Telehealth Acceptance Among Appalachian Respondents During COVID-19: A Secondary Data Analysis

Victoria Hood-Wells, PhD(c), BSN, MSN[1]

Florence M. Weierbach, PhD, BSN, MPH[2]

Amy E. Wahlquist, BS, MS[3]

Janet Keener, Ed.D [4]

Manik Ahuja, PhD, MA[5]

Hadii Mamudu, PhD, MA, MPA, FAHA [6]

[1]Instructor, East Tennessee State University, College of Nursing, hoodwell@etsu.edu

[2]Professor of Nursing, East Tennessee State University, Associate Director at the Center for Cardiovascular Risk Research, College of Public Health, weierbach@etsu.edu

[3] Research Associate Professor, Center for Rural Health Research, College of Public Health, East Tennessee State University, wahlquist@etsu.edu

[4]Research Computing Consultant, East Tennessee State University, Research Computing and Information Technology Services, janet@etsu.edu

[5]Assistant Professor and Associate Director for the Center for Cardiovascular Risk Research, East Tennessee State University, College of Public Health, ahujam@etsu.edu

[6]Full Professor, Department of Health Services Management and Policy, Director at the Center for Cardiovascular Risk Research, East Tennessee State University, College of Public Health, mamudu@etsu.edu

Abstract

Purpose: The purpose of this study is to examine the relationship between telehealth use, telehealth satisfaction, and chronic medical conditions among residents living in Appalachian and non-Appalachian communities.

Sample: A COVID-19 public health survey was distributed via social media and healthcare clinics in the tri-state region of central Appalachia. Survey responses were limited to adults aged ≥18 years who consented to participate in the survey that self-identified as an individual with one or more chronic medical conditions (n=195).

Method: Simple descriptive statistics including frequencies, percentages, means, and standard deviations (SDs) were calculated for variables of interest both overall and by subgroups of interest. Chi-squared tests were used to compare categorical outcomes between groups of interest, while two-sample t-tests were used for continuous outcomes. Significance for all tests was determined using an α level of 0.05.

Findings: There is no statistically significant relationship between respondents with regard to using telehealth services, satisfaction rates related to telehealth use, or reasons for electing not to use telehealth services during the COVID-19 pandemic. However, there was a trending statistical relationship between county status and the use of telehealth services in Appalachia with those counties doing economically better being more likely to use telehealth services as compared to those fairing less well (p=0.053). Findings also suggest that people living in urban areas of Appalachia were more likely to be satisfied using telehealth services than those living in non-urban areas of Appalachia (p=0.01).

Conclusions: Research is still limited as to how the expansion of broadband capabilities during the COVID-19 pandemic has benefited those residing in Appalachia in terms of managing chronic

health conditions. Future research should focus on expanding participation among Appalachian respondents looking for specific differences related to location within Appalachia, age, gender, ethnicity, and socioeconomic status.

Keywords: Telehealth, Satisfaction, Rural, Appalachian, COVID-19

Telehealth Acceptance Among Appalachian Respondents During COVID-19: A Secondary Data Analysis

Since January 2020, there have been more than 856,000 COVID-19 reported deaths across the United States spanning through both Appalachian and non-Appalachian communities (Centers for Disease Control [CDC], n.d.). Subsequently, providing healthcare services during a global pandemic has been met with unique challenges and often resistance as providers and patients adjust, out of necessity, to a virtual care option of healthcare delivery. Those residing in rural Appalachian communities are often plagued by lack of access to care, isolation, and well documented health disparities that has only been magnified by the spread of COVID-19 at disproportionate rates as compared to their urban counterparts (Bauerly et al., 2019; Bhopalwala et al., 2022; Cortelyou-Ward et al., 2020; Jukins et al., 2021; Vanderpool et al., 2021). Although the use of telehealth can play an important role in managing chronic conditions and continuity of care during the COVID-19 pandemic, its overall use among various Appalachian and non-Appalachian communities has resulted in a variable uptake and an even more uncertain future.

Telehealth, COVID-19, & Chronic Disease Management

In 2021 and due to the growing concern over the COVID-19 pandemic, geographical restrictions were eliminated by the Centers for Medicare and Medicaid Services (CMS) allowing for expanded reimbursement of telehealth services (CMS, 2020a; CMS, 2020b). However, its

incorporation into health care practices from both a provider and patient standpoint was primarily associated with regional location and urbanicity (Demeke et al., 2020). Of 245 health centers examined, rural areas of the South were consistently found to have the lowest weekly average of telehealth usage (Demeke et al., 2021). Either directly or indirectly, the COVID-19 pandemic has impacted those suffering from chronic disease via social and economic hardship, access to health care, inability to prevent exacerbation, or lack of routine management for their chronic health condition (Czeisler et al., 2020; Hacker et al., 2021; London et al., 2020). The use of telehealth during a global pandemic could positively impact the health of those managing chronic conditions and the providers caring for them but only if accepted as a viable alternative to in-person provider interaction.

