How technology impacts communication between cancer patients and their health care providers: A systematic literature review

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Abstract

Objective: To ensure the well-being of their patients, health care providers (HCPs) are putting more effort into the quality of the communication they provide in oncology clinics. With the emergence of Health Information Technology (HIT), the dynamics between doctors and patients in oncology settings have changed. The purpose of this literature review is to explore and demonstrate how various health information technologies impact doctor-patient communication in oncology settings.

Method: A systematic literature review was conducted in 4 databases (PubMed, Cochrane, Web of Science, IEEE Xplore) to select publications that are in English, published between January 2009 and September 2020. This review reports outcomes related to the impacts of using health information technologies on doctor-patient communication according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Reviews and Meta-Analysis guidelines (PRISMA).

Results: We identified 31 studies which satisfied the selection and eligibility criteria. The review revealed a diverse range of HIT used to support communication between cancer patients and their HCPs in oncology settings. Outcomes related to communication efficiency were examined to demonstrate how technology can improve access to care in clinical settings and online. When technology is used effectively to support patient knowledge and shared understanding, this increases the patient's satisfaction and ability to manage emotions, make decisions, and progress in their treatment, in addition to increasing social support and building a stronger therapeutic alliance based on shared knowledge and transparency between clinicians and patients.

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Conclusion: Technology-based solutions can help strengthen the relationship and communication between patients and their doctors. They can empower the patient's well-being, help doctors make better decisions and enhance the therapeutic alliance between them. Thus, using technology to enhance communication in healthcare settings remains beneficial if its use is structured and target oriented. Future studies should focus on comparing in-depth the difference between outpatient and inpatient settings in terms of the efforts required and the extent of the impacts from both clinicians' and cancer patients' perspectives.

Keywords

Electronic health record; patient safety; patient engagement; healthcare quality; OpenNotes; medical informatics

1. Introduction

A cancer diagnosis can be overwhelming to patients and family members. Visits with oncology healthcare providers are essential to convey information about the patient's cancer, prognosis, treatment goals, and options, as well as address patient's psychological, social, financial, and other support concerns and needs. Cancer patients require effective communication and need attention from their physicians to provide an effective treatment that also addresses the vulnerability of their emotions. Effective patient-provider communication is crucial for high-quality cancer care and psychological well-being and has been linked to a more appropriate medical decisions, and better health outcomes [1,3].

Compared to other health care settings, the communication of information that occurs during oncology visits, especially initial visits, is critically important but can be particularly challenging due to the substantial amount of information provided, complex treatment decision options, involvement of multiple different providers (surgical, medical and radiation oncology), and highly emotional situation with high patient cognitive workload [4]. Patients might not recall information accurately and might face difficulties understanding the information given, and when information is particularly upsetting, many patients are too stunned to register any further information given to them [3]. Patients report leaving initial visits feeling that their informational needs (particularly about treatment, side effects, and prognosis) are not always met [3], which can lead to uncertainty, anxiety, and depression [4]. In one study with newly diagnosed cancer patient-oncologist dyads, agreement about the content of topics discussed ranged from only 37.5% for treatment side effects to 60% for prognosis [5]. Incomplete or inaccurate information about the disease process and treatment options increases the likelihood that patients will receive a suboptimal quality of care [6]. Misunderstanding resulting from lack of communication have been shown to impact healthcare outcomes such as decision making, trust, and effective treatment [7, 8].

The increasing adoption of various health information technologies (HIT) has created new channels for doctor-patient communication beyond the walls of office visits. For instance, patient portals provide opportunities for e-communication. Some other smart /collaborative health technologies as well as m-health applications help patients to formulate questions, therefore improving patient engagement and communication [9, 10]. Telehealth has also

become a primary communication tool during the recent pandemic [11,12]. Furthermore, the use of electronic health records (EHR) during clinic visits has changed the dynamics of patient-provider communication [13]. Given the increased cognitive and time demand for providers to use EHR, it can undermine patient-centeredness by directing conversation away from the patient's needs. On the other hand, increasingly research has focused on how to use EHR, patient portals, and mobile health applications in a patient-centered way to enhance patient-provider communication and patient engagement during clinic visits and beyond. To date, most such research regarding the impact of HIT has been conducted in primary care settings [14,15]. The nature and content of oncology visits are much different from primary care visits. They typically include a discussion of the advantages and disadvantages of multiple different treatment options (some potentially toxic), their associated risks and side effects, and their impact on survival and disease progression or recurrence for curable to potentially rapidly fatal diseases. Therefore, it is essential to extend the existing knowledge base to understand better how HITs used in oncology care impact provider-patient communication. We address this gap by conducting this systematic literature review on the influence of HIT on doctor-patient communication in cancer care.

2. Method

2.1 Protocol Registration and Information Sources

This systematic review is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Reviews and Meta-Analysis guidelines (PRISMA) [16]. Our protocol (OSF link of the protocol) was registered with the Open Science Framework on May 15, 2020. We searched for peer-reviewed publications in PubMed, CENTRAL (Cochrane), and Web of Science databases as well as IEEE Xplore to identify articles within the scope and eligibility criteria of this systematic literature review.

2.2 Search strategy

We followed a systematic method for creating all search terms to capture all related and eligible papers in the used databases. Keywords used in the search were determined at first by an initial review of the literature and then modified by feedback from content experts as well as the librarian.

We then collaboratively refined a search strategy to ensure all papers related to the use of various HIT and their impact on doctor-patient communication in cancer care are covered in our review and determined the *MeSH* terms.

We grouped the query keywords which were derived from *MeSH* terms and combined through an AND/OR operator to identify all relevant studies that match with our scope and inclusion criteria. The keywords consisted of mesh terms such as "*cancer OR oncology*" "*Electronic health records OR Health information technology*" in combination with narrower MeSH terms such as "communication." The figure 1 contains all the combinations of MeSH terms used (e.g. "cancer OR oncology" and "Health information technology OR electronic health records" and "communication").

2.3 Inclusion and Exclusion criteria

This study focused on peer-reviewed publications satisfying the following two primary conditions: a) Studying communication between care providers and patients in *oncology setting*, b) Reporting influence of health information technology use on provider-patient communication from either the patient or provider perspective, or both (in-person or e/virtual-communication). Any papers that failed to satisfy both conditions were excluded from this review. For instance, studies only focused on reporting communication independent from technology use were excluded. Secondary research, such as reviews, commentaries, and conceptual articles, were also excluded from this review. The search was restricted to papers published in English between January 2009 and September 2020. We also considered outcomes related to patient engagement, patient understanding, and empowerment if they were linked to communication.

2.4 Study selection and quality assurance

Two authors together reviewed all the publications for eligibility. We first screened the publications by reviewing the titles and abstracts and removed duplications. Then, we read the full text for the remaining papers and finalized the selection. To minimize any selection bias, all discrepancies were resolved by discussion requiring consensus from both reviewers. As a complementary approach, we also conducted a manual search in several journals to make sure we were not missing any potential articles (JAMA Oncology, Patients Education and Counseling, IJMI, JAMIA, JAMIA Open, BMC, Support Care Cancer, JMIR Cancer, JMIR Medical Informatics, Journal of Cancer Education, Journal of Oncology Practice, Journal of Health Communication, Health Communication International Perspectives and Applied Ergonomics). A data abstraction form was used to record standardized information from each paper.

3. Results

3.1 Study selections and Data extractions

Figure 2 illustrates the flowchart of the selection process of the articles included in this systematic literature review. The initial search using a set of queries returned a total of *9347 papers*. We also added **305** distinct articles from the manual search to this pool. We used Zotero to manage the filtering and duplication removal process. As a first step, we removed duplicates and all the review/opinion/perspective papers. Two authors then applied a second filtering by reading abstracts and titles (n=9280). The screening process guided by inclusion criteria left 102 papers for a full-text review. We removed 70 more articles based on the full-text review. Hence, the final number of studies included in the systematic review was 31, with consensus from both authors. We used a systematic approach to extract information listed in Table 1 from each eligible article.

