BMJ Open

# Telehealth service use and quality of care among US adults with diabetes: A cross-sectional study of the 2022 health information national trends survey

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**To cite:** Hong Y-R, Xie Z, Nguyen OT, *et al*. Telehealth service use and quality of care among US adults with diabetes: A cross-sectional study of the 2022 health information national trends survey. *BMJ Open* 2024;**14**:e086418. doi:10.1136/bmjopen-2024-086418

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-086418).

Received 14 March 2024
Accepted 30 September 2024



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## ABSTRACT

**Objective** To characterise telehealth use, reasons for using or not using telehealth and the factors associated with telehealth use among US adults with diabetes.

**Design** A cross-sectional study.

**Setting** Data were sourced from the 2022 Health Information National Trends Survey.

**Participants** US adults aged 18 years or older with self-reported diagnosis of diabetes (both type 1 and type 2).

**Primary and secondary outcomes** Past 12-month utilisation of telehealth services, modality (eg, video, voice only), overall perception of quality of care, perceived trust in healthcare system and patient-centred communication score.

**Results** In an analysis of 1116 US adults with diabetes, representing 33.6 million individuals, 48.1% reported telehealth use in the past year. Telehealth users were likely to be younger, women, with higher income, and urban dwellers. Older adults (≥65 years) were less likely to use telehealth compared with those aged 18–49 years (OR 0.43, 95% CI 0.20 to 0.90). Higher income and more frequent healthcare visits were predictors of telehealth usage, with no significant differences across race, education or location. Across respondents with telehealth usage, 39.3% reported having video-only, 35.0% having phone (voice)-only and 25.7% having both modalities. The main motivations included provider recommendation, convenience, COVID-19 avoidance and guidance on in-person care needs. Non-users cited preferences for in-person visits, privacy concerns and technology challenges. Patient-reported quality-of-care outcomes were comparable between telehealth users and non-users, with no significant differences observed by telehealth modality or area of residence (metro status).

**Conclusions** Around half of US adults with diabetes used telehealth services in the past year. Patient-reported care quality was similar for telehealth and in-person visits. However, further efforts are needed to address key barriers to telehealth adoption, including privacy concern, technology difficulties, and care coordination issues.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A large, nationally representative sample of US adults with diabetes, allowing for generalisability of findings.
⇒ A comprehensive assessment of telehealth usage patterns, motivations and barriers.
⇒ This cross-sectional study provides only a snapshot of telehealth use patterns, limiting the ability to infer causality between telehealth use and patient-reported quality-of-care outcomes.
⇒ Lack of provider-level information and clinical outcomes (eg, glycated haemoglobin levels).
⇒ Inability to differentiate between type 1 and type 2 diabetes or the nature of telehealth visits (endocrinology vs primary care).

## INTRODUCTION

Since the COVID-19 pandemic, there has been a considerable upsurge in the endorsement and adoption of telehealth, which is the provision of healthcare services using virtual technology and platforms.[1 2] In the USA, the implementation of telehealth services has been extensively adopted by both patients and providers due to the Coronavirus Aid, Relief, and Economic Security Act and the Centers for Medicare and Medicaid Service's reimbursement-related changes.[1 3] Growing evidence has shown that telehealth expansion has improved access to care and both patient and provider satisfaction.[4–6] A recent review study found most (>90%) patients reported satisfaction with their telehealth experience during the COVID-19 pandemic.[4] Additionally, a survey conducted in 2021 by the American Medical Association revealed that more than 80% of physicians surveyed reported that their patients have better access to healthcare since using telehealth services; and over 50% of physicians felt that telehealth increased their professional satisfaction.[5] Our previous work using national physician survey data also found that more than 80% of US physicians (weighted n=277 480) reported they had the intention to sustain telehealth services even after the pandemic.[7]

The effectiveness of telehealth services in managing chronic conditions, particularly diabetes, is well documented through improvements in clinical outcomes such as glycated haemoglobin (HbA1c) and blood pressure.[6 8 9] During the COVID-19 pandemic, telehealth utilisation among low-income patients with type 2 diabetes—a historically undertested population[10]—led to increased provider engagement and a 15% rise in HbA1c testing.[6] Patients using telehealth services also demonstrated superior HbA1c control compared with those receiving only in-person care, achieving an overall reduction of 0.49% in HbA1c levels.[8] Moreover, a recent meta-analysis of 10 clinical trials, primarily involving black and Hispanic patients, revealed that telehealth interventions were associated with a significant pooled reduction of 0.47% in HbA1c (95% CI −0.65% to −0.28%).[9] These findings suggest that telehealth is not only an effective tool for diabetes management but also a means to address health disparities. By improving both access to care and clinical outcomes, particularly for underserved populations, telehealth demonstrates its potential to advance chronic disease management.

Although telehealth has become more widely used for diabetes management,[11–13] there is still a lack of understanding about how it is used, obstacles to its adoption and the quality of care provided to this population.[10] Limited evidence exists regarding telehealth use patterns, barriers faced and perceived quality of care among individuals with diabetes. More research at the population level is needed to address telehealth disparities and help inform practices and training for high-quality diabetes management. To address this gap, we analysed nationally representative data to characterise telehealth use, reasons for using or not using telehealth and the factors associated with telehealth use among US adults with diabetes. We also evaluated patient-reported quality of care outcomes (overall quality, trust and patient-centred communication (PCC)) between telehealth users and non-users.

