Title Page

**Systematic Literature Review of Telehealth Use in the Rural United States**

by

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**Abstract**

Bonny Rockette-Wagner, PhD

**Systematic Literature Review of Telehealth Use in the Rural United States**

Sarah Morgan, MPH

University of Pittsburgh, 2019

**Abstract**

**Introduction:** Individuals living in rural areas of the United States experience healthcare inequity, with much of it based on a lack of access to services. As rural hospitals continue to close due to lack of funding, this inequity will continue to grow unless addressed. Telehealth, a way of connecting health providers to their patients digitally, could be used to address this inequity. However, the implementation and public health significance of telehealth and other forms of eHealth are not yet fully understood due to concerns about feasibility, fidelity, and effectiveness.

**Objective:** This literature review aimed to assess how telehealth programs have been implemented in the rural United States. This will include gathering information on state-by-state reimbursement policies for telehealth programs.

**Methods:** The search uses the PubMed Central database to find papers between 2015 and 2019 with relevant keywords. Papers were then included based on: if they were written in the United States, if they were not a literature review, if they addressed a rural population, and if they used an eHealth intervention.

**Results:** 47 relevant articles were analyzed. 14 were feasibility studies, 7 were qualitative analyses, 17 were randomized controlled trials, 8 were non-RCT prospective studies, and 1 was a Centers for Disease Control report.

**Discussion:** The articles primarily focused on the feasibility and implementation of telemedicine programs and gathered information on user experience, patient satisfaction, and program implementation factors like fidelity. This leaves a gap in the literature about the actual efficacy and public health significance of recent telehealth programs and their effect on user health. However, it also shows a trend towards implementing more telemedicine programs once they are shown to be feasible.

**Keywords:**

telemedicine, rural health

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# Introduction

## Overview of the Impact of Hospital Closures in the Rural United States

Over 100 hospitals have closed in the United States between 2010 and 2019 (Sheps Center). Many of these closures occurred in the rural South and Appalachia regions of the United States. While a few hospitals continued to offer outpatient or urgent care, all of the hospitals categorized as closed, ceased inpatient services (Beckers Hospital Review). Additionally, 20% of rural hospitals are on the verge of closing, with 64% of these at-risk hospitals being considered essential to their communities due to trauma status, service to vulnerable populations, geographic impact, and economic impact (Navigant).

As rural areas continue to lose hospitals, more people will be forced to either travel great distances to access healthcare or go without. Respondents to a Kaiser Family Foundation survey noted that while transportation to an Emergency Room (ER) is available via ambulance, they have problems getting back home afterwards, especially if they are low-income. While federally qualified health centers (FQHCs) can expand primary care services to fill the gap left behind by a closed hospital, specialty care is difficult to access (KFF). Patients are also unlikely to be able to keep in touch with their prior health care providers, as physicians and providers often leave communities immediately following a rural hospital closure (KFF). Rural hospital closures can also increase inpatient mortality by about 6% (NBER).

While telehealth will not be able to fully address the growing healthcare access gap in rural America, it could be used to alleviate it. Telehealth allows patients to be connected to a health care provider without requiring them to be in the same physical location. This would allow patients to ignore distance and transportation limitations when accessing healthcare. However, telehealth utilization in the United States is dependent upon how health care providers are reimbursed by insurance, whether private or through Medicare/Medicaid.

This paper will review the literature for evidence of the utilization and efficacy of telehealth programs used in the rural United States. The utilization of telehealth can also depend on Medicaid expansion in each state, as this influences how the doctors involved in the telehealth program are paid, as well as what patients can access these programs. A brief overview of each state’s telehealth policy will also be made.

## Telemedicine and Rural Health

### Telehealth Terminology

eHealth is the use of information and communication technology to promote health. mHealth, a subset of eHealth, is the use of phones or other mobile devices in accessing health information. This can include things like patient portals to access health records, educational health apps, diagnostic chat bots, and telemedicine. Telemedicine can be used to connect doctors to patients without needing the patients to be physically located at the doctor’s office (WHO). Typically, telemedicine uses a video and/or audio connection to connect a patient to a doctor, but text conversations can also be used. The relationship between eHealth, mHealth and telemedicine is shown in Figure 1.

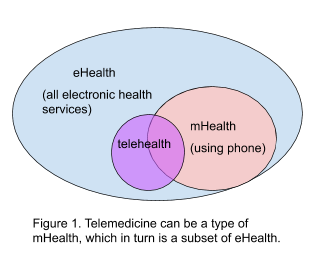


Figure 1 Telemedicine can be a type of mHealth which is in turn a subset of eHealth

Another type of telehealth called “store-and-forward” includes taking photos or other types of data, sending them to a provider, and then waiting for a diagnostic response. For example, a patient could photograph a mole and send it to a dermatologist for an initial melanoma screening. Remote patient monitoring, or RPM, uses a device to gather data over time and then sends that data to a provider. For example, a diabetic patient with RPM could send data about insulin use to their doctor using an app.

### Rural Health Needs

Individuals living in rural areas face barriers to healthcare access. Common barriers include but are not limited to: a lack of transportation, a lack of healthcare supplies, a lack of quality health care, social isolation, and financial constraint. These barriers can then lead to rationing medication, using unproven alternative medicines, and limiting other expenses (Goins, T. et al. 2006). Rural areas have $9,242 lower per capita income as compared to the average throughout the U.S. (NRHA). This leads to medical expenses taking up a larger portion of an individual’s income. When rural hospitals close, the local community per capita income can fall by up to 4% and unemployment can rise by up to 1.6%, exacerbating this problem (Navigant).

Rural populations face other health inequities. Rural areas have higher prevalence of diabetes and coronary artery disease, higher smoking rates, higher suicide rates, and higher opioid-use rates compared to non-rural areas (RHIhub, NRHA). Rural populations are also more likely to have cancers related to risk behaviors such as tobacco use and HPV exposure (Warshaw, 2017). Unintentional injury rates are 50% higher in rural areas when compared to urban areas (CDC). For those under the age of 65, 19% of rural residents are uninsured, compared to 16% of urban residents (Georgetown University). While the median total out-of-pocket health care expenditure for urban populations is $98, it is $124 for rural patients (Georgetown University).

Rural areas also face a healthcare workforce shortage. In rural areas, there are about 40 physicians per 100,000 people; in urban areas, there are 53 per 100,000 (NRHA). 54% of rural counties do not have a hospital with obstetrics services (AAMC, 2014). As hospitals continue to close throughout the rural US, these barriers to accessible quality care may become harder to surmount.

### Telehealth Implementation in the Rural US

While telehealth has the potential to alleviate the problems caused by distance and lack of access to health care in rural areas, there are several barriers to its implementation. One barrier is that roughly half of rural Americans lack sufficient bandwidth for internet service (FCC, 2015). Some telehealth methods, such as videoconferencing or accessing information online, require access to the internet.

Hospitals also need to have dedicated teleconferencing time and space in order to provide telemedicine services. They also need to have data management systems for store-and-forward and RPM services. 55% of hospital-owned practices and 37% of nonhospital-owned practices in the U.S. have implemented telehealth services. While 90% of hospitals and health systems have planned to invest in building telehealth systems, less than 10% have a dedicated telemedicine center (Landi, H. 2019).

Another barrier to telehealth implementation is limited, unclear, or nonexistent state policies regarding reimbursement for telehealth services. As of 2016, 29 states have passed telemedicine parity laws that ensure that commercial insurers reimburse telemedicine visits at the same rates as in-person visits (Mehrotra, A. et al). States with parity laws and more comprehensive policies regarding telehealth reimbursement had significantly higher rates of telehealth utilization, especially for mental health services, compared to states that did not (Mehrotra, A. et al. 2017).

### Reimbursement

Within Medicare reimbursement guidelines, telemedicine is usually limited to live video conferencing calls (CCHPCA). Some states fund the cost of the video conferencing equipment, while others do not. As shown in Figure 2, reimbursement of time spent on the call can be limited based on the type of service provided, the type of provider giving the service, and the location of the patient, or the “originating site.” Some “originating sites” are allowed to be the patient’s home, while some states only allow community health centers to be an originating site.

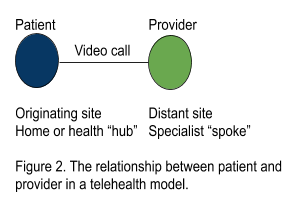


Figure 2 The relationship between patient and provider in a telehealth model

While the providers that can be reimbursed for offering telehealth services vary from state to state, there is also a difference in how *entities* such as federally qualified health centers (FQHCs) and rural health centers (RHCs) are reimbursed as “distant site” providers. Some states specifically note that these centers can be reimbursed, while others do not.

Store-and-forward and RPM are reimbursed differently from state to state. Generally, communications over email or FAX are not reimbursed. Depending on the state, a telemedicine phone call will *not* be reimbursed, and only live video calls are acceptable.

Table 1 Overview of Medicare/Medicaid policy on telehealth service reimbursement in the United States

|  |  |
| --- | --- |
| **Service covered by Medicare/Medicaid** | **# States providing service** |
| Live video teleconferencing with care provider | 50 |
| Offer a telehealth license | 27 |
| Indian Health Service, Rural Health Center, Federally Qualified Health Centers specified as originating and/or distant sites eligible for reimbursement | 27 |
| Reimbursement of site fee (originating and/or distant) | 24 |
| Remote patient monitoring | 23 |
| Store and forward | 19 |
| Patient home specified as originating site | 13 |
| Allows providers outside of state | 11 |
| Reimbursement of setup and maintenance of telehealth equipment | 5 |
| Reimbursement of transmission fee | 2 |

As shown in Table 1, while all states will reimburse live video conferencing, less than half will reimburse store-and-forward services or RPM. Many of these services are also limited in specific ways, such as only being provided for behavioral health services, only being required to patients with heart failure, etc. Some states also require that patients travel to a health care facility and use their equipment to teleconference with another health care facility, which negates the ability for telehealth to overcome transportation barriers. A state-by-state overview of telehealth policies is in Appendix B.

As states develop more policies regarding reimbursement for telehealth services, telehealth will have the opportunity to be utilized more and address rural healthcare disparities.

## Current Gaps in the Literature

Reimbursement policies for telemedicine vary widely by state and often lack information, leading to regional differences in implementation and evaluation of telehealth programs from a policy perspective. Telemedicine is also a relatively new field that can advance just as quickly as communication technologies can advance. Finally, there is a gap in the literature on how telemedicine and other eHealth interventions can be used in the rural United States specifically. While many publications note that telemedicine *can* be used in rural settings, there are a limited amount of studies that actually measure the impacts of telemedicine in rural settings.

## Public Health Significance

Telemedicine is a way to bring health care access to populations experiencing severe health disparities based on their location. A telemedicine intervention could, at best, bring health care of equal quality to an in-person visit to a person without being limited by distance or geographic inaccessibility. The use of telemedicine can also reduce costs for both the patient and providing health care service. For example, in Minnesota, the use of a telemedicine intervention led to an average $88 lower cost per visit compared to an in-person visit while also retaining a 98% participant satisfaction rate (Courneya et al, 2013). As hospitals in rural areas close, health care becomes less accessible. If telemedicine is found to be an effective and feasible way to deliver health care, it could partially address this growing problem in rural America.

