How effective is video consultation in clinical oncology? A systematic review

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ABSTRACT

Background

Video-consultation (VC) is a specialized type of telemedicine that uses technology to provide real-time visual and audio patient assessment at a distance. In the present review, we set out to evaluate whether VC is feasible for the assessment, monitoring, and management of oncology patients.

Methods

A search strategy designed to capture studies that addressed the use of telemedicine to deliver cancer care identified relevant articles in the MEDLINE (1966 to September 2008) and PubMed (to 2008) databases. Articles were included if they described studies incorporating

- video-conferencing between patient and provider for assessment or monitoring,
- physicians or nurses as the care providers,
- cancer patients,
- consultation in real-time, and
- reporting of 1 or more outcomes.

Results

Of the more than three hundred articles retrieved, nineteen articles describing 15 unique patient populations involving 709 patients were inclusded in the analysis. No randomized trials were located. Eight studies included a control group; seven involved a case series. The most commonly reported outcomes were patient satisfaction (ten studies), cost to perform consultation (six studies), patient preference for VC compared with in-person consultation (five studies), provider satisfaction (four studies), and provider convenience (four studies). Of these outcomes, satisfaction on the part of patients and physicians has been positive overall, total costs were comparable to or less than those for in-person consultations, and patients valued having VC as an option for consultation. Outcomes evaluating the effect on clinical care were infrequently reported.

Conclusions

While there is evidence to suggest that VC is both feasible and effective for use in the clinical care of oncology patients, studies are generally small and methodologically weak, with limited power of inference.

KEY WORDS

Telemedicine, teleconsultation, video consultation, remote consultation

1. INTRODUCTION

Telemedicine (TM) is the use of telecommunications and information technologies to share and maintain patient health information and to provide clinical care and health education to patients and professionals when distance separates the participants [1]. More simply, TM involves the practice of medicine at a distance [2], and tele-oncology is therefore the delivery of oncology services from a distance [3].

Several authors have described the development and evaluation of TM applications in oncology for the purpose of enabling health professionals to share knowledge, opinions, and experiences [3–13]. These technologies often take the form of electronic patient records, multidisciplinary meetings, sharing of test results (radiology, pathology analyses), and treatment planning (radiotherapy, chemotherapy) to improve patient care.

Video consultation (VC) is a specialized form of TM that uses technology to provide real-time visual and audio patient assessment. Originally, VC was developed to connect physicians with patients located isolated in areas in which climatic or geographic conditions render provider or patient transportation difficult and costly [14], resulting in inequalities in patient care [15]. Oncologic care is no exception, because medical expertise is generally

concentrated in urban tertiary centres whose distance may impede access to quality care [16]. Telemedicine may be useful to bridge this gap, but the heavy psychosocial burden inherent in oncologic disease may limit the application of TM [17].

The use of VC to aid in the provision of cancer care for primarily medical (viz. psychosocial) management was first described by Allen and Hayes in Kansas in 1994 [18]. Their system demonstrated the feasibility of linking oncologists from the University of Kansas Medical Center (KUMC) with patients in rural community hospitals. In addition to TM services, oncologists from the KUMC periodically conduct in-person outreach clinics. The group attributes their successes to the combined approach of TM and outreach clinics and to effective collaboration between participating health care professionals, including nurses, administrative personnel, and technical support staff. The successes of the program have spawned many additional groups that use VC to extend specialized oncologic care to patients. Still, although VC has been used in patient care for more than 40 years [19] and in cancer care for 15 years, formal evaluation is sparse.

There are a number of potential barriers to the widespread use of VC in cancer care. The cost of implementing and operating a VC system obviously must be considered. Even in environments in which VC systems are part of the infrastructure, the efficacy of interpersonal communication through TM and the inability of the provider to directly conduct a physical examination represent potential barriers.

We conducted a systematic review to address the question of whether VC is efficacious for the assessment, monitoring, and management of oncology patients. Specifically, we focused on evidence evaluating the use of telemedicine systems as a real-time link between providers and patients for the purpose of clinical consultation.