Upon a review of the literature exploring telehealth use prior to the public health crisis and subsequent mitigation strategies, several major concepts and themes regarding telehealth use and acceptance arose including community support, infrastructure, buy-in, and cost containment. Throughout the works reviewed, community support of telehealth appeared to be a vital component holding a key to client utilization with researchers finding that telehealth services supported by a client's personal healthcare provider, schools of nursing and medicine, or community-based centers were more likely to be well-received (Bernstein et al., 2021; Office et al., 2020; Resnick et al., 2012). According to Pierce et al. (2021) increased telehealth use was significantly correlated with training ($p=0.002$) and organizational encouragement ($p=0.003$).

Many of the researchers also stressed the importance of adequate infrastructure in order to have a successful telehealth program suggesting the need for advanced policy and procedure development, software integration, and network capabilities (Calyam et al., 2016; Gillespie et al., 2019; Lindeman, 2011; Noel et al., 2018; Norman et al., 2018; O'Brien et al., 2014; Satariano et

al., 2014; Shah et al., 2013). However, findings revealed that attitude of providers and patients can greatly encourage or hinder efforts to implementation and sustainability of telehealth services necessary to manage health and wellness with reluctance identified by not only clients, but also staff and providers (Akbar et al., 2020; Carolan et al, 2020; Shah et al., 2013). Telehealth services have been shown to decrease the financial burden associated with managing chronic conditions including ambulance transport, emergency room costs, and potential risks associated with hospitalization (Calyam et al., 2016; Gillespie et al., 2019; Norman et al., 2018; Shah et al., 2013), but its utilization and acceptance remains variable. Currently, there is a lack of research in the United States on telehealth use during the pandemic or due to the pandemic in terms of client perception, experience, and factors impacting its utilization comparing Appalachian and non-Appalachian communities. Examining these concepts can help providers to identify potential barriers to telehealth success and develop strategies designed to improve overall health of rural Appalachian residents using telehealth as a means of managing chronic health conditions.

A COVID-19 public health survey was distributed to adults aged 18 years and over via social media and healthcare clinics focusing mainly in the tri-state region of central Appalachia. The survey received IRB approval from a regional university prior to administration. The focus of the survey was on COVID-19 mitigation strategies, health literacy, and chronic health conditions. The survey also addressed alternate methods of receiving health care services for those with chronic health conditions which included the use, acceptability, and accessibility of telehealth services. The purpose of this study is to examine the relationship between telehealth use, telehealth satisfaction, and chronic medical conditions among residents living in Appalachian and non-Appalachian communities. A secondary data analysis was conducted using the COVID-9 public health survey results.

Methods and Analysis

For this study, survey responses were limited to adults aged ≥18 years who consented to participate in the survey that self-identified as an individual with one or more chronic medical conditions and answered two specific questions on the survey: 1) Have you ever used telemedicine services? and 2) When the vaccine for COVID-19 becomes available to you, will you seek to obtain it?. Respondents were classified as being Appalachian or non-Appalachian based on their self-reported response for county and state where the individual lives, according to Appalachian Regional Commission (ARC) designation for the Appalachian Region (n.d.-a)). County level data was determined using ARC's County Economic Status and Distressed Areas by State 2021 report (n.d.-b)), and rural/urban data was determined using the 2013 Rural-Urban Continuum Codes (Economic Research Service [ERS], n.d.)). When county and/or state was missing or invalid, respondents were excluded from those corresponding analyses.

Data was analyzed based on telehealth use (independent variable) and dependent variables including age, education level, reasons for not using telehealth, ARC designation, and rural-urban continuum codes. Simple descriptive statistics including frequencies, percentages, means, and standard deviations (SDs) were calculated for variables of interest both overall and by subgroups of interest. Chi-squared tests were used to compare categorical outcomes between groups of interest, while two-sample t-tests were used for continuous outcomes. Significance for all tests was determined using an α level of 0.05.

Findings

Of the original 430 survey participants, 195 responded met all inclusion criteria for this study, with 175 having available data on Appalachian (vs. non-Appalachian) status. The vast majority of

participants (n=169) reported female (86.7%) and had at least some degree of post-secondary education (Table 1).