# Objective

The objective of this essay is to systematically review the literature for evidence of the efficacy and feasibility of telemedicine and other eHealth interventions in the rural United States. This will be done by searching the PubMed Central database for all relevant papers published on telemedicine or other eHealth interventions over the past five years. Then, the papers will be summarized and judged for quality, especially publications reporting on the results of randomized clinical trials. The overall trends in the publications on their methodology and results will be summarized and discussed.

# Methods

Table 2 Search methods for systematic literature review on PMC database following the PICO format

|  |  |  |  |
| --- | --- | --- | --- |
| Search Grid | | | |
| **P= people in rural United States** | **I= Telemedicine**  **Limited to title and abstract** | **C=Impact comparisons** | **O=Outcomes** |
| Medicaid users OR Enrolled in Medicaid OR Medicare users OR Enrolled in Medicare OR  United States OR Rural population OR Rural health service OR Rural health OR Hospitals, rural | Telemedicine OR Mobile health OR Mobile healthcare OR Mobile medicine OR Remote medicine OR Remote health OR Remote consultation OR mHealth OR eHealth OR Health app(s) OR Healthcare app(s) OR Health portals OR Teladoc OR Telehealth OR Telehealthcare OR Store and forward OR Remote monitoring OR Remote patient monitoring OR Virtual medicine OR Virtual health | Morbidity OR DALY OR Medicaid expansion OR Medicaid utilization OR  Medicare expansion OR Quality of life OR Usability OR Feasibility OR Effectiveness OR Cost OR Services | Healthcare access OR Healthcare disparities OR Healthcare inequalities OR Utilization OR Healthcare utilization OR Healthcare costs |
| Exclusion terms: NOT (abstracts from) NOT (proceedings from) NOT Africa NOT China NOT Canada NOT Mexico NOT Europe NOT Australia NOT India  AND english[lang] AND “last 5 years "[PDat] AND United States  Search conducted during September and October of 2019 on Pub Med Database. | | | |

The search was built using PICO, or Patient/Population, Intervention/Indicator, Comparison/Control, and Outcome. The search was performed on the PubMed Central. MeSH terms, the National Library of Medicine’s controlled vocabulary thesaurus, were not used because while telemedicine and eHealth do have MeSH terms, it did not account for many of the synonyms of and types of eHealth described in Table 2. MeSH terms also have a time delay between a new article being published and it being indexed with the term. The search was also further limited to full-text articles written in English.

Table 3 Count of search results for PICO terms listed in Table 2 on the PMC database

|  |  |
| --- | --- |
| **Time frame** | **Results** |
| 1 year | 21 |
| 5 years | 115 |
| 10 years | 183 |

The results were compared over a span of one, five and ten years to show how many relevant papers were published through each time span, as shown in Table 3. The 115 publications found from the past five years were then included or excluded as shown in Figure 3.

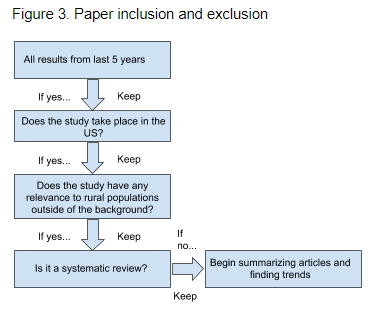


Figure 3 PMC search result inclusion and exclusion from systematic review based on time, location, relevance, and publication type

As shown in Figure 3, the search results were limited to the past five years to show the most recent developments in telemedicine research in accordance with the most recent changes in telemedicine reimbursement policies as shown in Table 1. Since many papers only mentioned the use of telemedicine to alleviate rural health disparities in their background section, the abstracts and methods sections were read for evidence of relevance to rural populations. After excluding irrelevant papers, 47 publications remained. The 47 publications were then analyzed using the CONSORT 2010 checklist of information to assess study content and quality. Information on each publication’s title, authors, year published, study purpose, population, timeframe, location, measures, results, weaknesses and strengths were collated into summary tables.

# Results

There were 47 total publications used in this systematic review. In Table 4, the types of studies published are listed.

Table 4 From the 47 selected publications: counts of each study type

|  |  |
| --- | --- |
| **Row Labels** | **Count** |
| 3-armed mixed methods | 1 |
| CDC report | 1 |
| Feasibility | 14 |
| Prospective case control | 1 |
| Prospective cohort | 3 |
| Prospective single-arm pilot study | 1 |
| Prospective, non-randomized pilot | 1 |
| Qualitative interview | 1 |
| Qualitative survey | 6 |
| Quasi experimental, waitlist control | 1 |
| RCT | 13 |
| RCT 2-arm | 1 |
| RCT with wait list control | 2 |
| Secondary analysis of RCT | 1 |
| **Grand Total** | **47** |

Overall, there were 14 feasibility studies, 8 prospective non-RCT studies, 7 qualitative studies, 16 RCTs, 1 secondary analysis of an RCT, and 1 CDC report. RCTs and feasibility studies were the most common type of publication. In Figure 4, the comparative counts of each study type are shown. The secondary analysis publication is included in the RCT category, bringing the count to 17 total.

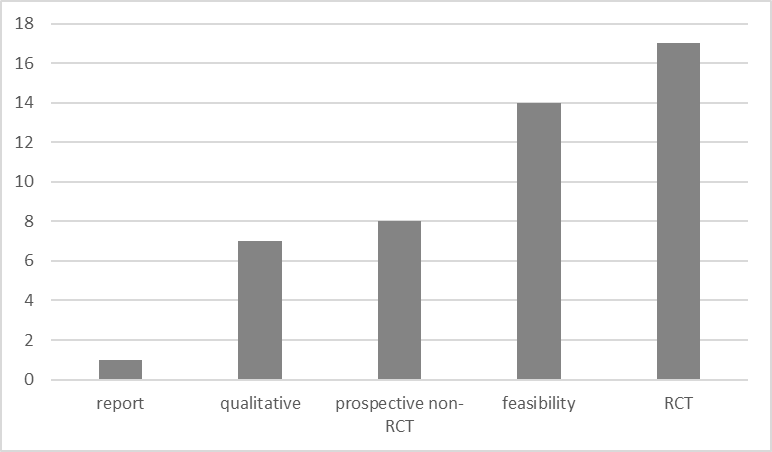


Figure 4 Bar graph of study type, (report, qualitative study, feasibility study, prospective non-RCT, and RCT) by count

In Table 5, the types of services provided in the studies are summarized. Many of the services relate to either chronic disease management or mental health.

Table 5 Counts of services provided in each publication by service type

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Count** | **Type** | **Count** | **Type** | **Count** |
| Abortion | 1 | Home IV | 1 | Sex ed | 2 |
| Asthma | 1 | Hypertension | 3 | Smoking cessation | 4 |
| Cardiac | 4 | Mental health | 7 | Sore throat | 1 |
| Caregiver support | 3 | Pain management | 1 | Speech pathology | 1 |
| Consent | 1 | Physical activity | 1 | Spinal cord injury | 2 |
| Diabetes | 4 | Prostate biopsies | 1 | Stroke | 2 |
| Eye care | 2 | Rheumatology | 1 | Transgender health | 1 |
|  |  |  |  | Weight management | 3 |

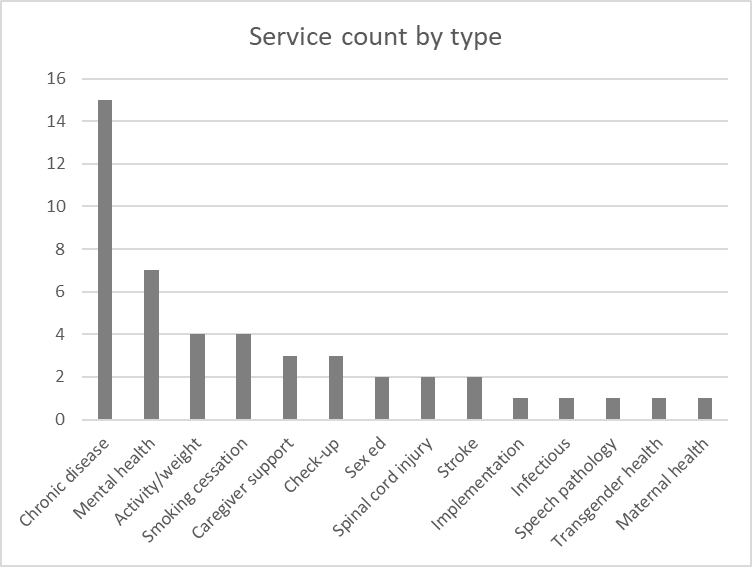


Figure 5 Bar graph of simplified service count by type found in each publication

As shown in Figure 5, there are 15 chronic disease related studies, 7 mental health studies, and 4 or less of every other category.

Table 6 Counts of eHealth intervention type found in each publication

|  |  |
| --- | --- |
| **Type of intervention** | **Count** |
| Video conference call | 22 |
| Link to resources | 7 |
| Text message | 7 |
| Focus group | 6 |
| mHealth app | 5 |
| Remote monitoring | 5 |
| Phone call | 2 |

As shown in Table 6, videoconferencing was the most common delivery method found in the publications. Videoconferencing is also the only form of telehealth reimbursed in every state.

Table 7 Summarized overview including design, population, location, results, and limitations of papers published in 2015

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Design** | **Population** | **Location** | **Results** | **Limitations** |
| Smith, C. et al. | Feasibility | 45 patients and 6 professionals | Kansas | High ease of use, high quality of audio video transmission, 93.6% of patients recommend service to others | Time frame only covered 2 appointments per patient |
| Riley, W. et al. | Feasibility | 50 heart failure patients compared to a matched cohort | Arizona | Successful implementation in a rural, underserved area | No difference in health care utilization between matched cohort and intervention group |
| Nelson, L. et al. | Prospective cohort | 80 patients with type 2 diabetes | Tennessee | 57% call participation, 84% response to texts, less engagement in racial minorities, older adults, persons with lower health literacy, persons with depressive symptoms | Need to address health literacy disparities, some technical implementation issues |
| Myers, K. et al. | RCT | 223 children with ADHD randomized to telehealth only or PCP treatment and telehealth consultation groups | Washington and Oregon | Children in telehealth model improved significantly more than children in PCP+consultation group | Including minor telemedicine in the control group could have reduced differences between the groups |
| Ingersoll, B. et al. | RCT | 27 participants in a self-directed program or therapist assisted telehealth program | Michigan | Participants in the therapist assisted group were more engaged, more likely to complete program |  |
| Richter, K. et al. | RCT | 566 smokers randomly assigned to telemedicine or telephone call counseling | Kansas | No significant difference in abstinence between groups at 12 months; telemedicine users more likely to use cessation medications, recommend program to others; phone was less costly; telemedicine had to take place in a clinic | Does not address utilization rates |

In 2015, there were six total studies, with two feasibility studies, one prospective non-RCT study, and three RCTs. There were five studies with n>30 and one with an n<30. Of the three RCTs, all three found significant differences between the telehealth intervention and control groups, though one was not significant in its primary outcome measure of smoking cessation.