3.2 Study characteristics

Of the 31 papers reviewed, the study designs were as follow: 7 interviews (5 semi-structured ones), 2 cohort studies presenting a randomized controlled trial, 3 focus groups, 3 mixed-methodology studies, and the remaining 17 were questionnaire based. Fifteen of the studies

reported only patients' perspectives, 3 of them reported only providers' perceptions, and the rest explored both of their points of view. We also reported the type of HITs studied in Table 1, including 12 various consumer Health ITs and 10 patient portals as being the most commonly studied technologies.

3.3 Influences of health information technologies on patient-provider communication

We classified this section using the communication pathway framework (Figure 3). This conceptual framework articulates seven essential functions of patient-centered communication including boosting access to care, improving patient knowledge and shared understanding, enhancing therapeutic alliances, supporting quality medical decisions, increasing social support, refining patient agency, and empowerment and ameliorating the management of emotions [45].

3.3.1   Improving access to care—Access to care has often been defined as the use of health care, qualified by need for care [46]. Studies using patient portals and telehealth showed improved access to care, which also resulted in improved communication outcomes. These technologies provided continuous communication beyond the walls of the clinic between provider and patient, enabled just-in-time access, and made communication possible even in pandemic conditions [42]. Jordan M. Alpert and colleagues discuss that patient portals are providing 24-hour access from anywhere with an internet connection. The tool "Secure Messaging" has the capability to produce benefits, such as improving access and patient perceptions of access, thus enabling more direct and focused communication that enriches patient engagement and trust [32, 40]. While clinicians may be skeptical to rely on messaging instead of face-to-face office visits, a study that took place across 10 countries found that three-quarters of consumers were comfortable with the idea of communicating with doctors using technology instead of seeing them in person [32, 56]. Furthermore, another study in our review examined low-income breast cancer patients' use of an online health consultation service called "Ask an Expert." The study showed that low-income patients with breast cancer felt more confident and empowered to actively participate in their health care, perceived greater involvement in coping with their illness, and had a more positive appraisal of their relationship with their doctors [37]. Finally, studies in the review showed that telehealth also improved access to care and communication for pediatric cancer patient [45] as well as for adult cancer patients, in addition to reducing burden of transportation [41]

3.3.2   Supporting patient knowledge and shared understanding.—It is essential for both patients and physicians to have a shared understanding of the situation, including cancer perception, risks associated with each decision, and treatment regimen in cancer care (42,60). This is a core part of communication in cancer care. One study in our review developed a tool "The Edmonton Symptom Assessment System (ESAS)" to standardize assessment and documentation of symptoms. The study showed that the tool shaped communication because it was used as a tangible guide for identifying and addressing shared priorities around symptom management [38]. Furthermore, several studies have suggested that asking patients to report their symptoms proactively increases the accuracy of collected data, improves health outcomes, and increases patients' satisfaction with the treatment as

well as patient-provider communication [17–19,43, 44]. For instance, HeNeA, which is an application designed to collect patient-reported symptoms through a mobile app and remotely monitor systems operating in real time for the acquisition of clinical parameters, helped improve communication with cancer patients [17]. Another tool called ESRA-C is used to encourage patients to report their symptoms and quality of life via e-measurement, which improved shared understanding of the situation as well as communication between patients and providers [30,44].

3.3.3 Enhancing the therapeutic alliance—The therapeutic alliance includes interrelationships among patients, their care providers, and their family members helping the caregiving process [62, 63]. The clinician–patient alliance is enhanced when clinicians are optimally informative and show empathy with the patient's circumstances, when patients have an opportunity to express their concerns, and when the patient receives consistent messages and coordinated care from the clinical team [63]. Our review showed a mixed effect of technology use on the therapeutic alliance in cancer care.

One study tested an electronic web-based tool that assembles patients with their HCPs and caregivers in a virtual space for team-based communication, with the goal of increasing patient participation in care management and decision making [24]. The study showed some negative impacts on the therapeutic alliance, specifically showing that cancer patients preferred face to face meetings instead of web-based tools for communication, and that they want their results first verified by experts [24]. Two studies also reported that providers think their communication worsened with patients when there was electronic automatic release of pathology and radiology reports to the patients [10,34]. In one other study, providers discouraged cancer patients from the use of online health resources due to increased doubts, confusion, and misinformation which caused emotional distress, while patients felt their use of the internet increased their knowledge and awareness [21]. Furthermore, another quantitative study ((N=267) patients and (N=27) HCPs), explored the effect of cancer-related internet information on communication. When doctors show seriousness and interest towards patients' internet information seeking, patients reported better communication perception and alliance as well as high satisfaction and trust [25]. Finally, one study used a PRO tool called "Men like Me" which captures prostate cancer patients' needs for treatment assessment and reported improvement in communication and therapeutic alliance [23].

3.3.4 Higher quality medical decisions—Patients will more likely experience better health when they and clinicians reach decisions that are based on the best clinical evidence, are consistent with patient values, are mutually agreed upon, and are feasible to implement [63,70,71]. CONNECT is an example of a web-based intervention designed [20] to improve communication between cancer patients and their oncologists in order to optimize decision making. The internet-based intervention, tested on a sample of (N=627) cancer patients, was demonstrated to improve patient satisfaction with the format of oncologist communication and discussion regarding the quality of life they have. Patients also reported that the tool made their treatment decisions easier and more efficient to reach [20]. In addition, Cancer in the Family, an online clinical decision support tool, calculated women's Hereditary Breast Ovarian Cancer risk and promoted shared patient–provider decisions about screening [22].

This study showed that this AI-enabled health information technology helped patient-provider discussions to encourage shared decision making and reduced patients' concerns about cancer as a result of enhanced communication [22]. Another study also showed the impact of an online platform collecting patient-reported outcomes on improved shared decision making around chemotherapy symptoms management [29].

3.3.5   Enhancing patients' ability to manage emotions—Many patients find relief in discussing emotional concerns with their oncologists and prefer seeing physicians who are willing to address such concerns [74]. Additionally, when oncologists attend to distress, patients receive tangible benefits; they report improved quality of life, adherence to treatment plans, overall satisfaction, and willingness to disclose future concerns [75–78]. Patients' disclosures of emotion present many opportunities for oncologists to respond with empathy language. In a randomized clinical trial that followed (N=325) breast cancer and prostate cancer patients, using a web-based illness management support system (WebChoice) for one year was proven to help them reduce their symptom distress, improve emotional well-being, and enhance self-efficacy [19]. In another study in our review, a telehealth tool (Health Buddy) helped patients feel emotionally safer and improved their self-management of emotions as well as overall communication with their oncology providers [43]. In addition, a recent study during the COVID-19 pandemic showed the telehealth tool "VALUE" helped improve cancer patients' situations by relieving their emotional burden and facilitating communication between the provider and the patient and their family [42]. Finally, one study also showed the negative impact of a patient portal on the emotion and stress level of cancer patients due to the way a diagnosis is delivered [33]. The study showed automatically delivered diagnoses without involvement of doctors creates distress and an extra emotional burden on cancer patients [33].

3.3.6   Improving family and social support—The National Cancer Institute's Dictionary of Cancer Terms defines social support as "a network of family, friends, neighbors, and community members that is available in times of need to give psychological, physical, and financial help" (www.cancer.gov). In our review, one study tested a tool, "Oncology Interactive Navigator," for virtual navigation, which was used by doctors to enhance communication and support between cancer patients and their family in addition to their doctors [36].

Social support consists also of patients' access to emotional, fiscal and tangible resources within their social network [79]. It can affect physical health and quality of life in several ways. The perception of having social support may have a direct impact on physiological processes. A study in our review (N=53) proved that simulated social media messages and posts between patients and providers are beneficial to public health with a change in attitude and health behavior [31].

With a strong social support network, patients feel more connected and are given opportunities to discuss difficult situations with other people who can share their emotions and enhance their well-being [83]. Networks based on social support can also provide instrumental help (e.g., transportation), financial resources, encouragement, and advocacy in gaining access to needed health services [84, 85]. Clinicians could potentially counter or at

least help address positive and negative social support. They can, for example, inform patients about ways to strengthen existing social networks to provide tangible help and emotional support, and suggest new sources of online social networks as reported in our review, such as the chatbot Infinity [18] or the platform "Listening Time" [28], which both help elderly patients better prepare for clinical encounters with their providers and overcome communication barriers. The "Listening time" platform offers cancer patients the emotional support they need after diagnosis or treatment and helps them overcome difficulties in processing the providers' information [28].

