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REVIEW ARTICLE

How technology can improve communication and health outcomes in patients with advanced cancer: an integrative review

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Abstract

Objective Patients facing an advanced cancer diagnosis require clear communication with their clinicians. Technology has been utilized in many different capacities to navigate communication in cancer care, but few authors examine the specific areas of communication from a theoretical perspective. The purpose of this literature review was to (1) identify articles focused on technology-based communication strategies to improve health outcomes in individuals with advanced cancer, and (2) using Epstein and Street's framework, identify areas in which technology-based communication has been used to improve health outcomes, and (3) identify gaps that exist in technology-based communication care in patients with advanced cancer.

Methods A systematic search was conducted which returned 446 articles. Using Epstein and Street's 2007 framework, the final sample was 39.

Results Nine clinical trials, 29 observational studies, and 1 case study were identified. The articles were categorized into one area within Epstein and Street's areas of communication. Many of the articles examined the patient's and provider's acceptability and feasibility of technology-based methods of communication, while other articles examined their efficacy.

Conclusions While research studies were identified in each of the areas of communication, the majority of technology-based communication strategies were focused on the exchange of information between patients and their providers. Further research and the development of technology-based communication interventions assessed through clinical trials are needed in the areas of healing relationships and making decisions in cancer care. Additionally, the communication strategies found effective at improving health outcomes in advanced cancer should begin implementation into clinical practice, therefore reaching more patients.

Keywords Cancer · eHealth · Internet · Palliative · Technology · Telemedicine

Background

The National Cancer Institute defines advanced cancer as "cancer that is unlikely to be cured or controlled with treatment"[1]. Patients facing an advanced cancer diagnosis require clear and individualized communication with their oncology clinicians. If clinicians cannot thoroughly and accurately communicate with patients about their symptoms, illness, prognosis, and treatment then patient care suffers. Such discussions must happen early and often for cancer patients. Paladino et al. [2] state, "Earlier clinician-patient conversations about patients' values, goals, and preferences

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in serious illness are associated with better health outcomes but occur inconsistently in cancer care." Fifty-five percent of cancer patients with a poor prognosis, who were receiving palliative care, inaccurately described their disease as curable [3]. Patients and their loved ones deserve open, honest, and clear communication. Patients who do not have an accurate understanding of their prognosis may agree to aggressive treatment that may be futile, lead to poorer quality of life before their death, have poor symptom management, and be inconsistent with care goals. A study conducted in the USA found end of life discussions result in less aggressive medical interventions surrounding death as well as earlier hospice admissions [4]. In addition, aggressive medical intervention is associated with worse quality of life for the patient and the bereaved [4].

End of life communication is recommended for all terminal diseases, and there is no doubt how important this topic is for cancer patients with advanced disease [5]. Research findings indicate that cancer patients cared for at cancer centers, receive suboptimal end of life planning [6–8]. End of life discussions should include goals of symptom management, expectations in response to therapies or progression of cancer, as well as having a plan of care for dying [5].

Technology can facilitate crucial conversations to achieve patients' goals and health outcomes regarding their advanced cancer diagnosis. Health information technology may help improve the effectiveness, achievability, and timeliness of symptom management patient-clinician communication [9]. Such technology has growing evidence of improved quality of care as well as feasibility, cost-effectiveness, and acceptability by both patients and clinicians [10]. Advanced technology enables electronic health reporting by patients to clinicians and encourages data sharing between care teams, which means patients physically at a distance from their care team are still able to receive follow-up care [11]. Telehealth programs have improved the quality of care for patients in many aspects of healthcare and symptom management [12]. Telehealth in palliative care for cancer patients with advanced disease is considered a feasible and useful resource with the potential to improve quality of life and clinical effectiveness [12].

Technology will be defined as tools, resources, or equipment used to enhance direct communication between clinician and patient and vice versa. In order to better understand how technology has aided communication in improving health outcomes in patients with advanced cancer, this literature review is guided by Epstein and Street's [13] framework of "Patient-Centered Communication in Cancer Care." This framework identifies and defines the core areas of patient-centered communication that could be utilize to advance research and enhance clinical cancer care [13]. The 6 core areas, defined below, are responding to emotions, exchanging information, making decisions, fostering healing relationships, enabling patient self-management, and managing uncertainty [13].