Table 8 Summarized overview including design, population, location, results, and limitations of papers published in 2016

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Design** | **Population** | **Location** | **Results** | **Limitations** |
| Rutledge, S. et al. | CDC report | United States nonmetropolitan counties | United States, nonmetropolitan | 62% of nonmetropolitan counties did not have a DSME program. Very few DSME programs were via telemedicine. | Unclear information about TM adoption. |
| Guiberson, M. | Prospective case control | 62 Spanish-speaking preschool age children, 22 with language disorders and 40 without | "three states in the Mountain-West region of the United States" | Only reported vocabulary had classification accuracy high enough for screening | Unequal group sizes, large confidence intervals |
| Jenkins, C. et al. | Qualitative survey | 60 patients that had experienced a stroke | South Carolina | 85% felt comfortable using mHealth, 78.3% thought it would help them follow directions, 83.3% thought it would effectively communicate their needs | Pre-post-demonstration survey would have been more informative |
| Rockhill, C. et al. | Qualitative survey | Paper lists referring PCPs but not # of telepsychiatrists | Texas | 91% fidelity; considered an effective service model; protocol deviations were documented and justified in all but 1 case | Selection bias |
| Rhodes, L. et al. | Qualitative survey | 651 patients, predominantly African American | Alabama | All patient responses in knowledge and attitude significantly improved from baseline, 99% patient satisfaction |  |
| Dionne-Odom, J. et al. | RCT | 123 caregivers in two telehealth groups: one right after an advanced cancer diagnosis and the other 12 weeks later | Vermont and New Hampshire | Delayed group had higher depression scores, mean complicated grief scores, but adjusted between group differences were not statistically significant | Low power; more about time of delivery than methodology |
| Hepburn, S. et al. | RCT with wait list control | 17 in waitlist control, 16 in intervention, all from rural and frontier communities | Colorado | High acceptability but some issues with usability, high fidelity | Small sample size, no blinding |

**Table 8 Continued**

Of all seven studies published in 2016, one was a CDC report, one was a prospective non-RCT, three were qualitative, and two were RCTs. There were four studies with n>30, one with n<30, and one with an unclear sample size. Of the RCTs, one was n<30 while the other was n>30. One of the two RCTs found significant differences between the telehealth intervention and control groups.

Table 9 Summarized overview including design, population, location, results, and limitations of papers published in 2017

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Design | Population | Location | Results | Limitations |
| K, Shem et al. | Feasibility | 10 individuals with spinal cord injuries. | County hospital in rural California | Of the half of participants that actually used TM, 100% self-reported satisfaction in use of program. No statistically significant changes in QoL measures. | Very small sample size with 50% participation. |
| Serwe, K. et al. | Feasibility | 4 family care givers with barriers to health care access in "suburban or small town setting" | Wisconsin | "Favorable" TUQ usability score, high class attendance, self-reported change in care giving satisfaction | Very small sample size, lack of user diversity |
| Rhoads, S. et al. | Feasibility | 48 post partum women, over 30% rural, with choice to use blood pressure, weight, pulse, and oxygen saturation monitors | Arkansas | mHealth users had lower levels of perceived technology barriers, higher perceived benefits | No randomization |
| Lindauer, A. et al. | Feasibility | 33 patients and their 33 caregivers, 75% over 10 miles from clinic | Oregon and Southwest Washington | Clinicians and participants found it to be a feasible option, "excellent reliability" | Several patients did drop out due to frustration with video conference set up |
| Aschbrenner, K. et al. | Feasibility | 13 adults that were obese and had SMI | New Hampshire | 56% attendance, 45% of participants lost weight, 45% improved walking distance, desired more active learning and mental health resources | Small sample size, no control |
| Reisner, SL. et al.  **Table 9 Continued** | Prospective cohort | Four asynchronous online focus groups with 25 trans masculine adults. | Around Boston | The online bulletin board focus group system was an effective way to reach out to and hear from sexual and racial minorities. | Only peripheral focus on rurality. |
| Jhaveri, M. et al. | Prospective single-arm pilot study | up to 50 participants | Texas | Currently only a protocol | |
| Nelson, L. et al. | Qualitative survey | 80 adults with type 2 diabetes | Tennessee | Patients found the program helpful; younger patients had more favorable experiences; texts were preferred over interactive voice response messaging |  |
| Bendixen, R. et al. | Qualitative survey | 16 young adults with brain and spinal cord anomalies (9 rural or suburban), 11 caregivers | Pennsylvania | Desire for mHealth programs to: make it easy, be engaging, be educational, be motivational and supportive, and be personalized | "inability to recruit minority participants" |
| Bullock, D. et al. | Qualitative survey | 159 parents or guardians at a pediatric rheumatology clinic | Minnesota | 28% traveled more than 3 hours to get to clinic, 43% said travel was problematic, but 95% said they preferred in-person visit unless they were already familiar with telemedicine | Convenience sample |
| Pekmezi, D. et al. | RCT | 63 mostly obese adults in a randomized controlled trial with waitlist control. | around Birmingham, Alabama | Trial still ongoing; only reports baseline measures. | |
| Haggerty, A. et al. | RCT  **Table 9 Continued** | 196 participants, 20% rural participants; 41 women in each group: telemedicine with Wi-Fi scales, text messages, or enhanced usual care control. | Pennsylvania | No significant difference in weight loss across interventions, but improvement in body image and physical health for telemedicine; control lead to weight loss | Only 32 women completed the full trial assessment |
| Bobb, M. et al. | RCT | 64 in telemedicine group, 67 in-person | Iowa | Quality of Informed Consent measures were not significantly different | "telemedicine" consult took place in the same facility, just in different rooms |
| Wilson, S. et al. | RCT | 310 participants randomized to mHealth ART or best practice control | North Carolina | Currently ongoing | |

Of the 14 studies published in 2017, three were qualitative studies, five were feasibility studies, two were prospective non-RCTs, and four were RCTs. There were eight studies with n<30, five with n>30, and one that had not yet finished recruitment. Of the RCTs, four had n>30. Two of the RCTs has not yet been completed. Of the two completed RCTs, one found that the quality of informed consent and effectiveness of a weight loss intervention was not significantly different between the telemedicine and control groups.

Table 10 Summarized overview including design, population, location, results, and limitations of papers published in 2018

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Design** | **Population** | **Location** | **Results** | **Limitations** | |
| Lefler, L. et al. | 3-armed mixed methods | 28 patients aged 55 or up with heart failure | Southern state including rural areas | mHealth groups were more likely to self-monitor blood pressure and weight, reduced distress over health |  | |
| Bauer, AM. et al | Feasibility | 5 care managers and 10 patients | Rural US | High usability rating, usage of self-monitoring tools is more frequent than clinic-based symptom assessment | Small sample size, unclear location | |
| Beatty, A. et al. | Feasibility | 15 veterans in outpatient cardiology clinic | Seattle, Washington | SUS score and app utilization improved after app revision based on user feedback, ending with 78% task completion success rate and a SUS of 76. | Small sample size, only one female participant. Not necessarily rural population. | |
| Materia, F. et al. | Feasibility | 40 women with BMI>25 and not currently pregnant | Pennsylvania | Users preferred texting, mobile websites, and app over other modes | All white women | |
| Bouskill, K. et al. | Feasibility | 23 staff members | California | Telemedicine can generate new "workarounds" that point out weaknesses in a clinical workflow | |  |
| Akhtar, M. et al. | Prospective cohort | 62 adult patients (all received both in person and telemedicine service) | Midwest | Telemedicine had poor agreement on tonsil size, was easier to use for providers than patients | |  |
| Perry, T. et al. | RCT  **Table 10 Continued** | 393 rural children aged 7-14 with 81% African American, 88% reporting uncontrolled asthma symptoms, in a cluster randomized controlled trial. | Arkansas | No statistically significant differences in reported symptom free days for intervention or control group. Higher use of asthma medication and monitoring devices for intervention group. | Significant baseline morbidity and lack of access to a controller medication could underestimate impact of the program. Low parent survey completion rates at 55% at 6 months. | |
| Morawski, K. et al | RCT | 411 hypertensive adults | "A mix of rural, suburban, and urban locations" | Small improvement in medication adherence, no improvement in blood pressure | Adherence was measured by self-report | |
| Leon-Salas, A. et al. | RCT | 104 pharmaceutical assistance program eligible smokers | Kansas | Only 49 linked to PAP, paper does not comment at all on telemedicine vs telephone calls | Data is self-reported | |

Of the nine papers published in 2018, four were feasibility studies, two were prospective non-RCTs, and three were RCTs. There were five studies with n>30, and four studies with n<30. Of the RCTs, all three had n>30. Two of the three RCTs reported no significant difference in primary outcome measure between telemedicine intervention and control groups, but did report higher use of medication adherence for the telemedicine group. One study had unclear outcomes.

Table 11 Summarized overview including design, population, location, results, and limitations of papers published in 2019

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Design** | **Population** | **Location** | **Results** | **Limitations** |
| Khairat, S. et al. | Feasibility | 30 patients over the age of 65 that did not have dementia | in an inpatient geriatric specialty unit in North Carolina | Overall positive response | 26 of the 30 participants were women, all were white. |
| Lindauer, A. et al | Feasibility | 13 family caregivers | Oregon and Southwest Washington | Reduced caregiver burden, retained fidelity | Small sample size |
| Lewinski, A. et al. | Feasibility | 141 patients recruited from an FQHC with type 2 diabetes and poorly controlled hypertension | Southeastern US | Did not affect behavioral change that led to hypertension control, but had high engagement |  |
| Gore, M. et al. | Prospective,  non-randomized pilot | 204  participants in the intervention and 408 in the control | Rural program sites in Colorado | Increase in program retention, decrease in self reported fat intake | Non randomized application |
| Ehrenreich, K. et al. | Qualitative interview | 20 women recruited from Planned Parenthood Association | Utah | Waiting period and travel distance main reasons given for use of telehealth |  |
| Nepper, M. et al.  **Table 11 Continued** | Pseudo-experimental, waitlist control | 79 individuals with type 2 diabetes over the age of 30 | Nebraska | 94% self-reported the program as useful, significant increase in CVD risk awareness, having fresh fruits and vegetables in the home, and physical activity | Quasi-experimental design: control group started 2 months later than intervention |
| Balakrishnan, A. et al. | RCT | 473 in control, 359 in intervention | California | 4.5/5 mean satisfaction in program, less cancelled appointments, more preprocedural telephone calls | Only 11% of participants were rural |
| Prochaska, J. et al. | RCT | 300 Alaskan  Native adults that smoke and have high blood pressure or high cholesterol | Alaska | Study has not yet been completed | |
| Siegler, AJ. et al. | RCT 2-arm | aiming for 50% participation with black or Latino MSM | rural Georgia, Mississippi, and North Carolina | Study will complete in 2022 | |
| Scull, T. et al. | RCT with wait list control | 184 community college students aged 18 to 19 randomly assigned to intervention or wait-list control | Southeastern US | Lowered self-reported risky sexual behaviors, improvement in post-session knowledge | 41% attrition in the intervention group |
| Eaton, L. et al. | Secondary analysis of RCT | 65 rural residents and 114 non-rural residents; secondary analysis of data |  | Rural residents were less likely to use self-management and were more likely to use opioids for pain relief. |  |

**Table 11 Continued**

Of all 11 studies published in 2019, three were feasibility studies, two were prospective studies, one was a qualitative study, and five were RCTs. There were six studies with n>30 and two studies with n<30. Two of the RCTs have not yet been completed. Of the three completed RCTs, all three had an n>30. One RCT had significantly less cancelled appointments in the telemedicine intervention group, but only 11% of participants were rural. One RCT had significantly different outcomes in the intervention group compared to the control. One RCT was secondary analysis of data that looked at opioid pain relief behaviors by region.