2. METHODS

2.1 Search Strategy

Using MeSH terms including "telemedicine" and "oncology care" (Table I), we searched the MEDLINE (1966 to 2008) and PubMed (to 2008) databases for relevant articles (last searched in September 2008). No language restrictions were imposed.

2.2 Inclusion Criteria

The objective of the review was to examine the efficacy of VC in providing a real-time link between patient and provider for the purpose of providing a clinical assessment. The inclusion criteria for the literature search reflected that objective:

- Video consultation between patient and provider was conducted for assessment or monitoring.
- The physicians or nurses were directly involved in the patient's treatment.
- Patients with a suspected or diagnosed neoplasm were involved.
- The patient was present at a point of care, and the consultation took place in real time.
- At least 1 objective oncology-specific provider performance or outcome, patient outcome, or societal or system outcome was reported.

Given the relative paucity of studies in the literature, all design types, including case series, controlled studies, controlled trials, and reviews were included.

2.3 Method of Review

All references were screened CK. Data were extracted by CK, and checked for accuracy by RW. Any discrepancies were resolved by consensus. Relevant data on the quality and results of the studies were summarized in the results. Because of significant heterogeneity across trial designs, no quantitative analyses were performed. Outcomes were grouped into those addressing patient and provider satisfaction, effect on clinical outcomes, cost, and convenience (for patient and provider alike).

TABLE I Search strategy

Step	*Search term*
1	telemedicine.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
2	Telecommunication.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
3	Teleconferencing.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
4	Teleconsultation.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
5	Videoconferencing.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
6	Videoconsultation.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
7	Remote Consultation.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
8	Rural Consultation.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
9	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
10	oncology.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
11	cancer.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
12	neoplasm.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
13	(tumor or tumour).mp. [mp=title, original title, abstract, name of substance word, subject heading word]
14	10 or 11 or 12 or 13
15	9 and 14

3. RESULTS

More than three hundred articles were identified. Most of the literature focused on descriptions of non-VC TM technologies—for example, asynchronous transmission of patient data and test results, development of electronic medical record systems, and TM-aided education. When VC was the modality used in the article, the focus was generally on interprofessional collaboration (that is, multidisciplinary team meetings), either to obtain a second opinion or to facilitate patient management in the case of multiple providers.

Nineteen articles met the eligibility criteria. These articles described 15 unique patient populations involving 709 study (VC) patients and 346 control (in-person) patients. A single small randomized controlled trial was identified. In addition, seven non-randomized trials with a control group (the study patients served as personal controls in two of those populations) and seven case series were identified (Table II).

The clinical conditions involved were general oncology (medical) consultation [10,17,21,23,29,31–33], hospice (palliative) consultation [25,34], genetics counselling [27,30], case conference with patient in attendance [11], nursing follow-up [20], and dermatology assessment for suspected skin cancer [24]. The care providers were medical oncologists [10,17,21,23,29,31–33], nurses [20,27,30,34], otolaryngology surgeons [11], palliative care physicians [25], and dermatologists [24].

3.1 Patient Satisfaction

The outcome most commonly reported was patient satisfaction with the consultation, which was reported in 10 of 15 [10,17,18,20–22,27–32] patient populations. No validated satisfaction scales were use in these studies. Table III summarizes the tools used to measure satisfaction and the corresponding outcomes. One study used a visual analog scale [32], and one used a yes/no response [29]. For their studies, the remaining investigators created and assembled a series of questions created based on face validity.

Satisfaction focused on a variety of domains. The most frequently cited were convenience and reduced travel time and costs [18,20,22]; reduced wait time for the appointment and consultation, and enhanced access to care [17,20,31]; perceived ability to communicate effectively with the care provider [10,27]; and overall ease of use and quality of the picture and sound [17]. In two studies [27,30], patients reported that they felt they were listened to and understood by their care provider.

Disadvantages articulated by patients about the use of VC include nervousness about the use of new technology, difficulty (or reluctance) to communicate with providers using television-based systems [18,22], and the experience of emotional distance between patients and providers [27].

Overall, patients seen by VC wanted to continue to receive these services in the future [17,21,29,31]. Of all the study groups in which patients were given the choice between a VC and an in-person consultation, most patients in each group preferred a VC [18,20,28,29,32]. Other studies identified other qualifiers, such as having the option of an in-person consultation if needed [31].