Responding to emotions is defined as the clinician directly recognizing and appropriately responding to the ups and downs of various patient emotions [13]. Exchanging information is defined as assessing patient's information needs, understanding what patients know and believe about health, communicating clinical information, and sharing bad news and prognostic information throughout the cancer care phases of prevention, diagnosis, and treatment [13]. Making decisions is defined as the clinician evaluating and accounting for the patient's needs, values, and preferences in achieving a high-quality decision [13]. Fostering healing relationships is defined as addressing disparities in care, verifying understanding, cultivating self-awareness, trust, and rapport, as well as actively listening with empathetic nonverbal behaviors [13]. Enabling patient self-management is defined as advocating for patients and helping to navigate the healthcare system, supporting patient autonomy, and providing guidance, skills, and access to resources [13]. Although this category seems similar to exchanging information, it deals with the practicalities of following through with patient care and empowering patients to solve health-related problems and take actions to improve health outcomes. Communication for enabling patient self-management comprises of recommendations, instructions, and advocacy [13]. Managing uncertainty is defined as the clinician acknowledging and reducing uncertainty for the patient by providing information clearly, offering cognitive-behavioral techniques, and verifying emotional support is available [13]. Management of symptoms can occur in all 6 core areas as symptoms can manifest as both physical and psychological.

The purpose of this manuscript is to (1) identify articles focused on technology-based communication strategies to improve health outcomes in individuals with advanced cancer, and (2) using Epstein and Street's framework identify the areas in which technology-based communication has been used to improve health outcomes, and (3) identify gaps that exist in technology-based communication research and care for cancer patients with advanced disease.

Methods

This review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [14]. The first and second authors conducted a systematic search of the literature in three databases: PubMed, CINAHL, and PsycINFO. Each database was searched using MESH or subject headings and the terms technology, eHealth, mHealth, telemedicine, Internet, in conjunction with hospice, palliative, terminal care, and cancer and neoplasm. The search strategy is provided in Table 1 which

Table 1 Search strategy

PubMed search strategy	((technolog*[tiab] OR eHealth[tiab] OR mHealth[tiab] OR "Telemedicine"[Majr] OR "Internet"[majr] OR internet[tiab])) AND ((Hospice OR palliative OR terminal OR "terminal care"[mesh] OR "palliative care"[mesh] OR "hospice care"[mesh]) AND (cancer* OR neoplas* OR Neoplasms[mesh])) Select: adult filter 2000–present

was replicated in each database. In databases in which it was possible, keywords, MESH, or subject headings were exploded. Articles were included in the review if they were written in the English language, published after the year 2000, majority of study participants have advanced stage cancer, identified health outcomes, and included participants age 19 and older. Articles were excluded if they were not written in English, published before the year 2000, included more than 50% with early stages of cancer, did not identify health outcomes, and included participants younger than 19 years of age. Studies that focused on clinicians were still included if health outcomes were identified for advanced cancer patients.

The PRISMA diagram (Fig. 1) depicts the search process, review of articles for inclusion and exclusion conducted by two independent reviewers (who discussed and reached agreement on any discrepancies), and the final yield for examination. The initial search yielded 446 articles. When reviewing titles and abstracts for fit with the inclusion and exclusion criterion, this number was reduced to 46. In order to appraise and identify articles that focused on technology-based communication strategies that improved health outcomes in cancer patients with advanced disease, Epstein and Street's [13] framework of Patient-Centered Communication in Cancer Care, depicting the six core areas of communication, was applied. After applying Epstein and Street's