Further detail on individual studies such as outcome measures can be found in Appendix A.

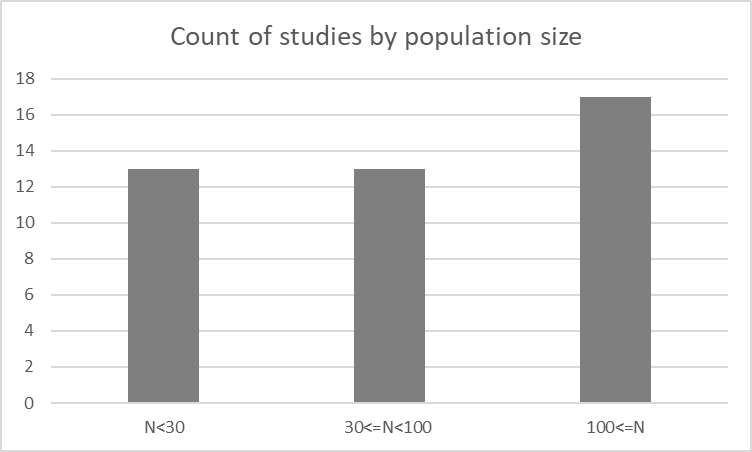


Figure 6 Count of studies by category of population size from all publications used in the systematic review

As shown in Figure 6, 30 of 43 studies with known population sizes had an n>30, with 17 studies having an n>100, while 13 studies had an n<30. Of all of the RCTs, 13 had an n>30, while two had an n<30.

Table 12. Count of outcomes and quality discussion by study type

|  |  |  |
| --- | --- | --- |
| **Feasibility studies** | | |
| Was feasible | Was not feasible | Unclear |
| 13 | 0 | 2 |
| Of the two unclear studies, one was about workarounds in the workplace caused by telemedicine implementation, and the other noted that while telemedicine led to no change in hypertension prevention behaviors, it had very high engagement with the users. | | |
| **Prospective studies** | | |
| Significant outcome | Non-significant outcome | Unclear |
| 4 | 1 | 1 |
| The unclear study noted unclear classification accuracy between groups. | | |
| **RCTs** | | |
| Significant outcome | Non-significant outcome | Unclear |
| 6 | 2 | 5 |
| Of the 5 unclear studies, one was based on a secondary analysis of data on drug use behavior, two showed that telemedicine was non-superior but not inferior to a traditional delivery method, and two showed that telemedicine did not lead to an improved outcome but did lead to higher treatment adherence. | | |
| **Qualitative studies** | | |
| Positive experience with telehealth | Negative experience with telehealth | Unclear |
| 4 | 1 | 2 |
| Of the two unclear studies, one was about future directions of telehealth engagement and another was a survey about hospital transportation methods. | | |

Of all of the studies included in the review, 4 showed evidence of lack of feasibility, low efficacy, or negative experiences using telehealth. 27 showed evidence of feasibility, efficacy, or positive experiences using telehealth. Unclear results were found in 10 studies. 6 studies were not yet completed and so had no results.

# Discussion

This literature review aims to summarize research on telemedicine utilization and effectiveness as shown by PubMed Central publications over the last five years. The review found that the most common types of studies on telemedicine were randomized controlled trials and feasibility studies. The most common type of telemedicine delivery systems used were video conference calls, texting, and smart phone apps. This roughly correlated with the types of telehealth most commonly reimbursed by state, with video conference calls being reimbursed in every state. A wide range of health care services were delivered in the studies, including weight management programs, cardiovascular health programs, caregiver wellness programs, and mental health programs. Chronic disease management was the most common type of program, with mental health programs being the second most common. This correlates with the fact that heart disease related chronic disease management and mental health programs are reimbursed in most states.

Publications over the past five years on the PMC database had an overall focus on feasibility, including factors such as user experience, patience satisfaction, and program adherence. The lack of focus on efficacy of telehealth interventions could either be due to research prior to 2015 showing the comprehensive efficacy of telehealth interventions (which is unlikely), or because feasibility studies are useful as an initial step before beginning a clinical trial or other measure of intervention efficacy, especially when the program is being done at a hospital that will have other time and money concerns.

The publications had several common limitations. Many of the studies used convenience sampling and had small sample sizes. Multiple studies identified issues with a lack of diversity due to this. Multiple studies also had high attrition rates, with some as high a 50% (Shem et al, 2017). Since the studies were focused on feasibility, more information as to why attrition rates were high and what future studies could do to address this would be helpful.

Feasibility studies of telemedicine delivery systems found overall that telemedicine was a feasible way of delivering health care from a distant site to patients at an originating site. Qualitative and prospective non-RCT studies echoed these findings. However, these types of studies have lower quality of evidence and higher risk of bias when compared to RCTs, as shown by the hierarchy of evidence pyramid (CEBM 2009.) So, this discussion will continue with further review and critique of the RCTs found.

There were 17 total RCTs found in the review. Myers et al. used a telemedicine intervention to treat ADHD in young children and found that children in the intervention group improved significantly more than those in the control group. Over 200 participants were randomized to a telehealth only or a PCP treatment with telehealth consultation group. However, the control group treatment had minor aspects of telemedicine consultation, which could have led to underestimation of the difference between the intervention and control groups.

Ingersoll et al. used a telemedicine intervention for behavioral health therapy. Participants in the intervention group were significantly more likely to complete the program, but the sample size was under 30, impacting the power and generalizability of the results.

Richter et al. had over 500 participants randomized to a telemedicine video conference smoking cessation intervention or a phone call counseling control. The primary outcome, smoking cessation, was not significantly different between the two groups. The telemedicine session also had to take place at the providing clinic, which reduces the generalizability to the more common practice of doing sessions at the home or at a different originating site.

Bobb et al. randomized participants into a telemedicine intervention and in-person control to measure the quality of informed consent for both delivery methods. They found that the quality of informed consent measures were not significantly different between the two groups. However, the telemedicine consultation being evaluated took place in the same facility as the in-person session by just putting the participant and the health provider in separate rooms. This prevents the findings from being fully generalizable to other telemedicine delivery settings such as in the home.

Perry et al. used a telemedicine intervention compared to in-person education sessions for asthma medication adherence and symptom monitoring in predominantly African American children. They found no statistically significant differences in the primary outcome measure of self-reported symptom free days. However, the telemedicine intervention group did have higher use of asthma medication and symptom monitoring devices than the control group. However, the population used in the study already had significant baseline asthma morbidity and parents only completed surveys 55% of the time at 6 months, which could introduce bias in the results.

Haggerty et al. used a telemedicine intervention using smart scales compared with a text message intervention and an enhanced usual care control. They found no significant difference in weight loss across interventions, but did find significant improvements in self-reported body image and physical health for the telemedicine group. However, out of 196 participants, only 31 women completed the full assessment, leading to an attrition rate of 84%. This could introduce bias into the final measures.

Morawski et al. used a telemedicine intervention to cause behavior change in hypertensive adults. While there was improvement in medication adherence for the telemedicine group, there was no significant improvement in the primary outcome of blood pressure. Medication adherence was also measured by self-report, which could introduce recall bias.

Leon-Salas et al. used a video conferencing telemedicine intervention compared to a telephone call program to link smokers to smoking cessation resources. However, the outcome measures are both self-reported and unclear about any actual linkage to care.

Balakrishnan et al. used a telemedicine intervention to measure program satisfaction and appointment attendance before major surgery as compared to usual care. Participants in the intervention group had high program satisfaction, less cancelled appointments, and more preprocedural phone calls than the control group. However, only 11% of participants were rural, which could reduce generalizability.

Dionne-Odom et al. randomized over 100 patients with an advanced cancer diagnosis to immediate and delayed telemedicine grief counseling interventions, with the delayed group temporarily serving as a control. The adjusted differences between the intervention and delayed intervention group were not statistically significant, and the statistical analysis had low power.

Hepburn et al. also used a wait list control, but study measures focused more on acceptability, usability, and fidelity of the teleconferencing equipment. While the intervention was highly acceptable as measured by patient surveys, the researchers did experience technical difficulties and video conferencing fidelity problems. They also noted that the researchers were not blinded.

Scull et al. also used a wait list control in a telemedicine sexual education intervention for community college students. While they found that the intervention lowered self-reported risky sexual behavior and significant improvements in post-session knowledge, there was also 41% attrition, lowering the generalizability of the findings and introducing bias.

Eaton et al. performed secondary analysis of prior RCT data to point out trends in opioid pain management. While the original RCT was using a telemedicine intervention, this secondary analysis was not as relevant to the objective of this review.

Pekmezi et al., Wilson et al., Prochaska et al., and Siegler et al. are all still ongoing.

For the randomized controlled trials, most showed that telemedicine programs were equivalent or better than the current standard of care. However, some RCT measures focused more on patient satisfaction and program fidelity than the health impact of the program. Of the RCTs that did focus on health impacts, such as weight loss or medication adherence, results were mixed. While telehealth often did not lead to changes in outcome measures, such as for asthma (Perry, T. et al. 2018) or hypertension (Lewinsky, A. et al. 2019), it did lead to improved medication adherence and engagement. It should also be noted that in this case, not having a significant difference between the telemedicine intervention and control groups does not mean that the telemedicine is not an effective delivery method. Instead, this shows that further study could be used to show that telemedicine is noninferior to the standard of care.

In the future, studies could obtain more data on telemedicine efficacy by doing more RCTs and making sure that their measures include more information about the intervention’s impact on user health. Future RCTs could also focus on telehealth interventions other than video conferencing; none of the RCTs found in the review studied store-and-forward diagnoses. However, the focus on feasibility shows that there could be plans for more RCTs in the future or that groups are looking for ways to begin implementing telemedicine programs.

This review found that while more research needs to be done, telemedicine is a feasible method of delivering healthcare to rural areas, and that telemedicine interventions can be as effective as in-person care. In the future, telemedicine could be used to address health access disparities for individuals in rural areas. Unfortunately, a robust and effective telemedicine program is unlikely to be funded by research grant money alone. State legislatures need to have clear and comprehensive telemedicine policies so that health providers participating in telemedicine delivery are reimbursed for their work. As seen in Appendix B, many states have limited to no reimbursement policies for telehealth delivery. If there are not clear telemedicine reimbursement policies in place, then health systems might not participate in a telemedicine program even if it is shown to be just as effective as in-person care. Further research in telemedicine feasibility and efficacy could be used to drive legislation forward that allows telemedicine to be equitably reimbursed.

