can reduce (or eliminate) travel times to and from the provider. This is particularly important for rural patients who may have to drive for hours to get to their health care provider's office. Telehealth also reduces waiting room time, and telehealth visits tend to have shorter durations than in-patient visits.

One study showed that telehealth visits saved Florida patients 2.9 hours of driving and 1.2 hours of in-clinic time for each visit¹¹. Specifically, patients who use RPM applications could reduce the number of times they had to go to a health care provider's office for routine checks of their vital signs; the devices could simply collect their information and send it directly to the medical office, who could then reach out to the patient if their vitals looked unusual.

To see if patients' opinions about time savings changed based on the type of telehealth services they used, we measured whether RPM users were more likely to agree that these types of medical services saved them time. We found that there is a small, measurable increase in the rate of agreement for

RPM users, but further analysis indicated that this was more indicative of demographic differences between RPM users and other telehealth patients.

In other words, we found that RPM users were just as likely as other telehealth users to say that telehealth applications saved them time, once other demographic factors were accounted for.

¹¹ Winstead, Edward. "Telehealth Can Save People with Cancer Time and Money." National Cancer Institute.
<https://www.cancer.gov/news-events/cancer-currents-blog/2023/telehealth-cancer-care-saves-time-money>

Telehealth appointments can save patients money in several ways. By checking in to their appointments virtually, patients avoid the costs associated with traveling to appointments, which could be substantial. Rural patients, in particular, may need to travel long distances to attend their appointments in person, which entails high fuel consumption. Patients who live far from the clinic may even need to stay overnight, meaning they would have to pay for lodging.

Telehealth appointments minimize these cost barriers by eliminating the need for travel. Additionally, patients with children could face higher costs for in-person appointments, as they may need to arrange childcare. Considering these costs, a recent study on telehealth in rural Michigan found that with an average of 4.02 health care visits each year, even for routine 15-minute visits with general practitioners, telehealth could save households an average of \$784.39 per year¹². Given that RPM technologies reduce the number of routine visits, patients in need of regular monitoring could stand to save even more.

To see if patients' perceptions about saving money differed based on the telehealth services they used, we tested whether households that used RPM were more likely to agree that these medical services saved them money. These analyses showed a significant increase in the rate of agreement for RPM users; however, further analysis revealed that demographic factors like household size and having children moderated some of that effect.

In other words, we found that RPM users were slightly more likely to agree that using telehealth applications saved them money compared with other telehealth users, after accounting for demographic differences.

**'Telehealth
saved me
money'**



¹² "Bringing Health Care Home: Telehealth Trends in Rural Michigan."
Connected Nation, December 2021.

https://s3.amazonaws.com/connected-nation/57280ecd-97d0-457c-a7c2-092acc283a0d/21_CN_TeleHealth_Michigan_hi.pdf

'Telehealth was more convenient than an in- person visit'

For many patients, telehealth services offer convenience that in-person services cannot match. After all, patients with a reliable home internet connection would not need to leave their homes to receive care. That ability to interact with providers from home affords patients greater flexibility. For example, employed patients may not need to take time off work to attend appointments. Patients with disabilities would not need to arrange transportation. Patients with children would not need to arrange childcare. This flexibility is front of mind for many prospective patients.

A recent telehealth satisfaction survey fielded by J.D. Power found that patients cited convenience as the top reason for utilizing telehealth¹³. Furthermore, RPM users may experience even greater convenience; since providers use RPM to track vital signs in real time, patients can send health information without going in for an appointment.

To determine patients' opinions on whether telehealth was more convenient than in-person visits varied based on the telehealth services they used; we examined whether RPM users were more likely to agree with the statement than other telehealth users. The results showed a significant increase in agreement among RPM users compared with other telehealth users. These findings remained significant even after controlling for key demographics like age.



¹³ "Telehealth Satisfaction Study," J.D. Power, September 24, 2024. <https://www.jdpower.com/business/healthcare/telehealth-satisfaction-study>

RPM users were significantly more likely to agree that using the application was more convenient than an in-person service, compared with other telehealth users. Moreover, this relationship was not affected by other demographic variables.

One common concern among patients who have not used telehealth is the worry that their health care would not be as good as an in-person visit. A recent study of households in the Central Upper Peninsula of Michigan found that compared with telehealth users, non-telehealth users were more concerned that their health issues would not be addressed and that their provider would not respond to the application¹⁴. That said, telehealth users typically report having positive experiences with these applications.

