

**Original Article**

# Evaluating the Feasibility and Acceptability of a Telehealth Program in a Rural Palliative Care Population: TapCloud for Palliative Care



Lindsay Bonsignore, PhD, Nicholas Bloom, MA, Karen Steinhauser, PhD, Reginald Nichols, NP, Todd Allen, RN, Martha Twaddle, MD, and Janet Bull, MD, MBA

*Four Seasons Compassion for Life (L.B., R.N., T.A., J.B.), Flat Rock, North Carolina; Duke University Medical Center (N.B., K.S.), Durham, North Carolina; and Aspire Health (M.T.), Chicago, Illinois, USA*

**Abstract**

**Context.** The impact of telehealth and remote patient monitoring has not been well established in palliative care populations in rural communities.

**Objectives.** The objectives of this study were to 1) describe a telehealth palliative care program using the TapCloud remote patient monitoring application and videoconferencing; 2) evaluate the feasibility, usability, and acceptability of a telehealth system in palliative care; and 3) use a quality data assessment collection tool in addition to TapCloud ratings of symptom burden and hospice transitions.

**Methods.** A mixed-methods approach was used to assess feasibility, usability, and acceptability. Quantitative assessments included patient symptom burden and improvement, hospice transitions, and advanced directives. Qualitative semistructured interviews on a subpopulation of telehealth patients, caregivers, and providers were performed to learn about their experiences using TapCloud.

**Results.** One-hundred one palliative care patients in rural Western North Carolina were enrolled in the program. The mean age of patients enrolled was 72 years, with a majority (60%) being female and a pulmonary diagnosis accounting for the largest percentage of patients (23%). Remote patient monitoring using TapCloud resulted in improved symptom management, and patients in the model had a hospice transition rate of 35%. Patients, caregivers, and providers reported overwhelmingly positive experiences with telehealth with three main advantages: 1) access to clinicians, 2) quick responses, and 3) improved efficiency and quality of care.

**Conclusion.** This is one of the first articles to describe a telehealth palliative care program and to demonstrate acceptability, feasibility, and usability as well as describe symptom outcomes and hospice transitions. *J Pain Symptom Manage* 2018;56:7–14. © 2018 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.

**Key Words**

*Telehealth, community-based palliative care, rural communities*

**Introduction**

This article demonstrates the acceptability, feasibility, and usability of a telehealth community-based palliative care (CBPC) program using remote patient monitoring (RPM) via the TapCloud application and videoconferencing in rural areas of Western North

Carolina (WNC). Quantitative assessments using a quality data assessment collection tool (QDACT) showed reduced symptom burden, documentation of advanced directives, and a high hospice transition rate for patients in the telehealth project. Qualitative semistructured interviews with patients, caregivers, and providers demonstrated overwhelmingly positive

*Address correspondence to:* Lindsay Bonsignore, PhD, Four Seasons Compassion for Life, 571 S Allen Road, Flat Rock, NC 28731, USA. E-mail: [lbonsignore@fourseasonscfl.org](mailto:lbonsignore@fourseasonscfl.org)

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experiences with both the telehealth model and TapCloud.

CBPC offers a specialized approach to caring for people living with serious illnesses in rural communities; however, delivery of palliative care in this setting is challenging.<sup>1–4</sup> There is a national shortage of palliative care providers,<sup>5–7</sup> and recruitment and retention of providers in rural areas are difficult due to compensation limitations, professional isolation, lack of resources, and burnout due to long travel time and hours.<sup>8</sup> As a result, there is an increase in patient response times, reduced patient/family satisfaction, inferior clinical outcomes, increased use of emergency departments, and reduced hospice transition rates in rural areas compared to more urban service areas.<sup>9,10</sup>