## METHODS

### Data and study population

This study conducted a secondary analysis of data from the 2022 Health Information National Trends Survey (HINTS 6), a nationally representative survey administered by the National Cancer Institute (NCI). HINTS gathers information on health communication, information-seeking behaviours and cancer knowledge and perceptions from US adults aged 18 years and older, irrespective of cancer status.[14] HINTS employs a stratified sample design, with an oversampling of minority populations and rural addresses. Data collection for HINTS 6 occurred from March to November 2022, yielding 6252 respondents and a final weighted response rate of 28.1%.[14] Further details on the survey design and sampling methodology are available at https://hints.cancer.gov/. The sample was restricted to respondents with self-reported diagnosis of diabetes (both type 1 and type 2) and complete data on telehealth use (n=1190). We also excluded those who did not have any visits to their healthcare provider (n=74), resulting in a final analytic sample of 1116 respondents. This study, a secondary analysis of deidentified, publicly available data from the HINTS survey, was approved as an exemption by the Institutional Review Board at the University of Florida and did not require additional ethics approval or informed consent. The original HINTS data collection was approved by the relevant institutional review boards, and informed consent was obtained from all individual participants.[14] We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology criteria for study reporting.[15]

### Telehealth services: usage, reasons for usage and reasons to avoid

The primary outcome was the past 12-month utilisation of telehealth services. Study participants were provided with the definition *A telehealth visit is a telephone or video appointment with a doctor or health professional.* They were then asked, *In the past 12 months, did you receive care from a doctor or health professional using telehealth?* with response options of yes by video, yes by phone, yes by both, or no. A binary indicator of any telehealth use (yes/no) was created. This study also aimed to understand the reasons for using and not using telehealth services. Participants were asked why they chose to have a telehealth visit. The options given were: *The health care provider recommended or required the visit use telehealth, I wanted to avoid possible infection at the doctor's office or hospital (for example, COVID-19 or flu), It was more convenient than going to the doctor (for example, less travel or wait times)* and *I could include family or other caregivers in their appointment.* Reasons for not using telehealth included: *I preferred to have the appointment(s) in person, I was concerned about the privacy of telehealth visits* and *I thought the technology would be difficult to use.*

### Quality of care, trust and PCC

Patient-reported quality-of-care outcomes were assessed with three measures in the HINTS: (1) overall perception of quality of care, (2) perceived trust in healthcare system and (3) PCC. To evaluate the overall quality of healthcare, a question was asked to the participants: *How would you rate the quality of healthcare you have received in the last 12 months?* The response options were excellent, very good, fair and poor. To gauge the level of trust in the healthcare system, another question was asked: *How much do you trust the healthcare system, including hospitals, pharmacies, and other organizations involved in healthcare?* The response options included not at all, a little, some and a lot. To assess the quality of PCC, we used the HINTS-based PCC scale. This scale consists of seven questions developed by the NCI to measure the efficacy of PCC. The questions evaluate various aspects of communication, such as the opportunities provided for patients to ask questions, emotional validation, shared decision-making, treatment understanding, explanation clarity, time adequacy and uncertainty management. Each question is rated on a

**Table 1** Respondents' characteristics by status of telehealth use and multivariable-adjusted odds of having telehealth use in the past 12 months

| Characteristics | Number (unweighted) | Number (weighted)* | Telehealth use % (95%CI) | | | Telehealth use |
|---|---|---|---|---|---|---|
| | | | No (n=626) | Yes (n=564) | P value | OR (95% CI) |
| Sample | 1116 | 36 632 338 | 51.9 (46.4–57.4) | 48.1 (42.6–53.6) | | |
| Age | | | | | 0.155 | |
| 18–49 | 144 | 8 745 482 | 20.1 (12.9–27.3) | 28.0 (19.7–36.2) | | 1.00 |
| 50–64 | 389 | 12 976 628 | 34.5 (29.2–39.7) | 36.5 (29.3–43.6) | | 0.60 (0.31 to 1.19) |
| 65+ | 583 | 14 910 229 | 45.4 (38.4–52.5) | 35.6 (29.1–42.1) | | 0.43 (0.20 to 0.90) |
| Sex | | | | | 0.099 | |
| Male | 464 | 18 273 527 | 53.7 (47.6–59.7) | 45.8 (38.7–53.0) | | 1.00 |
| Female | 652 | 18 358 811 | 46.3 (40.3–52.4) | 54.2 (47.0–61.3) | | 1.44 (0.94 to 2.22) |
| Race/ethnicity | | | | | 0.969 | |
| NH white | 507 | 19 410 361 | 53.1 (46.8–59.4) | 52.8 (46.5–59.2) | | 1.00 |
| NH black | 235 | 6 144 491 | 17.5 (12.3–22.6) | 16.0 (10.8–21.2) | | 0.87 (0.44 to 1.73) |
| Hispanic | 216 | 5 988 876 | 15.8 (11.7–19.9) | 16.9 (11.5–22.3) | | 1.05 (0.50 to 2.18) |
| Other | 158 | 5 088 610 | 13.6 (9.0–18.3) | 14.2 (9.4–19.0) | | 1.28 (0.64 to 2.58) |
| Education | | | | | 0.020 | |
| <High school | 93 | 3 195 264 | 8.3 (5.3–11.3) | 9.2 (0.6–17.8) | | 1.00 |
| High school | 254 | 10 264 306 | 34.1 (26.3–41.9) | 21.4 (15.1–27.7) | | 0.53 (0.13 to 2.16) |
| Some college | 352 | 14 884 296 | 38.5 (30.1–46.9) | 42.9 (34.6–51.3) | | 0.70 (0.17 to 2.88) |
| College graduate+ | 417 | 8 288 472 | 19.1 (14.7–23.5) | 26.4 (20.3–32.5) | | 0.87 (0.21 to 3.71) |
| Marital status | | | | | 0.188 | |
| Not single † | 527 | 20 389 174 | 52.4 (46.0–58.9) | 59.1 (51.6–66.7) | | 1.00 |
| Single | 589 | 16 243 164 | 47.6 (41.1–54.0) | 40.9 (33.3–48.4) | | 0.79 (0.50 to 1.25) |
| Household income (2022 USD) | | | | | 0.027 | |
| <$35 k | 433 | 12 937 216 | 42.4 (35.9–49.0) | 27.7 (19.0–36.3) | | 1.00 |
| $35k–<$75 k | 366 | 12 643 892 | 28.7 (22.7–34.7) | 40.8 (32.6–48.9) | | 2.14 (1.14 to 3.98) |
| ≥$75 k | 317 | 11 051 230 | 28.9 (23.7–34.1) | 31.6 (23.9–39.2) | | 1.37 (0.75 to 2.50) |
| Internet access | | | | | <0.001 | |
| No | 261 | 7 040 626 | 25.3 (19.5–31.0) | 12.7 (9.5–15.9) | | 1.00 |
| Yes | 855 | 29 591 712 | 74.7 (69.0–80.5) | 87.3 (84.1–90.5) | | 1.62 (0.96 to 2.73) |
| Insurance coverage | | | | | 0.223 | |
| Yes | 1063 | 35 130 876 | 95.0 (92.3–97.7) | 96.9 (95.2–98.6) | | 1.00 |
| No | 53 | 1 501 463 | 5.0 (2.3–7.7) | 3.1 (1.4–4.8) | | 0.69 (0.23 to 2.08) |
| Census region | | | | | 0.168 | |
| Northeast | 138 | 5 865 309 | 16.0 (11.3–20.6) | 16.0 (10.7–21.4) | | 1.00 |
| Midwest | 179 | 7 322 860 | 22.6 (16.0–29.2) | 17.2 (13.9–20.5) | | 0.67 (0.34 to 1.35) |
| South | 559 | 15 980 186 | 44.7 (36.9–52.6) | 42.4 (34.6–50.3) | | 0.87 (0.45 to 1.67) |
| West | 240 | 7 463 984 | 16.7 (11.0–22.4) | 24.3 (18.6–30.1) | | 1.27 (0.60 to 2.71) |
| Metro area ‡ | | | | | 0.040 | |
| No | 157 | 4 989 570 | 16.4 (11.8–21.0) | 10.6 (7.4–13.9) | | 1.00 |
| Yes | 959 | 31 642 768 | 83.6 (79.0–88.2) | 89.4 (86.1–92.6) | | 1.49 (0.91 to 2.44) |
| Number of chronic conditions § | | | | | 0.644 | |
| 1 | 183 | 6 683 070 | 20.3 (13.1–27.4) | 16.1 (10.7–21.5) | | 1.00 |
| 2 | 499 | 15 828 175 | 41.6 (35.4–47.8) | 44.9 (36.7–53.1) | | 1.57 (0.81 to 3.07) |
| 3–5 | 434 | 14 121 093 | 38.1 (31.4–44.8) | 39.0 (30.9–47.1) | | 1.53 (0.72 to 3.23) |

