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# Original Research

## Telehealth Group Interactions in the Hospice Setting: Assessing Technical Quality Across Platforms

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### Abstract

**Objective:** This study aims to examine the technical quality of videoconferencing used in hospice to engage caregivers as “virtual” members of interdisciplinary team meetings and their impressions of telehealth. Furthermore, it aims to compare the quality of plain old telephone service (POTS) and Web-based videoconferencing and provide recommendations for assessing video quality for telehealth group interactions. **Materials and Methods:** Data were obtained from an ongoing randomized clinical trial exploring Web-based videoconferencing and a completed prospective study of POTS-based videoconferencing in hospice. For the assessment of the technical quality, an observation form was used. Exit interviews with caregivers assessed impressions with the use of telehealth. A retrospective analysis of video-recorded team meetings was conducted rating attributes essential for the quality of videoconferencing (e.g., video artifacts, sharpness). **Results:** In total, 200 hospice team meetings were analyzed, including 114 video-recorded team meetings using Web-based videoconferencing and 86 meetings using POTS videophones. A direct comparison between the two modalities indicates the superiority of Web-based video in image quality but less so in audio quality. Transcripts of 19 caregiver interviews were analyzed. Caregivers found the use of videoconferencing to be a positive experience and a useful and essential tool to communicating with the hospice team. **Conclusions:** This study highlights the potential of telehealth to improve communication in hospice and the need for new tools that capture the quality of video-mediated communication among multiple stakeholders and strategies to improve the ongoing documentation of telehealth group sessions’ technical quality.

**Key words:** telecommunications, e-health, telehealth

### Introduction

Hospice care services are provided to almost 2 million Americans each year, mostly delivered in patients’ homes with the help of informal caregivers, namely, family members, spouses, friends, or others who assume an unpaid caregiving role.<sup>1</sup> The hospice philosophy is founded on the principle that both the patient and the informal caregiver comprise the unit of care, promoting self-determination and their active participation in the decision-making process. In addition to the emotional, physical, and financial burden associated with the disease of their loved one, informal caregivers are expected to manage all aspects of patient care, often without formal education and with minimal or no relief, leaving them anxious and exhausted.<sup>2</sup> More than one-third of hospice families have concerns about the amount of information they receive regarding what to expect when the patient is dying<sup>3</sup> and identify gaps in their communication with hospice providers.

Hospice agencies hold regular staff meetings that involve members from different disciplines, including medicine, nursing, social work, and spiritual care. The goal of these interdisciplinary team (IDT) meetings is to develop and coordinate plans of care for hospice patients and their families. Medicare Conditions of Participation mandate hospice agencies to hold IDT meetings and prescribe their frequency and the composition of teams. Although in theory these meetings are open to patients and caregivers to attend, hospice patients and their caregivers are mostly absent from these meetings because of geographic distance, the frail condition of the patient, and caregiving demands.<sup>4</sup>

Technology has the potential to bridge geographic distance and allow caregivers and patients to “virtually” participate in IDT meetings. Although participation may be possible with a regular telephone, the visual contact present with a video component has been found to be important to communication. The transmission of video can assist by providing (1) cognitive cues used to determine understanding,<sup>5</sup> (2) turn-taking cues afforded by head turning, posture, and eye gaze,<sup>6</sup> and (3) social or affective cues that reveal the participants’ emotional state or interpersonal attitudes, which are manifested in facial express, posture, or eye gaze.<sup>7,8</sup> Furthermore, visual feedback is important for group communication so that all participants can be identified, the size of the group is known, and the person speaking can be determined. Thus, the video component improves the flow of the conversation as speakers do not have to introduce themselves every time they speak.

Video can support communication between two people who are not in the same location or even a group of people. Group

videoconferencing can take place in the form of multiple participants each connecting via video or by one or more individuals communicating with a group located at a distance. This latter approach would allow individual patients and family members to connect with clinical teams such as those overseeing hospice care. When examining communication with teams via video, issues such as eye contact or appearance consciousness, which have been studied extensively in one-on-one video encounters, introduce new implications. Eye contact plays a significant role in conversation turn-taking and perceived intent and informs interactions in both individual and group communications.<sup>9</sup> Appearance consciousness—the psychological burden of being on camera and potentially being recorded and/or able to see oneself as one talks—has also been identified as a barrier to video communication and has different effects in video interactions between two individuals than within a group, but an extensive comparison has not been explored.<sup>10</sup>

Given the need for a videoconferencing platform that would be applicable and relevant to both rural and urban settings and would not require upgrading the residential infrastructure or training families, low-cost commercially available videophones operating over phone lines have been considered an appropriate tool. However, their use requires image transmission using a built-in dial-up modem via the plain old telephone service (POTS), which leads to significant video and audio degradation. Technological advances enabling the proliferation of broadband Internet have allowed for Web-based videoconferencing platforms to become more widely available, providing a higher-quality alternative.