Table 1

Demographic Data of Study Population (N=175)

Mean (SD)	Demographics	Appalachian n = 85	Non-Appalachian n = 90
Gender	Female	71 (84%)	80 (89%)
	Male	12 (14%)	10 (11%)
	Other	2 (2%)	0 (0%)
Age in years		53.54 (14.18)	54.49 (12.34)
Education	High School Graduate/GED	11 (14%)	17 (20%)
	Some College/Associate's/Bachelor's Degree	47 (59%)	49 (58%)
	Post Undergraduate	22 (28%)	18 (21%)

Note: percentages are based on non-missing values

Telehealth Use

A total of 20 participants were excluded from this analysis due to absence of a valid county on the survey instrument and were therefore unable to determine Appalachian or non-Appalachian status. Based on the remaining data (n=175), the majority of respondents (71.4%) reported using telehealth services sometime during the COVID-19 pandemic. The majority of both Appalachian (n=61, 72%) and non-Appalachian residents (n=64, 71%) reported using telehealth services during the pandemic (p=0.9). Respondents that denied use of telehealth services included 24 from Appalachia (28%) and 26 non-Appalachian respondents (29%). Combined, those that answered no to using telehealth services (n=50) accounted for 28.6% of the total population examined. There is no statistically significant relationship between Appalachian versus non-Appalachian respondents with regard to using telehealth services during the COVID-19 pandemic. Based on these initial findings, additional subset analyses for Appalachian counties examined relationships

between the ARC (n.d.-b)) guidelines for economic and distressed areas and the ERS (n.d.) rural-urban continuum codes for Appalachian counties.

The results for telehealth use accounting for Appalachian non-urban versus Appalachian urban respondents produced similar results as those found in Appalachian versus non-Appalachian. Of respondents in non-urban Appalachian counties (n=11), results in terms of use were almost equally divided with 45% denying use of such services and 55% answering yes to using telehealth services during the pandemic. Of the respondents classified as residing in urban Appalachian counties (n=73), almost three-quarters (74%) reported using telehealth services, while 26% denied (n=19). There is not a statistically significant relationship between non-urban/urban status and the use of telehealth services in Appalachia (p=0.3).

One West Virginia county was excluded from analysis due to the county being listed as USA. Any additional respondents that did not include a county were excluded from analysis resulting in a total of 84 Appalachian respondents included in the analysis. Using the county economic status as outlined by ARC (n.d.-b)), respondents fell into one of two categories: competitive/transitional or at-risk/distressed. Of the respondents from competitive/transitional counties (n=78), 74% reported using telehealth services during the COVID-19 pandemic. Conversely, from at-risk/distressed counties (n=6), 67% denied using such services. There was a trending statistical relationship between county status and the use of telehealth services in Appalachia with those counties doing economically better being more likely to use telehealth services as compared to those fairing less well (p=0.053).

Telehealth Satisfaction

The incorporation of telehealth services into an individual's healthcare practices relies upon user satisfaction and confidence with care provided at a distance. Of the 125 Appalachian versus

non-Appalachian respondents examined, the majority were satisfied with their telehealth visit (n=72, 57.6%). Notably, and despite physical location, the use of telehealth services was supported by 62% of Appalachian respondents (n=38/61) and by 53% of non-Appalachian respondents (n=34/64). A total of 48 respondents reported their experience with telehealth services as neutral (38.4%) and the remaining respondents (n=5, 4%) reported dissatisfaction. Findings suggest that there are no differences in satisfaction of using telehealth between Appalachian and non-Appalachian respondents (p=0.6). Similar results were found when examined using competitive/transitional counties as compared to at-risk distressed counties with 61.7% of overall respondents reporting satisfaction with their telehealth experience (Table 2). Findings once again suggested that there are no differences in satisfaction of using telehealth between competitive/traditional versus at-risk/distressed counties (p>0.9).

Table 2

Telehealth Satisfaction (n = 125)

	Unsatisfied	Neutral	Satisfied
Appalachian (n=61)	2 (3%)	21 (34%)	38 (62%)
Non-Appalachian (n=64)	3 (5%)	27 (42%)	34 (53%)
Appalachian Urban (n=54)	0 (0%)	20 (37%)	34 (63%)
Appalachian Non-Urban (n=6)	2 (33%)	1 (17%)	3 (50%)
Appalachian Competitive/Transitional County (n=58)	2 (3%)	20 (34%)	36 (62%)
Appalachian At-Risk/Distressed County (n=2)	0 (0%)	1 (50%)	1 (50%)

*Participants that reported Telehealth Use

Although the initial results did not suggest differences in satisfaction among respondents, additional analysis suggested otherwise when Appalachian communities were divided into urban versus non-urban areas. Of the 60 Appalachian respondents, 37 (61.7%) were satisfied with their overall experience. Analysis revealed that 50% (n=3) of non-urban Appalachian respondents reported being satisfied with using telehealth as compared to 63% (n=34) of urban Appalachian respondents. As such, findings suggest that people living in urban areas of Appalachia were more

likely to be satisfied using telehealth services than those living in non-urban areas of Appalachia (p=0.01).