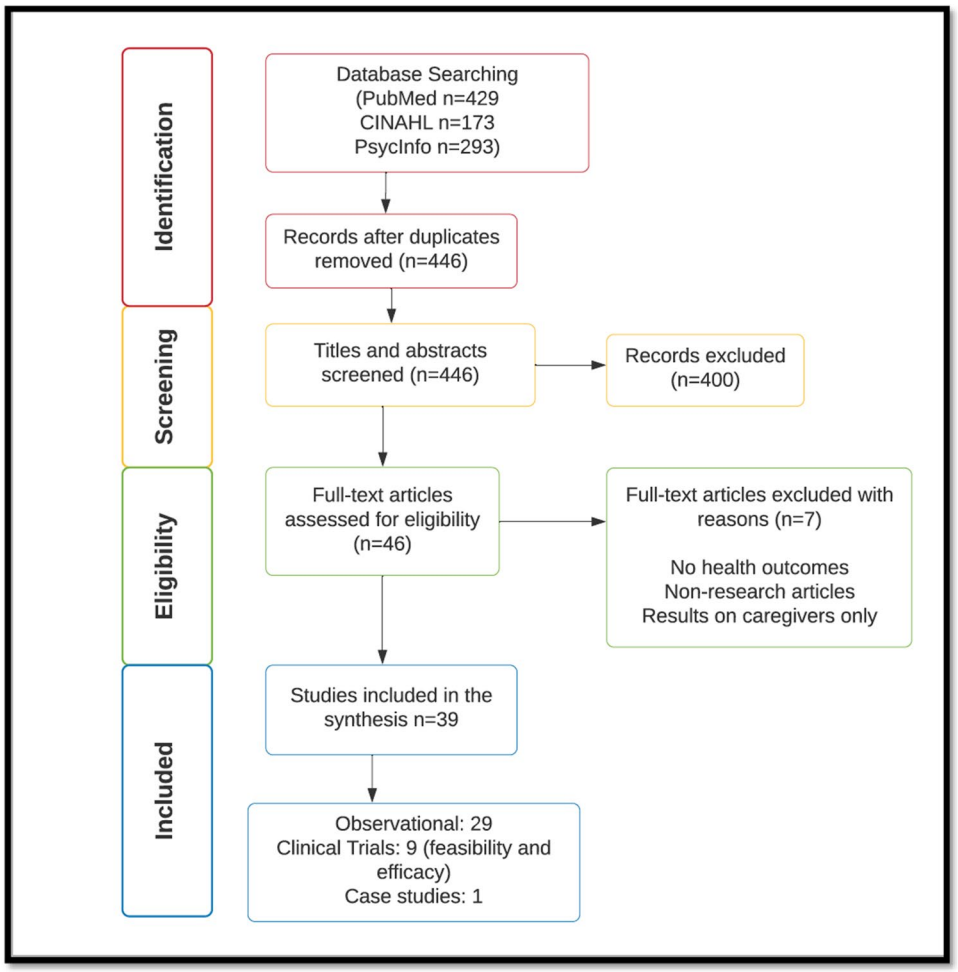

Fig. 1 PRISMA flowcharts

framework, 7 articles were removed and 39 full text articles were included in the review.

These articles were entered into a table (Table 2) to enable extraction and evaluation of study characteristics into categories that included full citation, country of origin, area of communication framework, study design, primary health outcomes, and GRADE (a criterion to assess quality).

Evaluation of articles

To better define and understand technology-based patient and clinician communication to improve health outcomes in advanced cancer, Epstein and Street's [13] framework, "Patient-Centered Communication in Cancer Care," was used as a guide to determine the health communication areas that scholarly articles addressed in this population. This framework focuses on 6 key areas of communication (responding to emotions, exchanging information, making decisions, fostering healing relationships, enabling patient self-management, and managing uncertainty) and how they influence important health outcomes; however, it is important to note that these categories overlap and are neither independent nor hierarchical [13]. Articles representative of more than one category were placed in the category of communication determined by the article's primary purpose or aims.

The Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) criterion were used to assess the quality of the included studies [15]. Data were analyzed and summarized qualitatively. The articles were reviewed independently by the authors and assigned a GRADE. Then authors met to discuss the assigned GRADEs, if discrepancies occurred, they were discussed and a final GRADE was decided upon by the authors.

Results

The 39 articles selected were categorized as such into the six framework categories: 6 in responding to emotions, 15 in exchanging information, 5 in managing uncertainty, 7 in enabling patient self-management, 2 in fostering healing relationships, and 4 in making decisions. By dividing the articles into these categories, the gaps in research are more visible.

Six framework categories

Responding to emotions

Six articles were found for the responding to emotions category and all included various types of advanced cancer. Of these articles, 4 were observational [12, 16–18], 1 was a case study [19], and 1 was a randomized controlled trial (RCT) [10]. The RCT by Hoek et al. [10] discussed here is the same study discussed in 2 observational studies in coming sections by Van Gurp et al. [20] and Van Gurp et al. [21]. The RCT focuses on responding to emotions, whereas the observational studies are more applicable in the making decisions and fostering healing relationships categories. Major themes found in these articles include live synchronous telehealth platforms (Table 2 lists the specific technology for each article), emotional and psychosocial care, and the patient-clinician interaction. Participants in these articles reported high levels of satisfaction, were comfortable with using technology, felt they could have meaningful conversations of sensitive topics through technology platforms, and that the technology enhanced their quality of life with no detriment to the patient-clinician relationship [12, 16–19].

Technology-based patient-clinician interaction provides patients and family members with more time to discuss their emotions and reduces additional burdens such as travel time, discomfort in waiting rooms, and health/safety risks of being out in public [12, 17–19]. Newer articles using web-based technologies such as Skype or FaceTime provided better connections with fewer issues compared to older technologies (e.g., analog video phones), which interfered with emotional connections due to static and/or feedback issues [10, 12, 16, 19]. The one clinical trial reported high satisfaction scores but worse symptom burden, possibly due to more assessments in the intervention frequently fluctuating symptoms, including symptom peaks [10].

Exchanging information

Fifteen articles were found in the category of exchanging information and most of studies focused on disease site-specific (i.e., breast, pancreas, lung). The majority were observational [11, 22–30]; in addition, there was 1 quasi-experimental study [31] and 4 RCTs [32–35]. The 2 articles by Gustafson et al. [36] and Gustafson et al. [33] address the same study here. Major themes addressed in these articles included communication of patient-reported outcomes (PROs), increased patient and/or caregiver usage with technology, and the inclusion of caregivers in the information exchange process between patients and clinicians.