Another nationally representative survey found that 86% of telehealth users were satisfied with their most recent appointments¹⁵. However, less research has explored whether patients felt their telehealth care was as good as an in-person appointment, especially among RPM users.

To understand whether patients' opinions about their telehealth experience was just as good as an in-person appointment based on the modalities of care they used, we analyzed whether RPM users were more likely to agree with the statement above than other telehealth users. The results indicated a significant increase in agreement among RPM users compared with other telehealth users, even when controlling for other pertinent demographics.

This means that RPM users were significantly more likely to agree that using the application was as good as an in-person service would have been, compared with other telehealth users. Other important factors, like age and whether the respondents had children, did not impact this result.

‘Resulted in service as good as an in-person visit’

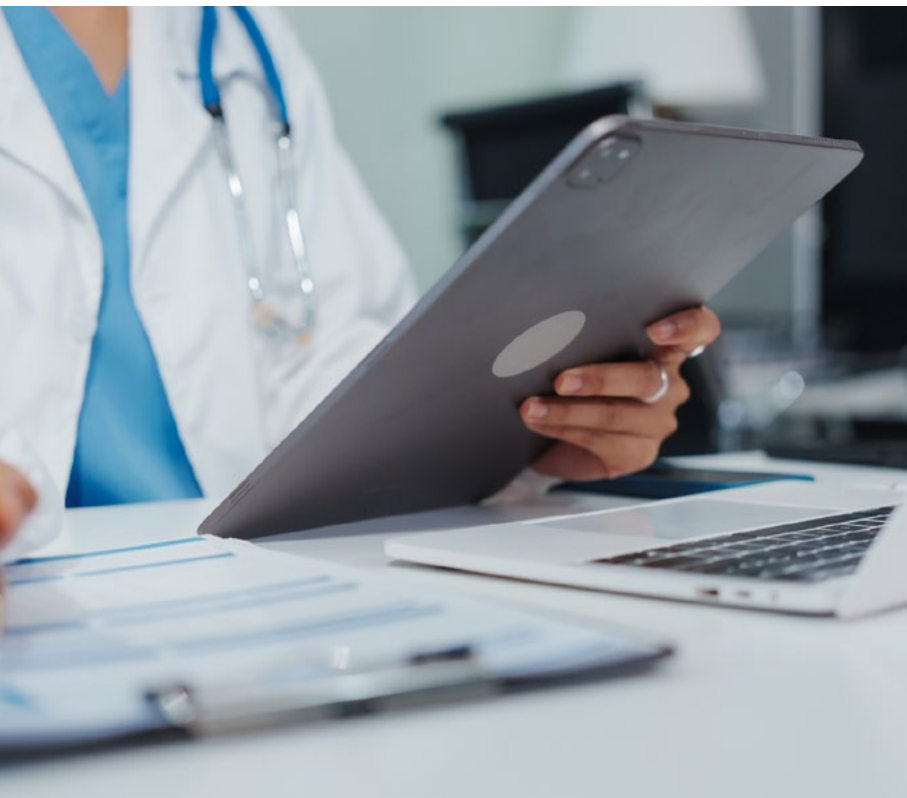


¹⁴ “Between the Lakes: Understanding Perceptions and Usage of Telehealth in the Central Upper Peninsula of Michigan.” Connected Nation, Oct. 2024. https://s3.amazonaws.com/connected-nation/79df1c60-6373-458e-a79d-02e648707b9f/24_Michigan_CUUPDA_Report_V4_9.23.pdf

¹⁵ Kyle, Michael A, Robert J Blendon, Mary G Findling, and John M Benson. “Telehealth Use and Satisfaction among U.S. Households: Results of a National Survey.” *Journal of Patient Experience* 8 (January 2021). <https://doi.org/10.1177/23743735211052737>

‘Practitioner seemed proficient and comfortable using the application’

To receive quality care, telehealth practitioners must be proficient and comfortable using the application through which they provide services. Without this fluency, patients could be left wondering about the provider’s professionalism, competence, and attentiveness — just as a provider’s demeanor impacts an in-person visit. These perceptions could be affected by several cues, like whether the provider makes eye contact through the camera, whether they are able to share results or other documents on screen, or whether they can resolve basic technical issues without a delay in care.



However, this concern should impact RPM users less than other telehealth users. These patients typically do not interact with the clinical teams that review this information. Instead, they discuss the results with a general practitioner or specialist after the fact in a follow-up appointment — not unlike a traditional telehealth appointment.