# Appendix A: Total Summary Tables for Publications Used in the Review

|  |  |
| --- | --- |
| SCiPad: Effective Implementation of Telemedicine Using iPads with Individuals with Spinal Cord Injuries, a Case Series. | K, Shem et al. |
| Purpose | Use iPad based telemedicine for individuals with spinal cord injury. |
| Population | 10 individuals with SCI. |
| Timeframe | 6 months |
| Location | County hospital in rural California |
| Measures | Health care utilization, quality of life indices |
| Results | Of the half of participants that actually used TM, 100% self reported satisfaction in use of program. No statistically significant changes in QoL measures. |
| Weaknesses | Very small sample size with 50% participation. |
| Strengths | Ease of access to user feedback. |
|  |  |
| Feasibility of Using Telehealth to Deliver the “Powerful Tools for Caregivers” Program | Serwe, K. et al. |
| Purpose | Feasibility study of use of video conferencing telemedicine to connect unpaid family caregivers to "Powerful Tools for Caregivers" health resources. |
| Population | 4 family care givers with barriers to health care access in "suburban or small town setting" |
| Timeframe | 6 weeks |
| Location | Wisconsin |
| Measures | Pre- and post-session surveys, class attendance, Telehealth Usabilty Questionnaire |
| Results | "Favorable" TUQ usability score, high class attendance, self-reported change in care giving satisfaction |
| Weaknesses | Very small sample size, lack of user diversity |
| Strengths | Ease of access to user feedback. |
|  |  |
| Diabetes Self-Management Education Programs in Nonmetropolitan Counties — United States, 2016 | Rutledge, S. et al. |
| Purpose | CDC descriptive report on DSME programs in nonmetropolitan USA. |
| Population | United States |
| Timeframe | July 2016 |
| Location | United States, nonmetropolitan |
| Measures | DSME programs by county |
| Results | 62% of nonmetropolitan counties did not have a DSME program. Very few DSME programs were via telemedicine. |
| Weaknesses | Unclear information about TM adoption. |
| Strengths | Clear overview of DSME adoption. |
|  |  |
| An Electronic Pre-Exposure Prophylaxis Initiation and Maintenance Home Care System for Nonurban Young Men Who Have Sex With Men: Protocol for a Randomized Controlled Trial. | Siegler, AJ. et al. |
| Purpose | Use electronic systems to bring PrEP to MSM in non-urban areas |
| Population | 2-arm randomized trial aiming for 50% participation with black or Latino MSM |
| Timeframe | 12 months |
| Location | rural Georgia, Mississippi, and North Carolina |
| Measures | Milestone tracking, behavioral surveys, oral PrEP levels |
| Results | Study completes in 2022. |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Applying the Principles for Digital Development: Case Study of a Smartphone App to Support Collaborative Care for Rural Patients With Posttraumatic Stress Disorder or Bipolar Disorder. | Bauer, AM. et al |
| Purpose | Incorporate an mHealth platform called SPIRIT to deliver primary care mental health services to rural pateints with PTSD or bipolar disorder. |
| Population | 5 care managers and 10 patients |
| Timeframe | 20 weeks |
| Location | Rural US |
| Measures | Text message feedback, interviews, frequency of use data |
| Results | High usability rating, usage of self-monitoring tools is more frequent than clinic-based symptom assessment |
| Weaknesses | Small sample size, unclear location |
| Strengths | Very in depth future directions |
|  |  |
| Sensitive Health Topics With Underserved Patient Populations: Methodological Considerations for Online Focus Group Discussions. | Reisner, SL. et al. |
| Purpose | Use online focus group discussions to discuss sensitive, health-related experience for underserved patient populations such as transgender individuals. |
| Population | Four asynchronous online focus groups with 25 trans masculine adults. |
| Timeframe | 2 years |
| Location | Around Boston. |
| Measures | Qualitative feedback |
| Results | The online bulletin board focus group system was an effective way to reach out to and hear from sexual and racial minorities. |
| Weaknesses | Only peripheral focus on rurality. |
| Strengths |  |
|  |  |
|  |  |
| Results of an Asthma Education Program Delivered via Telemedicine in Rural Schools | Perry, T. et al. |
| Purpose | Use a TM asthma education program in rural schools to prevent asthma morbidity |
| Population | 393 rural children aged 7-14 with 81% African American, 88% reporting uncontrolled asthma symptoms, in a cluste randomized controlled trial. |
| Timeframe | 6 months |
| Location | Arkansas |
| Measures | Self reported symptom free days, caregiver surveys |
| Results | No statistically significant differences in reported symptom free days for intervention or control group. Higher use of asthma medication and monitoring devices for intervention group. |
| Weaknesses | Significant baseline morbidity and lack of access to a controller medication could underestimate impact of the program. Low parent survey completion rates at 55% at 6 months. |
| Strengths |  |
|  |  |
| Rationale, design, and baseline findings from a pilot randomized trial of an IVR-Supported physical activity intervention for cancer prevention in the Deep South: the DIAL study. | Pekmezi, D. et al. |
| Purpose | Use telemedicine to promote physical activity for cancer prevention for populations in the South. |
| Population | 63 mostly obese adults in a randomized controlled trial with waitlist control. |
| Timeframe | 12 weeks |
| Location | around Birmingham, Alabama |
| Measures | Physical activity via accelerometer, BMI |
| Results | Trial still ongoing; only reports baseline measures. |
| Weaknesses | Not neccessarily rural participants |
| Strengths |  |
|  |  |
|  |  |
| VA FitHeart, a Mobile App for Cardiac Rehabilitation: Usability Study | Beatty, A. et al. |
| Purpose | Develop a mobile app for home cardiac rehabilitation and determine usability. |
| Population | 15 veterans in outpatient cardiology clinic |
| Timeframe |  |
| Location | Seattle, Washington |
| Measures | App utilization, system usabilty scale, qualitative interviews |
| Results | SUS score and app utilization improved after app revision based on user feedback, ending with 78% task completion success rate and a SUS of 76. |
| Weaknesses | Small sample size, only one female participant. Not neccessarily rural population. |
| Strengths |  |
|  |  |
| Mobile Phone Text Message Intervention on Diabetes Self-Care Activities, Cardiovascular Disease Risk Awareness, and Food Choices among Type 2 Diabetes Patients | Nepper, M. et al. |
| Purpose | Provide individuals with diabetes with mobile phone text messages on self-care, cardiovascular disease information, and food choice information |
| Population | 79 individuals with type 2 diabetes over the age of 30 |
| Timeframe | 12 weeks |
| Location | Nebraska |
| Measures | CVD knowledge, nutrition and activity changes |
| Results | 94% self reported the program as useful, significant increase in CVD risk awareness, having fresh fruits and vegetables in the home, and physical activity |
| Weaknesses | Quasi-experimental design: control group started 2 months later than intervention |
| Strengths | Future directions to expand to specifically rural populations |
|  |  |
| Would Geriatric Patients Accept Using a Telemedicine Platform for Post ICU-Discharge Follow-Up Visits? | Khairat, S. et al. |
| Purpose | Use telemedicine to assess delirium in elderly patients and measure user feedback. |
| Population | 30 patients over the age of 65 that did not have dementia |
| Timeframe |  |
| Location | in an inpatient geriatric specialty unit in North Carolina |
| Measures | Feasibility through user testing on Questionnaire for User Interface Satistfaction |
| Results | Overall positive response |
| Weaknesses | 26 of the 30 participants were women, all were white. |
| Strengths |  |
|  |  |
| Spatial dimensions of telemedicine and abortion access: a qualitative study of women’s experiences | Ehrenreich, K. et al. |
| Purpose | Understand the utilization of telehealth for the first required information visit prior to an abortion |
| Population | 20 women recruited from Planned Parenthood Association |
| Timeframe | Single interview |
| Location | Utah |
| Measures | Qualitative framework |
| Results | Waiting period and travel distance main reasons given for use of telehealth |
| Weaknesses |  |
| Strengths |  |
|  |  |
|  |  |
| A Mobile Health Intervention for Prostate Biopsy Patients Reduces Appointment Cancellations: Cohort Study | Balakrishnan, A. et al. |
| Purpose | Use an text message mHealth program to improve patient education before transrectal prostate biopsies. |
| Population | 473 in control, 359 in intervention |
| Timeframe | 1 year |
| Location | California |
| Measures | Patient satisfaction, cancellations, preprocedural phonecalls, satisfaction |
| Results | 4.5/5 mean satisfaction in program, less cancelled appointments, more preprocedural telephone calls |
| Weaknesses | Only 11% of participants were rural |
| Strengths |  |
|  |  |
| Using Technology to Facilitate Fidelity Assessments: The Tele-STAR Caregiver Intervention | Lindauer, A. et al |
| Purpose | Understand the fidelity of Tele-STAR, an mHealth Alzheimer support program that reduces family caregiver burden and depression. |
| Population | 13 family caregivers |
| Timeframe | 8 weeks |
| Location | Oregon and Southwest Washington |
| Measures | Affective burden and program fidelity |
| Results | Reduced caregiver burden, retained fidelity |
| Weaknesses | Small sample size |
| Strengths |  |
|  |  |
|  |  |
| Addressing Diabetes and Poorly Controlled Hypertension: Pragmatic mHealth Self-Management Intervention | Lewinski, A. et al. |
| Purpose | Measure the feasability of using a text message and phone call mHealth program for underserved patients with diabetes and poorly controlled hypertension. |
| Population | 141 patients recruited from an FQHC with type 2 diabetes and poorly controlled hypertension |
| Timeframe | 6 months |
| Location | Southeastern US |
| Measures | Hypertension control, call engagement and frequency |
| Results | Did not effect behavioral change that led to hypertension control, but had high engagement |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Evaluating the Use of Mobile Health Technology in Older Adults With Heart Failure: Mixed-Methods Study | Lefler, L. et al. |
| Purpose | Compare the use of an mHealth remote patient monitoring system to standard care for patients with heart failure. |