3.3.7 Enhancing patients' empowerment and agency—Making a patient an active and capable agent in managing his or her health plays an important role in enhancing clinician-patient communication. A patient who is well-informed about treatment goals is easier to involve in the process and more capable of making higher quality decisions [86]. A promising approach is the use of information technology (IT), which enables the provision of easily accessible, up-to-date, tailored information and automated feedback to patients. Many *empowering* Web-based interventions have been developed in the field of chronic diseases (e.g., diabetes, heart failure, and chronic obstructive pulmonary disease), but relatively few seem to have been developed for, and rigorously tested in, cancer care [90].

In our review, the use of the tool "Ask an Expert" showed that online health consultation can serve as an effective complement to help breast cancer patients feel more confident to participate actively in their healthcare, make decisions about their treatments, and enhance their relationships with their doctors [37]. Another study developed a technology called "PROSPECT," which helped oncology patients to set goals and preferences for communication with the providers, and thus improved engagement and empowerment [9]. One way of empowering patients is discussing topics that focus on their autonomy and providing them with information on how to decide about medical treatment (i.e., shared decision making) [91]. One study in our review also showed that when cancer patients find information and communicate with their providers using smartphone apps, they feel more empowered and engaged [35]. Finally, studies also showed the potential impact of ePRO systems on empowerment. These systems can immediately provide relevant, Web-based interventions to alleviate symptoms or improve coping ability for problems indicated on PROs [91,29].

4. Discussion

This systematic literature review addresses an important gap by showing the studies reporting how HITs influence patient-provider communication in cancer care. In this review, we found 31 studies focusing on various HITs, including clinical, collaborative and consumer technologies, which impact doctor-patient communication in cancer care. Most of the literature on this area focused on primary care settings; therefore, this review addresses a gap by demonstrating trends, studies, and outcomes related to the influence of HIT on patient-doctor communication in cancer care. This review also had the opportunity to capture a few papers from the recent COVID-19 pandemic era, specifically reporting the impact of telehealth on doctor-patient communication in cancer care.

The main findings are reported and discussed in detail according to the function of the patient-centered communication that influences patient outcomes as shown in Figure 3. By improving access to care, HIT solutions were proven to enhance care delivery efficacy and make patients feel more confident and empowered, which facilitates decision making and supports their active involvement in the process, creating better relationships with their doctors [36,57, 58]. By managing priorities with the help of HIT, patients can find enough time to learn more about their situations [39]. Doctors may also consider turning to technology to support the effectiveness of the information exchange with their patients.

Shared decision making is a key component of cancer care due to life altering decisions [93]. When cancer patients engage in shared decision making, they learn and understand their health conditions, they recognize that a decision needs to be made, and they are informed about the options and are better prepared to talk with their healthcare provider and to collaborate with their care team to make a decision that's right for them. Doctors think that sharing decision making helps them build a strong, lasting, and trusting relationships with their patients [93,94]. Health IT tools, such as interactive decision aids, patient portals, personal health records, and secure electronic messaging, can help involve cancer patients and their families more in decisions and care process. For example, patients can access relevant patient education materials via a patient portal and communicate with their health care team about the decision via secure messaging.

Furthermore, online tools offer access to hard-to-reach individuals, playing a potential role in shortening the distances between patients and knowledge about their health, especially during the pandemic era. The digital era and necessities such as patient care during the pandemic era driving healthcare processes to a new and different pathway, automatizing each step of it, from the way patients are diagnosed and treated to the way they are talked to. But efficient and effective technology support can help to provide better communication between doctors and cancer patients during the treatment process, taking into consideration the optimization of effort made by caregivers, the quality of service, and the management of the patients' emotions.

Thus, more studies should examine the impact of HITs on clinical outcomes, including patient/caregiver self-efficacy, care plan concordance, adverse events and preventable harm, resource utilization, and patient satisfaction from not only a short-term perspective but a long term one in cancer settings.

In this study, we considered the interaction between patients and healthcare providers as a standard task to follow the outcome-based framework and for the reported results to emphasize the impacts of HIT on the communication. However, we also need to consider that various level of interaction tasks' complexity might get different level of influence from HIT use depending on the need. For instance, a diagnosis disclosure might have different interaction dynamics and required needs than a follow up cancer treatment visit. On the other hand, trust beliefs and risk perceptions have important roles in the context of consumer acceptance of technologies providing online health information services [95,96] which highlights the importance of consumers beliefs' consideration in the technology use selection. Future HIT design studies should be adjusted to improve the most needed part of

doctor-patient communication in cancer settings to address the needs and improve patient centeredness.

4.1. Study limitations

This study has some limitations. First, the sample sizes for some studies are too small to generalize the results, which limits the power of the findings. Second, only studies conducted since 2009 were included in this synthesis to capture the exponential increase in technology-based interventions that impact communication between cancer patients and providers. Therefore, the findings from our qualitative synthesis may not reflect cancer patients' experiences of earlier technology interventions. Furthermore, the studies contained a mix of cancer types and did not focus on the differences across cancer types. Finally, ethnicity is missing, as it is not reported in all the studies so some groups of people may not be very well represented in the samples.

5. Conclusion

This systematic literature review addressed an important gap in the area of cancer care, focusing on the impact of HIT on doctor-patient communication. Studies showed some type of HIT can enhance care delivery efficacy and make patients feel more confident and empowered Therefore, they can facilitate decision making and support their active involvement in the care processes maintaining a good relationship with the healthcare team, and ultimately improve the communication and health outcomes.

Future research should focus on longitudinal studies to better understand long term impact of HIT on communication outcomes across various cancer types as well as demographics. Difference in complexity within the tasks a healthcare team ensures should be considered as it might impact the selection of the type of HIT design solutions to implement. Researchers should also acknowledge the unique needs of cancer patients, thus eliminating the biases coming from studies conducted in primary care settings and focusing on inputs from cancer stakeholders (patient and providers) to design these HIT systems. Finally, the impact of the COVID-19 era should be studied extensively on how HIT use has changed in cancer care to understand the impact on not only communication but also other outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgement

References

[1]. Makoul G, & Curry RH (2007). The value of assessing and addressing communication skills. JAMA, 298(9), 1057–1059. 10.1001/jama.298.9.1057 [PubMed: 17785653]

[2]. Street RL Jr, Makoul G, Arora NK, & Epstein RM (2009). How does communication heal? Pathways linking clinician-patient communication to health outcomes. Patient education and counseling, 74(3), 295–301. 10.1016/j.pec.2008.11.015 [PubMed: 19150199]

[3]. Hack TF, Degner LF, Parker PA, & SCRN Communication Team (2005). The communication goals and needs of cancer patients: a review. Psycho-oncology, 14(10), 831–847. 10.1002/pon.949 [PubMed: 16200519]

[4]. LeBlanc TW, Back AL, Danis M, & Abernethy AP (2014). Electronic Health Records (EHRs) in the oncology clinic: how clinician interaction with EHRs can improve communication with the patient. Journal of oncology practice, 10(5), 317–321. 10.1200/JOP.2014.001385 [PubMed: 25027025]

[5]. Eggly S, Penner LA, Hagiwara N, Gonzalez R, Harper FW, Heath EI, & Albrecht TL (2013). Patient, companion, and oncologist agreement regarding information discussed during triadic oncology clinical interactions. Psycho-oncology, 22(3), 637–645. 10.1002/pon.3045 [PubMed: 22337320]

[6]. Wagner EH, Aiello Bowles EJ, Greene SM, Tuzzio L, Wiese CJ, Kirlin B, & Clauser SB (2010). The quality of cancer patient experience: perspectives of patients, family members, providers and experts. Quality & safety in health care, 19(6), 484–489. 10.1136/qshc.2010.042374 [PubMed: 21127109]

[7]. Klasnja P, Hartzler AC, Unruh KT, & Pratt W (2010). Blowing in the Wind: Unanchored Patient Information Work during Cancer Care. Proceedings of the SIGCHI conference on human factors in computing systems. CHI Conference, 2010, 193–202. 10.1145/1753326.1753355