3.2 Clinical Impact Outcomes

Outcomes evaluating impact on clinical care were reported in seven studies [10,17,20,24,27,30,32]. Table IV summarizes the tools used to measure the clinical effects of VC and the corresponding outcomes.

Studies suggested that clinical care was not compromised with the use of VC. Three studies showed that VC can effectively reduce the psychopathologic correlates of the disease, including anxiety and depression, with the magnitude of improvement being comparable to that with traditional in-person consultations [17,27,30]. In another study, VC was used effectively to teach patients to change their ostomy pouch independently, with a positive effect on maintenance of independence and function [30]. In one study, VC was used to provide an opinion about whether a suspicious lesion should be biopsied. The VC opinions were compared with the decisions made when the same patients were seen in person by a different provider. High concordance between the decisions was observed [24]. Similarly, patients were equally likely to receive chemotherapy regardless of whether they were seen by VC or in person [10]. Finally, the number and frequency of follow-up visits was not affected by the modality (VC or in-person) of the consultation [20]. Overall, patients were able to receive and comprehend the information discussed during a VC, including knowledge about their disease state [27,30,32] and information pertaining to prognosis and treatment options [32].

3.3 Provider Perspectives

Outcomes evaluating provider perspectives were reported in seven studies [10,21,26,28–30,34]. When the effects of VC on completing specific functions were evaluated, providers reported no compromise in their ability to review laboratory, radiology, or other test results, to elicit a history, to perform an adequate physical exam (with the help of a surrogate), and to communicate effectively and with compassion with patients [21]. Providers believed that VC did not impair their ability to make an informed treatment decision and to decide on a management plan [29]. When compared with seeing patients in person, providers using VC reported a similarly high degrees of confidence in making a diagnosis and deciding on a treatment plan [21].

Active consultation time did not differ markedly between VC and in-person visits [21,28], but time was saved for the provider to reach the patient [34], leading to shorter overall consultation time. The increased efficiency of care that resulted was reflected in an increased number of patients seen each day and an

TABLE II Characteristics of included studies

Study[a]	*Caregiver*	*Study group*		*Control group (if applicable)*	
		(n)	*Description*	(n)	*Description*
Randomized controlled trials					
Bohnenkamp *et al.* 2004 [20]	General oncology nurse	14	Age 18 years or older, able to read and write in English, have a permanent ostomy, have a working residence telephone line, randomly assigned to groups	14	Same as study group
Non-randomized controlled studies					
Allen *et al.* 1995 [21], Allen and Hayes 1995 [22], Allen and Hayes 1994 [18]	Medical oncology physician	39	Oncology patients requiring consultation, weather would not permit oncologist to visit in person	21	Study patients seen subsequently in person
Doolittle *et al.* 1997 [23]	Medical oncology physician	103	Patients referred for initial consultation, reassessment, or follow-up; group inclusion criteria not reported	81	Same as study group, group inclusion criteria not reported
Phillips *et al.* 1998 [24]	Dermatology physician	51	Patients respond to flyers advertising skin cancer screening sessions	51	Study patients seen subsequently in person
Doolittle 2000 [25], Whitten *et al.* 1998 [26]	Palliative care physician	50	Inclusion criteria not reported	50	Inclusion criteria not reported
Coelho *et al.* 2005 [27]	Genetic counselling nurse	18	Referred to clinical genetics because of history of breast/ovarian or colon cancer, closer to VC site than in-person site	21	Closer to in-person site than VC site, otherwise same as study group
Weinerman *et al.* 2005 [10]	Medical oncology physician	30	Have gastrointestinal malignancy, live in the catchment area of Nanaimo Regional Hospital, have adequate vision and hearing, sequential referrals until 30 consenting patients	30	Same as study group
Stalfors *et al.* 2005 [11], Stalfors *et al.* 2003 [28]	Otolaryngology physicians (group review)	45	Inclusion criteria not reported	39	Inclusion criteria not reported
Case series					
Kunkler *et al.* 1998 [29]	Medical oncology physician	8	New patient referrals of follow-up appointments, located in Dumfries and Galloway Royal Infirmary	—	Not available
Gray *et al.* 2000 [30]	Genetic counselling nurse	8	Family history of cancer	—	Not available
Mair *et al.* 2000 [31]	Medical oncology physician	22	Age older than 18 years, free of mental impairment, no hearing or other impairment that would render telephone conversation difficult	—	Not available
Sezeur *et al.* 2001 [32]	Medical oncology physician	16	Inclusion criteria not reported	—	Not available
Doolittle *et al.* 2004 [33]	Medical oncology physician	121	Inclusion criteria not reported	—	Not available
Olver *et al.* 2005 [34]	Palliative care nurse	20	Inclusion criteria not reported	—	Not available
Laila *et al.* 2008 [17]	Medical oncology physician	6	Receiving chemotherapy, age older than 18 years, life expectancy > 12 weeks, vital signs state, receiving specialist medical care from home	—	Not available