This study explores the use of different telehealth platforms as tools to overcome existing barriers and bring caregivers of hospice patients into hospice IDT meetings. It aims to detect whether the video-mediated communication facilitates or impedes the communication between teams and caregivers. The study has four specific aims:

1. to examine the technical quality of videoconferencing used in the hospice setting to engage hospice caregivers as “virtual” members of the IDT meeting;
2. to compare the quality of POTS-based videophones with Web-based videoconferencing in the context of hospice team meetings;
3. to assess caregivers’ impressions of videoconferencing for communication with hospice teams; and
4. to provide recommendations for assessing video quality for telehealth group interactions.

## Materials and Methods

Data were obtained from an ongoing randomized clinical trial exploring Web-based videoconferencing and a completed prospective study of POTS-based videoconferencing.

The ongoing randomized clinical trial called Assessing Caregivers for Team Intervention through Video Encounters (ACTIVE) is designed to determine whether regular communication of patients’ informal caregivers (typically a family member or friend of the pa-

tient) with the hospice care team through videoconferencing alters caregivers’ perceptions of pain management and patients’ pain.<sup>11</sup> Caregivers in the experimental group can participate “virtually” in the biweekly hospice team meetings during which their loved one’s care is discussed. ACTIVE caregivers participate in team meetings until the patient dies, is decertified from hospice, or withdraws from the study. The equipment needed for their participation includes a computer connected to high-speed Internet service that has a project-supplied Web camera and headphones. A member of the research team installs the equipment, trains the caregiver in its use, and provides printed instructions. The hospice agency office has a computer with a Web camera and high-speed Internet service connected to a projector that displays an enlarged image of the caregiver for the hospice team meeting. Before the first meeting, a research team member connects and tests all equipment to insure proper functioning. For the interaction between caregivers and the hospice team, the Web-based videoconferencing platform Virtually Interactive Families ([www.vifamilies.com](http://www.vifamilies.com)) is used.<sup>11</sup>

## EXAMINING TECHNICAL QUALITY OF VIDEOCONFERENCING DURING HOSPICE TEAM MEETINGS

For the on-site assessment of the quality of the telehealth interactions, a previously validated instrument for assessing the technical quality of a “virtual visit” in home care,<sup>12</sup> a video-based interaction between healthcare providers and patients or caregivers, was used to review video-recorded interactions. The form includes identification of the caregiver, date, and starting and ending time of the video-call. The main section of the form contains five items describing the technical quality of the video-call. The first two items refer to observations made by research staff regarding the frequency of audio and image difficulties at the hospice team’s site. The next two items address problems with video and sound at the caregiver’s end, as reported to the team during the video-call. The last item addresses possible disconnection(s) and their frequency of occurrence. A score rating the overall technical quality of each video-call (ranging from 0 to 50) can be calculated from these elements. This instrument has been tested for reliability and validity and used to rate the technical quality of video-calls in home care settings.<sup>12</sup> The form was completed by a research staff member who was present during the team meeting.

## COMPARING POTS-BASED WITH WEB-BASED VIDEOCONFERENCING

In addition to data from the Web-based videoconferencing clinical trial, secondary data were also available from a previous pilot study that connected caregivers virtually with the hospice team but instead used a POTS-based videophone called Beamer (Vialta Inc., Milpitas, CA). In that study, caregivers were provided a designated time and date to use the videophone to participate in the hospice team meetings.<sup>13</sup> The videophone unit used in the hospice agency office was the Beamer TV™ model, which projected the caregiver’s image onto a large television screen for the entire hospice team to view. This POTS

connection allowed family members to have a visual image of the team as well as a two-way conversation with them.<sup>13</sup>

To better compare the technical quality of the video sessions between the two platforms (POTS-based videophone and broadband videoconferencing), in a retrospective analysis, randomly selected video-recorded team meetings from both studies were rated for a set of characteristics defined as essential for the quality of videoconferencing by industry standards<sup>14</sup>:

- *Video artifacts.* The rater reviewed the videorecording to identify possible video artifacts around the subject's head and shoulders (e.g., blocks, image distortions, or out-of-focus areas).
- *Sharpness.* The rater reviewed the tape to detect whether details and fine lines could be distinguished.
- *Contrast, brightness, and color saturation.*
- *Color depth.* The rater looked for color banding in the backgrounds and on the subjects' faces and compared with the video resolution test for color.
- *Stability.* The rater evaluated whether images were stable with no motion in the background due to video artifacts or video noise.
- *Background clarity.* The rater evaluated whether the background was out of focus and whether it was rich in color and texture.
- *Audio clarity.* The rater evaluated how clear the audio was and whether noise occurred.
- *Audio stability.* The rater evaluated whether the audio quality was consistent or whether interruptions or other audio degradation occurred.

For each of the parameters above, the rater was asked to assign a score from 1 to 5 (with 1 being poor and 5 being excellent quality). The form enabled the calculation of an overall score for video quality and a total score for audio quality. The maximum total score is 40 (30 for the video subscale and 10 for the audio scale). To compare ratings for the two groups (Web-based and POTS-based sessions), Student's *t* tests were performed.

## ASSESSING CAREGIVERS' IMPRESSIONS OF VIDEOCONFERENCING IN HOSPICE

At study completion, phone interviews are conducted with caregivers to assess their overall impression of the technology used as well as any challenges or barriers they identified in the use of videoconferencing to communicate with hospice teams. Interviews are audio-recorded and transcribed. Qualitative thematic coding of the transcripts was performed to identify caregivers' impressions, perceived advantages, barriers, and suggestions and recommendations pertaining to the use of video to communicate with hospice teams. We adopted an inductive approach to thematic analysis, identifying themes that were linked to the data themselves, as opposed to applying an *a priori* coding template.<sup>15</sup> Members of the research team independently reviewed the dataset and developed codes to classify items of information related to caregivers' comments about the use of video-mediated communication with hospice team members. Codes

for each caregiver were sorted and organized through discussion to identify patterns and create memos, larger explanations, and descriptions of meaning in the data. Working with a baseline organization of memos, we independently reviewed the dataset again to sort through the data and identify exemplars and assess saturation. Final development of themes was accomplished through joint review and discussion of the data. Themes were circulated among the research team to check for validity.

## Results

In total, 200 hospice team meetings were analyzed for this study, including 114 video-recorded hospice team meetings from the ongoing ACTIVE study using Web-based videoconferencing and 86 team meetings from the previous study using POTS-based videophones.

### EXAMINING TECHNICAL QUALITY OF VIDEOCONFERENCING DURING HOSPICE TEAM MEETINGS

For the ACTIVE study using Web-based videoconferencing, the average technical quality of the sessions as calculated by the technical quality form was 42.3, with the lowest score being 24 and the highest 50 (standard deviation 6.2). Average technical quality for the POTS-based videophone sessions was 37.1. *Table 1* summarizes the data from the technical quality forms for the sessions of both studies.

### COMPARING POTS-BASED WITH WEB-BASED VIDEOCONFERENCING

The overall technical quality of videoconferencing sessions was higher for Web-based videoconferencing tools than POTS-based video sessions (*Table 2*). More technical problems pertained to audio than video in both studies, and of these, most problems were reported pertaining to audio at the caregiver's end. *Table 2* shows the overall ratings for technical quality and usefulness of the telehealth visits as rated by the research team member. When five randomly selected videotaped Web-based videoconferencing and five POTS-based video sessions were reviewed, overall good audio and video quality was assessed for both platforms. *Table 3* lists the mean scores for all parameters of video and audio quality. A direct comparison between the two modalities indicates the superiority of Web-based video in image quality.

### ASSESSING CAREGIVERS' IMPRESSIONS OF VIDEOCONFERENCING IN HOSPICE

Transcripts of exit interviews with 19 caregivers who participated in the ACTIVE study using Web-based videoconferencing were analyzed to assess their overall impressions.