The use of telecommunication technologies in health care, telehealth, offers a potential solution to improve access and quality of care for those in rural settings. Telehealth has grown dramatically over the last decade among many specialties with demonstrated improvements in chronic care management and promising trends in improving access to care in rural area.<sup>10,11</sup> However, there is limited evidence to support the application of telehealth in palliative care.<sup>3,12</sup> A small telehealth study in Australia demonstrated the feasibility and acceptability of the use of videoconferencing and online patient/caregiver self-assessments in a home-based palliative care program.<sup>13</sup> A home-based palliative care program in the New York metropolitan area used telehealth services including 24/7 access to providers, nurses, and social workers by telephone or videoconferencing. Compared to patients receiving usual care, patients in the telehealth program had a 34% reduction in hospital admissions in the last month of life, a 35% increase in hospice utilization, and a significantly longer hospice length of stay.<sup>14</sup> In addition, a recent study demonstrated that integration of RPM of symptoms of patients with metastatic cancer was associated with increased survival compared to usual care.<sup>15</sup> Overall, these telehealth studies are limited as they do not examine patient well-being, symptom management, patient/family satisfaction, and existence of advanced directives—all important outcomes in high-quality palliative care. This article presents a descriptive view of a CBPC telehealth program using RPM and videoconferencing with results that demonstrate documentation of advanced directives, increased patient well-being with a reduction in symptom burden scores, and a trend toward high level of patient/family satisfaction.

## Methods

### Design

A mixed-method evaluation approach was used, which included quantitative assessments with QDACT

and TapCloud and qualitative semistructured interviews with a subset of patients, caregivers, and providers.

### Participants

Inclusion criteria for patients included 1) one or more life-limiting illnesses, 2)  $\geq 18$  years of age, 3) lived at home in one of the seven rural WNC counties that Four Seasons serves, and 4) wireless home or 3G/4G capabilities. When a patient was referred to palliative care services, the patient/caregiver was evaluated for participation in the project. If the patient and caregiver were interested in participating in the telehealth project, they signed a palliative care consent form agreeing to receive telehealth services as part of their care. As the telehealth project was a quality study, institutional review board (IRB) approval was not required. Qualitative interviews were conducted on a sample of telehealth patients, caregivers, and providers. The qualitative interview protocol was approved by the Duke University School of Medicine's IRB, and all interview participants provided informed consent. Clinicians identified patients and caregivers who they thought would be willing and able to complete an interview and made initial contact to gauge interest. Then, interested respondents were consented and interviewed via telephone by a behavioral psychologist at Duke.

In the initial 12 months of the telehealth project, 101 patients were enrolled. Of the 101 patients, 60% were female and the largest age cohort of patients was between the ages of 71–90 years (47%) (Table 1). Almost 11% of patients enrolled were over the age of 90 years. A primary pulmonary diagnosis accounted for the largest percentage of patients enrolled (23%), followed by a cancer diagnosis (19%). For the qualitative analysis, nine in-depth interviews were performed with two patients, five caregivers, and two telehealth providers.

### Program Description

Four Seasons CBPC addressed the needs of patients with life-limiting illness through symptom management, prognostication, psychosocial care, advance care planning (ACP), spiritual care, caregiver support, patient/family education, and coordination with community-based resources. The interdisciplinary CBPC team collaborated to ensure patient- and family-centered care through alignment of patient goals with treatment preferences. Based on risk stratification,<sup>16</sup> patients had an initial comprehensive visit by a physician, APP, or nurse that also included QDACT data collection and setup and instruction of telehealth equipment. The palliative care professional engaged the patient/caregiver with the telehealth applications and ensured their confidence and capability with the applications through demonstrated learning. The patient/caregiver either used their personal device or received a tablet for

Table 1  
Telehealth Patient Demographics

Total enrolled, N	101
Demographics, n (%)	
Female	61 (60.4)
Male	40 (39.6)
Age, n (%)	
≤40	3 (2.9)
41–50	8 (7.9)
51–60	11 (10.9)
61–70	21 (20.8)
71–80	24 (23.8)
81–90	23 (22.8)
>90	11 (10.9)
Primary diagnosis, n (%)	
Pulmonary	23 (22.8)
Cancer	19 (18.8)
Neurologic	14 (13.9)
Cardiovascular	14 (13.9)
Renal	5 (4.9)
Gastrointestinal	3 (2.9)
Other	12 (11.9)
Unknown	11 (10.9)
Transitions, n (%)	
Hospice	35 (34.7)
Deaths	8 (7.9)
Discharges	7 (6.9)
Active	51 (50.5)

Hospice = admitted to hospice; Deaths = died under palliative care; Discharges = discharged from palliative care; Active = ongoing palliative care service.