[a] Multiple studies at a single entry describe the same patient population.

TABLE III Summary of studies reporting patient satisfaction

Study	*Measurement instrument*	*Findings*[a]
Randomized controlled trials		
Bohnenkamp *et al.* 2004 [20]	Unspecified number of questions created by the study team to evaluate how satisfied subjects were with either home health and/or VC. Six-point scale: 1 (strongly disagree) to 6 (strongly agree)	93% of patients were "satisfied" with the VC visit; 81% were satisfied with the home health visit ($p<0.01$). **Two questions that showed significantly lesser satisfaction in the VC group: (a) Does the nurse seem to understand your problems? (b) Were you comfortable with what the nurse told you about your ostomy?** ($p<0.01$)
Non-randomized controlled studies		
Allen and Hayes 1994 [18], Allen and Hayes 1995 [22], Allen *et al.* 1995 [21]	Twelve-item questionnaire created by the study team to assess comfort, ease of access, ability to communicate, and overall satisfaction with the VC system. Five-point scale: 1 (strongly disagree) to 5 (strongly agree)	Satisfaction was "high and equal between the VC and control group for most questions." (nonsignificant) For the VC group, all mean scores were significantly higher than the midpoint, except for the item "I would rather see my oncologist on the TV system now than have to wait a few days to see him in person" (3.24/5), ($p<0.05$). **Higher responses in the VC group to the question "I didn't feel that I could say everything I wanted to say because it didn't feel private."** ($p<0.05$)
Stalfors *et al.* 2003 [28], Stalfors *et al.* 2005 [11]	Two questions created by study team 1. How pleased were you with the information received during the conference? 2. Are you satisfied with the information about your future treatment? Four-point scale: 1 (very good) to 4 (bad)	No difference between VC and in-person was found when patients were asked how satisfied they were with the information given about their specific treatments ($p=0.11$). **The in-person group was more satisfied with the information provided than was the group presented via VC** ($p=0.023$).
Coelho *et al.* 2005 [27]	Six questions created by study team: 1. Felt understood 2. Felt comfortable and at ease 3. Felt listened to 4. Felt that feelings and emotional needs were met 5. Questions/concerns were all answered completely and thoughtfully 6. Expectations were met Four-point scale: 1 (strongly agree) to 4 (strongly disagree)	Overall satisfaction was 23.12/24 for the VC group and 22.0/24.0 for the control group (nonsignificant). **Statistically higher responses in the VC group to the question "I did not feel that my feelings and emotional needs were met" (mean: 4.00 for VC group, 3.35 for in-person group)** ($p=0.02$).
Weinerman *et al.* 2005 [10]	Thirteen questions created by study team Five-point scale: 1 (strongly disagree) to 5 (strongly agree) Questions probe participants' ability to communicate effectively with their physician and whether they perceived their medical and emotional needs were met.	"Mean percentage score" on the satisfaction questionnaire was 90.3% (SD: 9.5) in the VC group, and 91.3% (SD: 7.5) in the face-to-face group (nonsignificant)

[a] Boldface type indicates negative outcomes.

VC = video consultation; SD = standard deviation.