Overall, participants found the use of videoconferencing to be a positive experience and found the use of telehealth in this context as useful and essential to communicating with the entire hospice team. One participant specifically commented on the ability to become introduced to team members who were essential to their loved one's

**Table 1. Technical Quality Characteristics**

	WEB-BASED VIDEOCONFERENCING (N= 114)	POTS-BASED VIDEOPHONE (N= 86)
Total score for technical quality mean ( $p=0.0012$ )	42.3 (SD 6.2)	37.1 (SD 5.2)
Would the conversation have been better in person?		
No	106 (93%)	55 (64%)
Yes	8 (7%)	31 (36%)
Did you experience any difficulty with sound?		
No	90 (79%)	80 (93%)
Yes	24 (21%)	6 (7%)
Did you experience any difficulty with picture quality?		
No	104 (91%)	51 (59%)
Yes	10 (9%)	35 (41%)
How many times was the connection lost?		
Total	8 (7%)	6 (7%)
POTS, plain old telephone service; SD, standard deviation.		

care but whom they did not meet in person: "I think it's nice to actually put a face to someone that's talking to you. You know, there were so many people I hadn't ever seen before, you know, that didn't come out there, like the pharmacist and things like that that I never had seen in person. Just to see someone's face made it nice."

**Table 2. Overall Evaluation of Telehealth Group Meetings**

	WEB-BASED VIDEOCONFERENCING	POTS-BASED VIDEOPHONE
Overall technical quality		
Excellent	39.52%	20.01%
Good	48.45%	68.23%
Acceptable	7.22%	6.43%
Poor	3.09%	3.21%
Unacceptable	1.72%	2.12%
Overall usefulness of telehealth visit		
Very useful	46.37%	45.22%
Useful	46.71%	48.15%
Neutral	5.54%	3.29%
Somewhat useful	1.04%	2.04%
Not at all useful	0.35%	1.30%
POTS, plain old telephone service.		

**Table 3. Evaluation of the Video-Call Quality**

	WEB-BASED	POTS	P VALUE <sup>a</sup>
Video quality <sup>b</sup>			
Video artifacts	4.12 (0.6)	4.04 (0.87)	0.0012
Sharpness	4.11 (0.64)	3.23 (0.77)	0.0002
Contrast, brightness, and saturation	4.04 (0.45)	3.89 (0.74)	0.0018
Color depth	4.42 (0.34)	3.72 (0.76)	0.0002
Stability	4.23 (0.61)	3.31 (0.79)	0.0027
Background clarity	4.08 (0.63)	3.48 (0.76)	0.0001
Total score for subscale (6–30)	25 (3.72)	21.67 (4.09)	0.0011
Audio quality <sup>c</sup>			
Audio clarity	4.12 (0.43)	4.26 (0.70)	0.023
Audio stability	4.02 (0.65)	4.29 (0.67)	0.073
Total score for subscale (2–10)	8.14 (1.42)	8.54 (1.36)	0.045

Data are mean (standard deviation) values.

<sup>a</sup>By *t* test.

<sup>b</sup>On a scale of 1=bad, 2=poor, 3=fair, 4=good, and 5=excellent.

<sup>c</sup>On a scale of 1=unacceptable, 2=problematic, 3=neutral, 4=acceptable, and 5=excellent.

POTS, plain old telephone service.

When examining challenges with the technology, responses were grouped into issues pertaining to audio delay, overall sound, overall video quality, and ease of use of the videoconferencing software. Four participants commented on the delay introduced by the videoconferencing and how it affected overall communication. As one subject pointed out, "I did find the delay was difficult sometimes...because I would say something, and then I couldn't tell if people responded or not." Another subject also spoke to the challenge of registering the conversation partners' response because of the delay: "which, you know, could be taken as, oh, they're just glossing on by."

Problems with the sound primarily included challenges to hearing all of the team members who were present at the other end. One caregiver commented, "I could hear the doctor talking in the background, but I couldn't understand what he was saying," and three other caregivers also stated that they had difficulty at times hearing some of the team members.

Challenges with the video included "freezing up" of the image and lack of clarity. One participant explained: "the picture is not good enough that you can actually see people's faces...and [their] reactions."

Finally, in terms of overall usability of the videoconferencing system and setting up hardware (microphone, camera) for the telehealth sessions, most participants found the system easy to use. One



subject pointed out, "I was real happy with it. It was very easy to log on. I could see everybody. And after we got through a couple of glitches of getting my sound going, you know, we could hear and everything." One caregiver commented that she relied on her spouse for technical assistance with the Web camera: "He's a little more technically inclined than I am, but we got it." One caregiver specifically commented on being able to problem-solve and quickly address technical challenges: "I had [the microphone] in the wrong thing. Once I got it in the microphone port, it was fine."