Demographics, primary diagnosis, and number and percentage of patients enrolled in the telehealth program that transitioned to hospice, died in palliative care, were discharged from palliative care, or currently on the active caseload (receiving ongoing palliative care).

telehealth services if they did not have a device or wireless services (~30% of patients received tablets). The telehealth program had two components: 1) TapCloud application for RPM (well-being, pain, symptom and medication management, messaging, photo upload) and 2) remote secure videoconferencing to facilitate real-time interactions. Using TapCloud, the palliative care team monitored data as patient's or caregiver's "check-in/tap-in" to inform providers of concerns and well-being. Information was transmitted directly to a dashboard and to the team's smartphones. When problems were identified, clinicians sent secure push messages via the application to the patient/caregiver to attempt to remedy the situation. If unsuccessful, telephone calls and/or videoconferencing were used to further resolve the issue, and if needed a home visit occurred.

#### TapCloud Technology and Patient Application

TapCloud™ is a medical company specializing in patient-generated health data. Their application, TapCloud, is a communication and monitoring application that connects patients and providers outside the clinical setting. The TapCloud application was designed for ease of use, customizability, and integration with any device with Internet capabilities and is a HIP-PA (Health Insurance Portability and Accountability

Act of 1996) compliant. TapCloud was designed to meet the needs of each patient via individualized care plan/reminders, symptom review and check-in, and medication management. The check-in includes a symptom assessment that is composed of questions and a custom word cloud. The word cloud consists of a dynamic screen view of words used to describe symptoms the patient may be experiencing on a given day (Fig. 1a). Patients/caregivers click or tap current symptoms and double-clicked to indicate if that symptom is particularly bad or getting worse. The proprietary word cloud is generated by a mapping engine and chooses words based on the common symptoms of the patient's diagnosis, possible associated complications, medication side effects, and responses at the last check-in. The word cloud is customized to each patient and gets smarter with each use. Symptom words include both physical and emotional symptoms and display positive and negative words. In addition, symptoms can be added by the patient/caregiver, which are then carried over into future word clouds. Check-in questions include "Compared to your last check-in, how do you feel now: worse, the same, or better" and "You last reported a pain level of 2 what is your current level of pain? (Fig. 1a)." Pain assessment is based on a 0–10 Likert scale where 0 represents absence of pain and 10 represents worst possible pain. The TapCloud assessment typically takes one to three minutes. TapCloud also allows for interactive communication with the providers including messaging, patient/caregiver education, and the submission of patients/caregivers notes or photos. All remain secure and encrypted within the application and deidentified in transmission. Patients can permit others to view their account.

#### TapCloud Clinical Dashboard

All patient data captured via TapCloud are streamed to a clinical dashboard that provides a consolidated view that can be assessed on any device via an Internet connection. The dashboard is monitored twice daily by CBPC staff and is set to receive alerts when measures fall out of set thresholds. The dashboard provides a visualization of all patients, their well-being, pain levels, symptoms, and medications (Fig. 1b). The clinical dashboard is designed to facilitate pattern recognition including onset, worsening or improving symptoms, sporadic vs. consistent symptoms, and medication changes. Within minutes, the clinician monitoring the dashboard can visualize who is having worsening symptoms and needs help. Data can also be displayed graphically to view the patient's health status over time (Fig. 1c). Providers can easily see patient notes and other provider notes and communicate with patients via a secure text or e-mail message in the system (Fig. 1d)