TABLE III *(Continued)*

Study	*Measurement instrument*	*Findings*[a]
Case series		
Kunkler *et al.* 1998 [29]	Patient asked if they were satisfied with the VC (yes/no).	All 8 patients in the series were satisfied with the VC service.
Gray *et al.* 2000 [30]	Unspecified number of questions created by study team; details not provided.	All 8 patients in the series reported "high levels of general satisfaction" with the VC consultation. "Comments from patients indicated that they had a high level of satisfaction with both the affective and instrumental aspects of the VC encounter."
Mair *et al.* 2000 [31]	Telephone interviews performed by a general practitioner using a thirteen-item, open-ended interview guide developed by the study team for the study.	All 22 patients in the series asserted that they were highly satisfied with the convenience of access that they gained from participation in the VC program. **For 11 of the 22 patients, satisfaction with the VC consultations depended on two conditions: (1) The VC clinic was perceived as being used "just for monitoring." (2) Subjects were also able to see the doctor in person from time to time.**
Sezeur *et al.* 2001 [32]	Global index of satisfaction on a visual analog scale.	Mean score of 79.9/100
Laila *et al.* 2008 [17]	Unspecified number of questions created by study team; details not provided.	All 6 patients found the VC system simple and easy to use and thought that it would accelerate and facilitate contact with caregivers. Of 4 patients, 3 found that image quality was good, and 4 found that the sound quality was good. At the end of the study, 4 of 4 patients expressed a wish to continue with VC.

[a] Boldface type indicates negative outcomes.
VC = video consultation; SD = standard deviation.

TABLE IV Summary of studies reporting clinical impact outcomes

Study	*Measurement instrument*	*Findings*
Disease or functional state		
Randomized controlled trials		
Bohnenkamp *et al.* 2004 [20]	Adjustment to living with ostomy: The Ostomy Adjustment Scale objectively tests the social readjustment of patients with ostomies using the number of days until patients can change the pouch independently.	Patients with in-person support averaged 15.07 days (SD: 8.42 days) after surgery or 6.79 days (SD: 7.49 days) after discharge. Patients given a VC could change their pouches at 13.71 days (SD: 14.39 days) after surgery or 6.14 days (SD: 12.04 days) after discharge (nonsignificant).
Non-randomized controlled studies		
Coelho *et al.* 2005 [27]	Anxiety: Unspecified measure.	A significant reduction in anxiety level was observed in the VC group [pre: 17.17 (SD: 4.12); post: 11.08 (SD: 3.08); $p < 0.01$], in the in-person group [pre: 15.70 (SD: 4.28); post: 12.45 (SD: 2.66); $p = 0.01$], and in a combined group [pre: 16.25 (SD: 4.21); post: 11.94 (SD: 2.86); $p < 0.01$].
Case series		
Gray *et al.* 2000 [30]	Anxiety: Unspecified measure.	A "trend towards reduced anxiety" was observed ($p > 0.05$). Levels of anxiety and worry were reduced for 8 of 8 patients receiving VC.
Laila *et al.* 2008 [17]	Anxiety and depression: Hospital Anxiety and Depression Scale (HADS)	The HADS scores for depression and anxiety were improved at each time point for 3 of 3 patients who completed this scale.
	Functioning: Short Form 36 (SF-36)	The SF-36 scores relating to emotional role and mental health and functioning improved for 4 of 4 patients who completed this scale.
	Quality of life: Palliative Care Outpatient Scale (POS)	The POS sum score was improved by the end of the study in 3 of 3 patients who completed this scale.
Disease knowledge or comprehension by the patient		
Non-randomized controlled studies		
Coelho *et al.* 2005 [27]	Knowledge of cancer genetics: Six-item questionnaire created by the investigators (true/false quiz) was administered pre- and post-consultation (scored out of 6).	A trend toward learning was observed in the VC group (pre: 4.12; post: 4.56; nonsignificant), in the in-person group (pre: 4.95; post: 5.29; nonsignificant), and in the combined group (pre: 4.59; post: 4.97; $p = 0.02$).
Case series		
Gray *et al.* 2000 [30]	Knowledge of cancer genetics: A questionnaire was developed by study investigators and administered before and after the consultation.	A "trend towards improved knowledge of cancer genetics" was observed. Scores assessing cancer genetics knowledge increased for 8 of 8 patients receiving a VC.
Sezeur *et al.* 2001 [32]	Understanding the content of the consultation: To evaluate memorization of information regarding the modalities and consequences of chemotherapy (a major focus of the consultation), 7–12 questions (average per patient: 9.8) were posed after 24 hours.	At 24 hours, the 80.5% correct answers on the quiz by participants was interpreted by investigators to suggest that VC "in no way alters either their degree of memorization of the information transmitted."