A wide array of technological platforms were utilized and shown to aide in satisfaction in the exchange of information between clinicians, cancer patients with advanced disease, and their caregivers [25–27, 32, 33]. There are eHealth, tablets, and smart phone platforms that allow for the report of PROs, and wearables provide objective information to clinicians on real-time factors related to patient conditions [22, 28, 30–33, 35]. In addition, videoconferencing allows the direct exchange of information between patients and their clinicians whereas webpages allow for patient engagement

Table 2 Article characteristics and appraisals

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Enabling Patient Self-management	**Allsop et al. (2019a)**	England	Observational/description of RCT	eHealth pain symptom tracker	Patients reported improved pain management and feeling united with the care team — clinicians used it either proactively or reactively for pain management and communication with patients	Very low
Enabling Patient Self-management	**Allsop et al. (2019b)**	England	Observational	eHealth pain symptom tracker	Conducted interviews with patients receiving palliative care to assess pain and technology in their lives. Patients reported preference for simple approaches that use well-established technologies. In order for technology to have application for a patient, it needs to account for their multifaceted pain experiences and existing relationships with health clinicians	Very low
Enabling Patient Self-management	**Knegtmans et al. (2020)**	Netherlands	Observational, quasi-experimental	Message and an interactive voice response (IVR) sent to mobile phones	Patients were asked 3 times a week to provide their pain score. Increased registration of pain and prescriptions of analgesics in outpatient medical records, also helped to increase the awareness of pain and its management	Very low
Enabling Patient Self-management	**Mooney et al. (2017)**	USA	RCT, efficacy	Automated IVR symptom management system	Sought to determine if it reduced chemotherapy-related symptoms for patients at home. Symptom Care at Home demonstrated statistically and clinically significant improvement in symptom outcomes. The results demonstrate that symptoms can be improved through automated home monitoring and follow-up	High

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Enabling Patient Self-management	**Nemecek et al. (2019)**	Austria	Observational	Telemedical device enabling patients to send a direct request to a palliative care team	Participants received either standard palliative care or telemedically augmented palliative care. Results showed increased quality of life and user satisfaction, but basic technology knowledge is required (recruitment was difficult)	Moderate
Enabling Patient Self-management	**Schoppee et al. (2020)**	USA	Observational	Internet-enabled tablet with software	Allowed patients to report their pain to clinicians in real time in their own homes. Improved timely interventions and showed geriatric patients can learn new technology skills	Low
Enabling Patient Self-management	**Schuit et al. (2019)**	Netherlands	RCT, efficacy	eHealth self-management application	Supports patients in finding and obtaining optimal palliative care, tailored to their health status, personal characteristics, and preferences. Domains in the tool include physical, psychological, social, and existential topics. Results showed positive health outcomes of patients discussing crucial topics and having time to consider topics they would not normally	N/A
Exchanging Information	**Benze et al. (2019)**	Germany	Observational	Smartphone application	Patients documented their distress and symptoms. Adherence was high and missing data were low — on feedback forms, patients reported a good to very good user friendliness of the software and enthusiasm to use this tool again	Low

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Exchanging Information	**Denis et al. (2017)**	France	Quasi-experimental	Web application	Patients reported symptoms frequently and alerts were then sent to clinicians. Early detection of relapse and early palliative care initiation could be achievable with a web application such as this where clinicians are more informed of a patient's symptoms	Low
Exchanging Information	**Fyllingen et al. (2009)**	Norway	Observational	Touchscreen computer	Participants used the device for assessment of symptoms and mobility and to investigate which factors predicted the need for assistance during the assessment. Assessment tools should be short and user-friendly to ensure good compliance in frail patients	Low
Exchanging Information	**Gilbert et al. (2012)**	Canada	Observational	Web-based tool and kiosk	Improved symptom control when using this device for screening symptoms	Very low
Exchanging Information	**Grant & Wiegand (2011)**	USA	Observational	Webpage with access to a palliative care nurse practitioner	A webpage was added to the healthcare center's website and was visited 707 times by 395 unique computer addresses over the 8-week study period. Most survey respondents found the website helpful, and easy to use, and recommended that the webpage be an on-going resource	Very low
Exchanging Information	**Gustafson et al. (2013)**	USA	RCT, efficacy	Internet or an online support system (CHESS)	Caregivers reported patient symptom distress with significant improvement in patient symptom distress for those using CHESS	High