[8]. Gustafson DH, Hawkins RP, Boberg EW, McTavish F, Owens B, Wise M, Berhe H, & Pingree S (2002). CHESS: 10 years of research and development in consumer health informatics for broad populations, including the underserved. International journal of medical informatics, 65(3), 169–177. 10.1016/s1386-5056(02)00048-5 [PubMed: 12414016]

[9]. Dalal AK, Dykes PC, Collins S, Lehmann LS, Ohashi K, Rozenblum R, Stade D, McNally K, Morrison CR, Ravindran S, Mlaver E, Hanna J, Chang F, Kandala R, Getty G, & Bates DW (2016). A web-based, patient-centered toolkit to engage patients and caregivers in the acute care setting: a preliminary evaluation. Journal of the American Medical Informatics Association : JAMIA, 23(1), 80–87. 10.1093/jamia/ocv093 [PubMed: 26239859]

[10]. Winget M, Haji-Sheikhi F, Brown-Johnson C, Rosenthal EL, Sharp C, Buyyounouski MK, & Asch SM (2016). Electronic Release of Pathology and Radiology Results to Patients: Opinions and Experiences of Oncologists. Journal of oncology practice, 12(8), e792–e799. 10.1200/JOP.2016.011098 [PubMed: 27382001]

[11]. Kinney AY, Boonyasiriwat W, Walters ST, Pappas LM, Stroup AM, Schwartz MD, Edwards SL, Rogers A, Kohlmann WK, Boucher KM, Vernon SW, Simmons RG, Lowery JT, Flores K, Wiggins CL, Hill DA, Burt RW, Williams MS, & Higginbotham JC (2014). Telehealth personalized cancer risk communication to motivate colonoscopy in relatives of patients with colorectal cancer: the family CARE Randomized controlled trial. Journal of clinical oncology: official journal of the American Society of Clinical Oncology, 32(7), 654–662. 10.1200/JCO.2013.51.6765 [PubMed: 24449229]

[12]. Wu QL, & Street RL Jr (2020). Factors affecting cancer patients' electronic communication with providers: Implications for COVID-19 induced transitions to telehealth. Patient education and counseling, S0738–3991(20)30534–6. Advance online publication. 10.1016/j.pec.2020.0

[13]. LeBlanc TW, Back AL, Danis M, & Abernethy AP (2014). Electronic Health Records (EHRs) in the oncology clinic: how clinician interaction with EHRs can improve communication with the patient. Journal of oncology practice, 10(5), 317–321. 10.1200/JOP.2014.001385 [PubMed: 25027025]

[14]. Häyrinen K, Saranto K, & Nykänen P (2008). Definition, structure, content, use and impacts of electronic health records: a review of the research literature. International journal of medical informatics, 77(5), 291–304. 10.1016/j.ijmedinf.2007.09.001 [PubMed: 17951106]

[15]. Rao SR, Desroches CM, Donelan K, Campbell EG, Miralles PD, & Jha AK (2011). Electronic health records in small physician practices: availability, use, and perceived benefits. Journal of the American Medical Informatics Association : JAMIA, 18(3), 271–275. 10.1136/amiajnl-2010-000010 [PubMed: 21486885]

[16]. Levac D, Colquhoun H, & O'Brien KK (2010). Scoping studies: advancing the methodology. Implementation science : IS, 5, 69. 10.1186/1748-5908-5-69 [PubMed: 20854677]

[17]. Zini EM, Lanzola G, Quaglini S, Bossi P, Licitra L, & Resteghini C (2019). A pilot study of a smartphone-based monitoring intervention on head and neck cancer patients undergoing concurrent chemo-radiotherapy. International journal of medical informatics, 129, 404–412. 10.1016/j.ijmedinf.2019.06.004 [PubMed: 31445284]

[18]. Piau A, Crissey R, Brechemier D, Balardy L, & Nourhashemi F (2019). A smartphone Chatbot application to optimize monitoring of older patients with cancer. International journal of medical informatics, 128, 18–23 [PubMed: 31160007]

[19]. Børøsund E, Cvancarova M, Moore SM, Ekstedt M, & Ruland CM (2014). Comparing effects in regular practice of e-communication and Web-based self-management support among breast cancer patients: preliminary results from a randomized controlled trial. Journal of medical Internet research, 16(12), e295. 10.2196/jmir.3348 [PubMed: 25525672]

[20]. Meropol NJ, Egleston BL, Buzaglo JS, Balshem A, Benson III AB, Cegala DJ, ... & Fleisher L (2013). A Web- based communication aid for patients with cancer: The CONNECT Study. Cancer, 119(7), 1437–1445. [PubMed: 23335150]

[21]. Ochoa-Arnedo C, Flix-Valle A, Casellas-Grau A, Casanovas-Aljaro N, Herrero O, Sumalla EC, ... & Valverde Y (2020). An exploratory study in breast cancer of factors involved in the use and communication with health professionals of Internet information. Supportive Care in Cancer, 1–8.

[22]. Rupert DJ, Squiers LB, Renaud JM, Whitehead NS, Osborn RJ, Furberg RD, ... & Tzeng JP (2013). Communicating risk of hereditary breast and ovarian cancer with an interactive decision support tool. Patient Education and Counseling, 92(2), 188–196. [PubMed: 23664232]

[23]. Hartzler AL, Izard JP, Dalkin BL, Mikles SP, & Gore JL (2016). Design and feasibility of integrating personalized PRO dashboards into prostate cancer care. Journal of the American Medical Informatics Association : JAMIA, 23(1), 38–47. 10.1093/jamia/ocv101 [PubMed: 26260247]

[24]. Voruganti T, Husain A, Grunfeld E, & Webster F (2018). Disruption or innovation? A qualitative descriptive study on the use of electronic patient-physician communication in patients with advanced cancer. Supportive Care in Cancer, 26(8), 2785–2792. [PubMed: 29502156]

[25]. Bylund CL, Gueguen JA, D'Agostino TA, Li Y, & Sonet E (2010). Doctor– patient communication about cancer-related internet information. Journal of psychosocial onology, 28(2), 127–142.

[26]. Cook N, Maganti M, Dobriyal A, Sheinis M, Wei AC, Ringash J, & Krzyzanowska MK (2016). E-Mail Communication Practices and Preferences Among Patients and Providers in a Large Comprehensive Cancer Center. Journal of oncology practice, 12(7), 676–684. 10.1200/ JOP.2015.008722 [PubMed: 27352950]

[27]. Drewes C, Kirkovits T, Schiltz D, Schinkoethe T, Haidinger R, Goldmann-Posch U, Harbeck N, & Wuerstlein R (2016). EHealth Acceptance and New Media Preferences for Therapy Assistance Among Breast Cancer Patients. JMIR cancer, 2(2), e13. 10.2196/cancer.5711 [PubMed: 28410189]

[28]. Noordman J, Driesenaar JA, van Bruinessen IR, Portielje JE, & van Dulmen S (2019). Evaluation and Implementation of ListeningTime: A Web-Based Preparatory Communication Tool for Elderly Patients With Cancer and Their Health Care Providers. JMIR cancer, 5(1), e11556. [PubMed: 30698525]

[29]. Basch E, Artz D, Iasonos A, Speakman J, Shannon K, Lin K, ... & Scher HI (2007). Evaluation of an online platform for cancer patient self-reporting of chemotherapy toxicities. Journal of the American Medical Informatics Association, 14(3), 264–268. [PubMed: 17329732]

[30]. Berry DL, Blonquist TM, Patel RA, Halpenny B, & McReynolds J (2015). Exposure to a patient-centered, Web-based intervention for managing cancer symptoms and quality of life issues: impact on symptom distress. Journal of medical Internet research, 17(6), e136. [PubMed: 26041682]

[31]. Chou WS, Trivedi N, Peterson E, Gaysynsky A, Krakow M, & Vraga E (2020). How do social media users process cancer prevention messages on Facebook? An eye-tracking study. Patient education and counseling, 103(6), 1161–1167. 10.1016/j.pec.2020.01.013 [PubMed: 32044193]

