

# Trends in telehealth use among a cohort of rural patients during the COVID-19 pandemic

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## Abstract

**Objective:** Rural populations faced unique challenges to healthcare access during the COVID-19 pandemic. This analysis assesses trends in digital health technology use at the onset of the pandemic and describes digital health behaviors among a cohort of patients within a rural integrated healthcare network throughout the first 3 years of the pandemic.

**Methods:** We used data from both the electronic health record (EHR) and a patient survey. EHR data was used to longitudinally assess change over time in patient portal use and telehealth visits. Survey responses were used to provide additional context.

**Results:** Telehealth appointments peaked in the first quarter of 2020 at 28% of all office visits, before leveling off to 8–10% in 2022. Women and those younger than 65 were more likely to have participated in telehealth appointments. Active patient portal users increased from 34.1% in January 2019 to 63.7% in January 2022. There were no differences noted in portal use trends based on rurality.

**Conclusions:** Our findings corroborate previous research, as well as add context regarding digital health technology use throughout the COVID pandemic in a rural patient population. Future research must focus on understanding constraints to digital health expansion in order to continue providing safe, equitable care.

## Keywords

Telehealth, COVID-19, rural population, telemedicine

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## Introduction

Rural populations faced unique challenges to healthcare access during the COVID-19 pandemic. As society was forced to switch to virtual care, many residents in rural areas did not participate in video telehealth appointments due to lack of broadband coverage, inability to pay for internet access, unfamiliarity with or inability to use the technology, unwillingness to use the internet for healthcare appointments, or unwillingness on the part of the individual healthcare provider to use the technology.<sup>1–3</sup> Research has consistently shown that since the start of the pandemic, uptake of telehealth has been lower in rural areas.<sup>4–7</sup> Researchers identified the fragility of telehealth's relevance and utility prior to the pandemic,<sup>8,9</sup> and the concerns are

still relevant today.<sup>10,11</sup> Furthermore, while telehealth use spiked in both rural and urban areas during the first months of the pandemic, use significantly decreased by the summer of 2020,<sup>4,12</sup> and there has been limited research published on trends in telehealth use during the post-acute pandemic era. Yet, rural healthcare organizations have pushed forward with the implementation of telehealth in the hopes of addressing challenges to healthcare access in

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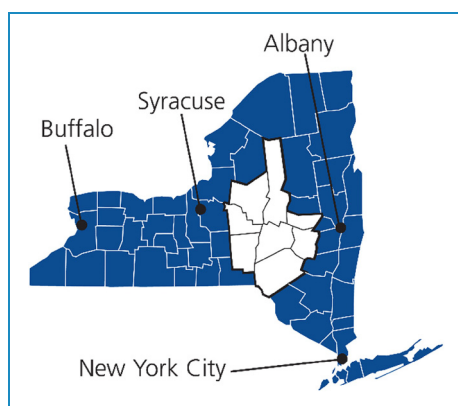
rural areas, e.g. long driving distances and an understaffed workforce.<sup>13–15</sup>

The purpose of this analysis was to assess the trends in digital technology and telehealth use at the onset of the pandemic and describe telehealth behaviors among a cohort of rural patients at a rural integrated academic healthcare network throughout the first 3 years of the pandemic (2020–2022). In order to accomplish this goal, we used data from both the electronic health record (EHR) as well as a patient survey to uncover trends in telehealth visits as well as patient portal use. Patient portals provide an alternative remote connection to healthcare by allowing patients to securely message their clinician, refill prescriptions, schedule appointments, and check lab results and visit notes.<sup>16</sup> The patient portal is a mechanism that helps patients manage their healthcare needs.<sup>17</sup> Meanwhile, telehealth visits (either through videoconference or audio-only) are a way to meet with a clinician in real time to address a health concern. The survey findings provided additional context that the EHR was unable to capture, including patients' experience with videoconferencing platforms and usage patterns for the patient portal. Crawford and Serhal's digital health equity framework was used as a conceptual guide.<sup>18</sup> Our analysis focuses on the digital determinants of health, specifically the use of digital health resources, and integration of digital health resources into community and health infrastructure and how patterns of use shifted during COVID. This study will be able to add nuance and context to the current body of literature on rural telehealth use during the pandemic.

## Methods

### Setting

This study took place in rural central New York (Figure 1). It involved collection of data from a survey of a sample of adult patients as well as queries of the EHR from a single-integrated healthcare network that covers a geographic area



**Figure 1.** Study area (unshaded counties).

of 5600 square miles across eight counties. Typical of other rural areas in the northeast, the population skews older (21.3% of the population is 65 or over) and identifies predominantly as white, non-Hispanic (86.2%). Household incomes are lower than state average, but poverty rates are aligned with the New York State average of 13.9%. The majority of households have broadband with an internet subscription (83.9%).<sup>19</sup>

### Outcomes of interest

The primary outcomes of interest were changes in the use of the patient portal, telehealth visits and videoconference platforms. Secondary objectives included understanding the sociodemographic characteristics of users of these digital health technologies.