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Exchanging Information	**Gustafson et al. (2017)**	USA	RCT, efficacy	Automatic e-Alert system	Alerted clinicians if symptoms exceeded a predetermined threshold of severity. There was significant reduction in patient distress	High
Exchanging Information	**Jaatun et al. (2014)**	Norway	Observational	Computerized pain map	Participants completed the map to accurately depict the location of their pain. The computer body map was well accepted by the patients	Moderate
Exchanging Information	**Kamal et al. (2015)**	USA	Observational	Computer software	Replaced paper questionnaires to standardize assessments. Increased efficiency, high satisfaction from users, and improved workflow	Low
Exchanging Information	**Kamal et al. (2019)**	USA	RCT, feasibility	Smartphone application	Patients used the app to prepare for an upcoming outpatient palliative care appointment. Preparedness for the upcoming visit increased 50% in the intervention group and 13.3% in the control group. Results also showed a significant difference in the number of patients with improved knowledge regarding palliative care	Moderate
Exchanging Information	**Melissant et al. (2018)**	Netherlands	Observational	eHealth application	Cancer survivors monitored their quality of life by completing patient reported outcome measures, followed by personalized feedback, self-care advice, and supportive care options to stimulate patient activation. Considered feasible, but needs further optimization to increase user satisfaction. This study shows the value of tailoring eHealth applications for cancer survivors to their specific tumor type	Low

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Exchanging Information	**Pavic et al. (2020)**	Switzerland	Observational	Activity monitoring application with sensor bracelet	Wearables could lead to a reduction of re-admissions or emergency visits by anticipating a health status deterioration. Patients tolerated it well	Low
Exchanging Information	**Voruganti et al. (2017)**	Canada	RCT, feasibility	Web-based communication tool	The tool was studied on continuity of care, quality of care, symptom distress, and healthcare utilization. Results showed improved continuity of care and communication regarding medical care management, symptom-related discussions, and appointment coordination	Moderate
Exchanging Information	**Watanabe et al. (2013)**	Canada	Observational	Telehealth appointments	Studied palliative care consultations via videoconferencing for rural cancer patients. Delivery is feasible, may improve symptoms, results in cost savings to patients and families, and is satisfactory to users	Low
Exchanging Information	**Wilkie et al. (2009)**	USA	Observational	Computer tablet	Results showed that terminally ill patients with cancer are willing and able to utilize computer tablet technology to record and describe their pain and other symptoms	Low
Fostering Healing Relationships	**Guo et al. (2017)**	Canada	Observational	Computer tablet	Confirmed the feasibility of offering Internet-based communication and information technologies on palliative care in-patient units. Participants used the technology to keep in touch with family and friends, entertain themselves, look up information, or accomplish tasks	Low

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Fostering Healing Relationships	**Van Gurp et al. (2015)**	Netherlands	Observational	Telehealth appointments	Observations and interviews with participants regarding the impact of teleconsultation technology on the relationships between at-home palliative care patients and palliative care providers. Teleconsultation provides insight into the patient's daily life and long-term interaction results in empathetic and trustful relationships between clinicians and patients	Very low
Making Decisions	**Keikes et al. (2019)**	Netherlands	Observational	Web-based decision support tool	For patients with metastatic colorectal cancer in palliative setting. Sufficient patient and oncologist satisfaction and high patient participation	Low
Making Decisions	**Van Gurp et al. (2016)**	Netherlands	Observational	Telehealth appointments	Studied how teleconsultation supports the integration of primary care, specialist palliative care, and patient perspectives and services and how patients and caregivers experience collaboration in this approach. Teleconsultation with home-based patients leads to collaboration between primary care physicians and hospital-based palliative care specialists	Very low
Making Decisions	**Vogel et al. (2013)**	USA	RCT, feasibility	Website	A website was studied to address advance care planning, focusing on advance directives and palliative care. Participants reported lower decisional conflict and were satisfied with the amount and quality of information on the website	Moderate

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Making Decisions	**Voruganti et al. (2018)**	Canada	Observational	Web-based messaging tool	Uses text-based communication for non-urgent matters (mainly goal-setting and plans of care). Introducing the tool alone did not have any effect. Facilitated implementation was required to discuss expectations and goals. Relationships became more patient-centered	Low
Managing Uncertainty	**Bernat et al. (2015)**	USA	Observational	Website	Created to facilitate legacy building and dissemination to family members for dignity therapy. Participants were highly satisfied with the abbreviated intervention and the final legacy projects they created, but were generally dissatisfied with the web portal	Very low
Managing Uncertainty	**Hennemann-Krause et al. (2015)**	Brazil	Observational	Telehealth appointments	Patients were monitored through monthly in-person consultations with a multidisciplinary healthcare team and weekly web conferences. Telehealth allowed greater access to the healthcare system, reduced emergency services, improved assessment and control of symptoms, and provided greater confidence in the care given by family members	Very low