Potential Barriers to Telehealth Use

The use of telehealth services can potentially improve access to care but it can also encounter factors or barriers that hinder overall acceptance and use within communities. Within the survey instrument, respondents who did not use telehealth were given a selection of reasons to why telehealth services were not used including: lack of internet access, lack of adequate phone or computer, confusion about how it works, preference for an in-person provider, and medical care not required. Analysis of the data strived to understand the relationship between reasons for not using telehealth services and classifications based on Appalachian/non-Appalachian, Appalachian urban/Appalachian non-urban, and county economic status. A thorough examination of each factor revealed that there are no differences in reasons for not using telehealth among respondents whether examined as Appalachian versus non-Appalachian, competitive/transitional versus at-risk/distressed counties, or Appalachian urban versus Appalachian non-urban (Table 3).

Table 3

*Reasons for Not Using Telehealth (n=50)**

	Appalachian n=24	Non-Appalachian n=26	Appalachian Urban n=19	Appalachian Non-Urban n=5	Appalachian Competitive/ Transitional n=20	Appalachian At-Risk/ Distressed n=4
Lack of Internet Access	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lack of Adequate Phone/Computer	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Confusion About How It Works	2 (8%)	1 (4%)	1 (5%)	1 (20%)	1 (5%)	1 (25%)
Prefer to Visit Healthcare Provider in Person	16 (67%)	17 (65%)	13 (68%)	3 (60%)	13 (65%)	3 (75%)

	Appalachian n=24	Non-Appalachian n=26	Appalachian Urban n=19	Appalachian Non-Urban n=5	Appalachian Competitive/ Transitional n=20	Appalachian At-Risk/ Distressed n=4
Have Not Required Medical Care	8 (33%)	9 (35%)	6 (32%)	2 (40%)	6 (30%)	2 (50%)

*Participants that did *not* report Telehealth Use. Note that these options are not mutually exclusive, and participants could choose more than one reason

Impact of Age and Education Level on Telehealth Use

Technology acceptance and telehealth use can often be impacted based upon participant characteristics such as the age of those using the services and their level of education. Survey data was examined to assess if there was a relationship between using telehealth and age or education level. Upon examination, those that had used telehealth had a mean age of 53.9 years (SD=12.6) and those that had not used telehealth had a mean age of 54.9 years (SD=13.9). Analysis suggests that there is no statistically significant relationship between age and using telehealth (p=0.7).

A total of 193 respondents answered the questions related to education and telehealth use. Of those respondents, two were removed from this specific analysis reporting an education level of less than high school and an additional eight were removed for "other" leaving 183 respondents for evaluation. A total of 133 (72.7%) respondents reported ever using telehealth services with the vast majority of total participants having at least some level of post-secondary education. Although there was not a statistically significant relationship between education level and use of telemedicine (p=0.1), there did appear to be a trend with respondents of lower education level being less likely to use telehealth services as compared to participants of a higher level of education.

Discussion

Telehealth Use

A relationship was determined to exist between county economic status and the use of telehealth services in Appalachia with those counties doing economically better being more likely to use telehealth services as compared to those fairing less well. Recent research supports this finding suggesting that areas with higher levels of economic distress are less likely to use telehealth services due to their rural nature regardless of the dramatic increases in acceptance nationwide secondary to the effects of COVID-19 (Patel et al., 2021). Research also suggests that those residing in rural communities represent a less significant percentage of users as compared to those living in urban communities, with lowest participation rates occurring in Appalachian areas of Kentucky, Tennessee, and the Midwest (Friedman et al., 2022; Suran, 2022; Vanderpool et al., 2021).

Although often cited as a potential barrier to telehealth use (Bauerly et al., 2019; Cortelyou-Ward et al., 2020), lack of internet access did not appear to be a contributing factor to telehealth use in this study with all respondents denying problems with broadband capabilities or lack of access to an adequate phone or computer. Rural isolation can lead to issues with broadband access. However, these findings are consistent with recent research suggesting that 97% of all Americans own a cell phone, approximately 75-85% own either a laptop or desktop computer, and there is an increased reliance among smartphones found among those of lower socioeconomic status and possessing less than a post-secondary education level (Pew Research Center, 2021). However, additional research is warranted to see if these findings are consistent among all rural communities in Appalachia.