### Data collection and analysis plan

**Survey.** The survey instrument was developed to capture historical and present patterns of technology access and use including: internet access; comfort level with various forms of digital technology; experience with telehealth visits conducted by videoconference or audio-only originating from home or from the clinic; patient portal access, frequency, and reasons for use; and experience with using videoconference platforms for work, school, or social interactions. Sociodemographic variables considered in this analysis included age, gender, marital status, education level, financial hardship, insurance status, job status, and disability status. Rurality was calculated based on the Rural-Urban Commuting Area (RUCA) code assigned to each participant's ZIP code in the medical record.

Surveys were sent to a stratified random sample of eligible participants identified in the EHR using the following criteria: participants were established patients meaning that they had used the network's healthcare services for non-emergent care within the previous 12 months. Participants were at least 18 years of age, had to be community dwelling within the medical system's service area, and were able to read and understand English. An initial sample size of 500 was estimated to provide a reasonable margin of error ( $\pm 4.5\%$ ) based on an equal distribution of survey-reported visit type preference (50% preferring in-person visits and 50% preferring telehealth). The sample was stratified (250 in each group) by those who had a "live portal account" meaning the patient portal had been activated by the user at some point in the past, as a proxy for digital health technology exposure. The reason for stratification was to ensure that we had adequate responses from those who were telehealth naïve versus those who had experience with telehealth for descriptive analysis reported elsewhere.<sup>20</sup>

Surveys were initially disseminated via patient portal (for those in the patient portal stratum) or via the US

postal service (for those in the non-patient portal stratum) between August and November 2021. If surveys were not returned in 2 weeks, participants were called and ultimately, surveys were resent to all non-responders (excluding those who refused).

Survey data were collected and managed in REDCap, a HIPAA compliant database hosted at Bassett Medical Center.<sup>21</sup> Survey analysis was conducted in SPSS v27.

**Survey statistical methods.** Survey responses were adjusted to account for the sampling design. McNemar's test was used to analyze change (from "never used" to "at least some use") in telehealth use, videoconferencing use, and patient portal use prior to versus during COVID. To better understand characteristics of portal users, we conducted multivariable logistic regression among those with live portal accounts. We tested different aspects of portal use as the outcome (e.g. check test results, view visit notes, message a provider, participate in an e-visit, check a child's record, pre-register for an appointment, request a refill, pay medical bills, schedule an appointment) and the following dichotomized survey self-reported sociodemographic variables as predictors: rural (yes or no based on RUCA 7-10), gender identity (male or female), marital status (yes or no), Medicaid status (yes or no), difficulty affording basic needs (yes or no), disability status (yes or no), health status (fair/poor or good/very good/excellent), education (at least some college or high school grad/less than high school), and age (less than 65 or 65 and older). We chose these specific variables based on our understanding of factors that could potentially influence different patterns of use. We used these same survey demographic variables to conduct chi-square analyses of associations with videoconferencing patterns of use. Statistical significance was defined as  $p < 0.05$  (two-tailed) for all analyses.

#### Electronic health record

**Patient portal use.** To measure patient portal use over time, we calculated the percentage of all adult patients who were active patient portal users at four different time points: January 2019, January 2020, January 2021, and January 2022. "Active patient portal user" was defined as using the portal at least once during the previous 12 months. For the analysis of change in portal use pre- vs peri-pandemic, we included only those patients who were active patients within the healthcare system at both time points and categorized them as follows: already using the portal pre-pandemic, started using portal peri-pandemic, and never used portal. Average age across the three portal use groups was compared using one-way analysis of variance. Chi-square analysis was used to compare proportions of females and rural dwellers across the three portal use groups.

**Telehealth visits.** To determine change in telehealth use over time, we calculated the percentage of completed telehealth visits (defined as video or audio-only visits originating from home) among all office visits by quarter. To calculate the percentage of patients who were using telehealth, the total number of adult patients with at least one telehealth visit (defined to include both audio-only and video visits) was divided by all adult patients who had an appointment during that time period. To determine the trend in overall volume, the total number of office visits (regardless of type) was summarized for each time period. We were unable to distinguish between audio-only and video telehealth visits in this analysis because there were differences in how departments initially coded these visits.

#### Ethical considerations

This study was approved by the Mary Imogene Bassett Institutional Review Board. Individuals who participated in the survey were given an information sheet describing the study and provided tacit consent through completing and returning the survey. Participants received a \$10 alcohol- and tobacco-free grocery store gift card for completing the survey and were entered into a lottery to earn one \$100 Visa gift card.