For this reason, we expected that patients’ opinions about whether the provider seemed comfortable and proficient with the application would not vary between RPM users and other telehealth users. To test whether patients were more likely to agree that the provider seemed proficient and comfortable using the application depending on their modality of care, we analyzed the likelihood of agreement with that statement for

RPM users and other telehealth users. The results illustrated no significant difference between the two groups.

In other words, we found that RPM users were just as likely to agree that the practitioner seemed proficient and comfortable using the application as other telehealth users. This result aligned with our theoretical expectations.

These results have some important policy implications. First and foremost, utilizing remote monitoring technologies could help rural residents recognize the benefits of using telehealth. RPM allows for confidential data transmission and does not require a visit to the office — affording patients additional time and money to use elsewhere. Moreover, RPM transmits this data in real time, which allows providers to catch serious issues before they develop further and saves the patient money on emergency care.

Our analyses highlighted that RPM users were more likely to agree that telehealth saved them money, that the care is more convenient than an in-person visit, and that the care is comparable in quality to what they would have received in person, compared with other telehealth users.

But the expansion of RPM technology usage also requires a robust broadband infrastructure. These innovations transmit information synchronously, meaning if coverage lapses, providers cannot receive the data necessary to keep patients healthy and safe. Rural broadband availability has long been a problem in the United States, although coverage has improved over time. In their 2024 Broadband/Internet Availability Survey Report, the NTCA reports that 76.4% of their survey respondents' customer bases have access to 1 Gbps downstream service¹⁶. The federal government is also committed to expanding broadband availability in rural areas, exemplified by the Broadband Equity, Access, and Deployment (BEAD) program administered

by the National Telecommunications and Information Administration (NTIA), the Rural Digital Opportunity Fund (RDOF) run by the Federal Communications Commission (FCC), and the Rural Utilities Service (RUS) administered by the U.S. Department of Agriculture (USDA).

While increased coverage would move us in the right direction, transmitting health information in real time also requires a low latency threshold. If the transmission is delayed, providers may fail to catch life-threatening issues and intervene in time. Latency is largely determined by distance from the network operator and/or content provider. Because these entities tend to be located in urban areas, data in rural areas must travel farther, which leads to increased latency. Some experts even posit that latency could be the next urban/rural Digital Divide for this reason¹⁷.

Building internet exchange points (IXPs) could be a key solution to this problem. IXPs are physical locations where multiple internet service providers (ISPs) and network operators come together to exchange internet traffic. They improve regional internet performance and reduce latency by keeping internet traffic local and content closer to end-users¹⁸. With respect to RPM technologies, this means fewer delays in transmitting health information to providers and potentially saved lives. In addition to expanding broadband coverage in rural areas, building IXPs should be a key priority for policymakers looking to bolster telehealth utilization, especially RPM.

¹⁶ "Broadband/Internet Availability Survey Report 2024." NTCA: The Rural Broadband Association, December 2024. <https://www.ntca.org/sites/default/files/documents/2025-01/2024-broadband-internet-availability-report.pdf>

¹⁷ Engebretson, Joan. "Will Latency Be the Next Rural/Urban Digital Divide?" Telecompetitor, February 14, 2024. <https://www.telecompetitor.com/will-latency-be-the-next-rural-urban-digital-divide/>

¹⁸ "Internet Exchange Points: Programs," Connected Nation, July 26, 2023. <https://connectednation.org/programs/internet-exchange-points>

This study relies on several items from the survey to evaluate the impact of RPM exposure on respondents' perceptions of their telehealth care. In particular, the survey asked: "Would you strongly agree, mostly agree, mostly disagree, or strongly disagree with these statements about the online health applications that you used?" The five prompts that serve as dependent variables include "using the application saved me time," "using the application saved me money," "using the application was more convenient than an in-person visit would have been," "using the application resulted in service that was as good as I would have received during an in-person visit," and "the practitioner seemed proficient and comfortable using the application."

The primary independent variable, RPM exposure, derives from the survey question "In the past 12 months, have you or anyone in your household used any of these online health services?" Respondents were prompted with a list of options, which included "gait, seizure, or falls monitoring," "remote heart rate monitoring," "remote blood pressure monitoring," "remote blood sugar monitoring," and "remote monitoring of other vital signs." These variables were originally coded dichotomously; this study then created a new dichotomous RPM variable measuring whether the respondent (or anyone in their household) used any of these services.

This research also considers several demographic control variables that could influence respondents' perceptions of their telehealth experiences. Including these variables in multivariate models shows whether the independent variable remains significant or if other factors better explain the variance.