[32]. Alpert JM, Markham MJ, Bjarnadottir RI, & Bylund CL (2019). Twenty-first Century Bedside Manner: Exploring Patient-Centered Communication in Secure Messaging with Cancer Patients. Journal of cancer education: the official journal of the American Association for Cancer Education, 10.1007/s13187-019-01592-5. Advance online publication. 10.1007/s13187-019-01592-5

[33]. Alpert JM, Morris BB, Thomson MD, Matin K, & Brown RF (2018). Implications of Patient Portal Transparency in Oncology: Qualitative Interview Study on the Experiences of Patients, Oncologists, and Medical Informaticists. JMIR cancer, 4(1), e5. 10.2196/cancer.8993 [PubMed: 29581090]

[34]. Asan O, Nattinger AB, Gurses AP, Tyszka JT, & Yen T (2018). Oncologists' Views Regarding the Role of Electronic Health Records in Care Coordination. JCO clinical cancer informatics, 2, 1–12. 10.1200/CCI.17.00118

[35]. Collado-Borrell R, Escudero-Vilaplana V, Calles A, Garcia-Martin E, Marzal-Alfaro B, Gonzalez-Haba E, Herranz-Alonso A, & Sanjurjo-Saez M (2018). Oncology Patient Interest in the Use of New Technologies to Manage Their Disease: Cross-Sectional Survey. Journal of medical Internet research, 20(10), e11006. 10.2196/11006 [PubMed: 30355554]

[36]. Haase KR, & Loiselle CG (2012). Oncology team members' perceptions of a virtual navigation tool for cancer patients. International journal of medical informatics, 81(6), 395–403. 10.1016/j.ijmedinf.2011.11.001 [PubMed: 22244817]

[37]. Lu HY, Shaw BR, & Gustafson DH (2011). Online health consultation: examining uses of an interactive cancer communication tool by low-income women with breast cancer. International journal of medical informatics, 80(7), 518–528. 10.1016/j.ijmedinf.2011.03.011 [PubMed: 21530381]

[38]. Brooks JV, Poague C, Formagini T, Sinclair CT, & Nelson-Brantley HV (2020). The Role of a Symptom Assessment Tool in Shaping Patient-Physician Communication in Palliative Care. Journal of pain and symptom management, 59(1), 30–38. 10.1016/j.jpainsymman.2019.08.024 [PubMed: 31494177]

[39]. Childess JM, Palmer AD, Fried-Oken M, & Graville DJ (2017). The Use of Technology for Phone and Face-to-Face Communication After Total Laryngectomy. American journal of speech-language pathology, 26(1), 99–112. 10.1044/2016_AJSLP-14-0106 [PubMed: 28166547]

[40]. Alpert JM, Morris BB, Thomson MD, Matin K, & Brown RF (2019). Identifying How Patient Portals Impact Communication in Oncology. Health communication, 34(12), 1395–1403. 10.1080/10410236.2018.1493418 [PubMed: 29979886]

[41]. Solomons NM, Lamb AE, Lucas FL, McDonald EF, & Miesfeldt S (2018). Examination of the Patient-Focused Impact of Cancer Telegenetics Among a Rural Population: Comparison with Traditional In-Person Services. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 24(2), 130–138. 10.1089/tmj.2017.0073 [PubMed: 28737998]

[42]. Wu YR, Chou TJ, Wang YJ, Tsai JS, Cheng SY, Yao CA, Peng JK, Hu WY, Chiu TY, & Huang HL (2020). Smartphone-enabled Telehealth for Palliative Care Family Conference during the COVID - 19 Pandemic: Pilot Observational Study. JMIR mHealth and uHealth, 10.2196/22069. Advance online publication. 10.2196/22069

[43]. Head BA, Keeney C, Studts JL, Khayat M, Bumpous J, & Pfeifer M (2011). Feasibility and Acceptance of a Telehealth Intervention to Promote Symptom Management during Treatment for Head and Neck Cancer. The journal of supportive oncology, 9(1), e1–e11. 10.1016/j.suponc.2010.12.006 [PubMed: 21499540]

[44]. Berry DL, Blumenstein BA, Halpenny B, Wolpin S, Fann JR, Austin-Seymour M, Bush N, Karras BT, Lober WB, & McCorkle R (2011). Enhancing patient-provider communication with the electronic self-report assessment for cancer: a randomized trial. Journal of clinical oncology: official journal of the American Society of Clinical Oncology, 29(8), 1029–1035. 10.1200/JCO.2010.30.3909 [PubMed: 21282548]

[45]. Pedrosa F, Shaikh F, Rivera G, Ribeiro R, & Qaddoumi I (2017). The Impact of Prospective Telemedicine Implementation in the Management of Childhood Acute Lymphoblastic Leukemia in Recife, Brazil. Telemedicine journal and e-health : the official journal of the American Telemedicine Association, 23(10), 863–867. 10.1089/tmj.2016.0273 [PubMed: 28422613]

[46]. Street RL Jr, Makoul G, Arora NK, Epstein RM. How does communication heal? Pathways linking clinician-patient communication to health outcomes. Patient Educ Couns 2009;74(3):295–301. doi:10.1016/j.pec.2008.11.015 [PubMed: 19150199]

[47]. Waters HR (2000). Measuring equity in access to health care. Social science & medicine (1982), 51(4), 599–612. 10.1016/s0277-9536(00)00003-4 [PubMed: 10868673]

[48]. Daniels N (1982). Equity of access to health care: some conceptual and ethical issues. The Milbank Memorial Fund quarterly. Health and society, 60(1), 51–81.

[49]. Bashshur RL, Shannon GW, & Metzner CA (1971). Some ecological differentials in the use of medical services. Health services research, 6(1), 61–75. [PubMed: 5569227]

[50]. Dutton D: Financial, organizational and professional factors affecting health care utilization. Soc Sci Med 1986, 23: 721–735. 10.1016/0277-9536(86)90121-8. [PubMed: 3775454]

[51]. Penchansky R, Thomas WJ: The concept of access: definition and relationship to consumer satisfaction. Med Care 1981, 19: 127–140. 10.1097/00005650-198102000-00001. [PubMed: 7206846]

[52]. Adams O, Shengelia B, and Stilwell B. "Health systems performance assessment, debates, methods and empiricism" World Health Organisation, Geneva (2003).

[53]. Margolis PA, Carey T, Lannon CM, Earp JL, & Leininger L (1995). The rest of the access-to-care puzzle. Addressing structural and personal barriers to health care for socially disadvantaged children. Archives of pediatrics & adolescent medicine, 149(5), 541–545. 10.1001/archpedi.1995.02170180071011 [PubMed: 7735408]

[54]. Cronin R et al. (2015) Growth of secure messaging through a patient portal as a form of outpatient interaction across clinical specialties. Appl Clin Inform 6(02):288–304 [PubMed: 26171076]

[55]. Nazi KM (2013) The personal health record paradox: health care professionals' perspectives and the information ecology of personal health record systems in organizational and clinical settings. J Med Internet Res 2013;15(4):e70 [PubMed: 23557596]

[56]. Barney K (2013) Cisco customer experience report for health care announced at HIMSS [cited 2019 March 14]; Available from: https://blogs.cisco.com/healthcare/cisco-customer-experiencereport-for-health-care-announced-at-himss

[57]. Eysenbach G (2000). Towards ethical guidelines for e-health: JMIR theme issue on eHealth ethics. Journal of medical Internet research, 2(1), E7. 10.2196/jmir.2.1.e7 [PubMed: 11720926]

[58]. Geissbuhler A, Boyer C, Health and the internet for all, Int. J. Med. Inform 75 (January (1)) (2006) 1–3. [PubMed: 16325462]

[59]. Braddock CH 3rd, Edwards KA, Hasenberg NM, Laidley TL, & Levinson W (1999). Informed decision making in outpatient practice: time to get back to basics. JAMA, 282(24), 2313–2320. 10.1001/jama.282.24.2313 [PubMed: 10612318]

[60]. Kleinman A Patients and healers in the context of culture Berkeley, CA: University of California Press; 1980.