| Population | Three-armed mixed methods study with 28 patients aged 55 or up with heart failure |
| Timeframe | 12 weeks |
| Location | Sourthern state including rural areas |
| Measures | Qualitative analysis and use surveys |
| Results | mHealth groups were more likely to self monitor blood pressure and weight, reduced distress over health |
| Weaknesses |  |
| Strengths | 3-arm design |
|  |  |
|  |  |
| A controlled trial of mobile short message service among participants in a rural cardiovascular disease prevention program | Gore, M. et al. |
| Purpose | Enhance the effectiveness of a state CVD prevention program using a text message based mHealth program. |
| Population | Prospective, non-randomized pilot trial with 204 participants in the intervention and 408 in the control |
| Timeframe | 2 years |
| Location | Rural program sites in Colorado |
| Measures | Program engagement, retention, behavior change, risk factors |
| Results | Increase in program retention, decrease in self reported fat intake |
| Weaknesses | Non randomized application |
| Strengths |  |
|  |  |
| Telemedicine Physical Examination Utilizing a Consumer Device Demonstrates Poor Concordance with In-Person Physical Examination in Emergency Department Patients with Sore Throat: A Prospective Blinded Study | Akhtar, M. et al. |
| Purpose | Compare telemedicine-facilitated exams with in-person exams for patients with sore throats. |
| Population | 62 adult patients (all recieved both in person and telemedicine service) |
| Timeframe | 1.5 years |
| Location | Midwest |
| Measures | Compare consensus between examinations on tonsil size, lymph node abnormality, ease of use survey |
| Results | Telemedicine had poor agreement on tonsil size, was easier to use for providers than patients |
| Weaknesses |  |
| Strengths | 80% power |
|  |  |
| Examining the efficacy of an mHealth media literacy education program for sexual health promotion in older adolescents attending community college | Scull, T. et al. |
| Purpose | Determine feasibility of a sexual health education mHealth program for community college students. |
| Population | 184 community college students aged 18 to 19 randomly assigned to intervention or wait-list control |
| Timeframe | 7 months |
| Location | Southeastern state |
| Measures | Self-reported risky sexual behaviors, knowledge and attitude surveys |
| Results | Lowered self-reported risky sexual behaviors, improvement in post-session knowledge |
| Weaknesses | 41% attrition in the intervention group |
| Strengths | Also measured session fidelity |
|  |  |
| Use of self-management interventions for chronic pain management: A comparison between rural and non-rural residents | Eaton, L. et al. |
| Purpose | Compare mHealth self management approaches for pain between rural and non-rural patients. |
| Population | 65 rural residents and 114 non-rural residents; secondary analysis of data |
| Timeframe |  |
| Location |  |
| Measures | Differences in use of self-management, pain intensity, and opioid dose |
| Results | Rural residents were less likely to use self management and were more likely to use opioids for pain relief. |
| Weaknesses |  |
| Strengths |  |
|  |  |
|  |  |
| A Randomized, Controlled, Multicenter Study of Technology-Based Weight Loss Interventions among Endometrial Cancer Survivors | Haggerty, A. et al. |
| Purpose | Test the efficacy of mHealth weight loss interventions for obese endometrial cancer survivors |
| Population | 196 participants, 20% rural participants; 41 women in each group: telemedicine with Wi-Fi scales, text messages, or enhanced usual care control. |
| Timeframe | 6 months |
| Location | Pennsylvania |
| Measures | Weight and body composition, psychosocial assessment |
| Results | No significant difference in weight loss across interventions, but improvement in body image and physical health for telemedicine; control lead to weight loss |
| Weaknesses | Only 32 women completed the full trial assessment |
| Strengths |  |
|  |  |
| Exploring Implementation of m-Health Monitoring in Postpartum Women with Hypertension | Rhoads, S. et al. |
| Purpose | Examine remote patient monitoring mHealth interventions for postpartum women with hypertension. |
| Population | 48 post partum women, over 30% rural, with choice to use blood pressure, weight, pulse, and oxygen saturation monitors |
| Timeframe | 2 weeks |
| Location | Arkansas |
| Measures | Ease of use, baseline and follow up surveys |
| Results | mHealth users had lower levels of perceived technology barriers, higher perceived benefits |
| Weaknesses | No randomization |
| Strengths |  |
|  |  |
|  |  |
| Dementia Care Comes Home: Patient and Caregiver Assessment via Telemedicine | Lindauer, A. et al. |
| Purpose | Evaluate feasibility of telemedicine dementia assessments. |
| Population | 33 patients and their 33 caregivers, 75% over 10 miles from clinic |
| Timeframe | 2 weeks |
| Location | Oregon |
| Measures | Test-retest reliability between in-person and telemedicine |
| Results | Clinicians and participants found it to be a feasible option, "excellent reliability" |
| Weaknesses | Several patients did drop out due to frustration with video conference set up |
| Strengths |  |
|  |  |
| Telemedicine-guided education on secondary stroke and fall prevention following inpatient rehabilitation for Texas patients with stroke and their caregivers: a feasibility pilot study | Jhaveri, M. et al. |
| Purpose | Understand if stroke survivors and caregivers find telerehabilitation effective |
| Population | Prospective single-arm pilot study with up to 50 participants |
| Timeframe | 2 years |
| Location | Texas |
| Measures | Percent medication refill, aspiration risk, depression risk, fall risk, fracture risk, reintigration to normal living score |
| Results |  |
| Weaknesses | Unsure if this is just a protocol or not |
| Strengths | Aims to enroll rural participants |
|  |  |
|  |  |
| mHealth Intervention Elements and User Characteristics Determine Utility: A Mixed-Methods Analysis | Nelson, L. et al. |
| Purpose | Qualitative analysis of user experience of telehealth interventions for diabetes care |
| Population | 80 adults with type 2 diabetes |
| Timeframe | 3 months |
| Location | Tennessee |
| Measures | Baseline demographics, diabetes duration, health literacy, qualitative feedback |
| Results | Patients found the program helpful; younger patients had more favorable experiences; texts were preferred over interactive voice response messaging |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Preconceptional health behavior change in women with overweight and obesity: prototype for SMART strong healthy women intervention | Materia, F. et al. |
| Purpose | Evaluate user preferences of a maternal perinatal obesity prevention mhealth program |
| Population | 40 women with BMI>25 and not currently pregnant |
| Timeframe |  |
| Location | rural central Pennsylvania |
| Measures | Preferences and thematic analysis |
| Results | Users preferred texting, mobile websites, and app over other modes |
| Weaknesses | All white women |
| Strengths |  |
|  |  |
|  |  |
| Association of a Smartphone Application With Medication Adherence and Blood Pressure Control | Morawski, K. et al |
| Purpose | See if an mHealth app improve blood pressure control and medication adherence in users |
| Population | Randomized clinical trial of 411 hypertensive adults |
| Timeframe | 12 weeks |
| Location | "A mix of rural, suburban, and urban locations" |
| Measures | Medication adherence, blood pressure |
| Results | Small improvement in medication adherence, no improvement in blood pressure |
| Weaknesses | Adherence was measured by self report |
| Strengths |  |
|  |  |
| Blind spots in telemedicine: a qualitative study of staff workarounds to resolve gaps in diabetes management | Bouskill, K. et al. |
| Purpose | Look at the implementation of telemedicine for screen diabetic retinopathy |
| Population | 23 staff members |
| Timeframe |  |
| Location | FQHCs in California, including rural clinics |
| Measures | Qualitative workflow tracking |
| Results | Telemedicine can generate new "workarounds" that point out weaknesses in a clinical workflow |
| Weaknesses |  |
| Strengths |  |
|  |  |
|  |  |
| Telehealth delivery of cognitive-behavioral intervention to youth with autism spectrum disorder and anxiety: A pilot study | Hepburn, S. et al. |
| Purpose | Feasibilty study of a telehealth anxiety intervention for youth with autism spectrum disorders |
| Population | 17 in waitlist control, 16 in intervention, all from rural and frontier communities |
| Timeframe |  |
| Location | Colorado |
| Measures | fidelity and feasibility measures |
| Results | High acceptability but some issues with usability, high fidelity |
| Weaknesses | Small sample size, no blinding |
| Strengths |  |
|  |  |
| mHealth Clinic Appointment PC Tablet: Implementation, Challenges and Solutions | Smith, C. et al. |
| Purpose | Use an iPad based video conferencing mHealth intervention for patients on home IV nutrition. |
| Population | 45 patients and 6 professionals |
| Timeframe | about 4 months |
| Location | Kansas |
| Measures | Ease of use |
| Results | High ease of use, high quality of audio video transmission, 93.6% of patients recommend service to others |
| Weaknesses | Time frame only covered 2 appointments per patient |
| Strengths |  |
|  |  |
|  |  |
|  |  |
| Stroke patients and their attitudes toward mHealth monitoring to support blood pressure control and medication adherence | Jenkins, C. et al. |
| Purpose | Gather information on patients' attitudes on using mHealth devices after a demonstration |
| Population | 60 patients that had experienced a stroke |
| Timeframe |  |
| Location | South Carolina |
| Measures | Survey on willingness to use mHealth |
| Results | 85% felt comfortable using mHealth, 78.3% thought it would help them follow directions, 83.3% thought it would effectively communicate their needs |
| Weaknesses | Pre-post-demonstration survey would have been more informative |
| Strengths |  |
|  |  |
| Telemedicine Provides Non-Inferior Research Informed Consent for Remote Study Enrollment: A Randomized Controlled Trial | Bobb, M. et al. |
| Purpose | Determine if telemedicine-based informed consent is non-inferior to in-person informed consent for research studies |
| Population | 64 in telemedicine group, 67 in-person |
| Timeframe |  |
| Location | Iowa |
| Measures | Quality of Informed Consent tool |
| Results | Quality of Informed Consent measures were not significantly different |
| Weaknesses | "telemedicine" consult took place in the same facilty, just in different rooms |