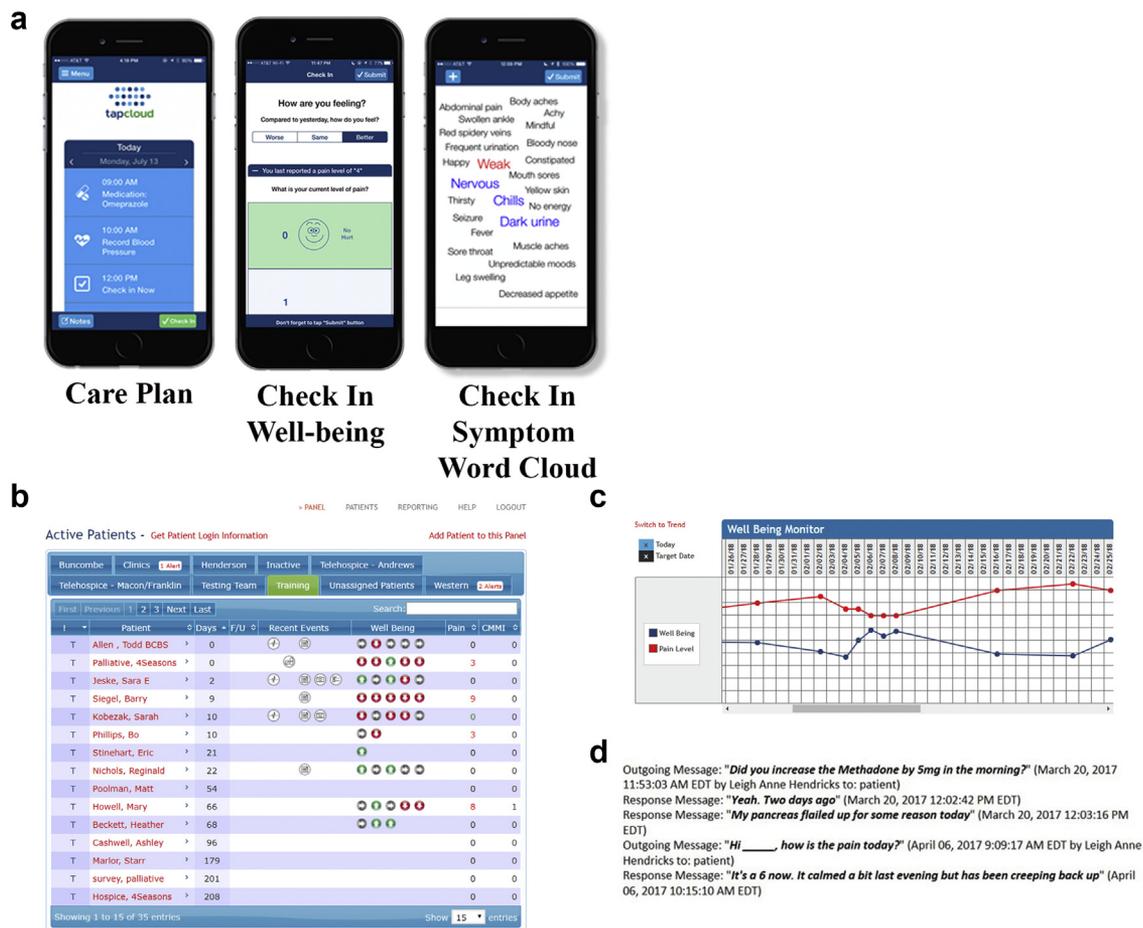


Fig. 1. TapCloud patient application and clinical dashboard. a) Telehealth patients have the remote patient monitoring application, TapCloud, on their phone, tablet, or computer. TapCloud is customized to meet the needs of each patient and contains the patient's care plan/reminders, check-in (symptom assessment), and medication management. b) Using the TapCloud clinical dashboard, the palliative care team can visualize all patients, their well-being, pain levels, and recent events. c) Data displayed graphically on the clinical dashboard to view the patient's health status over time. d) Patient-provider communication over secure messaging via TapCloud.

### Remote Videoconference

In addition to TapCloud, the CBPC team uses videoconferencing to further address symptoms, medication management, goals of care, and examination of any physical issue and to facilitate family-focused meetings and counseling. Family members can join the video session from around the country with patient consent.