The significant differences in sociodemographics, in terms of regionality and the lack of ethnic diversity among research participants, also requires further exploration. Telehealth services has the potential to maintain continuity of care in individuals suffering from chronic health conditions in Appalachian communities, but those residing in economically distressed areas of Appalachia do not appear to benefit from its use. Because the sample size was small when looking through the lens of rural-urban continuum codes, a larger sample size from various Appalachian communities is warranted. Larger studies are needed to allow for not only Appalachian versus non-Appalachian but also Appalachian urban versus Appalachian rural comparison. Additionally, future research must take a closer examination of reasons why the use of such technologies has not faired well within this specific vulnerable population accounting for differences in gender and ethnicity.

Telehealth Satisfaction

Satisfaction with telehealth services is a key factor to sustainability in managing chronic health conditions among those living in rural and urban areas along the Appalachia. Findings in this study found that there are no differences in satisfaction in telehealth use between Appalachian and non-Appalachian respondents as well as respondents compared by county status. However, findings do suggest that respondents living in non-urban areas of Appalachia are less satisfied with telehealth services as compared to those from urban areas of Appalachia.

Prior to the COVID-19 pandemic, satisfaction with telehealth use was subject to mixed review with a lack of focus on Appalachian communities. The vast majority of research suggested high levels of satisfaction with telehealth use in more urban communities and metropolitan areas across the United States (Akbar et al., 2020; Calyam et al., 2016; Shah et al., 2013). However, research found distinct differences between age groups with those of younger age and higher

education level reporting more favorably to telehealth use as compared to those of older age and lower education level. Results suggested that adults age 55 years and older were less acceptable of receiving medical care via telehealth secondary to inexperience with technology, decreased health literacy, and distrust (Akbar et al., 2020). During the COVID-19 pandemic, research suggests high levels of satisfaction expanding into various urban and rural communities though not necessarily specific to Appalachia (Brown et al., 2020; Chen et al., 2022; Junkins et al., 2021; Ramaswamy et al., 2022; Silvestrini et al., 2021; Thomson et al., 2021).

Although expanded research has provided valuable data, still little is known about telehealth satisfaction among varying communities within Appalachia. Future studies are needed to explore telehealth acceptance and satisfaction among various age groups within Appalachia. Implementation research is also needed to evaluate satisfaction among this population with exploration into guidelines that aid the building of successful telehealth models that are well received within this specific population. Furthermore, research should focus on processes needed to increase engagement and satisfaction with identification of factors that may impair attitudes toward telehealth use and community sustainability so that residents of Appalachia have the same opportunity to manage their chronic health conditions as their urban counterparts.

Potential Barriers to Telehealth Use

Telehealth services has the potential to help manage chronic health conditions among residents of Appalachia but has been hampered in the past by a variety of barriers. This study strived to examine potential barriers to telehealth use among this population during the COVID-19 pandemic including: lack of internet access, phone, or computer; confusion about telehealth; preference for in-person provider interaction; and, medical care not required. Findings suggest that there are no differences in reasons for not using telehealth among respondents whether examined

as Appalachian versus non-Appalachian, competitive/transitional versus at-risk/distressed counties, or Appalachian urban versus Appalachian non-urban.

According to the Population Reference Bureau (n.d.), the digital divide still exists between regions of the United States and Appalachia and within Appalachian rural and Appalachian urban areas. Between the years of 2013-2017 and of the 420 Appalachian counties examined, less than 75% of households owned a computer device especially in areas in and around Central Appalachia. Additionally, less than 60% of households in the Appalachian counties examined subscribed to broadband internet services (Population Reference Bureau, n.d.). Research conducted by O'Brien et al. (2014) in the Appalachian region of North Carolina found that only 79% of the participants in their study owned a cellular phone, however only one of the cell phone owners possessed a smartphone capable of accessing the internet. Furthermore, the authors found that a large percentage of the participants (30-50%) either did not own a desktop computer, laptop, or have knowledge as to how to use the internet. Similar results were found during the COVID-19 pandemic with 22% of North Carolina Appalachian areas lacking internet connection at rates of 22-40% (Engel-Smith, 2021). Cortelyou-Ward et al. (2020) stresses that the limited broadband access found in many rural areas must be considered a social determinant of health impacting both individuals and communities.