SD = standard deviation; VC = video consultation.

TABLE IV *(Continued)*

Study	*Measurement instrument*	*Findings*
Accuracy of diagnosis or treatment decision		
Non-randomized controlled studies		
Phillips *et al.* 1998 [24]	Concordance in cancer diagnosis, whether the lesion is malignant, and in the decision to biopsy between patients seen in a VC, and then subsequently in person by a different physician.	For cancer diagnosis, agreement was significant between the VC and the in-person consultations (agreement in 63/107 lesions, $\kappa = 0.32$). Agreement was significant about whether the lesion was likely malignant ($\kappa = 0.56$). In the decision to biopsy, agreement was significant between the VC and the in-person consultations ($\kappa = 0.47$). A trend for patients in the VC group to be more often recommended for biopsy was observed (nonsignificant).
Impact of telemedicine on treatment offered		
Non-randomized controlled studies		
Weinerman *et al.* 2005 [10]	Comparison of the percentage of patients offered chemotherapy when seen in a VC or in person.	After the consultation, chemotherapy was offered to 46.7% of the VC patients and to 43.3% of the in-person patients (nonsignificant)
Impact of telemedicine on (frequency of) follow-up visits		
Randomized controlled trials		
Bohnenkamp *et al.* 2004 [20]	Number of follow-up visits by an oncology nurse.	The in-person group received 6.29 in-person visits (SD: 4.25). The VC group received 5.43 in-person visits (SD: 3.03 in-person visits) and 3.57 VC visits (SD: 1.28 VC visits; statistical test not done).

SD = standard deviation; VC = video consultation.

increased percentage of the day that providers spent seeing patients [26].

Provider satisfaction was evaluated from different perspectives. It was favourably evaluated for both the technical performance and the communication aspects of the consultation [21], which were comparable with evaluations for in-person consultations [10]. In one study, providers reported no significant difference between VCs and in-person consultations [29]. Less than optimal satisfaction was reported because of suboptimal ability to observe non-verbal behaviour of patients and an inability to physically examine patients [30]. In two studies, when asked whether they would be willing subsequently to use VC for patient assessment and monitoring, providers expressed interest in doing so [21,29].

3.4 Additional Outcomes

Additional outcomes that have been explored in groups employing VC in oncologic care include the total cost, from a systems perspective, to perform the consultation [11,20,23,25,32,33] and the frequency and consequences of technology failures during the consultation [29,34].

Six studies undertook an economic evaluation. The overall conclusion was that total costs were comparable to or less than those for in-person consultations. In the earlier stages of implementing a VC system, set-up costs (such as equipment costs and training) can be substantial, but the overall costs to the health care system are generally still equal to [23] or lower than [11] the costs associated with having the caregiver meet the patient in person for a consultation. Over time and as VC systems are used more frequently, operating costs can be reduced by as much as half or more [33]. When compared with having a nurse travel to the patient for supportive care, the cost savings associated with the use of VC can be even more significant [20,25]. Cost savings are particularly pronounced when in-person consultation necessitated patient transfer by ambulance [32].

When technology issues were evaluated, instances of dropped, interrupted, or failed calls were observed [29,34]. In general, the video link was easy to establish, and technology problems such as voice echo, poor image, loss of sound, and asynchrony of voice and sound were rarely seen or transient when they occurred [29]. Radiology images were also considered to be of adequate quality [29].

4. DISCUSSION

The present systematic review is the first focused specifically on the use of VC in the diverse circumstances to which it has been applied in cancer care. The evidence supports the feasibility of VC in the assessment, monitoring, and management of oncology patients.