### Data Reporting and Analysis

The research team tracked data including date of birth, gender, diagnosis, admit date, transitions, discharge to hospice, and discharge due to death. Patient-/caregiver-reported word cloud data from TapCloud were exported and analyzed. Patient symptom burden (based on Edmonton Symptom Assessment Scale [ESAS] scale), ACP, Palliative Performance Scale, prognosis, spirituality/religious concerns, and caregiver involvement were measured using QDACT during in-person patient visits. QDACT is a web-

based, provider-entered, quality assessment and reporting tool for palliative care that was developed by Duke University in conjunction with Four Seasons.<sup>17</sup> The QDACT has undergone validation and usability testing and assesses seven domains: demographics, symptom assessment and management, ACP, functional status, spirituality, prognosis, caregiver assessment, and transitions/discharges.<sup>18,19</sup> These assessments are derived from nationally recognized quality measures such as the National Quality Forum, Measuring What Matters, and the Physician Quality Reporting System. Seventy-three of the 101 patients enrolled had QDACT encounters.

### Qualitative Surveys

Qualitative feedback was provided from patients, caregivers, and providers about telehealth through semistructured interviews. Study staff developed the interview guide as a team in accordance with standard

qualitative protocol design methods, with input from clinicians, administrators, and qualitative methodologists.<sup>20</sup> The interview guide was semistructured in that it contained specific questions of interest but allowed interviewers to pursue or probe topics that emerged as the interviews were being conducted. Interviews lasted an average of 45 minutes and focused on several aspects of patient/caregiver/clinician experiences with TapCloud: on-boarding and setup, usage, likes/dislikes, and areas for improvement.

## Results

Of the 101 patients enrolled in the telehealth pilot, 35 (35%) transitioned to hospice, eight (8%) died in palliative care, seven (7%) were discharged from palliative care, and 51 (50%) were currently active patients as of December 2017 (Table 1). While enrolled in the program, patients/caregivers used TapCloud consistently with an average of 29.2 check-in symptom assessments per patient for a total of 2953 check-ins annually. On receiving an action alert in TapCloud (alert that patient exceeded a set threshold), the palliative care team members contacted the patient/caregiver with an average of 20.6 responses per patient or a total of 2082 responses. Patients sent 1374 text messages to providers who responded 1342 times. In addition, push messages were sent that included automatic reminders for scheduling and care plan adherence a total of 13,382 times. Table 2 shows the number of times symptom words were tapped by patients/caregivers in TapCloud's customized word clouds. The top two symptoms tapped were positive symptoms: good mood and comfortable. Top negative symptom responses included back pain, tired, short of breath, anxiety, no energy, bloated, and weak.

At the initial in-person palliative care visit, more patients reported higher levels ( $\geq 4$ ) of pain, dyspnea, depression, and poor well-being on the ESAS as shown by QDACT data (Table 3). Of those patients who reported a moderate to high level of pain ( $\geq 4$ ), 82% showed improvement by the second or third in-person palliative care visit. Improvement was defined as a reduction in  $\geq 1$  point on the ESAS. Symptom improvement occurred in 78% of patients with moderate to high dyspnea, 90% of patients with moderate to high depression, and 79% of patients with poor well-being (Table 3). As a spiritual distress screen, patients were asked if they were at peace; only 11% of patients reported no or a little bit (Table 4). In response to being a burden to family members, 71% patients felt none or little burden to family. At the initial palliative care in-person visit, QDACT data indicated the majority of patients (81%) had a Palliative Performance Scale score ranging from 40% to 60% and 71% of