## Results

### Survey sample characteristics

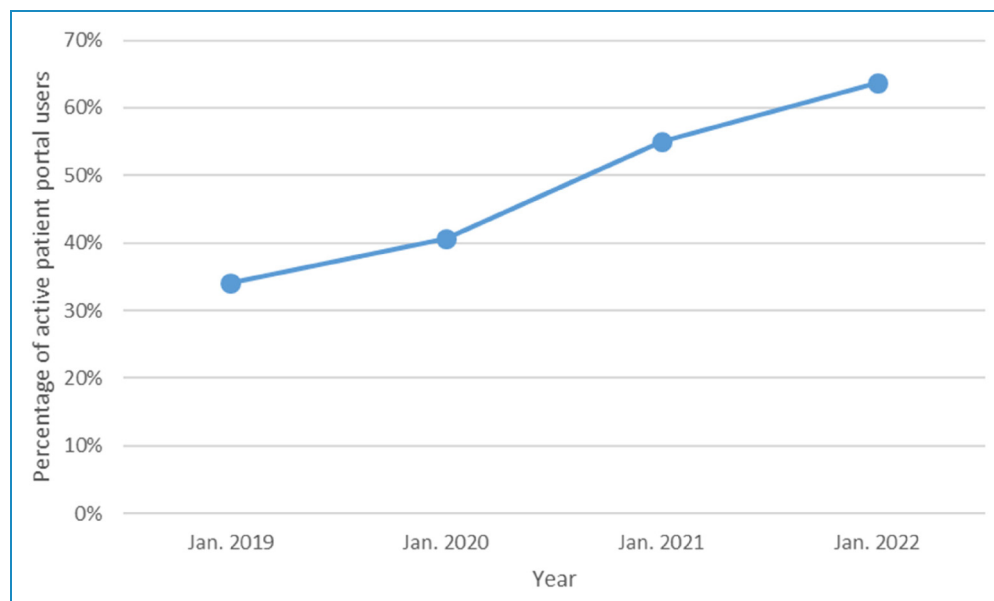
The survey completion rate was 41.2% (206/500). Survey respondents had a mean adjusted age of 59.8 years, 62.9% were female, 62.7% had some college education, and 50.0% lived in a rural area as defined by a RUCA designation of 7–10, with 85 unique zip code areas represented.

### Patient portal use: EHR

Patient portal use nearly doubled between 2019 and 2022 (Figure 2) from 34.1% to 63.7% of the patient population being active portal users. As depicted in Table 1, patients who started using the portal after the onset of the pandemic were significantly younger than those who were already using or had never used the patient portal ( $F = 2155.17$ ,  $p < 0.0001$ ). Women were significantly more likely than men to have already been using the portal ( $\chi^2 = 1468.21$ ,  $p < 0.0001$ ). There was no difference in portal use behavior based on rurality ( $\chi^2 = 4.00$ ,  $p = 0.136$ ).

### Patient portal use: Survey

Among the survey participants who had "live" portal accounts per the EHR, 93.4% used it at least occasionally for at least one of the following activities: checking test results (85.8%), sending a message to a clinician (66%),



**Figure 2.** Percentage of active patient portal users, 2019–2022.

reviewing visit notes (53.8%), requesting a refill (49.1%), pre-registering (48.1%), scheduling an appointment (35.8%), paying a bill (27.4%), checking a child's record (10.4%), or participating in an e-visit (6.6%).

*Multivariable logistic regression* revealed that among those with live portal accounts, there was no difference between any of the survey-reported sociodemographic

**Table 1.** Comparison of characteristics of non-portal users, active portal users prior to COVID, and those who began using portal during COVID.

	Never used	Started using	Already using	<i>p</i> -value
Portal use, pre-pandemic	No	No	Yes	
Portal use, during pandemic	No	Yes	Yes	
<i>N</i>	22,073	14,622	35,103	
Total (%)	30.7	20.3	48.8	
Age as of Jan. 2019, mean	61.6	50.7	53.9	<0.0001
Female (%)	48.8	57.8	65.0	<0.0001
Rural (%)	48.4	49.4	48.8	0.136