| Strengths |  |
|  |  |
|  |  |
| Pharmaceutical assistance programs to support smoking cessation medication access | Leon-Salas, A. et al. |
| Purpose | Effectiveness of in-office telemedicine vs telephone based counseling sessions for rural smokers trying to stop smoking |
| Population | Randomized clinical trial of 104 pharmaceutical assistance program eligible smokers |
| Timeframe | 6 months |
| Location | Kansas |
| Measures | Use of smoking cessation methods, smoking cessation, completion of PAP application |
| Results | Only 49 linked to PAP, paper does not comment at all on telemedicine vs telephone calls |
| Weaknesses | Self-reporting of data |
| Strengths |  |
|  |  |
| Telepsychiatrists' Medication Treatment Strategies in the Children's Attention-Deficit/Hyperactivity Disorder Telemental Health Treatment Study | Rockhill, C. et al. |
| Purpose | Describe prescribing strategies used by telepsychiatrists taking part in an ADHD Telemental Health Treatment Study |
| Population | Paper lists referring PCPs but not # of telepsychiatrists |
| Timeframe | 22 weeks |
| Location | Texas |
| Measures | Fidelity to medication management plans |
| Results | 91% fidelity; considered an effective service model; protocol deviations were documented and justified in all but 1 case |
| Weaknesses | Selection bias |
| Strengths |  |
|  |  |
|  |  |
| The Healing and Empowering Alaskan Lives Toward Healthy-Hearts (HEALTHH) Project: Study protocol for a randomized controlled trial of an intervention for tobacco use and other cardiovascular risk behaviors for Alaska Native People | Prochaska, J. et al. |
| Purpose | Identifiy culturally-tailored telemedicine tobacco use interventions for rural Alaskan Natives |
| Population | RCT with a tobacco and physical activity intervention vs medication adherence and heart-healthy diet with 300 Alaskan Native adults that smoke and have high blood pressure or high cholesterol |
| Timeframe | 1.5 years |
| Location | Alaska |
| Measures | Smoking status, physical activity, BP, cholesterol, medication compliance, risk behavior, cost-effectiveness |
| Results | Study has not yet been completed |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Effectiveness of a Telehealth Service Delivery Model for Treating Attention-Deficit/Hyperactivity Disorder: A Community-Based Randomized Controlled Trial | Myers, K. et al. |
| Purpose | Test effectivenes of a telehealth ADHD pharmacological treatment method |
| Population | 223 chlidren with ADHD randomized to telehealth only or PCP treatment and telehealth consultation groups |
| Timeframe | 25 weeks |
| Location | Washington and Oregon |
| Measures | Vanderbilt ADHD Rating Scale |
| Results | Children in telehealth model improved significantly more than children in PCP+consultation group |
| Weaknesses | Including minor telemedicine in the control group could have reduced differences between the groups |
| Strengths |  |
|  |  |
| A User-Centered Approach: Understanding Client and Caregiver Needs and Preferences in the Development of mHealth Apps for Self-Management | Bendixen, R. et al. |
| Purpose | Develop an mHealth program promoting self-management skills for young adults with chronic illness |
| Population | 16 young adults with brain and spinal cord anomalies (9 rural or suburban), 11 caregivers |
| Timeframe |  |
| Location | Western Pennsylvania |
| Measures | Qualitative feedback from adolescents, young adults with chronic disease, and their caregivers |
| Results | Desire for mHealth programs to: make it easy, be engaging, be educational, be motivational and upportive, and be personalized |
| Weaknesses | "inability to recruit minority participants" |
| Strengths |  |
|  |  |
| Telemedicine and other care models in pediatric rheumatology: an exploratory study of parents’ perceptions of barriers to care and care preferences | Bullock, D. et al. |
| Purpose | Understand patient perspectives on telehealth for pediatric rheumatology |
| Population | 159 parents or guardians at a pediatric rheumatology clinic |
| Timeframe | 6 weeks |
| Location | Minnesota |
| Measures | Qualitative surveys |
| Results | 28% traveled more than 3 hours to get to clinic, 43% said travel was problemati, but 95% said they preferred in-person visit unless they were already familiar with telemedicine |
| Weaknesses | Convenience sample |
| Strengths |  |
|  |  |
| Feasibility of Behavioral Weight Loss Treatment Enhanced with Peer Support and Mobile Health Technology for Individuals with Serious Mental Illness | Aschbrenner, K. et al. |
| Purpose | Measure feasbility of an mHealth behavioral weight loss intervention for obese patients with a serious mental illness |
| Population | 13 adults that were obese and had SMI |
| Timeframe | 24 weeks |
| Location | New Hampshire |
| Measures | Program attendance, participant satisfaction |
| Results | 56% attendance, 45% of participants lost weight, 45% improved walking distance, desired more active learning and mental health resources |
| Weaknesses | Small sample size, no control |
| Strengths |  |
|  |  |
| Telehealth Measures Screening for Developmental Language Disorders in Spanish-Speaking Toddlers | Guiberson, M. |
| Purpose | Determine classification accuracy of telehealth language screening for Spanish-speaking toddlers in rural and underserved areas |
| Population | 62 Spanish-speaking preschool age children, 22 with language disorders and 40 without |
| Timeframe |  |
| Location | "three states in the Mountain-West region of the United States" |
| Measures | Language disorder diagnostics and classification accuracy, complexity of play |
| Results | Only reported vocabulary had classification accuracy high enough for screening |
| Weaknesses | Unequal group sizes, large confidence intervals |
| Strengths |  |
|  |  |
|  |  |
| Abstinence Reinforcement Therapy (ART) for Rural Veterans: Methodology for an mHealth Smoking Cessation Intervention | Wilson, S. et al. |
| Purpose | Evaluate effectivenes of a smart phone based mHealth smoking cessation intervention in veterans |
| Population | Clinical randomized trial with 310 participants randomized to mHealth ART or best practice control |
| Timeframe | 12 months |
| Location | North Carolina |
| Measures | Smoking cessation and cost effectiveness |
| Results | Currently ongoing |
| Weaknesses | Self reported |
| Strengths | But biochemically validated |
|  |  |
| Family Caregiver Depressive Symptom and Grief Outcomes from the ENABLE III Randomized Controlled Trial | Dionne-Odom, J. et al. |
| Purpose | Understand the impact of early pallative care telehealth programs for family caregivers |
| Population | Randomized controlled trial of 123 caregivers in two telehealth groups: one right after an advanced cancer diagnosis and the other 12 weeks later |
| Timeframe | 3 years |
| Location | Vermont and New Hampshire |
| Measures | Center for Epidemiological Study Depression Scale, Prigerson Inventory of Complicated Grief |
| Results | Delayed group had higher depression scores, mean complicated grief scores, but adjusted between group differences were not statistically significant |
| Weaknesses | Low power; more about time of delivery than methodology |
| Strengths |  |
|  |  |
|  |  |
| Eye Care Quality and Accessibility Improvement in the Community (EQUALITY): impact of an eye health education program on patient knowledge about glaucoma and attitudes about eye care | Rhodes, L. et al. |
| Purpose | Understand impact of an educational telemedicine program on glaucoma and assess patient satisfaction |
| Population | 651 patients, predominantly African American |
| Timeframe | 4 weeks |
| Location | Alabama |
| Measures | Patient knowledge and attitude |
| Results | All patient responses in knowledge and attitude significanly improved from baseline, 99% patient satisfaction |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Parent Engagement With a Telehealth-Based Parent-Mediated Intervention Program for Children With Autism Spectrum Disorders: Predictors of Program Use and Parent Outcomes | Ingersoll, B. et al. |
| Purpose | Understand how parents engage with telehealth programs for autism spectrum disorder |
| Population | Randomized clinical trial with 27 participants in a self-directed program or therapist assisted telehealth program |
| Timeframe |  |
| Location | Michigan |
| Measures | Demographics, engagement |
| Results | Participants in the therapist assisted group were more engaged, more likely to complete program |
| Weaknesses |  |
| Strengths |  |
|  |  |
| Disparities in the use of a mHealth medication adherence promotion intervention for low-income adults with type 2 diabetes | Nelson, L. et al. |
| Purpose | Measure engagement with a text-message based mHealth program for adults with type 2 diabetes |
| Population | 80 patients with type 2 diabetes |
| Timeframe | 3 months |
| Location | Tennessee |
| Measures | Call and text participation |
| Results | 57% call particiaption, 84% response to texts, less engagement in racial minorities, older adults, persons with lower health literacy, persons with depressive symptoms |
| Weaknesses | Need to address health literacy disparities, some technical implementation issues |
| Strengths |  |
|  |  |
| Comparative and Cost Effectiveness of Telemedicine Versus Telephone Counseling for Smoking Cessation | Richter, K. et al. |
| Purpose | Assess effectiveness and cost effectiveness of a telemedicine counseling versus telephone call only counseling for rural smokers. |
| Population | Randomized clinical trial of 566 smokers randomly assigned to telemedicine or telephone call counseling |
| Timeframe | 12 months |
| Location | Kansas |
| Measures | 7 day point prevalence smoking abstinence |
| Results | No significant difference in abstinence between groups at 12 months; telemedicine users more likely to use cessation medications, reccomend program to others; phone was less costly; telemedicine had to take place in a clinic |
| Weaknesses | Does not address utilization rates |
| Strengths |  |
|  |  |
| Program Evaluation of Remote Heart Failure Monitoring: Healthcare Utilization Analysis in a Rural Regional Medical Center | Riley, W. et al. |
| Purpose | Assess effects of a remote monitoring program for heart failure |
| Population | 50 heart failure patients compared to a matched cohort |
| Timeframe | 6 months |
| Location | Arizona |
| Measures | Implementation success, feasibility |
| Results | Successful implementation in a rural, underserved area |
| Weaknesses | No difference in health care utilization between matched cohort and intervention group |
| Strengths |  |