Table 2  
TapCloud Symptom Word Cloud Data

Symptom Word	Number of Times
<i>Good mood</i>	502
<i>Comfortable</i>	450
<b>Back pain</b>	445
<b>Tired</b>	434
<i>Blessed</i>	429
<i>Active day</i>	402
<b>Short of breath</b>	387
<b>Anxiety</b>	384
<b>No energy</b>	369
<b>Joint pain</b>	358
<b>Bloated</b>	350
<b>Weak</b>	329
<i>Good day</i>	323
<i>Driven</i>	314
<b>Cold sore</b>	308
<b>Blurry vision</b>	303
<b>Cant sleep</b>	296
<b>Chills</b>	295
<b>Achy</b>	284
<i>Calm</i>	282
<i>At peace</i>	275
<b>Cramps</b>	264
<b>Sleepy</b>	264
<b>Fatigued</b>	260
<b>Fearful</b>	245
<b>Afraid</b>	240
<b>Dry mouth</b>	238
<b>Pain</b>	231
<b>Abdominal pain</b>	228
<i>Happy</i>	220
<b>Diarrhea</b>	217
<i>Thankful</i>	208
<i>Loved</i>	178
<i>Creative</i>	178
<i>Focused</i>	176
<i>Grateful</i>	174
<b>Unsteady</b>	173

The number of times world cloud symptoms were tapped by patients/caregivers. Italic entries correspond to positive symptoms while bold entries correspond to negative symptoms.

patients had a prognosis of greater than six months by clinician estimate (Table 4). In addition, 63% of patients at the initial palliative care visit had documented advanced directives, 80% had a health care proxy, and 73% had caregiver involvement. At the first visit, 34% of patients had a full-code resuscitation status and 41% were DNR/DNI, whereas by the second or third visit, only 23% of patients remained full code and 56% of patients were now DNR/DNI (Table 4).

## Qualitative Interview Results

We completed nine in-depth interviews with TapCloud users to explore application proof concept, acceptability, and usefulness. Respondents reported three main advantages regarding improved interaction with the team: access to clinicians, quick responses, and improved efficiency and quality of care.

*Access to Clinicians.* As one patient noted, TapCloud guarantees that they're going to get the message—a patient.

Table 3  
Patient Symptom Burden and Symptom Improvement

Total Patients = 73	0–3	4–6	7–10	Unable to Respond	Unknown	Improvement
Pain, <i>n</i> (%)	49 (67.1)	11 (15.1)	6 (8.2)	2 (2.7)	5 (6.9)	9/11 (81.8)
Dyspnea, <i>n</i> (%)	57 (78.1)	9 (12.3)	2 (2.7)	1 (1.4)	4 (5.5)	7/9 (77.8)
Constipation, <i>n</i> (%)	65 (89)	4 (5.5)	0 (0)	1 (1.4)	3 (4.1)	2/2 (100)
Tiredness, <i>n</i> (%)	59 (80.8)	2 (2.8)	3 (4.1)	2 (2.7)	7 (9.6)	5/5 (100)
Nausea, <i>n</i> (%)	62 (84.9)	3 (4.1)	2 (2.7)	2 (2.7)	4 (5.5)	3/4 (75)
Depression, <i>n</i> (%)	55 (75.3)	6 (8.2)	3 (4.1)	2 (2.7)	7 (9.6)	9/10 (90)
Anxiety, <i>n</i> (%)	59 (80.8)	3 (4.1)	4 (5.5)	2 (2.7)	5 (6.9)	2/5 (40)
Drowsiness, <i>n</i> (%)	60 (82.3)	3 (4.1)	2 (2.7)	2 (2.7)	6 (8.2)	3/3 (100)
Appetite, <i>n</i> (%)	55 (75.3)	5 (6.9)	3 (4.1)	2 (2.7)	8 (11)	5/9 (55.6)
Well-being, <i>n</i> (%)	46 (63)	15 (20.6)	2 (2.7)	4 (5.5)	6 (8.2)	11/14 (78.8)

Edmonton Symptom Assessment Scale (ESAS) scores of patients using the quality data assessment collection tool (QDACT) scores at the first in-person palliative care visit. Improvement is defined as patients with a score of  $\geq 4$  on the first visit who have had  $\geq 1$ -point reduction in that assessment by the second or third in-person visit.

This was contrasted with the less direct process of leaving messages at a doctor's office or clinic.