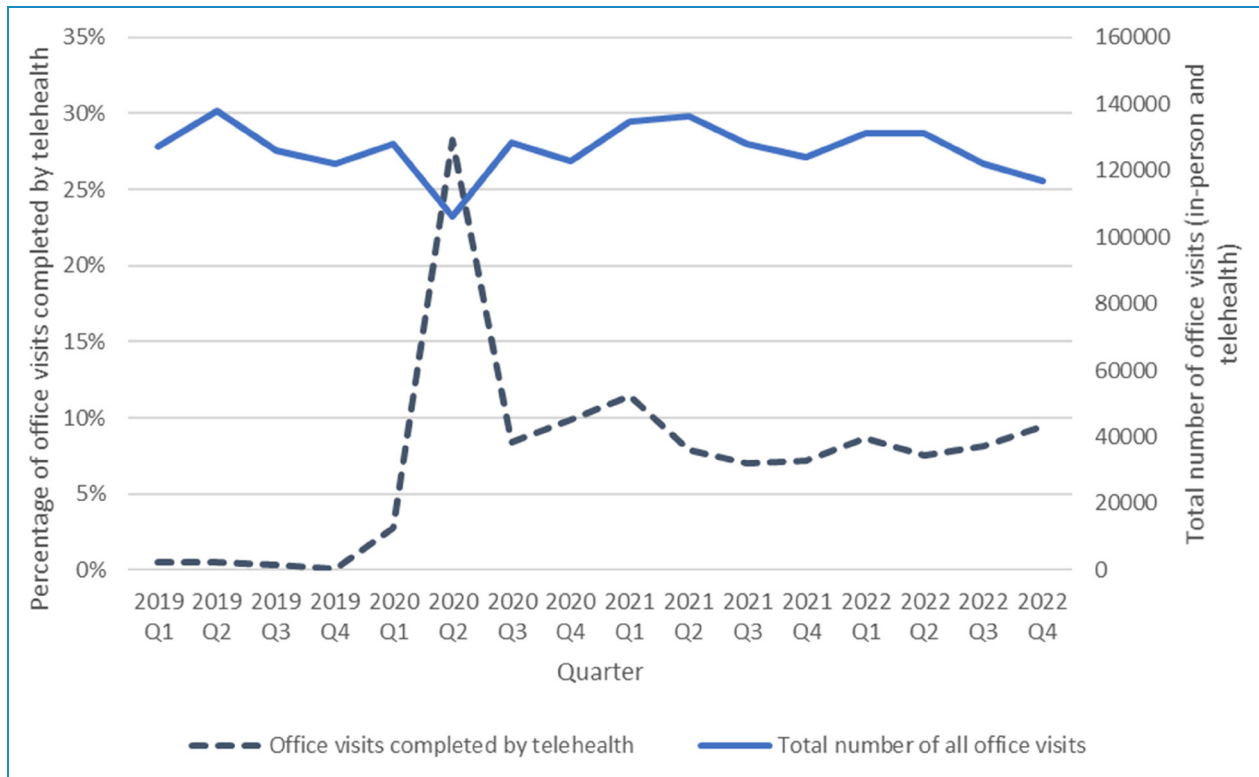
*Note:* to be included in the analysis, individuals had to have been a patient of the healthcare system during all years.

groups for using the portal to check test results, view visit notes, message a provider, participate in an e-visit, check a child's record, or pre-register for an appointment. Being married/partnered ( $p=0.033$ , OR = 4.71 [95% CI = 1.13, 19.57]) and not being enrolled in Medicaid ( $p=0.048$ , OR = 9.31 [95% CI = 1.02, 84.84]) independently predicted increased likelihood of using the portal to pay bills. Those who were less than 65 years old were more likely to use the portal to schedule an appointment ( $p<0.001$ , OR = 7.76 [95% CI = 2.31, 26.04]). Not having any difficulty affording basic needs was an independent predictor of using the portal to request a medication refill ( $p=0.016$ , OR = 3.36 [95% CI = 1.26, 8.96]).

### Telehealth visits: EHR

Prior to the COVID pandemic, almost no encounters were conducted remotely. Exploring the data longitudinally (quarterly), telehealth use spiked in spring 2020, when telehealth appointments accounted for 28% of all visits and then decreased to a relatively stable 8–10% of visits being telehealth in 2022 (Figure 3). By the end of 2022, 48% of active users of the healthcare system had engaged in a telehealth appointment, whereas prior to the pandemic only 1.8% had engaged in telehealth

Examining these trends by gender (Figure 4), during the acute phase, men and women engaged in telehealth at similar rates. However, during the post-acute phase, women were more likely to engage in telehealth than men. Examining these trends by age (Figure 4), those younger than 65 were more likely to engage in telehealth during the acute and post-acute phases of the pandemic.



**Figure 3.** Percentage of office visits completed by telehealth and total number of office visits (in-person and telehealth), 2019–2022.

The patterns of use in the post-acute phase were consistent regardless of age group or gender (e.g. small increases in the 4<sup>th</sup> quarter of each year).