## Discussion

As anticipated, the overall technical quality of videoconferencing sessions was higher for Web-based videoconferencing tools than POTS-based video sessions. A direct comparison between the two modalities indicates the superiority of Web-based video in image quality (including all related attributes such as video artifacts, sharpness, contrast, brightness, saturation, color depth, stability, and background clarity) but less so in audio quality. Overall technical quality for Web-based video was rated higher both by an external rater and by participants, leading to a higher evaluation of overall usefulness of telehealth visits. The findings confirm the superiority of broadband video for applications that promote interactivity for residential users.<sup>16</sup>

In the larger intervention study the telehealth platform provides a context for participation of family caregivers in hospice IDT meetings, eliminating numerous logistical barriers. Principles inherent within hospice provide the team with a supportive structure that acknowledges patient/family feedback as valuable. Telehealth tools in this context provide opportunity for temporary team membership. Patients/families are viewed as "specialists," with important information and knowledge required for assessment, care planning, and evaluation.

Web-based videoconferencing was accepted by hospice caregivers, who generally found the platform easy to use and saw great benefit in seeing all the team members and being able to virtually participate in the team meetings. These findings of overall acceptance of group videoconferencing align with evaluation studies of group videoconferencing in other settings, such as the study by Taylor et al.,<sup>17</sup> who assessed participants in a group-based stroke self-management program using videoconferencing, or Laitinen et al.,<sup>18</sup> who also found participants were satisfied with group videoconferencing for group counseling by a clinical nutritionist. Challenges pertaining to audio delay or lack of clarity with the video as well as some challenges in setup and operation of cameras and microphone highlight limitations of low-cost videoconferencing and potentially the need for further testing during the initial setup after caregivers consent to participate.

This study also highlights the need for new tools that capture the quality of video-mediated communication among multiple stakeholders/team members. Most assessment forms assume two stakeholders (the local and remote partner). The challenge of video-mediated team discussions is the fact that team members may have diverse professional backgrounds and different levels of familiarity with technology and personal preferences pertaining to audio and

video settings, making the subjective evaluation of a video-call by the entire team difficult to capture. As technology advances, new ways to support and enhance communication between healthcare teams and individual patients and their families are identified. In our study we used a technical quality assessment form that was originally developed for one-on-one telehealth interactions. This form captures both frequency and nature of challenges and audio/image degradation. It also captures the subjective assessment of the observer/rater in terms of overall quality and usefulness of the encounter. In cases where a group is involved in the session, it would be time consuming to have every member present in the session provide a rating for overall quality or usefulness. On the other hand, it is important to capture any challenges individuals may experience. Therefore, rather than prompting every participant to provide scorings, it may be efficient for the facilitator to ask for anyone who would like to have an observation documented on the form.

Additional recommendations resulting from our study that inform assessing the technical quality of telehealth group encounters include the following:

- establishing turn-taking rules to avoid interruptions and allow participants to recognize potential audio delays.
- providing training for healthcare providers who need to engage remote participants regarding eye contact (e.g., looking into the camera) because in team interactions it is more frequent that team members may look down on their notes or focus on participants physically present and rarely look up to the camera (acknowledging the remote participant). Additionally, training should address avoiding side conversations during the group encounter or other activities that can be disruptive to the telehealth group encounter.
- tasking the facilitator with addressing conversation partners with their name or title so that remote participants are aware of the speakers (even if they cannot see their face well).
- addressing seating arrangements for the group to ensure that all members are in close proximity to the microphone if at all possible and that are all captured by the camera.
- ensuring that lighting in the room maximizes clarity and makes the entire team visible.
- reminding caregivers and patients (or remote participants in general) to ask for clarification or a statement to be repeated if they were not able to hear or to ask speakers to identify themselves.

Ongoing monitoring of the technical quality in telehealth sessions is important in order to ensure that technology does not become a barrier. Previous work has documented that overall video quality affects the content of communication, with the themes of communication and time spent on them being clearly affected by the level of image and audio quality.<sup>12</sup> In order to establish meaningful and efficient ways to communicate across geographic barriers, emphasis should be placed on assessing and improving the technical quality of telehealth sessions. As videoconferencing platforms advance and stakeholders become more comfortable with and experienced in their

use, technology should become “invisible” during telehealth encounters, allowing for effective communication among multiple entities and sites and introducing new ways to engage patients and their families in the healthcare process.

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No competing financial interests exist.

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