#### Quick Responses.

If you [send a message], they're right on top of it. If I send it and it goes through, they're on it—caregiver.

#### Improved Efficiency and Quality of Care.

Normally phone call may take 10–15 minutes, because you have to go through all the formalities ... [with TapCloud] you can get done in about 4–6 sentences—a clinician.

As a result, clinicians reinforced that they were greatly able to expand their caseload—by more than an order of magnitude—because of TapCloud's facilitation of direct, efficient contact with patients. The direct, quick, and improved efficiency and quality of care provided three main benefits in daily care to patients and caregivers: improved efficiency of medication refills, easier symptom checks, and increased comfort and peace of mind, which results in more efficient and effective care.

**Medication Refills.** Patients and caregivers were particularly enthusiastic about how easy medication refills are with TapCloud.

[The patient] gets her medication a lot quicker, we're not worrying about how to get her medication—caregiver.

Another caregiver explained TapClouds' documented communication had improved her relationship with her loved one (the patient).

Before, [medication refills] were a constant conversation, but now it's not an issue ... it's alleviated stress between [my loved one] and I. Everything being on record and her knowing—family caregiver.

**Symptom Checks.** Direct, efficient access to care team members helped caregivers offload the task of diagnosing potential problems.

[TapCloud] is a great alternative for [the patient], to have someone to come in to see her quick and keep her from having to go to the urgent care or to the hospital. To know that that service is there, is great for me—caregiver.

Clinicians echoed these sentiments and enumerated the multiple times they had saved patients costly and time-consuming trips to the emergency department.

**Increased Comfort.** More than simply reducing stress and wasted time, TapCloud also gave patients and caregivers a deep sense of comfort, knowing a qualified care team was only a tap away.

[The patient] has got a lot more confidence, and she knows if she is sick she doesn't have to wait on an appointment with somebody. She's got somebody who's gonna take care of her—caregiver.

Clinicians also described situations where they met patients' emotional and spiritual needs over TapCloud, by offering daily prayers or encouragement through messages.

When asked about challenges or limitations to TapCloud, patients, caregivers, and clinicians alike noted that TapCloud is not able to replace the depth of in-person care. However, clinicians were careful to note that providing exclusively in-person services, in a large rural catchment area, brings significant staffing challenges, and that they could care for many more patients using TapCloud than they would be if focusing solely on home visits. Despite this limitation, patients, caregivers, and clinicians alike gave TapCloud strong praise.

## Discussion

This article describes Four Season's palliative care telehealth project as part of a CMMI award using a

Table 4  
Telehealth Patient Quality Data

Total patients, <i>N</i>	73	
PPS, <i>n</i> (%)		
0–30	5 (6.9)	
40–60	59 (80.8)	
70–100	4 (5.5)	
Unknown	5 (6.8)	
Prognosis, <i>n</i> (%)		
One to six months	6 (8.2)	
More than six months	52 (71.2)	
Unknown	15 (20.6)	
Advanced directives, <i>n</i> (%)		
Yes, documented	46 (63)	
Yes, undocumented	6 (8.2)	
No—has interest	5 (6.9)	
No—not interested	6 (8.2)	
Unknown	10 (13.7)	
Resuscitation status, <i>n</i> (%)	First visit	Second or third visit
Full code	25 (34.3)	17 (23.3)
DNR/DNI	30 (41.1)	41 (56.2)
Mostly DNR/DNI	5 (6.9)	4 (5.5)
DNI, not DNR	1 (1.3)	1 (1.3)
Other	2 (2.7)	2 (2.7)
Does not wish to discuss	4 (5.5)	4 (5.5)
Unknown	6 (8.2)	4 (5.5)
Health care proxy, <i>n</i> (%)		
Yes	58 (79.5)	
None	9 (12.3)	
Unknown	6 (8.2)	
Caregiver involvement, <i>n</i> (%)		
Yes	53 (72.6)	
Unknown	20 (27.4)	
Are you at peace, <i>n</i> (%)		
Not at all	1 (1.4)	
A little bit	7 (9.5)	
A moderate amount	30 (41.1)	
Quite a bit	11 (15.1)	
Completely	13 (17.8)	
Unknown	11 (15.1)	
Do you feel you are a burden to your family, <i>n</i> (%)		
Not at all	10 (13.7)	
A little bit	42 (57.6)	
A moderate amount	6 (8.2)	
Quite a bit	3 (4.1)	
Completely	0 (0)	
Unable to respond	2 (2.7)	
Unknown	10 (13.7)	

PPS = Palliative Performance Scale; DNR = do not resuscitate; DNI = do not intubate.