### Telehealth visits: Survey

When asked if they had ever had a telehealth visit with a clinician where the patient was at home (e.g. not requiring traveling to a clinic) 84 (42.8%) survey respondents reported that they had. In contrast, only 6.2% of all survey respondents reported having engaged in a telehealth appointment from home prior to the pandemic. Of those who had ever used telehealth from home, 37 (44%) reported conducting the appointment through a regular phone, whereas 47 (56%) reported using a computer or smartphone.

### Videoconferencing platform: Survey

A prerequisite for engaging in video telehealth appointments is the capacity to use a videoconference platform. Just over a third of survey respondents (38.7%) reported using a videoconferencing platform prior to COVID. However, at the time the survey was administered in August 2021, 55.5% had reported using a videoconferencing platform at some point in the last month. The difference in the percentage of users before COVID (38.7%)

vs. during COVID (55.5%) was statistically significant ( $p < 0.001$ ). Those who were younger and had at least some college education were more likely to be using a videoconferencing platform ( $p < 0.001$ ) as well as more likely to have started using a video conferencing platform during COVID ( $p < 0.001$ ). There was no difference in videoconference platform use based on rurality, Medicaid status, financial distress, disability status, self-reported health, or marital status.

Reported reasons for using videoconferencing platforms among those who used them ( $n = 97$ ) included staying in touch with friends and family (59.8%), work or school (40.2%), receiving healthcare (33%), group meetings (26.8%), and religious services (14.4%). Among videoconference users, there were no demographic differences among the various reasons for use except for those aged 65 or older being significantly less likely to use videoconferencing for work or school ( $\chi^2 = 19.222$ ,  $p < 0.001$ ).

Among those who were new to using videoconference platforms during COVID, the majority taught themselves how to use it (35.1%) or relied on a friend or family member to help them (37.8%).

### Discussion

Similar to others' research, we found that patient portal use and telehealth use increased significantly during the