Limitations

There are several limitations noted in this study. First, and as a retrospective study, there is no comparison of results prior to the COVID-19 pandemic from which to compare. Second, the limitation to a web-based survey instrument prevents the recruitment of participants that lack internet access which could lead to potential bias towards participants with a higher level of digital literacy. Third, the participants in this study appear to be highly educated and may not be

representative of all rural Appalachian communities. Fourth, the sample size specific to rural Appalachia was relatively small making generalizability difficult. Lastly, the study population lacked ethnic and racial diversity resulting in an inability to capture results from underrepresented minorities living in rural areas of Appalachia.

Implications & Future Research

Although broadband capabilities have expanded in response to the COVID-19 pandemic, there is limited research as to how the expansion has benefited those residing in Appalachia in terms of managing chronic health conditions. Research reflects the need for published surveillance and strategies used for telehealth in Appalachian communities, as well as qualitative examination to explore potential barriers toward its implementation. Research should also be designed to assess the type of training needed to support its use among this population. Because sample sizes were relatively small within the sample population of interest and scattered among varying geographical locations of Appalachia, future research should focus on expanding participation among Appalachian respondents looking for specific differences related to location within Appalachia, age, gender, ethnicity, and socioeconomic status.

References

Akbar, A., Iqbal, A., Gaziano, D., Gasior, F., Zaidi, A. J., Iqbal, A., & Silva, A. (2020). A cross-sectional survey on telemedicine use for doctor-patient communication. *Cureus* 12(9): e10402. https://doi.org/10.7759/cureus.10402

Appalachian Regional Commission. (n.d.-a). *About the Appalachian region.* https://www.arc.gov/about-the-appalachian-region/

Appalachian Regional Commission. (n.d.-b). *County economic status and distressed areas by state, fy 2021*. https://www.arc.gov/county-economic-status-and-distressed-areas-by-state-fy-2021/

Bauerly, B. C., McCord, R. F., Hulkower, R., & Pepin, D. (2019). Broadband access as a public health issue: The role of law in expanding broadband access and connecting underserved communities for better health outcomes. *The Journal of Law, Medicine & Ethics 47*(S2), 39–42. https://doi.org/10.1177/1073110519857314

Bernstein, P., Ko, K., Israni, J., Cronin, A. O., Kurliand, M. M., Shi, J. M., Chung, J., Borgo, L., Reed, A., Kosten, L., Chang, A. M., Sites, F. D., Funahashi, T., & Agha, Z. (2021). Urgent and non- emergent telehealth care for seniors: Findings from a multi-site impact study. *Journal of Telemedicine and Telecare*. https://doi.org/10.1177/1357633X211004321

Bhopalwala, H., Dewaswala, N., Kolgatla, S., Wisnieski, L., Piercy, J., Bhopalwala, A., & Moka, N. (2022). Predictors of mortality for patients with COVID-19 in the rural Appalachian region. International Journal of General Medicine, 15, 2207-2214. https://doi.org/10.2147/IJGM.S355083

Brown, J. D., Hales, S. Evans, T. E., Turner, T., Sword, D. O., O'Neil, P. M., Ballentine, S., Lovelace, O., & DuBose-Morris, R. A. (2020). Description, utilization and results from a telehealth primary care weight management intervention for adults with obesity in South Carolina. *Journal of Telemedicine & Telecare, 26*(1/2), 28-35. https://doi.org/10.1177/1357633X18789562

Calyam, P., Mishra, A., Antequera, R. B., Chemodanov, D., Berryman, A., Zhu, K., Abbott, C., & Skubic, M. (2016). Synchronous Big Data analytics for personalized and remote physical therapy. *Pervasive and Mobile Computing, 28*(C), 3-20. https://doi.org/10.1016/j.pmcj.2015.09.004

Carolan, K., Grabowski, D. C., Mehrotra, A., & Hatfield, L. A. (2020). Use of telemedicine for emergency triage in an independent senior living community: Mixed methods study. *Journal of Medical Internet Research*, *22*(12), e23014. https://doi.org/10.2196/23014

Centers for Disease Control and Prevention. (n,d,). *COVID data tracker weekly review*. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html

Centers for Medicare & Medicaid Services. (2020a). *COVID-19 emergency declaration blanket waivers for health care providers.* https://www.cms.gov/files/document/covid19-emergency-declaration-health-care-providers-fact-sheet.pdf

Centers for Medicare & Medicaid Services. (2020b). *Telemedicine health care provider fact sheet.* Baltimore, MD: US Department of Health and Human Services. https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet

Chen, M. H., Goverover, Y., Botticello, A., DeLuca, J., & Geneva, H. M. (2022). Healthcare disparities and the use of telehealth services among people with multiple sclerosis during the COVID-19 pandemic. *Archives of Physical Medicine and Rehabilitation, 000,* 1-8. https://doi.org/10.1016.j.apmr.2021.12.028