[61]. Makoul G, Clayman ML, Lynch EB, & Thompson JA (2009). Four concepts of health in America: results of national surveys. Journal of health communication, 14(1), 3–14. 10.1080/10810730802592213

[62]. DiMatteo MR, Sherbourne CD, Hays RD, Ordway L, Kravitz RL, McGlynn EA, Kaplan S, & Rogers WH (1993). Physicians' characteristics influence patients' adherence to medical treatment: results from the Medical Outcomes Study. Health psychology: official journal of the Division of Health Psychology, American Psychological Association, 12(2), 93–102. 10.1037/0278-6133.12.2.93

[63]. Boyle FM, Robinson E, Heinrich P, Dunn SM. Cancer: communicating in the team game. ANZ J Surg 2004;74:477–81. [PubMed: 15191487]

[64]. Epstein R (2007). Patient-centered communication in cancer care: promoting healing and reducing suffering (No. 7) US Department of Health and Human Services, National Institutes of Health, National Cancer Institute.

[65]. Pinto RZ, Ferreira ML, Oliveira VC, Franco MR, Adams R, Maher CG, & Ferreira PH (2012). Patient-centred communication is associated with positive therapeutic alliance: a systematic review. Journal of physiotherapy, 58(2), 77–87. [PubMed: 22613237]

[66]. Charmel PA, & Frampton SB (2008). Building the business case for patient-centered care. Healthc Financ Manage, 62(3), 80–5. [PubMed: 19097611]

[67]. Tang PC, & Newcomb C (1998). Informing patients: a guide for providing patient health information. Journal of the American Medical Informatics Association, 5(6), 563–570. [PubMed: 9824803]

[68]. Rozenblum R, Miller P, Pearson D, Marielli A, Grando M, & Bates D (2015). Patient-centered healthcare, patient engagement and health information technology: the perfect storm. Information technology for patient empowerment in healthcare, 3–22.

[69]. Carman KL, Dardess P, Maurer M, Sofaer S, Adams K, Bechtel C, & Sweeney J (2013). Patient and family engagement: a framework for understanding the elements and developing interventions and policies. Health Affairs, 32(2), 223–231. [PubMed: 23381514]

[70]. Baker A (2001). Crossing the quality chasm: a new health system for the 21st century (Vol. 323, No. 7322, p. 1192). British Medical Journal Publishing Group.

[71]. Sepucha K, Ozanne E, Silvia K, Partridge A, & Mulley AG Jr (2007). An approach to measuring the quality of breast cancer decisions. Patient education and counseling, 65(2), 261–269. [PubMed: 17023138]

[72]. Epstein RM, Alper BS, & Quill TE (2004). Communicating evidence for participatory decision making. Jama, 291(19), 2359–2366. [PubMed: 15150208]

[73]. Parle M, Jones B, & Maguire P (1996). Maladaptive coping and affective disorders among cancer patients. Psychological medicine, 26(4), 735–744. [PubMed: 8817708]

[74]. Fogarty LA, Curbow BA, Wingard JR, McDonnell K, & Somerfield MR (1999). Can 40 seconds of compassion reduce patient anxiety?. Journal of Clinical Oncology, 17(1), 371–371. [PubMed: 10458256]

[75]. Heaven CM, & Maguire P (1997). Disclosure of concerns by hospice patients and their identification by nurses. Palliative medicine, 11(4), 283–290. [PubMed: 9373579]

[76]. Maguire P (1999). Improving communication with cancer patients. European Journal of Cancer, 35(14), 2058–2065. [PubMed: 10711246]

[77]. Kennifer SL, Alexander SC, Pollak KI, Jeffreys AS, Olsen MK, Rodriguez KL & Tulsky JA (2009). Negative emotions in cancer care: do oncologists' responses depend on severity and type of emotion?. Patient education and counseling, 76(1), 51–56. [PubMed: 19041211]

[78]. Ruland CM, Andersen T, Jeneson A, Moore S, Grimsbø GH, Børøsund E, & Ellison MC (2013). Effects of an internet support system to assist cancer patients in reducing symptom distress: a randomized controlled trial. Cancer Nursing, 36(1), 6–17. [PubMed: 22495503]

[79]. Albrecht TL, & Goldsmith DJ (2003). Social support, social networks, and health

[80]. Ozbay F, Johnson DC, Dimoulas E, Morgan CA III, Charney D, & Southwick S (2007). Social support and resilience to stress: from neurobiology to clinical practice. Psychiatry (Edgmont), 4(5), 35.

[81]. Southwick SM, Vythilingam M, & Charney DS (2005). The psychobiology of depression and resilience to stress: implications for prevention and treatment. Annu. Rev. Clin. Psychol, 1, 255–291. [PubMed: 17716089]

[82]. Kelly ME, Duff H, Kelly S, et al. The impact of social activities, social networks, social support and social relationships on the cognitive functioning of healthy older adults: a systematic review. Syst Rev 2017;6(1):259. Published 2017 Dec 19. doi:10.1186/s13643-017-0632-2 [PubMed: 29258596]

[83]. Arora NK, Finney Rutten LJ, Gustafson DH, Moser R, & Hawkins RP (2007). Perceived helpfulness and impact of social support provided by family, friends, and health care providers to women newly diagnosed with breast cancer. Psycho- Oncology, 16(5), 474–486. [PubMed: 16986172]

[84]. Kahana E, & Kahana B (2003). Patient proactivity enhancing doctor–patient–family communication in cancer prevention and care among the aged. Patient Education and Counseling, 50(1), 67–73. [PubMed: 12767588]

[85]. Shields CG, Epstein RM, Fiscella K, Franks P, McCann R, McCormick K, & Mallinger JB (2005). Influence of accompanied encounters on patient-centeredness with older patients. The Journal of the American Board of Family Practice, 18(5), 344–354. [PubMed: 16148244]

[86]. O'Hair D, Villagran MM, Wittenberg E, Brown K, Ferguson M, Hall HT, & Doty T (2003). Cancer survivorship and agency model: Implications for patient choice, decision making, and influence. Health Communication, 15(2), 193–202. [PubMed: 12742770]

[87]. Street RL Jr, Gordon HS, Ward MM, Krupat E, & Kravitz RL (2005). Patient participation in medical consultations: why some patients are more involved than others. Medical care, 960–969. [PubMed: 16166865]

[88]. Heisler M, Piette JD, Spencer M, Kieffer E, & Vijan S (2005). The relationship between knowledge of recent HbA1c values and diabetes care understanding and self-management. Diabetes care, 28(4), 816–822. [PubMed: 15793179]

[89]. Heisler M, Bouknight RR, Hayward RA, Smith DM, & Kerr EA (2002). The relative importance of physician communication, participatory decision making, and patient understanding in diabetes self- management. Journal of general internal medicine, 17(4), 243–252. [PubMed: 11972720]

[90]. Kuijpers W, Groen WG, Aaronson NK, & van Harten WH (2013). A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: relevance for cancer survivors. Journal of medical Internet research, 15(2), e37 [PubMed: 23425685]

[91]. Coulter A, & Collins A (2014). Making shared decision-making a reality: no decision about me, without me 2011. The King's Fund: London.

[92]. Chen J, Ou L, & Hollis SJ (2013). A systematic review of the impact of routine collection of patient reported outcome measures on patients, providers and health organisations in an oncologic setting. BMC health services research, 13(1), 211. [PubMed: 23758898]

[93]. Fact Sheet: Shared Decision Making. (2013). National Learning Consortium Advancing America's Health Care Retrieved from https://www.healthit.gov/sites/default/files/nlc_shared_decision_making_fact_sheet.pdf.

[94]. Six simple steps to shared decision making. Adapted from "A Simple Approach to Shared Decision Making in Cancer Screening." (2018). FPM Editors. Retreived from https://www.aafp.org/journals/fpm/blogs/inpractice/entry/shared_decision_making.html

[95]. Shin DH, & Biocca F (2017). Health experience model of personal informatics: The case of a quantified self. Computers in Human Behavior, 69, 62–74.

[96]. Mou J, Shin DH, & Cohen J (2016). Health beliefs and the valence framework in health information seeking behaviors. Information Technology & People

8.