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Managing Uncertainty	**Middleton-Green et al. (2019)**	England	Observational	24/7 nurse-led telephone and video-consultation support service	For patients thought to be in the last year of life. Enabled patients to feel supported and remain in their place of residence, hence reducing the pressure for avoidable hospital admissions. Providing this service may encourage healthcare professionals to identify more patients approaching the last year of life	Very low
Managing Uncertainty	**Stern et al. (2012)**	Canada	Observational	Telehealth appointments	Studied perceptions of family caregivers and palliative cancer patients of home telehealth, and their experiences with it. Family caregivers and telenurses felt that home telehealth enabled increased access to care and patient and family caregiver reassurance. Pain management was the most common reason for initiating contact with the nurse, followed by emotional support	Low
Managing Uncertainty	**Wilkie et al. (2020)**	USA	RCT, efficacy	Electronic summary of the patient's pain data, decision support for hospice nurses, and multimedia education regarding misconceptions about pain	Patients and caregivers completed pre-/post-pain measures. They received usual hospice care with interventions. Post-test worst pain intensity was significantly higher for the experimental group. Caregivers' pain misconceptions were significantly lower in the experimental group	Moderate

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Responding to Emotions	**Brecher (2013)**	USA	Case studies	Skype	A palliative team used Skype to communicate with patient's family members. Skyping between patient and family can help relieve burdens and strengthen relationships	Very low
Responding to Emotions	**Cluver et al. (2005)**	USA	Observational	Sessions alternated between face-to-face and remote sessions delivered by analog videophone	Subjects received six sessions of individual cognitive therapy with the same therapist. Participants reported strong positive perceptions and acceptance after almost all therapy sessions, regardless of service delivery mode	Very low
Responding to Emotions	**Guzman et al. (2020)**	USA	Observational	Telehealth or telephone	Implementation of an outreach counseling program via videoconferencing or telephone to patients receiving care in an outpatient palliative care clinic. Enhanced patient access to psychological counseling (more encounters and fewer days between follow-ups)	Very low
Responding to Emotions	**Hoek et al. (2017)**	Netherlands	RCT, efficacy	Telehealth appointments	Participants were randomized to receive weekly, prescheduled teleconsultations or to receive "care as usual" in-person. Teleconsultations resulted in worsening patient distress, possibly due to the frequent check-ups	Moderate
Responding to Emotions	**Passik et al. (2004)**	USA	Observational	Telehealth appointments	The Dignity Psychotherapy intervention was conducted with patients to deliver the therapy into their homes. Patients reported overall benefit from the intervention along with a high level of satisfaction	Low

Table 2 (continued)

Framework category	Authors (year)	Country of origin	Design	Technology	Health outcomes of major concepts	GRADE
Responding to Emotions	**Tasneem et al. (2019)**	USA	Observational	Telehealth appointments	Patients favored having the opportunity for telehealth visits, felt that the doctor-patient relationship would not suffer, had confidence in their or their surrogate's technical skills, and believed a video alternative to an in-person visit might increase access, save time, as well as increase comfort and safety by avoiding travel	Low

and preparation for their care [25, 29, 34]. These platforms have led to enhanced communication, increased satisfaction, and improved health outcomes [25–27, 32, 33].

eHealth systems, tablets, and smart phone applications allowed for the patient to report using validated measures and rating scales (e.g., Edmonton Symptom Assessment Scale, Mini-Mental State Exam, and Karnofsky Performance Status) [22, 24, 28] but some publications also took PRO patient reports to be transmitted to their clinicians (e.g., pain location on a body map) [11, 23]. While validated measures and rating scales, with regard to PROs, were much more commonly represented in these studies, there was a noted change over time for these to include graphics that aided patients in transmitting symptom concerns through the technology-based platforms [28, 34, 35].

Managing uncertainty

Five studies addressed managing uncertainty, including 4 observational studies [37–40] and 1 RCT [41]. All studies included a mix of cancer diagnoses with 1 study including patients with other, non-cancer end stage disease with 56% having a cancer diagnosis [39]. Three of the studies evaluated telehealth applications and found increased access to care and clinician support that resulted in increased caregiver confidence [38–40]. The remaining two studies took different approaches using a multimedia Internet-based intervention to support pain management [41] and a patient portal to promote individual's end of life wishes [37].

Wilkie et al. [41] conducted an RCT aimed at evaluating differences in analgesic adherence after the addition of a multimedia Internet-based intervention to support pain control management. The study found no difference in analgesic adherence but did find a significant reduction in pain misconceptions among caregivers using the intervention compared to those who received usual care. However, there was no significant difference in pain misconceptions among patients and no difference in adherence to pain medications between the groups [41].

While most of the studies targeted both patients and lay caregivers, Bernat et al. [37] examined a web portal utilizing dignity therapy to facilitate legacy building. The study found high rates of satisfaction both with the intervention and the final legacy project. However, fewer than half of participants used the portal to complete the legacy project [37].