Cortelyou-Ward, K., Atkins, D. N., Noblin, A., Rotarius, T., White, P., & Carey, C. (2020). Navigating the digital divide: Barriers to telehealth in rural areas. *Journal of Health Care for the Poor and Underserved, 31*(4), 1546-1556. https://doi.org/10.1353/hpu.2020.0116

Czeisler, M. É, Marynak, K, Clarke, K. E., et al. (2020). Delay or avoidance of medical care because of COVID-19–related concerns — United States, June 2020. *Morbidity and Mortality Weekly Report*, *69*(36), 1250-1257. https://doi.org/10.15585/mmwr.mm6936a4

Demeke, H. B., Pao, L. Z., Clark, H., Romero, L., Neri, A., Shah, R., McDow, K. B., Tindall, E., Iqbal, N. J., Hatfield-Timajchy, K., Bolton, J., Le, X., Hair, B., Campbell, S., Bui, C.,

Sandhu, P., Nwaise, I., Armstrong, P. A., & Rose, M. A. (2020). Telehealth practice among health centers during the COVID-19 pandemic — United States, July 11–17, 2020. *Morbidity and Mortality Weekly Report*, *69*, 1902–1905. http://dx.doi.org/10.15585/mmwr.mm6950a4

Demeke, H. B., Merali, S., Marks, S., Pao, L. Z., Romero, L., Sandhu, P., Clark, H., Clara, A., McDow, K. B., Tindall, E., Campbell, S., Bolton, J., Le, X., Skapik, J. L., Nwaise, I., Rose, M. A., Strona, F. V., Nelson, C., & Siza, C. (2021). Trends in use of telehealth among health centers during the COVID-19 Pandemic - United States, June 26-November 6, 2020. *Morbidity and Mortality Weekly Report*, *70*(7), 240–244. https://doi.org/10.15585/mmwr.mm7007a3

Economic Research Service. (n.d.) *Rural-urban continuum codes.* U.S. Department of Agriculture. https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx

Engel-Smith, L. (July 7, 2021). In North Carolina's mountains, broadband isn't a given. https://www.northcarolinahealthnews.org/2021/07/07/in-north-carolinas-mountains-broadband-isnt-a-given/

Friedman, A. B., Gervasi, S., Song, H., Bond, A. M., Chen, A. T., Bergman, A., David, G., Bailey, J. M., Brooks, R., & Smith-McLallen, A. (2022). Telemedicine catches on: Changes in the utilization of telemedicine services during the COVID-19 pandemic. *The American Journal of Managed Care, 28*(1), e1-e6. https://doi.org/10.37765/ajmc.2022.88771

Gillespie, S. M., Wasserman, E. B., Wood, N. E., Wang, H., Dozier, A., Nelson, D., McConnochie, K. M., & Shah, M. N. (2019). High-intensity telemedicine reduces emergency department use by older adults with dementia in senior living communities. *Journal of the*

American Medical Directors Association, 20(8), 942–946. https://doi.org/10.1016/j.jamda.2019.03.024

Hacker, K. A., Briss, P. A., Richardson, L., Wright, J., & Petersen, R. (2021). COVID-19 and chronic disease: The impact now and in the future. *Preventing Chronic Disease*, *18*, E62–E62. https://doi.org/10.5888/pcd18.210086

Junkins, A., Psaros, C., Ott, C., Azuero, A., Lambert, C. C., Cropsey, K., Savage, R., Haberer, J. E., Safren, S. A., & Kempf, M. C. (2021). Feasibility, acceptability, and preliminary impact of telemedicine-administered cognitive behavioral therapy for adherence and depression among African American women living with HIV in the rural South. *Journal of Health Psychology, 26*(14), 2730-2742. https://doi.org/10.1177/1359105320926526

Lindeman, D (2011). Interview: Lessons from a leader in telehealth diffusion: A conversation with Adam Darkins of the Veterans Health Administration. *Ageing International*, *36*(1), 146–154. https://doi.org/10.1007/s12126-010-9079-7

London, J. W., Fazio-Eynullayeva, E., Palchuk, M. B., Sankey, P., & McNair, C. (2020). Effects of the COVID-19 pandemic on cancer-related patient encounters. *JCO Clinical Cancer Informatics*, *4*, 657–665. https://doi.org/10.1200/CCI.20.00068

Noel, K., Yagudayev, S., Messina, C., Schoenfeld, E., Hou, W., & Kelly, G. (2018). Tele-transitions of care. A 12-month, parallel-group, superiority randomized controlled trial protocol, evaluating the use of telehealth versus standard transitions of care in the prevention of avoidable hospital readmissions. *Contemporary Clinical Trials Communications, 12*, 9–16. https://doi.org/10.1016/j.conctc.2018.08.006