Currell *et al.* [35] reviewed seven VC trials involving more than 800 people from non-oncology populations. They found that no study showed a detrimental effect of VC, but also that no study showed unequivocal benefits. None of the studies reviewed by those authors included a formal economic analysis, but the technological aspects of VC were shown to be reliable, and VC was observed to be well accepted by patients. Our review included fifteen unique groups that used clinical VC, suggesting that patients and caregivers alike were satisfied with its use, that selected clinical outcomes were not compromised, and that economy of time and costs can possibly be realized depending on the evaluation perspectives.

Methodologic limitations in the quality of the existing evidence—and hence the associated power of inference—are significant. The results were supportive, and multiple aspects of care were assessed, but the sample sizes were small, usually lacking in appropriately matched controls, and (when a control group was present) lacking in appropriate randomization, except for one underpowered trial. Nevertheless, the present review is the most comprehensive regarding the advantages and disadvantages of VC use in clinical oncology. Where previous work has identified potential weaknesses in VC technology, further investigation should assess the effects of those weaknesses on perceived care (from the perspective of patient and provider alike) and on clinical outcomes. By summarizing key outcomes of interest that have been reported by investigators in this area, our review provides a good point of reference for future study designs.

For future trials, the need to use validated outcome assessment tools cannot be overstated. This need is best illustrated in the reporting of patient satisfaction. In all but one instance in which satisfaction was measured using a visual analog scale [32], investigators created and compiled a series of non-validated questions that they felt reflected the components of satisfaction. Similar weaknesses were observed in non-oncology studies [36–43]. Although VC-specific patient satisfaction tools are lacking, existing patient satisfaction tools [44–46] can be adapted and validated in the TM setting to facilitate assessment. Arguably, effect on clinical outcome should be an integral part, if not the primary outcome, for an evaluation of VC, and yet this parameter is infrequently addressed. The frequency with which patients refuse to participate in VC and the instances in which VC fails to permit consultation were rarely reported [29,34]; addressing those outcomes in subsequent work would be warranted.

What kinds of clinical conditions are suitable for VC?

As identified in our review, the clinical conditions addressed so far are diverse, ranging from the more traditional general oncology consultation to hospice consultation. Circumstances in which patient hearing, vision, or cognition is impaired may be less

ideal for VC. A strong history and objective diagnostic reports can readily be communicated in a VC, but circumstances in which a physical examination is critical to successful assessment may be less suited to the technique. In some cases, this limitation has been supplemented by specialized tools (such as electronic stethoscopes); in others, collaboration and confidence in the assessment by someone qualified to perform and report the relevant findings of distant patients is likely a critical component of VC success.

An important aspect of future work in the evaluation of VC is an appropriate analysis framework. Specifically, the framework may be use of VC as a strategy to facilitate communication between patient and provider, where the intervention is the provision of care facilitated by VC where necessary (as opposed to individual VC encounters). The outcomes of interest would then also include effect on access and overall quality of care.

Improved access is the product of several factors, including issues of distance and logistics such as patient mobility—factors that may be so restrictive as to preclude access to care altogether. The reduced time spent by patients in attending the consultation, the reduced costs, and the ability to have local family and supporters attend the consultation [10] may also increase the likelihood that patients will seek care when it is needed. So far, no work has directly measured the effect that the opportunity to receive care by VC has had on the willingness of patients to seek care, and whether, in some instances, continuity of care could be enhanced if VC were available. It is clear, however, that patients appreciate having the option to see their physician in person periodically [31], with potential improvement in efficiency for patient and provider alike.

5. CONCLUSIONS

In cancer care, VC has been adapted to diverse circumstances. There is evidence to suggest that VC is both feasible and effective for the assessment, monitoring, and management of oncology patients, but the relevant studies are generally small and methodologically weak, with limited power of inference. Future studies should incorporate multidimensional outcomes including effects on accessibility of care and clinical outcomes, supplemented by level of satisfaction, convenience, and cost-effectiveness to guide the optimal strategy to incorporate VC into clinical practice.

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