Summary table

Already known

- Health Information Technologies changed the dynamics in patient physician-patient interaction both in primary and oncology care.

- Patient Centered communication is critical in cancer care for better treatment and adherence.

- The dynamics and nature of the visits in cancer care is different than traditional primary care visits.

Added knowledge

- There are various HIT including clinical and consumer-based impact communication in cancer care.

- There is lack of systematic studies studying benefits and impact of HIT on communication related outcomes

- User centered health information technologies can help in decision making, treatment management as well as adherence in cancer care.
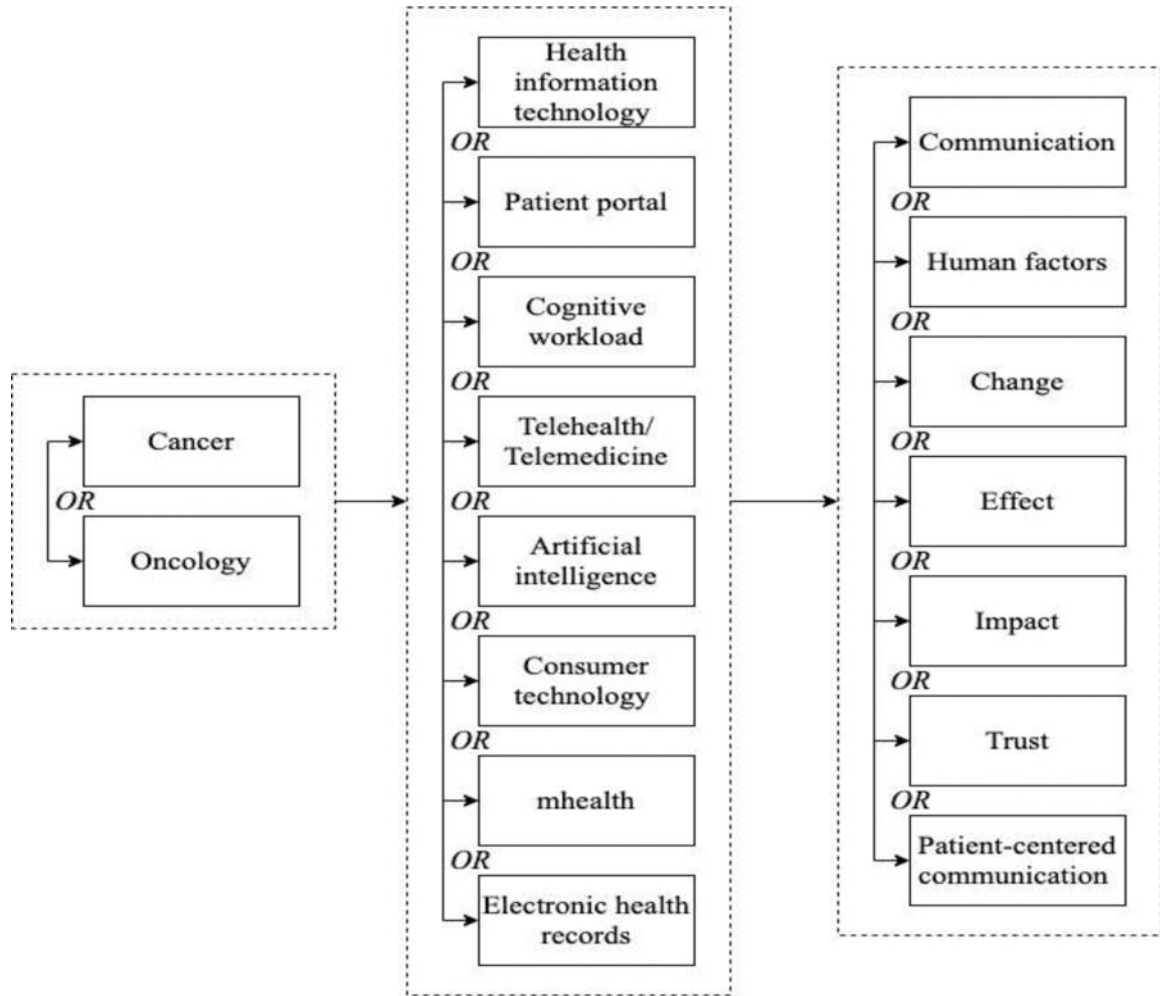
Fig 1:
Conceptual Framework of the search MeSH terms used in the query of the studies for the literature review
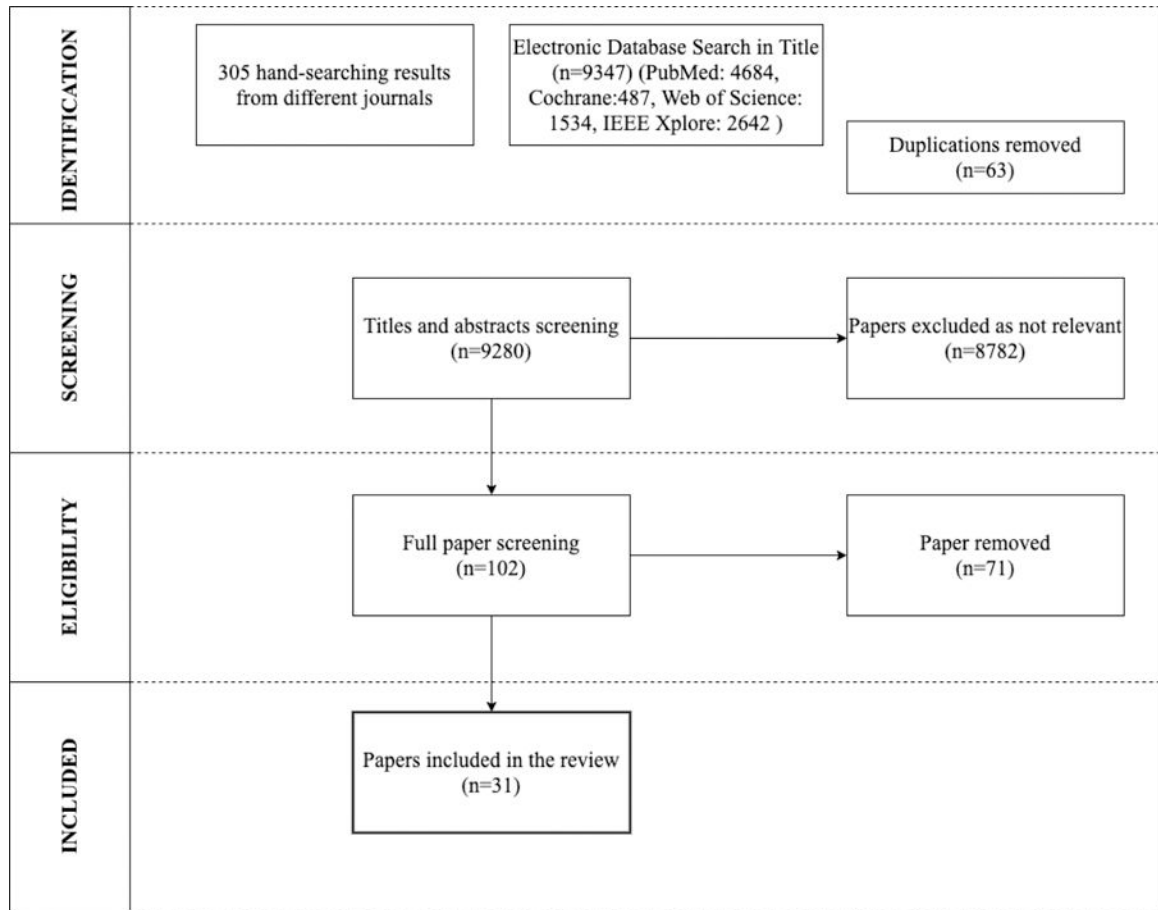
Fig 2:
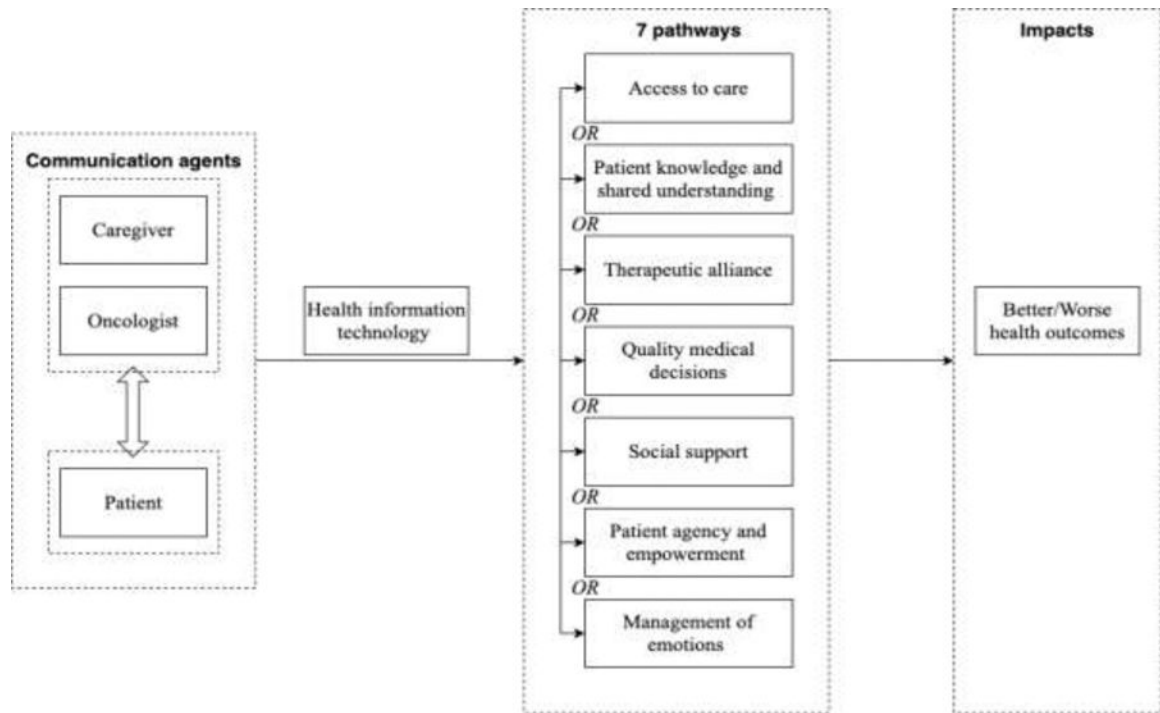PRISMA Flow Diagram for Searching and Selection process