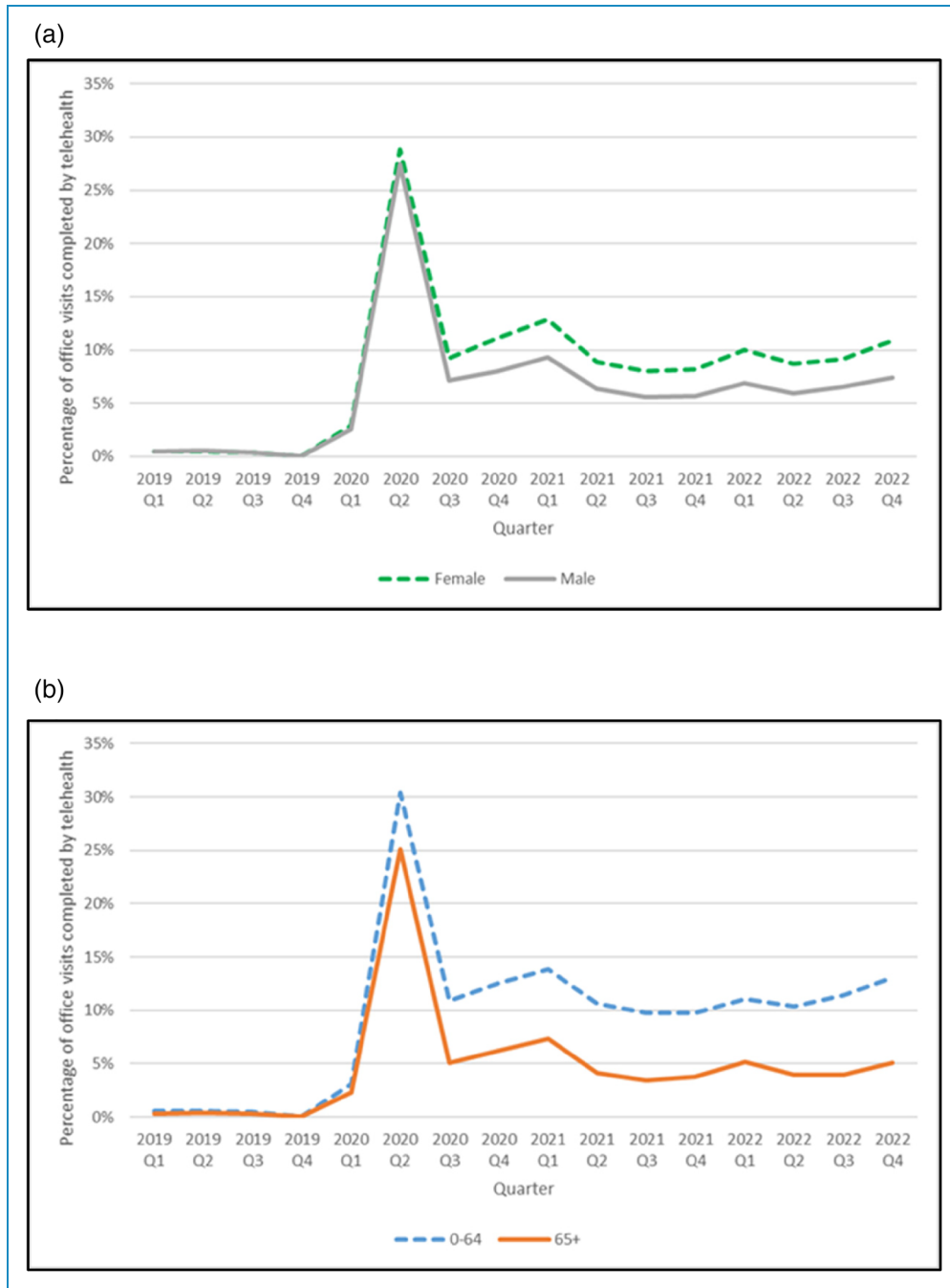


Figure 4. Percentage of office visits completed by telehealth by (a) gender and (b) age, 2019–2022.

pandemic.<sup>4,22,23</sup> Much of the recently published research describing telehealth comes from administrative data or large population-based surveys during the first year of the pandemic.<sup>4,5,24,25</sup> By examining two local data sources, our study provided additional context during the post-acute pandemic phase in understanding trends in use of digital health technologies within a predominantly rural population. Almost 65% of the patient population had activated

their patient portal account by January 2022, and 85% of those surveyed who had a live portal account reported using the portal for checking test results, while 66% reported using the portal to message a clinician or nurse. Telehealth’s rapid expansion during the pandemic has resulted in 48% of the patient population having been exposed to telehealth. However, its use had leveled off to about 10% of office encounters by the end of 2022. Our



results are consistent with a National Center for Health Statistics (NCHS) data brief which indicated that 37% of all adults had used telehealth in the past 12 months.<sup>26</sup> The healthcare industry is reporting a leveling off of telehealth visits around 10–20%.<sup>27</sup>

Our results demonstrated that women were more likely than men to engage with portal use and telehealth appointments with their provider. This finding agrees with previous research indicating that men are generally less likely to seek healthcare services,<sup>28</sup> and this is particularly true for men in rural communities.<sup>29,30</sup>

We also found that those who are 65 or older are less likely to adopt patient portal, telehealth, and videoconference use. Prior to the pandemic, older populations tended to use telehealth less than younger populations.<sup>31</sup> However, there is inconsistent evidence regarding whether this trend continued during the pandemic. The NCHS data brief indicated a positive linear trend in telehealth exposure with increasing age,<sup>26</sup> while Chu et al. (2021) reported less use among those over 80 years of age.<sup>4</sup> In a comparison of audio-only versus video telehealth appointments, Chen et al. (2022) found that during the first peak of the pandemic (April–June 2020), being older was associated with less participation in video telehealth.<sup>32</sup> Further research is needed to determine if the lower adoption rate is due to digital health literacy issues, lack of available digital technologies, incongruence with values and norms, healthcare provider preferences, or a combination of these factors.

Surprisingly, there was no difference in rural status, as defined by RUCA codes, among digital health users, non-users, and users who started during COVID. Previous research indicates that rural populations disproportionately face telehealth access disparities.<sup>4,22,26</sup> A possible explanation for this discrepancy is that our analysis was unable to differentiate between audio-only and video telehealth. Chen et al. (2022) did find that those who lived in rural areas or lived in zip codes with lower broadband access would be more likely to use audio-only telehealth than video telehealth.<sup>32</sup> Had we been able to differentiate, we may have seen similar patterns. Another possible explanation for this finding is the use of RUCA to define rural, as we previously reported.<sup>20</sup> RUCA is based on commuting patterns, which may not be the most suitable metric for a study of telehealth use. Our healthcare system's geographic area is largely rural even though some individuals technically live in an area with a metro/micropolitan RUCA code.

### *Practice and policy implications*

The findings from this study point to several important implications. First, the analysis demonstrates that while digital health technology use increased, particularly for the patient portal, the majority of healthcare encounters are still conducted in person. There is a strong business

case for expanding digital health technologies, suggesting that these technologies can reduce expensive and unnecessary trips to the emergency department through the use of a virtual triage system, can reverse the chronic disease crisis using remote monitoring, can help address disparities in healthcare since it can be conducted through a cell-phone, and can increase access to specialty care.<sup>15</sup> However, despite these potential benefits, the longitudinal trend in use that was reflected in our study as well as others' points to the much broader issue of the social context for further telehealth expansion. It has been argued that when we do not acknowledge the complex social environment in which telehealth sits, and fail to involve communities (including the community of clinicians and support staff) in implementation, we risk not only low adoption, but also widening disparities to care.<sup>1,11</sup> Researchers have recognized numerous barriers to sustained digital health technology expansion beyond the social determinants of health. Barriers identified include design elements of the technology not being appropriate for all users,<sup>33</sup> privacy and safety concerns,<sup>3,34</sup> the ever-changing payment parity and reimbursement landscape for digital health technology services,<sup>35,36</sup> and the overall sentiment among both clinicians and patients that "telemedicine's benefits [are] hindered by the potential for missing information and decreased human connection between patients and providers during a telemedicine visit."<sup>36</sup> (p.12)