Norman, G. J., Orton, K., Wade, A., Morris, A. M., & Slaboda, J. C. (2018). Operation and challenges of home-based medical practices in the US: findings from six aggregated case

studies. *BMC Health Services Research*, *18*(1), 45–45. https://doi.org/10.1186/s12913-018-2855-x

O'Brien, T. R., Treiber, F., Jenkins, C., & Mercier, A. (2014). Use of computer and cellular phone technology by older rural adults. *Computers Informatics Nursing, 32*(8), 390–396. https://doi.org/10.1097/CIN.0000000000000080

Office, E. E., Rodenstein, M. S., Merchant, T. S., Pendergrast, T. R., & Lindquist, L. A. (2020). Reducing social isolation of seniors during COVID-19 through medical student telephone contact. *Journal of the American Medical Directors Association, 21*(7), 948–950. https://doi.org/10.1016/j.jamda.2020.06.003

Patel, S.Y., Mehrotra, A., Huskamp, H. A., Uscher-Pines, L., Ganguli, I., & Barnett, M. L. (2021). Variation in telemedicine use and outpatient care during the COVID-19 pandemic in the United States. *Health Affairs, 40*(2), 349-358. https://doi.org/10.1377/hlthaff.2020.01786

Pew Research Center. (2021). *Mobile fact sheet.* https://www.pewresearch.org/internet/fact-sheet/mobile/

Pierce, B. S., Perrin, P. B., Dow, A. W., Dautovich, N. D., Rybarczyk, B. D., & Mishra, V. K. (2021). Changes in physician telemedicine use during COVID-19: Effects of practice setting, demographics, training, and organizational policies. *International Journal of Environmental Research and Public Health, 18*(19). https://doi.org/10.3390/ijerph18199963

Population Reference Bureau. (n.d.). *As schools close in response to coronavirus, children in rural Appalachia may have less access to tools for remote learning.* https://www.prb.org/resources/appalachias-digital-gap-in-rural-areas-leaves-some-communities-

behind/#:~:text=During%20the%202013%2D2017%20period,60%20percent%20(see%20Figure)

Ramaswamy, A., Yu, M., Drangsholt, S., Ng, E., Culligan, P. J., Schlegel, P. N., & Hu, J. C. (2022). Patient satisfaction with telemedicine during the COVID-19 pandemic: Retrospective cohort study. *Journal of Medical Internet Research, 22*(9), e20786. https://doi.org/10.2196/20786

Resnick, H. E., Ilagan, P. R., Kaylor, M. B., Mehling, D, & Alwan, M. (2012). TEAhM-Technologies for enhancing access to health management: A pilot study of community-based telehealth. *Telemedicine and E-Health, 18*(3), 166-174. https://doi.org/10.1089/tmj.2011.0122

Satariano, W. A., Scharlach, A. E., & Lindeman, D. (2014). Aging, place, and technology: Toward improving access and wellness in older populations. *Journal of Aging and Health, 26*(8), 1373–1389. https://doi.org/10.1177/0898264314543470

Shah, M. N., McDermott, R., Gillespie, S. M., Philbrick, E. B., Nelson, D., & Lang, E. (2013). Potential of telemedicine to provide acute medical care for adults in senior living communities. *Academic Emergency Medicine, 20*(2), 162-168. https://doi.org/10.1111/acem.12075

Silvestrini, M., Indresano, J., Zeliadt, S. B., & Chen, J. A. (2021). "There's a huge benefit just to know that someone cares." A qualitative examination of rural veterans' experiences with TelePain. *BMC Health Services Research, 21*(1), 1-8. https://doi.org/10.1186/s12913-021-07133-5

Suran, M. (2022). Increased use of medical telehealth during the pandemic. *Journal of the American Medical Association, 327*(4), 313. https://doi.org/10.1001/jama.2021.23332

Thomson, M. D., Mariani, A. C., Williams, A. R., Sutton, A., & Sheppard, V. B. (August 5, 2021). Factors associated with use of and satisfaction with telehealth by adults in rural Virginia during the COVID-19 pandemic. *JAMA Network Open, 4*(8), e2119530. https://doi.org/10.1001/jamanetworkopen.2021.19530

Vanderpool, R. C., Stradtman, L. R., Gaysynsky, A., & Chen, Q. (2021). Access to use of technology for health: Comparisons between Appalachian Kentuckians and the general U. S. population. *Journal of Appalachian Health, 3*(4), 60-73. https://doi.org/10.13023/jah.0304.06