Continued

Table 1 Continued

| Characteristics | Number (unweighted) | Number (weighted)* | Telehealth use % (95%CI) | | | Telehealth use |
|---|---|---|---|---|---|---|
| | | | No (n=626) | Yes (n=564) | P value | OR (95% CI) |
| Perceived health status | | | | | 0.483 | |
| Poor/fair | 367 | 11 567 910 | 30.3 (24.7–35.9) | 33.0 (26.5–39.4) | | |
| Good/excellent | 749 | 25 064 428 | 69.7 (64.1–75.3) | 67.0 (60.6–73.5) | | 0.85 (0.54 to 1.32) |
| Number of provider visits | | | | | 0.002 | |
| 1–2 | 299 | 10 893 831 | 37.2 (30.3–44.1) | 21.7 (16.5–26.8) | | 1.00 |
| 3 | 207 | 6 077 322 | 17.3 (12.4–22.2) | 15.8 (10.7–21.0) | | 1.60 (0.85 to 3.01) |
| >3 | 610 | 19 661 186 | 45.5 (38.3–52.7) | 62.5 (55.8–69.2) | | 2.30 (1.38 to 3.81) |

*The weighted number might exhibit slight variations due to mathematical rounding up.
†Married or living with a romantic partner.
‡Counties in metro areas of ≥250 000 population.
§Including diabetes, hypertension, chronic lung conditions, heart disease and cancer.
NH, Non-Hispanic.

Likert scale, and the cumulative score ranges from 0 to 100, reflecting the patients' overall communication experience. We sorted the PCC scores into four quartiles to address negative skewness and for ease of analysis.

### Covariates

We considered socioeconomic demographic and health-related factors as covariates that are known to moderate telehealth or health service use, including age group (18–49, 50–64, 65+), sex at birth (male, female), race and ethnicity (non-Hispanic white, non-Hispanic black/African American, Hispanic other (Asian, Pacific Islander, American Natives, multiracial)), education (less than high school, high school graduate, some college, college degree or higher), marital status (single, not single (married or living with a romantic partner)), family income (<$35 000, $35 000 to <$75 000, ≥$75 000 in 2022 USD), internet access (had access to the Internet or send and receive e-mail), insurance status (had insurance or not), census region (northeast, midwest, south, west), area of residence (metro area or non-metro based on rural–urban commuting area system), the number of comorbidities (hypertension, chronic lung conditions, heart disease and cancer) from available survey data, perceived health status (poor/fair, good/excellent), and the number of provider visits in the past 12 months.