While it may make business sense to increase digital technology services, perhaps the current rates that we and others have reported for both portal use and telehealth appointments may be approaching the maximum threshold. It will be important to evaluate the extent to which this increase over pre-pandemic rates has affected care outcomes as well as any realized cost savings. Research will also need to continue exploring the implementation and utilization of digital health technologies from a health equity standpoint.

### *Limitations*

There are several limitations to this analysis which must be addressed. First, this is a descriptive study using data over 4 years from the EHR as well as data from a single cross-sectional survey. While the use of multiple data sources enriches the analysis, the survey responses are limited in that they were from a single point in time. Therefore, we cannot establish temporality of patient characteristics and use/non-use of telehealth. In addition, individuals may have interpreted some of the survey questions differently than intended by the researchers. As the pandemic has settled down, digital health use by our patient population could be significantly different than it was in the summer and fall of 2021 when the survey data was collected. In addition, there were limitations to extracting the EHR data due to coding inconsistencies for telehealth appointments

through the first months of the pandemic. These inconsistencies prevented us from being able to distinguish between audio-only and video telehealth visits in this analysis. While our processes were clearly articulated, using a different approach (e.g. extracting billing data instead of encounter data) could have resulted in different findings. Finally, our analysis is limited to portal use and telehealth visits and did not include examining the trends of e-consults (provider to provider communication), or remote monitoring.

## Conclusions

Our analysis highlights telehealth patterns from prior to the COVID pandemic through the post-acute pandemic era using multiple data sources within a rural population. We found a significant increase in telehealth and patient portal use during the early phases of the pandemic. The patterns of use noted in this study are generally concordant with much larger studies. The rapid expansion and subsequent reduction in engagement in telehealth begs important questions regarding sustainability, reimbursement policies, involvement of community in decision making processes, and capacity and willingness of both patients and clinicians to partake in digital health technologies as they are currently envisioned.

**Contributorship:** WB and KP conceived the study. KP researched literature. NK, AC, and KP collected data. WB, MS, MK, NK, and KP contributed to statistical analysis. KP and WB drafted the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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## References

1. Bailey JE, Gurgol C, Pan E, et al. Early patient-centered outcomes research experience with the use of telehealth to address disparities: scoping review. *J Med Internet Res* 2021; 23: e28503.
2. Budhwani S, Fujioka J, Thomas-Jacques T, et al. Challenges and strategies for promoting health equity in virtual care: findings and policy directions from a scoping review of reviews. *J Am Med Inform Assoc* 2022; 29: 990–999.
3. Pullyblank K. A scoping literature review of rural beliefs and attitudes toward telehealth utilization. *West J Nurs Res* 2022; 45: 1939459221134374.
4. Chu C, Cram P, Pang A, et al. Rural telemedicine use before and during the COVID-19 pandemic: repeated cross-sectional study. *J Med Internet Res* 2021; 23: e26960.
5. Hsiao V, Chandereng T, Lankton RL, et al. Disparities in telemedicine access: a cross-sectional study of a newly established infrastructure during the COVID-19 pandemic. *Appl Clin Inform* 2021; 12: 445–458.
6. Larson AE, Zahnd WE, Davis MM, et al. Before and during pandemic telemedicine use: an analysis of rural and urban safety-net clinics. *Am J Prev Med* 2022; 63: 1031–1036.
7. Demeke HB, Merali S, Marks S, et al. Trends in use of telehealth among health centers during the COVID-19 pandemic—United States, June 26–November 6, 2020. *MMWR Morb Mortal Wkly Rep* 2021; 70: 240–244.
8. Call VR, Erickson LD, Dailey NK, et al. Attitudes toward telemedicine in urban, rural, and highly rural communities. *Telemed J E Health* 2015; 21: 644–651.
9. Standing C, Standing S, McDermott ML, et al. The paradoxes of telehealth: a review of the literature 2000–2015. *Syst Res Behav Sci* 2018; 35: 90–101.
10. Thomas EE, Haydon HM, Mehrotra A, et al. Building on the momentum: sustaining telehealth beyond COVID-19. *J Telemed Telecare* 2022; 28: 301–308.
11. Warr D, Luscombe G and Couch D. Hype, evidence gaps and digital divides: telehealth blind spots in rural Australia. *Health (London)* 2021; 27(4); 13634593211060763.588–606.
12. Rodriguez JA, Betancourt JR, Sequist TD, et al. Differences in the use of telephone and video telemedicine visits during the COVID-19 pandemic. *Am J Manag Care* 2021; 27: 21–26.
13. Lee S, Black D and Held ML. Factors associated with telehealth service utilization among rural populations. *J Health Care Poor Underserved* 2019; 30: 1259–1272.
14. Lum HD, Nearing K, Pimentel CB, et al. Anywhere to anywhere: use of telehealth to increase health care access for older, rural veterans. *Public Policy Aging Rep* 2020; 30: 12–18.
15. Pearl R and Wayling B. The telehealth era is just beginning. *Harv Bus Rev* 2022: 87–94.
16. Kruse CS, Argueta DA, Lopez L, et al. Patient and provider attitudes toward the use of patient portals for the management of chronic disease: a systematic review. *J Med Internet Res* 2015; 17: e40.
17. Liu SK, Osborn AE, Bell S, et al. Patient characteristics and utilization of an online patient portal in a rural academic general internal medicine practice. *BMC Med Inform Decis Mak* 2022; 22: 42.
18. Crawford A and Serhal E. Digital health equity and COVID-19: the innovation curve cannot reinforce the social gradient of health. *J Med Internet Res* 2020; 22: e19361.
19. Quick Facts: New York. In: Bureau USC, (ed.). 2022. <https://www.census.gov/quickfacts/fact/table/NY/PST045222> Last retrieved September 25, 2023.