Enabling patient self-management

Seven articles were found in the category of enabling patient self-management. The majority were observational [42–45]. One study utilized a quasi-experimental design [46], 1 was a RCT evaluating efficacy [47], and the remaining study was a protocol of a RCT in process [48]. None of the studies

focused on a specific cancer diagnosis. Two articles by Allsop et al. [42] and Allsop et al. [43] discuss the same study.

Six of the 7 studies focused on symptom management [42–46, 48] with 4 focusing exclusively on pain management [42–45]. Multiple studies demonstrated the feasibility of collecting pain and symptom scores either utilizing live synchronous telehealth systems [46, 47] or using Internet enabled tablets [45]. The only study in this category powered to evaluate efficacy found that use of telehealth to report symptoms followed by automated self-management coaching and close practitioner follow-up resulted in significantly less symptoms [47]. A third study utilized telehealth but allowed patients the ability to send messages to initiate hospice encounters resulting in improved quality of life [44].

Despite feasibility and potential efficacy, integration with routine care remained an expressed concern [43] and Allsop et al. [42] struggled with enrollment reluctance from clinicians when prescribing intervention use for patients/caregivers. Schuit et al. [48] took an alternative approach for utilizing technology publishing a protocol evaluating an eHealth self-management application to support patients finding and obtaining optimal personalized palliative care. The primary aims of the study are to evaluate patients' knowledge, skills, and confidence after using eHealth self-management application, and results have not yet been published.

Fostering healing relationships

Two articles were found in the category of fostering healing relationships. Both studies were observational and included a mix of cancer diagnoses. One study targeted patients admitted to inpatient hospice and their family members [49], offering them access to tablet technology for the purposes of maintaining connections and relationships, while the other targeted patients in home hospice and focused on relationship with hospice team through the use of teleconsultation [21]. Guo et al. [49] found that offering Internet-based technology to inpatient hospice patients and their families was feasible and received positive feedback from patients, family members, and clinicians. The most common use of Internet-based communication and information technology was to engage in activities identified as keeping in touch. Most patients and family members reported positive feeling about being able to engage in these activities and patients showed significant improvement in mean self-reported satisfaction in quality-of-life scores after using the tablet technology compared to before. Van Gurp et al. [21] focused on the impact of weekly teleconsultations on the relationship between home-based palliative care patients and hospital-based palliative care specialists. Themes that emerged from qualitative analysis include being able to transcend the institutional walls of home and hospital, the transparency of telecommunication changed the quality of care, and technologized but personalized patient-professional relationships were possible with teleconsultations.

Making decisions

Four articles were found for the making decisions category; of these, 3 were observational [20, 50, 51] and 1 was a RCT [52]. The observational study by Voruganti et al. [52] fits in this section but stemmed from preliminary data in the larger RCT by Voruganti et al. [35] discussed in a previous section. Two of the web-based interventions targeted specific cancer types (i.e., ovarian, colorectal) [50, 52], whereas others were on team-based care [20, 51]. Overarching themes in these articles were patient perspective, collaboration between multi-site teams, and web-based tools [20, 50–52]. Earlier web-based tools had poor patient engagement rates and were revised to include prompts and triggers to promote patient engagement and task completion [52], while later web-based tools report higher patient participation but difficulty with hospital implementation [50]. In addition to the web-based tools, these articles focused on patient participation in decision-making and advanced care planning. Results from these studies show high user satisfaction and low decisional conflict [50, 52].

Gaps in research and clinical practice

While there is ongoing research within each of the 6 areas of the communication framework, there are 3 major themes that should be addressed in future research: (1) design, development, and testing of technology communication, (2) expansion into other disease types and cancer-related topics, and (3) enhanced reporting/measurement using technology. The design, development, and testing of interventions and movement of current interventions into RCT efficacy testing are crucial to improve patient care. Studies like those performed in the exchanging information [11, 22–30], responding to emotions [12, 16–18], and managing uncertainty [37–40] categories have shown good feasibility and should be advanced for ultimate implementation — like the Mooney et al.'s [47, 53] study within the self-management category. Researchers have advocated for the efficacy and implementation of research-driven technology interventions to improve care [54]. Additionally, early research is necessary to refine and develop high-quality communication interventions, as demonstrated by O'Cathain et al., from the health promotion and research design field [55].

The feasibility to utilize technology to foster healing relationships has been demonstrated; however, the design and development of additional interventions are needed to improve care and corroborate the evidence of technology to enhance communication in this area. Specifically, research has shown that lack of rapport in relationships

between patients and clinicians can occur when discussing sexual health in cancer [56, 57] as well as the importance of fostering healing relationships in other populations such as the dementia patient and caregiver [58]. Additionally, more development and testing regarding decision-making are needed. Previous research has cited the need for discussions about decisions regarding treatment and curability of advanced cancer and assistance with caregivers' decision-making in the advanced cancer population [6, 59].