# Appendix B: Telehealth Policies by State

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Alabama | ✓ |  | ✓ | ✓ |
| Details → |  |  | Diabetes, congestive heart failure |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  | ✓ |
| Details → |  |  |  | Must have special purpose license |
| Etc → | For rehabilitative services, the originating site cannot be at the patient’s home | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Alaska | ✓ | ✓ | ✓ |  |
| Details → | Does not reimburse pharmacy, transportation, end-stage renal disease, direct-entry midwife, personal care assistants, visual care |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Arizona | ✓ | ✓ | ✓ | ✓ |
| Details → |  | Dermatology, radiology, ophthalmology, pathology | Chronic health failure |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  | ✓ |
| Details → |  |  |  |  |
| Etc → | Includes eligible Indian Health Services and tribal providers | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Arkansas | ✓ |  |  |  |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → |  |  |  |  |
| Etc → | Supports RHCs. Distant site provider must have “a professional relationship between provider and patient," which generally means following a manual for initial telemedicine session OR having met in person for one visit | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| California | ✓ | ✓ |  |  |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ | ✓ |  |  |
| Details → | Almost no limitations on originating site setting |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Colorado | ✓ |  | ✓ | ✓ |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ | ✓ | ✓ |  |
| Details → | for physicians, osteopaths, doctorate or MA psychologists, physician assistants, and nurse practitioners |  |  |  |
| Etc → |  |  |  |  |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Connecticut | ✓ | ✓ |  |  |
| Details → | For behavioral health services for clients under 18 only |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Will reimburse provider-to-provider communication for specialty care. Legislation states that telehealth services are those that "the commissioner determines are clinically appropriate." | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Delaware | ✓ |  |  |  |
| Details → | For up to 3 different consulting providers |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  |  |
| Etc → | Originating site can be the patient's home. Reimbursement includes prescribing services. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Florida | ✓ |  |  |  |
| Details → | Only for community behavioral health services |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Georgia | ✓ | ✓ |  |  |
| Details → |  | Teledentistry only |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  | Must have GA license |
| Etc → | Supports FQHCs and RHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Hawaii | ✓ | ? |  |  |
| Details → |  | Unclear legislation |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Includes patient home as originating site BUT must be in a federally designated Rural Health Professional Shortage Area, a county outside of a Metropolitan Statistical Area, or participates in a federal telemedicine demonstration project.(Changes to this are coming as amendments). | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Idaho | ✓ |  |  | ✓ |
| Details → | Requires a high quality connection |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Initial evaluations must be in person. Support FQHCs and RHCs. Reimburses oral and sign language interpretation services. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Illinois | ✓ |  | ✓ | ✓ |
| Details → | a physician or health care professional must be present with the patient at all times during the call, and must be done at physician’s office, health department, outpatient hospital, or community health center. Only diabetic patients getting nutrition info qualify for home calls. |  | Home uterine and pregnancy induced hypertension (not covered if they have a history of chronic hypertension) |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → |  |  |  |  |
| Etc → | No reimbursement for group psychotherapy. Supports FQHC and RHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Indiana | ✓ |  | ✓ |  |
| Details → | Does not cover: ambulatory surgical centers, outpatient surgical services, home health agencies, radiology, laboratory services, long-term care facilities, anesthesia, chiropractic, care coordination, home medical equipment, optometry, podiatry, physical therapy, provider to provider consultations |  | COPD, congestive heart failure, diabetes, 2+ emergency room visits or inpatient hospital stays in a year |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  |  |
| Etc → | Supports FQHCs and RHCs. Requires prior authorization. Recommends one traditional in person visit per year. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Iowa | ✓ |  |  | ✓ |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Policy does not have a set definition for telehealth so it's hard to measure what is covered | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Kansas | ✓ |  | ✓ | ✓ |
| Details → | Will reimburse live video for office visits, individual psychotherapy, pharmacological management services. Specifically must reimburse speech language pathology and audiology, will reimburse home telehealth |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Kentucky | ✓ | ✓ |  |  |
| Details → | Subject to utilization review |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  | Must be licensed in Kentucky |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Louisiana | ✓ |  | ✓ | ✓ |
| Details → |  |  | Must be based on "verified need" |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  | ✓ | ✓ |
| Details → |  |  | Benefit assessment on any equipment over $500 |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Maine | ✓ |  | ✓ | ✓ |
| Details → | Has specific list of accepted codes |  | Must have "thorough justification" |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  | ✓ |  |
| Details → | If originating site is a healthcare facility |  |  | Must be licensed in Maine |
| Etc → | Does support FQHCs and RHCs. Will reimburse audio-only calls in specific cases. IHS can use direct email and telephone consultations. Will also pay for transportation to originating site | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Maryland | ✓ | ✓ | ✓ | ✓ |
| Details → | Limits behavioral services to designated rural areas or special cases | Dermatology, opthalmology, and radiology only | COPD, congestive heart failure, and diabetes only. Reimbursement does not cover the cost of the equipment itself. |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  |  |
| Etc → | Home is not included as an originating site. Does support FQHCs and RHCs. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Massachusetts | ✓ |  |  |  |
| Details → | For behavioral health |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Massachusetts is a managed care state, so it depends on the individual plan. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Michigan | ✓ |  |  |  |
| Details → | Lists specific codes |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  | Must be licensed in Michigan |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Minnesota | ✓ | ✓ | ✓ | ✓ |
| Details → | Limited to three per calendar week per patient. Does not cover: prescription renewals, scheduling, clarifications, test result reportings |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Home can be originating site in specific cases. Does specify reimbursement for tribal facilities. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Mississippi | ✓ | ✓ | ✓ | ✓ |
| Details → |  | For radiology, and only if no local radiologists are available | one reimbursement no matter how many diseases are being monitored, must have more than two hospitalizations in the past year related to a specific chronic disease cause, CHF or COPD |  |
|  | Site fee | Transmission fee | Setup/maintenance | Allow out of state providers |
|  | ✓ |  | ✓ |  |
| Details → | Includes IHS sites |  | One-time fee |  |
| Etc → | Supports FQHCs and RHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Missouri | ✓ |  | ✓ |  |
| Details → | Does not cover anesthesiology |  | much wider range of conditions than most states (pregnancy, asthma, diabetes, cancer, COPD, hypertension, mental illness, stroke…) But with limitation of 2 or more additional factors: 2 or more hospitalizations in a year, or history of falls, or no support systems, or live alone, etc |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  | ✓ |
| Details → |  |  |  | Must be within the US |
| Etc → | Supports FQHCs and RHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Montana | ✓ |  |  | ✓ |
| Details → | Does not include crisis hotlines. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  | Must be licensed in Montana. |
| Etc → | Includes IHS in originating sites. Calls can happen at home. Supports FQHCs and RHCs. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Nebraska | ✓ | ✓ | ✓ | ✓ |
| Details → | Practitioner consultation is not covered for behavioral health when the client has an urgent psychiatric condition requiring immediate attention by a licensed mental health practitioner. Behavioral health services also have to develop an additional "safety plan." | Radiology only |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  | Covers out of staet services in case of emergency. |
| Etc → | Limits how much FQHC and RHCs can be paid. Does cover IHS facilities. Does reimburse physician to physician consult calls. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Nevada | ✓ | ✓ |  | ✓ |
| Details → | End-stage renal disease requires 1 in person visit. Psychotherapy is reimbursed, but evaluation and management is not. | No facility fee |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | Everywhere but home gets a facility fee. |  |  |  |
| Etc → | Supports RHCs, FQHCs. Supports IHS. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| New Hampshire | ✓ |  |  | ✓ |
| Details → | Lists limitations |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Home can be originating site if patient has end stage renal disease. New Hampshire is a managed care state, so can be different depending on the care plan. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| New Jersey | ✓ |  | ? |  |
| Details → | Must take place at clinic or outpatient hospital program. |  | Is defined, but has no guidelines. |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Managed care state. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| New Mexico | ✓ | ✓ |  | ✓ |
| Details → | Prescription services are overseen by a quality assurance initiative called project ECHO. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Supporots IHS. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| New York | ✓ | ✓ | ✓ |  |
| Details → |  | 75% reimbursement fee | Billed once per month. Pays $48 for collecting and interpreting RPM data. |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  | Can be anywhere in US |
| Etc → | Home is allowed to be originating site. FQHCs that have opted out of APGs are unable to bill for RPM services | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| North Carolina | ✓ |  |  |  |
| Details → | Medical, psych, and dental. Distant site must be of "sufficient distance" away from the originating site. Must apply for approval. Children must be over 6 years old. Up to three different consulting providers may be reimbursed for a separately identifiable telemedicine or telepsychiatry service per date of service. Limits on eligible medical provider types. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| North Dakota | ✓ |  |  |  |
| Details → | Reimbursement for telemedicine is reimbursed at the all-inclusive rate regardless of whether the originating site is outside the “four walls” of the facility or clinic. Does NOT cover: group therapy, targeted case management for high risk pregnant women and infants, targeted case management for individuals in need of long-term care services. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Supports IHS. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Ohio | ✓ |  |  | ✓ |
| Details → | Eligible providers are MD, DO, Psychologist, and FQHCs only. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site. |  |  |  |
| Etc → | Supports FQHCs and RHCs. Originating site does NOT include the home, inpatient hospitals, nursing facilities, inpatient psychiatric hospitals. No reimbursement for anything under 5 miles away of originating site. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Oklahoma | ✓ | ✓ | ✓ |  |
| Details → |  | Must comply with OHCA | Must comply with OHCA |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  | ✓ |
| Details → |  |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Oregon | ✓ |  | ✓ | ✓ |
| Details → | Also reimburses adio calls, fax, and emails when needed. |  | Mostly for teledentistry. |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  | ✓ |
| Details → |  |  |  |  |
| Etc → |  | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Pennsylvania | ✓ |  |  |  |
| Details → | Only eligible providers are physicians, certified nurse practitioners, and certified nurse midwives. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  | Must be licensed in PA. |
| Etc → | FQHCs and RHCs are only reimbursed for behavioral health services. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Rhode Island | ✓ |  |  |  |
| Details → | Lists specific eligible codes. |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Very little available legislation. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| South Carolina | ✓ |  | ✓ |  |
| Details → | Allied health professionals are NOT eligible. Injectables, nursing services, crisis intervention, psychotherapy, mental health assessment by non-physician, and service plan development, autism spectrum disorder treatment are NOT eligible. A health care professional MUST present the patient at the originating site at the beginning of the consultation. |  | For eligible home aging program members. Must have insulin dependent diabetes mellitus, hypertension, COPD, and/or congestive heart failure. Medical telemonitoring must record body weight, blood pressure, oxygen saturation, blood glucose levels, and basic heart rate information |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | For originating site |  |  |  |
| Etc → | Home is not an eligible originating site for medical services. Supports RHCs and FQHCs. | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| South Dakota | ✓ |  |  | ✓ |
| Details → | Lists accepted codes |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → |  |  |  |  |
| Etc → | An originating site may not be located in the same community as the distant site, unless the originating site is a nursing facility. Supports RHCs and FQHCs. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Tennessee | ✓ | ✓ |  | ✓ |
| Details → | Only for crisis services | In managed care plans only |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Managed care state | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Texas | ✓ | ✓ | ✓ |  |
| Details → |  |  | Once per week for diabetes or hypertension with 2 or more risk factors. When it is determined by Texas Health and Human Services Commission to be cost effective and feasible the following conditions are also included: pregnancy, heart disease, cancer, chronic obstructive pulmonary disease, congestive heart failure, mental illness, asthma, myocardial infarction or stroke. Notwithstanding any other law, providers may not receive reimbursement under Medicaid for the provision of home telemonitoring services on or after September 1, 2019. |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  |  |
| Etc → | "A patient receiving telehealth services must be evaluated annually by a physician or other healthcare professional (in-person or via a telemedicine visit) to determine if the patient has a continued need for the service. Exception for patients receiving telehealth services to treat a mental health diagnosis or condition."  "Use of telemedicine medical services is not permitted for the treatment of a client for chronic pain with scheduled drugs. However, telemedicine medical service is permitted to be used in the treatment of acute pain with scheduled drugs. " Originating site includes the patient's home. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Utah | ✓ |  | ✓ | ✓ |
| Details → |  |  | prior authorization for cardiac monitoring for 30 days, ordered by a neurologist |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Supports RHCs and FQHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Vermont | ✓ |  | ✓ | ✓ |
| Details → |  | Conflicting legislation | Congestive heart failure bill once per month includes equipment and maintenance cost, data management can be billed once per week |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  |  |
| Details → | unless the facility site provider is employed by the same entity as the distant site provider |  |  |  |
| Etc → | Patient home is included as originating site | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Virginia | ✓ | ✓ | ✓ |  |
| Details → | Lists specific accepted codes, includes specific opioid treatment services | diabetic retinopathy and radiology, teledermatology | continuous glucose monitoring, congestive heart failure, cardiac arrhythmias, pulmonary diseases, anticoagulation treatment, must be authorized |  |
|  | Site fee |  | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  | Must be in US |
| Etc → | Home is not listed as originating site. Supports FQHCs and RHCs | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Washington | ✓ | ✓ | ✓ | ✓ |
| Details → |  | Dermatology, dentistry, and behavioral | "The Medicaid agency covers the delivery of home health services through telemedicine for clients with a high risk of sudden change in medical condition which could compromise health outcomes and prescription drug monitoring. Home health monitoring is not covered in Applied Behavior Analysis Program for clients Age 20 or younger." |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | Managed care state. Supports RHCs. Home is listed as originating site. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| West Virginia | ✓ |  |  | ✓ |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  |  |  |  |  |
| Details → |  |  |  |  |
| Etc → | RHCs and FQHCs can ONLY be originating sites. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Wisconsin | ✓ |  |  | ✓ |
| Details → |  |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  | With prior authorizations |
| Etc → | Supports FQHCs, RHCs, and IHS. | | | |
|  |  |  |  |  |
| State Name ↓ | Live Video | Store-and-forward | Remote patient monitoring | Telehealth license offered |
| Wyoming | ✓ |  |  | ✓ |
| Details → | End stage renal disease must have one in person exam per month |  |  |  |
|  | Site fee | Transmission fee | Setup and maintenance | Allow out of state providers |
|  | ✓ |  |  | ✓ |
| Details → |  |  |  |  |
| Etc → | Telehealth operations must have a dedicated quality improvement strategy. Supports RHCs, FQHCs, and IHS. Home is listed as an originating site. | | | |

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