20. Brunner W, Pullyblank K, Scribani M, et al. Determinants of telehealth technologies in a rural population. *Telemed e-Health* 2023; 0: null. Epub ahead of print
  21. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform* 2019; 95: 103208.
  22. Bhatia R. Telehealth and COVID-19: using technology to accelerate the curve on access and quality healthcare for citizens in India. *Technol Soc* 2021; 64: 101465.
  23. Johnson C, Dupuis JB, Goguen P, et al. Changes to telehealth practices in primary care in New Brunswick (Canada): a comparative study pre and during the COVID-19 pandemic. *PLOS ONE* 2021; 16: e0258839.
  24. Haggerty T, Stephens HM, Peckens SA, et al. Telemedicine versus in-person primary care: impact on visit completion rate in a rural Appalachian population. *J Am Board Fam Med* 2022; 35: 475–484.
  25. Jaffe DH, Lee L, Huynh S, et al. Health inequalities in the use of telehealth in the United States in the lens of COVID-19. *Popul Health Manag* 2020; 23: 368–377.
  26. Lucas JW and Villarroel MA. Telemedicine use among adults: United States, 2021. *NCHS Data Brief* 2022; 445: 1–8.
  27. Center for Connected Medicine. *The Intersection of Value and Telehealth*. 2021.
  28. Mursa R, Patterson C and Halcomb E. Men's help-seeking and engagement with general practice: an integrative review. *J Adv Nurs* 2022; 78: 1938–1953.
  29. Hiebert B, Leipert B, Regan S, et al. Rural men's health, health information seeking, and gender identities: a conceptual theoretical review of the literature. *Am J Mens Health* 2018; 12: 863–876.
  30. Morgan EH, Graham ML, Foltz SC, et al. A qualitative study of factors related to cardiometabolic risk in rural men. *BMC Public Health* 2016; 16: 305.
  31. Poeran J, Cho LD, Wilson L, et al. Pre-existing disparities and potential implications for the rapid expansion of telemedicine in response to the coronavirus disease 2019 pandemic. *Med Care* 2021; 59(8).
  32. Chen J, Li KY, Andino J, et al. Predictors of audio-only versus video telehealth visits during the COVID-19 pandemic. *J Gen Intern Med* 2022; 37: 1138–1144.
  33. Veinot TC, Mitchell H and Ancker JS. Good intentions are not enough: how informatics interventions can worsen inequality. *J Am Med Inform Assoc* 2018; 25: 1080–1088.
  34. Moqbel M, Hewitt B, Nah FF, et al. Sustaining patient portal continuous use intention and enhancing deep structure usage: cognitive dissonance effects of health professional encouragement and security concerns. *Inf Syst Front* 2022; 24: 1483–1496.
  35. Cordina J, Fowkes J, Malani R, et al. *Patients love telehealth—physicians are not so sure*. New York, New York: McKinsey & Company, 2022.
  36. Lindenfeld Z, Berry C, Albert S, et al. Synchronous home-based telemedicine for primary care: a review. *Med Care Res Rev* 2023; 80: 3–15.
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