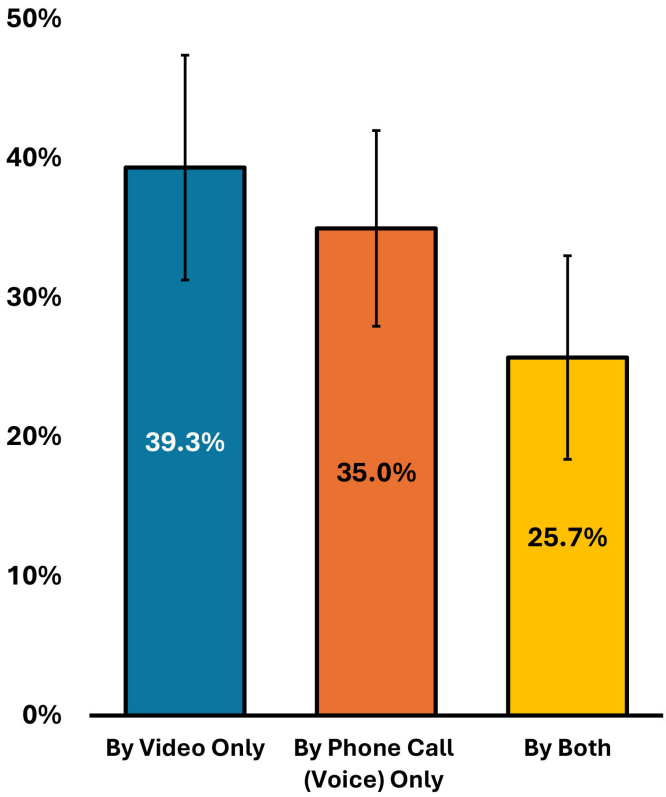


Figure 1 Telehealth modality type among US adults with diabetes in 2022. *Error bars indicate 95% CI.

### Statistical analyses

Survey-weighted descriptive analyses were performed to examine the socioeconomic demographics and health-related characteristics of study participants with patterns of telehealth use. Due to the complex survey design of HINTS, we employed jackknife replication weights to account for SE adjustments. Bivariate associations between participants' characteristics and telehealth use were evaluated using Wald $\chi^2$ statistics and weighted relative proportions. Multivariable logistic regression analysis was used to examine the relationship between predictor variables and the use of telehealth, including all covariates listed above. We conducted a weighted bivariate analysis to compare three quality-of-care outcomes between the telehealth use group and the non-telehealth use group. We then enumerated the reported reasons for telehealth use and non-use. To explore potential disparities in telehealth utilisation based on geographical location, we performed a subgroup analysis with another bivariate analysis to compare telehealth use patterns and study outcomes between metro and non-metro areas. All statistical analyses were performed using SAS V.9.4 software and we defined statistical significance as p<0.05 in

**Table 2** Characteristics of telehealth users by telehealth modality

| Characteristics | Number (unweighted) | Number (weighted)* | Telehealth use % (95%CI) | | | P value |
|---|---|---|---|---|---|---|
| | | | By video only (n=202) | By phone call (voice) only (n=225) | By both (n=116) | |
| Sample | 543 | 17 623 468 | 39.3 (31.3–47.4) | 35.0 (27.9–42.0) | 25.7 (18.4–33.0) | |
| Age | | | | | | <0.001 |
| 18–49 | 90 | 4 926 387 | 36.1 (17.7–54.4) | 16.5 (10.9–22.0) | 31.2 (13.5–48.8) | |
| 50–64 | 187 | 6 424 929 | 38.4 (26.7–50.2) | 28.1 (19.4–36.7) | 44.9 (26.1–63.6) | |
| 65+ | 266 | 6 272 151 | 25.5 (15.0–36.0) | 55.5 (48.0–63.0) | 24.0 (11.8–36.1) | |
| Sex | | | | | | 0.518 |
| Male | 213 | 8 075 146 | 49.5 (37.5–61.6) | 40.3 (31.3–49.4) | 47.6 (26.7–68.6) | |
| Female | 330 | 9 548 322 | 50.5 (38.4–62.5) | 59.7 (50.6–68.7) | 52.4 (31.4–73.3) | |
| Race/ethnicity | | | | | | 0.642 |
| NH white | 238 | 9 313 940 | 60.2 (50.4–70.0) | 46.4 (36.0–56.7) | 50.4 (32.4–68.4) | |
| NH black | 114 | 2 825 451 | 14.0 (6.7–21.4) | 16.1 (9.7–22.5) | 18.9 (2.2–35.7) | |
| Hispanic | 117 | 2 982 861 | 13.5 (6.8–20.2) | 18.7 (13.1–24.4) | 19.7 (5.2–34.2) | |
| Other | 74 | 2 501 215 | 12.2 (4.6–19.9) | 18.7 (11.2–26.2) | 11.0 (1.4–20.6) | |
| Education | | | | | | 0.015 |
| <High school | 39 | 1 618 800 | 13.2 (0.0–32.2) | 10.8 (5.4–16.2) | 0.8 (0–1.9) | |
| High school | 101 | 3 778 071 | 14.7 (7.6–21.8) | 29.8 (18.4–41.2) | 20.4 (5.7–35.2) | |
| Some college | 172 | 7 569 010 | 41.2 (29.5–52.9) | 35.1 (24.7–45.6) | 56.2 (38.7–73.7) | |
| College graduate+ | 231 | 4 657 586 | 30.9 (18.2–43.5) | 24.3 (17.1–31.5) | 22.5 (11.0–34.0) | |
| Marital status | | | | | | 0.049 |
| Not single † | 276 | 10 422 494 | 62.8 (45.0–80.6) | 48.5 (38.6–58.5) | 68.0 (52.0–83.9) | |
| Single | 267 | 7 200 973 | 37.2 (19.4–55.0) | 51.5 (41.5–61.4) | 32.0 (16.1–48.0) | |
| Household income (2022 USD) | | | | | | 0.091 |
| <$35 k | 188 | 4 872 901 | 23.9 (6.0–41.8) | 38.0 (28.5–47.4) | 19.3 (9.1–29.6) | |
| $35k–<$75 k | 199 | 7 186 397 | 44.9 (31.4–58.4) | 33.8 (23.8–43.9) | 44.0 (25.4–62.6) | |
| ≥$75 k | 156 | 5 564 170 | 31.2 (18.5–44.0) | 28.2 (19.3–37.1) | 36.7 (19.2–54.1) | |
| Internet access | | | | | | <0.001 |
| No | 92 | 2 239 457 | 4.3 (2.1–6.5) | 25.3 (18.3–32.2) | 8.5 (2.5–14.5) | |
| Yes | 451 | 15 384 010 | 95.7 (93.5–97.9) | 74.7 (67.8–81.7) | 91.5 (85.5–97.5) | |
| Insurance coverage | | | | | | 0.201 |
| Yes | 520 | 17 076 524 | 98.1 (96.4–99.8) | 94.3 (89.8–98.7) | 98.6 (96.9–100) | |
| No | 23 | 546 944 | 1.9 (0.2–3.6) | 5.7 (1.3–10.2) | 1.4 (0–3.1) | |
| Census region | | | | | | 0.179 |
| Northeast | 65 | 2 828 443 | 10.5 (2.7–18.3) | 18.5 (10.2–26.9) | 21.1 (3.7–38.6) | |
| Midwest | 73 | 3 028 644 | 22.7 (15.2–30.2) | 13.9 (8.4–19.5) | 13.1 (3.2–23.1) | |
| South | 259 | 7 476 603 | 47.4 (34.6–60.2) | 33.0 (22.6–43.5) | 47.6 (28.4–66.7) | |
| West | 146 | 4 289 778 | 19.4 (7.8–30.9) | 34.5 (25.5–43.4) | 18.2 (9.1–27.2) | |
| Metro area‡ | | | | | | 0.515 |
| No | 60 | 1 871 827 | 10.9 (6.1–15.7) | 8.2 (3.6–12.7) | 13.5 (3.0–24.1) | |
| Yes | 483 | 15 751 641 | 89.1 (84.3–93.9) | 91.8 (87.3–96.4) | 86.5 (75.9–97.0) | |
| Number of chronic conditions§ | | | | | | 0.123 |
| 1 | 91 | 2 830 817 | 21.7 (9.9–33.5) | 12.2 (6.4–18.0) | 12.6 (4.6–20.7) | |