The literature supports the importance of disease-specific communication [25, 27, 31–33, 50, 52]. Expansion into other disease types, as well as other important cancer-related topics, is necessary within the categories of exchanging information, enabling patient self-management, and making decisions. From this review, information exchange was demonstrated through successful technology platforms on disease-specific information [25, 27, 31–33, 50, 52]. However, the promotion of exchanging information should not be cancer-site specific nor specific to pain and symptom management. Exchanging information is important across all diagnosis and issues that arise in cancer care. The use of technology to support other aspects of enabling patient self-management including medication management and therapy adherence remains unexplored. Within the palliative arena, research has been done to exchange information [60] as well as making decisions regarding symptoms and treatment as well as medication adherence, pediatric, adolescent, and young adult cancer populations [61–63].

Consistent reporting and measurement using technology is important in the areas of responding to emotions, managing uncertainty, and fostering healing relationships. While some studies in responding to emotions and enabling patient self-management use similar measures [10, 12, 53], many studies did not use consistent measures. Patient-reported outcomes including those assessed by technology, however, have been shown to improve health outcomes in cancer patients receiving treatment [47, 53, 64, 65]. Such studies demonstrate that utilizing standardized measurements and consistent reporting is essential for future research in cancer communication and technology.

Discussion

The purpose of this literature review was to (1) identify articles aimed at technology-based communication strategies to improve health outcomes in individuals with advanced cancer, and (2) appraise them using Epstein and Street's framework, to identify the areas in which technology-based communication had been used to improve cancer health outcomes, and (3) identify gaps that exist in technology-based communication research and care in cancer patients with advanced disease. This literature review demonstrates that the majority of technology communication research is in exchanging information, enabling patient self-management, and responding to emotions, whereas research is deficient in the areas of managing uncertainty, making decisions, and fostering healing relationships. Such communication topics are crucial to cancer patients with advanced disease and should not be overlooked. Technology-based interventions may be able to address more than 1 area of Epstein and Street's communication framework categories — importantly managing patient care more holistically.

The research in exchanging information, enabling self-management, and responding to emotions categories was more robust and heterogenous. Research findings demonstrated a variety of technology platforms (tablets, live synchronous telehealth, etc.) that led to increased satisfaction as well as improved health outcomes for advanced cancer patients and their caregivers [25–27, 32, 33]. Multiple studies demonstrated the feasibility of collecting pain and symptom scores utilizing live synchronous telehealth systems [46, 47] or using Internet-enabled tablets [45]. Mooney et al. [47] found a decrease in reported symptoms with the use of remote symptom monitoring followed by automated self-management coaching and close practitioner follow up. Nemecek et al. [44] found patient's quality of life improved when they utilized telehealth for patients to send messages and initiate hospice encounters.

Due to the design nature of the included articles being observational, most GRADEs were assigned low (15) or very low (13) ratings. A moderate rating was assigned to 5 RCTs and 2 observational studies. A high rating was assigned to 3 efficacy RCTs. While there was a significant amount of low or very low ratings, 2 of these studies led to full-scale efficacy trials [10, 42]. Therefore, these observational studies provide foundational evidence with potential to advance research and improve clinical practice.

Limitations

This integrative review has a few limitations. First, the authors focused this review only on adults with advanced cancer so this is not be generalizable to pediatric/adolescent patients or those patients with early-stage cancer. Secondly, this may not be inclusive of all articles surrounding communication and advanced cancer because an explicit framework was utilized. However, the use of this established framework highlights the most important evidence of communication strategies that clinicians should use. Additionally, only English articles were included in this integrative review. However, the scope of review was international, including articles from 9 countries, across 3 continents.

Conclusions

Patients facing an advanced cancer diagnosis require clear and distinct communication with oncology clinicians. Technology is evolving at a rapid rate and has been utilized in many different capacities to navigate communication in cancer care, but few authors examine the specific areas of communication from a theoretical perspective. This review identified 39 articles which were then categorized into one area that fit best within Epstein and Street's [13] areas of communication: responding to emotions ($n=6$), exchanging information ($n=15$), managing uncertainty ($n=5$), enabling patient self-management ($n=7$), fostering healing relationships ($n=2$), making decisions ($n=4$). While research studies were identified in each of the areas, the majority of technology-based communication strategies were focused on the exchange of pertinent information between patients and their clinicians. Further research and the development of technology-based communication interventions assessed in clinical trials are needed in the areas of fostering healing relationships and making decisions in cancer care. Additionally, the communication strategies found effective at improving health outcomes in advanced cancer should begin to be implemented into clinical practice, therefore reaching more patients.

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