The first, "age 65+," is a dichotomous variable indicating whether the respondent is 65 or older. This demographic group often struggles with using internet-enabled technologies, which could affect their telehealth experiences. "Household income under 25k" dichotomously measures whether the respondent lives in a household that collectively earns less than \$25,000 per year. This group may be less inclined to seek medical care (and therefore telehealth/RPM) due to concerns about cost, and this barrier could also influence their overall perceptions of care.

"Households with children" is a dichotomous measure indicating whether the respondent has any children under 18 living in their household. This demographic tends to utilize telehealth at higher rates than respondents without children, as they may benefit more from some of telehealth's inherent advantages over traditional health care. Finally, "household size" is a continuous variable measuring the number of individuals living in the respondent's household. Because the RPM variable derives from a survey question that asks about all household members, respondents from larger households may be more likely to have RPM exposure.

This study relies on ordered logistic regression models to test the theorized relationship between RPM (a dichotomous independent variable) and telehealth perceptions (ordinal dependent variables). Results from these models illustrate how different factors (like RPM) affect the likelihood of being in a higher or lower category of the outcome (perceptions of telehealth care).

Table 1: “Using the application saved me time”

The table below depicts Models 1 and 2, which examine the relationship between RPM exposure and the perception that “using the application saved [them] time.”

	MODEL 1 (Bivariate)	MODEL 2 (Multivariate)
Remote Monitoring	0.195+ (0.104)	0.144 (0.119)
Age 65+		-0.292* (0.140)
Household Income Under 25K		0.199 (0.326)
Households with Children		0.405** (0.144)
Household Size		0.048 (0.060)
Num.Obs.	1421	1253
AIC	2748.4	2292.9
BIC	2769.4	2333.9
RMSE	3.20	3.25

+ p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.001

Table 2: “Using the application saved me money”

The table below shows the results from Models 3 and 4, using the dependent variable “using the application saved [them] money.”

	MODEL 3 (Bivariate)	MODEL 4 (Multivariate)
Remote Monitoring	0.490*** (0.103)	0.201+ (0.118)
Age 65+		-0.369** (0.140)
Household Income Under 25K		-0.421 (0.311)
Households with Children		0.812*** (0.061)
Household Size		0.231*** (0.061)
Num.Obs.	1421	1253
AIC	3083.7	2489.3
BIC	3104.7	2530.3
RMSE	3.08	3.12

+ p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.001

Table 3: “Using the application was more convenient than an in-person visit”

The table below depicts the results from Models 5 and 6, which use the dependent variable “using the application was more convenient than an in-person visit would have been.”

	MODEL 5 (Bivariate)	MODEL 6 (Multivariate)
Remote Monitoring	0.343*** (0.103)	0.282* (0.118)
Age 65+		-0.297* (0.139)
Household Income Under 25K		0.383 (0.318)
Households with Children		0.546*** (0.145)
Household Size		0.073 (0.060)
Num.Obs.	1421	1253
AIC	2919.1	2388.1
BIC	2940.1	2429.2
RMSE	3.16	3.20

+ p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.001

Table 4: “Using the application resulted in service that was as good as I would have received during an in-person visit”

The table below illustrates Models 7 and 8, testing the relationship between RPM exposure and the dependent variable “using the application resulted in service that was as good as I would have received during an in-person visit.”

	MODEL 7 (Bivariate)	MODEL 8 (Multivariate)
Remote Monitoring	0.386*** (0.104)	0.358** (0.119)
Age 65+		-0.448** (0.139)
Household Income Under 25K		-0.284 (0.324)
Households with Children		0.664*** (0.145)
Household Size		-0.006 (0.060)
Num.Obs.	1421	1253
AIC	2843.3	2329.0
BIC	2864.3	2370.1
RMSE	3.19	3.23

+ p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.001

Table 5: “The practitioner seemed proficient and comfortable using the application”

Finally, Table 5 shows the results from Models 9 and 10, which test the relationship between RPM exposure and the dependent variable “the practitioner seemed proficient and comfortable using the application.”

	MODEL 9 (Bivariate)	MODEL 10 (Multivariate)
Remote Monitoring	0.003 (0.104)	-0.006 (0.119)
Age 65+		-0.173 (0.140)
Household Income Under 25K		0.319 (0.320)
Households with Children		0.482*** (0.145)
Household Size		-0.010 (0.060)
Num.Obs.	1421	1253
AIC	2731.3	2304.4
BIC	2752.3	2345.4
RMSE	3.20	3.23

+ p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.001