Continued

Table 2 Continued

| Characteristics | Number (unweighted) | Number (weighted)* | Telehealth use % (95%CI) By video only (n=202) | By phone call (voice) only (n=225) | By both (n=116) | P value |
|---|---|---|---|---|---|---|
| 2 | 233 | 7916599 | 46.5 (28.5–64.5) | 41.4 (33.1–49.8) | 47.3 (28.5–66.1) | |
| 3–5 | 219 | 6876051 | 31.8 (19.3–44.2) | 46.4 (37.3–55.4) | 40.1 (22.8–57.4) | |
| Perceived health status | | | | | | 0.060 |
| Poor/fair | 189 | 5808150 | 22.9 (15.3–30.5) | 37.0 (26.7–47.3) | 42.9 (24.4–61.3) | |
| Good/excellent | 354 | 11815318 | 77.1 (69.5–84.7) | 63.0 (52.7–73.3) | 57.1 (38.7–75.6) | |
| Number of provider visits | | | | | | 0.011 |
| 1–2 | 112 | 3817691 | 23.6 (12.1–35.2) | 28.5 (18.7–38.3) | 9.3 (1.6–17.0) | |
| 3 | 97 | 2792022 | 14.7 (7.0–22.4) | 20.7 (12.8–28.5) | 11.0 (3.6–18.3) | |
| >3 | 334 | 11013755 | 61.6 (48.0–75.2) | 50.8 (42.5–59.1) | 79.7 (69.0–90.4) | |

*The weighted number might exhibit slight variations due to mathematical rounding up.
†Married or living with a romantic partner.
‡Counties in metro areas of ≥250 000 population.
§Including diabetes, hypertension, chronic lung conditions, heart disease and cancer.
NH, Non-Hispanic.

two-tailed tests. The study was exempted from institutional review board's review due to the use of publicly available data.

### Patient and public involvement

The study used deidentified datasets and did not involve patients or the public in the design, conduct, reporting or dissemination plans of the research.

## RESULTS

### Overall telehealth use patterns

A total of 1116 individuals, representing 33.6 million US adults with diabetes (mean age 59.4 years (SE: 1.0), 50.0% women, 53.0% non-Hispanic white) were included in the analysis. In 2022, 48.1% (95% CI 42.6% to 53.6%) of US adults with diabetes reported using telehealth in the past 12 months. Telehealth users were more likely to be younger, women, have higher household incomes, have health insurance coverage, live in metro areas, have multiple chronic conditions, have poorer perceived health status and have more frequent doctor visits compared with non-users (table 1).

In the analysis adjusting for other factors, adults aged 65 years and older had a significantly lower likelihood of telehealth use compared with those aged 18–49 years (OR 0.43, 95% CI 0.20 to 0.90). Respondents with