Palliative Performance Scale, prognosis, advanced directives, health care proxy, caregiver, and spiritual distress collected by the provider from the patient/caregiver using the quality data assessment collection tool (QDACT) at the first in-person visit. Resuscitation status documented in QDACT at the first in-person visit compared to the second or third in-person visit.

combined approach of RPM (via the TapCloud application) and videoconferencing and highlights patient, caregiver, and clinician experience around the benefits of telehealth. The results of this study show the feasibility, usability, and acceptability of a telehealth palliative care model in a rural population in WNC. Disparities in health care outcomes in rural areas are often due to lack of access to care when it is needed most. By capturing real-time patient symptom data,

TapCloud alerts providers to emerging patient health issues, which can be acted upon immediately, preventing unnecessary suffering and potential emergency room visits or hospitalizations. The QDACT validates that symptom burden and well-being were improved upon (Table 3).

Patients and caregivers report overwhelmingly positive experiences with the telehealth program as demonstrated by the qualitative survey results. Patients and caregivers like that TapCloud is specifically tailored to their conditions, symptoms, and medications and allows their voice to be captured in a meaningful way. In addition, they find the TapCloud application intuitive, easy to use, and not time intensive. Initially, there was concern that using this technology would be burdensome and difficult for elderly patients. Once coached on using the application, patients readily adopted the technology and often felt a sense of accomplishment in doing so. This is demonstrated by the fact that over a third of the patients in this study were over the age of 80 years, and 10% over 90 years. Most importantly, patients and caregivers appreciated the quick response time from the clinical team and frequently commented that their provider was a “tap away.” For patients living in rural areas, real-time access to clinicians is not the norm as they often have to wait several days to see a provider. Thus, the implications of using telehealth monitoring are significant especially in remote areas where there is a lack of primary and specialty providers. The ability to bridge in a family member who lives far away for a videoconference or allow them to follow their loved one’s symptom assessments and communication with providers via TapCloud gave family members an increased knowledge about what is occurring and provided a heightened level of involvement and a sense of comfort.

CBPC providers also reported overall positive results with TapCloud and the telehealth model. Clinicians indicated that they were able to use the TapCloud clinical dashboard to identify changes in patient comfort, symptoms, and medication needs, which led to interventions to improve pain and symptom management. The clinical dashboard also streamlined efficiency for the CBPC team as they are able to provide the right care for the right patient at the right time, assigning the right intervention and resource based on data. For example, increased patient anxiety and/or depression may be best addressed by a social worker via a video counseling session. Both patients/caregivers and the CBPC clinical team indicated telehealth enhanced communication between them and allowed pre-emptive management of problems. Data from quantitative analyses demonstrated that moderate to severe symptoms were well controlled. In addition, hospice transitions are increased in rural WNC areas

where the death service ratio in these counties can be as low as 19.5%.<sup>9</sup>

There are several limitations to this study. First, the study involved a small sample size at only one site. A high percentage of the patients enrolled in the study are white and represent an older population from retirement communities in WNC, therefore, generalizability is reduced. In addition, the qualitative analysis included a small number of dyads. Despite these limitations, this pilot study shows acceptability, feasibility, and usability of telehealth and the TapCloud application in CBPC delivery. This telehealth model for CBPC will likely improve patient outcomes, and reduce unnecessary health care utilization, optimize resource allocation, and increase patient satisfaction. A larger study, with a comparison condition, is needed to provide evidence that telehealth can positively affect patient outcomes and reduce health care utilization in palliative care.

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