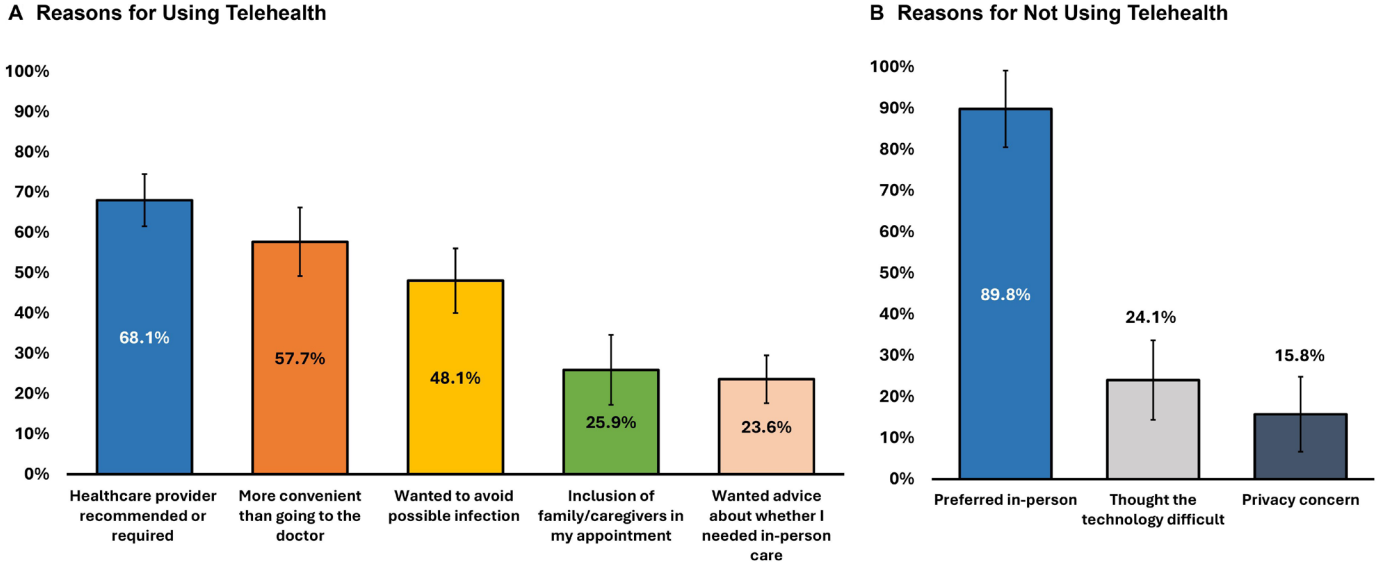


Figure 2 Reasons for (A) using or (B) not using telehealth services among US adults with diabetes in 2022. *Error bars indicate 95% CI.

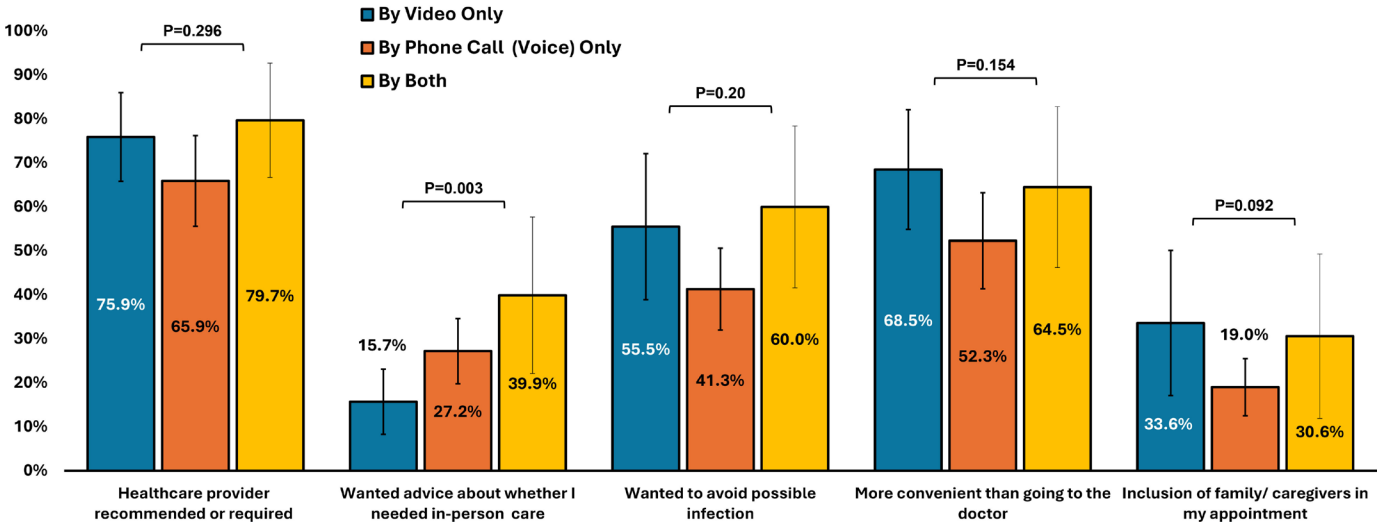


**Figure 3** Reasons for using telehealth services among US adults with diabetes who used telehealth services in 2022, by modality. *Error bars indicate 95% CI.

a household income between $35 000 and $74 999 (in 2022 USD) exhibited more than double the likelihood of telehealth use (OR 2.14, 95% CI 1.14 to 3.98) compared with those below $35 000. A trend was similarly observed among those with frequent healthcare provider interactions, defined as more than three visits (OR 2.30, 95% CI 1.38 to 3.81), versus those with one to two visits in the past year. There were no significant differences in the use of telehealth among different racial/ethnic, educational, geographic or residential groups.

### Telehealth use by modality

Among the telehealth users, 39.3% (95% CI 31.3% to 47.4%) used video only, 35.0% (95% CI 27.9% to 42.0%) phone only and 25.7% (95% CI 18.4% to 33.0%) used both modalities (figure 1). Telehealth modality use varied across age groups. Among adults aged 65 and older, 55.5% (95% CI 48.0% to 63.0%) used phone calls only, while 25.5% (95% CI 15.0% to 36.0%) used video only. In contrast, adults aged 18–49 showed higher rates of video-only use (36.1%, 95% CI 17.7% to 54.4%) and combined video/phone use (31.2%, 95% CI 13.5% to 48.8%). Education levels corresponded with different modality preferences. College graduates used video-only services at a rate of 30.9% (95% CI 18.2% to 43.5%), while 24.3% (95% CI 17.1% to 31.5%) used phone-only services. Internet access rates differed among users of various modalities. Among video-only users, 95.7% (95% CI 93.5% to 97.9%) reported having internet access, which was significantly higher than phone-only users with 74.7% (95% CI 67.8% to 81.7%) (table 2).

### Reasons for using or not using telehealth

The most commonly reported reasons for using telehealth were healthcare provider recommendation (68.1%), convenience compared with in-person visits (57.7%), avoiding potential COVID-19 exposure (48.1%) and obtaining advice about the need for in-person care (23.6%; figure 2A). Among adults who were offered but did not use telehealth, the primary reasons were preferring in-person appointments (89.8%), privacy concerns (15.8%) and perceived technology difficulties (24.1%; figure 2B). Among telehealth users, the reasons for utilising these services varied by modality (figure 3). The most notable difference was that phone-only users (27.2%) were significantly more likely than video-only users (15.7%) to seek advice about needing in-person care (p=0.003). The inclusion of family/caregivers was also more common among those using video only (33.6%) than phone-only users (19.0%), though this difference was not statistically significant (p=0.092).

### Patient-reported quality of care

The overall quality of care ratings was similar between telehealth users and non-users (figure 4). Around 70% of individuals with diabetes in both groups rated their quality of care as 'excellent' and 'very good', while less than 10% rated it as 'fair' and 'poor'. There were no significant differences in the distribution of ratings between the two groups (p=0.58). Similarly, trust in the healthcare system was comparable between telehealth users and non-users; 41.0% of non-users and 41.3% of users reported trusting the healthcare system 'very much' (p=0.46) PCC scores were also evenly distributed, with approximately one-quarter of adults in each quartile of the communication score among both telehealth users and non-users (p=0.80). There was no significant difference in quality-of-care outcomes by telehealth modality (online supplemental table 1).

### Subgroup analysis

Our subgroup analysis found no statistically significant differences in telehealth use, barriers to adoption or perceived quality of care between metro and non-metro areas (online supplemental figures 1–3).

## DISCUSSION

Using a nationally representative sample, this study examined patterns and reasons for using or not using telehealth

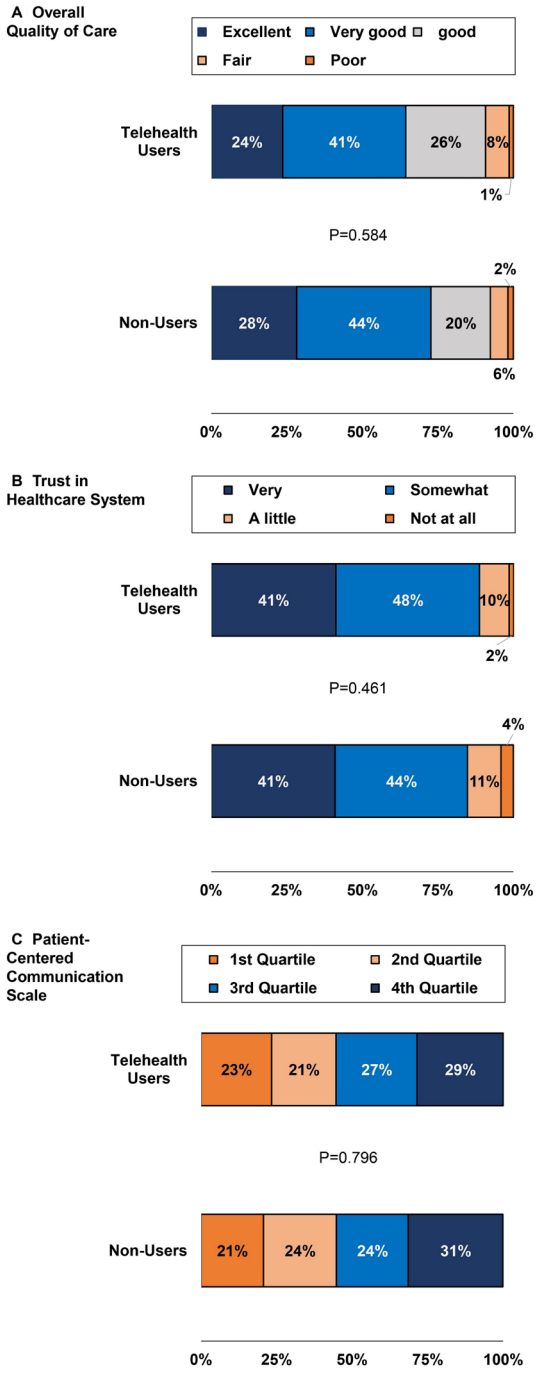


**Figure 4** Patient-reported quality of care outcomes by telehealth use among US adults with diabetes.

among US adults with diabetes in 2022. Overall, we found that approximately half of the population reported using telehealth services in the past year, with both video and phone modalities being common. This suggests telehealth delivery methods should remain flexible to accommodate different needs and capacities.[1 5 16] Telehealth use among individuals with diabetes was more prevalent among younger, higher income adults, and those with more frequent visits to their health providers. These findings align with previous research indicating that those with greater access to communication technology and higher socioeconomic status are more likely to use telehealth services.[17 18]

The increase in healthcare utilisation among telehealth users supports the observation that individuals with frequent visits to their health providers are more likely to use telehealth services.[6] Previous studies suggested that increased use of telehealth among those with chronic conditions, including diabetes, is likely due to the convenience and accessibility of virtual care for regular provider follow-ups and disease management.[6 19] However, we also found that older adults preferred using only the phone; those with lower education or without internet access tended to use phone or voice-only services. Research has highlighted that factors such as health literacy and area deprivation may influence the type of telehealth modality used, with lower health literacy and higher area deprivation potentially leading to a preference for or necessity of audio-only interfaces.[20] This is particularly important given the increasing insurance coverage requirements for video telehealth visits, which may inadvertently create barriers for certain populations and providers.[7 21 22] Taken together, our findings suggest that telehealth has served as an important tool for diabetes care and management; however, not all patient groups appeared to benefit from it. More effort is needed to optimise telehealth in a way that improves access and health outcomes equitably across patient groups and their social determinants of health context.[11 12 17 18 20 23]

The COVID-19 pandemic was a major driver of the wide adoption of telehealth use, with many using it to avoid potential virus exposure during in-person visits. We found that the primary motivations for telehealth use among individuals with diabetes were healthcare provider recommendations, avoiding COVID-19 exposure, convenience and seeking advice on in-person care needs. These motivations reveal provider endorsement, perceived safety benefits and accessibility as major drivers of telehealth adoption,[23] which is consistent with findings in the general population.[24] Interestingly, the modality of telehealth appears to influence care-seeking behaviours, with phone-only users significantly more likely than video-only users to seek advice about needing in-person care. This suggests that video consultations may be more effective in addressing patient concerns without escalation to in-person visits.[25 26] However, among non-users offered telehealth, preference for in-person care, privacy concerns and technology difficulties were common barriers.[16 23] While these findings demonstrate expanding acceptance of telehealth, they also highlight that a substantial portion of patients may still prefer in-person care or face challenges with virtual care.[11 16 23] As telehealth is increasingly integrated into diabetes care models,[12 19 23] it would be critical to address patient concerns through enhanced privacy safeguards, technology support and care coordination emphasising the complementary role of telehealth alongside traditional in-person delivery. A nuanced understanding of patient preferences and

values is essential to ensure telehealth improves existing patient-provider relationships and overall care quality.[12 16]

The quality of care provided through telehealth for patients with diabetes has been a matter of concern and has been investigated.[11 27 28] However, our study found that there were no significant differences in the indicators of patient-reported quality of care between those who used telehealth and those who did not. Furthermore, we observed no significant differences in quality of care outcomes between different telehealth modalities (eg, video vs phone-only). Both telehealth users and non-users, regardless of the specific telehealth modality used, rated the overall quality of care, trust in the healthcare system and PCC similarly. This suggests that individuals across all groups had mostly positive experiences in terms of feeling heard, understood and respected by their healthcare providers.[11 28] The lack of significant differences across these measures, in its various forms, could support that telehealth can provide care quality and maintain the relational aspects comparable to in-person care from the patient's perspective.[4] However, it is crucial to maintain these standards as telehealth becomes more integrated into regular diabetes management.[12 23] It is important to highlight that integrating telehealth effectively with in-person care is essential to ensure that it enhances rather than replaces the beneficial aspects of face-to-face visits.[16 23] Further research should examine whether care quality is maintained long-term with sustained telehealth use in diabetes care and management across diverse healthcare settings, as observed in more homogeneous samples.[29 30] Additionally, future studies should explore whether these findings hold true for specific clinical outcomes and across different patient populations, particularly those who may face barriers to video-based telehealth.

Several limitations should be considered. First, the cross-sectional design of this study provided only a snapshot of telehealth use patterns in time and limited the ability to infer causality between telehealth use and patient-reported quality-of-care outcomes. Potential selection bias exists among telehealth users, as patients who opted into telehealth may be systematically different from those who refused it. Second, the HINTS data lack provider-level information and constrained examination of how physician factors affect telehealth use and quality of care, which limited our ability to analyse their impact on telehealth adoption and use. Third, we were not able to examine clinical outcomes (eg, HbA1c level, diabetic complication). Longitudinal studies tracking objective health metrics are necessary to further validate the impact of telehealth on diabetes management. Another important limitation was the inability to account for the frequency of telehealth visits. Patients with a singular telehealth interaction may have experiences or perceptions distinct from those engaging in multiple sessions, potentially indicating dissatisfaction or differing healthcare needs that our study cannot elucidate. Fourth, our study did not differentiate between type 1 and type 2 diabetes or distinguish the nature of telehealth visits (whether endocrinology-related or primary care provider consultations). This oversight limits our understanding of how telehealth services cater to the diverse needs of the population with diabetes. Fifth, it should be noted that the small sample sizes of rural populations and limited geographic information available at the state level pose a limitation to the generalisability of our findings. Due to the small sample size of individuals living in rural areas (n<15), we were unable to conduct analyses specific to this population. This constraint prevents capturing the diverse needs and challenges faced across various regions. Finally, we relied on perceived satisfaction with healthcare rather than objective health outcomes or screening for diabetes complications. Furthermore, we did not assess the typical distance or time required to access in-person healthcare, which could significantly influence telehealth adoption and utilisation. Future studies should target individuals with limited healthcare access, particularly in rural areas, to explore barriers to telehealth use and its impact on diabetes management.

## Conclusions

Our study found that telehealth services were widely adopted among US adults with diabetes during the COVID-19 pandemic, primarily due to concerns about virus exposure, convenience of telehealth and provider recommendations. However, many patients still preferred traditional in-person care or struggled with aspects of virtual care. We did not find significant differences in patient-reported quality of care between telehealth and in-person visits only. However, addressing patient concerns around privacy, technology difficulties and care coordination appears critical for more effective integration of telehealth. Our findings contribute to a growing body of literature suggesting telehealth can play an important role in facilitating access to high-quality, patient-centred diabetes care and management. Further research is needed to examine the long-term clinical outcomes of sustained telehealth use in the postpandemic setting as well as to explore provider perspectives and optimise telehealth implementation strategies.

**Contributors** Y-RH, ZX and AFW developed and designed the study. ZX, ON and KT contributed and provided advice on methodological aspects. Y-RH conducted the statistical analyses, and all authors interpreted the data. Y-RH drafted the manuscript, prepared tables and figures, and all authors critically reviewed the manuscript for intellectual content and approved the final version. AFW supervised the study, and Y-RH and AFW are the study guarantors. In the preparation of this manuscript, we used Grammarly to enhance the clarity and grammatical accuracy of our writing.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study used de-identified and publicly available data from the National Cancer Institute (NCI) and was approved as an exemption by the

Institutional Review Board at the University of Florida. Patient consents were not required as this study was based on publicly available data.

**Provenance and peer review** Not commissioned; externally peer-reviewed.

**Data availability statement** Data are available upon reasonable request. The data used in this study are from the Health Information National Trends Survey (HINTS), sponsored by the National Cancer Institute (NCI). HINTS data are publicly available and can be accessed directly through the NCI's HINTS website: https://hints.cancer.gov/.



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