Fig 3:
Conceptual Framework of the 7 pathways functions serving as links between communication and health outcomes guiding the literature review

Table 1.

Summary of Extracted data from finalized papers

Citation	Objective	Study theme	HIT Type/ Technology name	Study design	Communication findings
Winget et al., (2016) [10]	Exploring the effects of a digital health initiative to improve patient engagement on oncologists.	Communication web-based technology	Electronic medical record systems/ Electronic Release of Pathology and Radiology Results	Questionnaires N= 0 (Patients), 82 (Doctors) After 4 months from implementation, an automated system to release finalized radiology and pathology reports via the health care portal to discuss the impacts on communication with patients.	Oncologists agree that patient online access to abnormal radiology or pathology results has negative consequences, but for normal results has almost half of oncologists reported that sharing online results had worsened their communications with patients. Comments related to quality of care included issues related to communication, coordination, and patient's safety.
Zini et al., (2019) [17]	Exploring the context of outpatients' remote monitoring through the collection of patient-reported outcomes using the application HeNeA.	Malignancy therapy	Consumer health IT applications/ HeNeA	Questionnaires N=10 (Patients), 3 (Doctors) Data is automatically synchronized to the servers of hospitals and shared with the doctors Users' satisfaction, feasibility and usability were reported.	HeNeA helped improve communication with cancer patients who remain more willing to report their symptoms through a mobile app giving them the freedom they need to report their experience.
Piau et al., (2019) [18]	Assessing health outcomes of semi- automated messaging applications for older patients with cancer.	Symptoms follow up	Consumer health IT applications / Infinity	Questionnaires N=9 (Patients), 0 (Doctors) 6 questionnaires over 7 weeks of an average of 3.5 minutes. The health-care team had real time access to a dashboard, giving them relevant details of the questionnaires	The Chatbot answers revealed serious health (e.g. fever, skin rash, abnormal sensitivity in the extremities) or care plan adherence (e.g. weekly blood test) issues that required timely interventions, which helps in improving communication with older people, and optimizing nursing time between interventions and phone calls.
Børøsund et al., (2014) [19]	Assessing the impacts of web-based solutions on primary and secondary outcomes through comparing WebChoice to an Internet-based patient provider communication service (IPPC) and usual care.	Self-management of illness emotions and symptoms	Patient Portals/ WebChoice	Questionnaires N=167(Patients), 20 (Doctors) Patients and doctors participated in an e-messages exchange. Effects on outcomes were measured (primary outcomes (symptom distress, anxiety, and depression), secondary outcome (self-efficacy)) at baseline, 2, 4, and 6 months thorough self-assessed questionnaires sent to participants by postal mail.	Patients using WebChoice were able to communicate with providers through e-messages, and they showed less anxiety and depression with more self-efficacy. WebChoice helped them feel better about communicating with their doctors. Obtaining immediate access to the self-management advice component improved patient-provider communication.
Meropol et al., (2013) [20]	Assessing satisfaction with a web-based intervention, CONNECT.	Communication skills aid web-based technology	Patient Portals/ CONNECT.	Survey N= 629 (Patients), 42 (Doctors) Post consultation survey accessed consultation content, treatment outcome expectations, decisional conflict, patient satisfaction with the content and format of the communication, and satisfaction with surveys and training of communication skills.	Web-based CST delivered before the initial oncology consultation can increase satisfaction with oncologist communication, influence expectations of benefit and toxicity from treatment, and improve treatment decision-making.

Citation	Objective	Study theme	HIT Type/ Technology name	Study design	Communication findings
Dalal et al., (2016) [9]	Evaluating the enrollment strategy, use, and usability of patient tools and the content of patient-generated messages.	web-based, patient-centered toolkit	Patient Portals/ OSPECT	Survey N= 119 (Patients), 120 (Doctors) System usability and satisfaction survey was conducted on PROSPECT users to test their satisfaction and a visit tendency was analyzed from messages content	PROSPECT helped oncology patients, users, develop new goals (66% of the users set new goals for their treatment path related to comfort and healthcare results). It also helped communicate their preferences (64% of the users gave feedback regarding whether the care team met their expectations or not), which can help in having effective engagement of patients.
Ochoa-Arnedo et al., (2020) [21]	Assessing patients' use of internet for health-related information, and the impact on patients, psychological outcomes, and impact on relationship with professionals.	Technology's impact on knowledge	Consumer health IT applications / INTERNET	Mixed methodology (focus groups, questionnaires) N= 186 (Patients), 59 (Doctors) 2 questionnaires and three focus groups were conducted.	Patients felt that their use of internet increased their knowledge and awareness without affecting their emotional distress or illness concerns. But professionals reported that it increased doubts, confusion, and misinformation, resulting in emotional distress, which can be explained by doctors' fear of a leveling affect, where their expertise is subverted with digital tools.
Rupert et al., (2013) [22]	Evaluating technology tools' impact on knowledge, attitudes, and screening decisions.	Shared decision making about screening	Clinical decision support/CANCER IN THE FAMILY	Survey N= 48 (Patients), 9 (Doctors) 3 surveys for patients and 4 for providers	AI-based technology tools can encourage discussions about genetic testing and discourage inappropriate screening between doctors and cancer patients.
Hartzler et al., (2016) [23]	Promoting effective patient-reported outcomes use in patient-centered care.	Patient- reported outcomes	Electronic Medical Records/Men Like Me	Focus groups N= 50 (Patients), 50 (Doctors) Capturing user needs for PROs following prostate cancer treatment assessing the needs of patients and providers through focus groups and interviews.	Patient-centered care tools help improve communication, interaction, and visits satisfaction for cancer patients.
Voruganti et al., (2018) [24]	Understanding participants' perceptions of electronic communication in general and the added value of the new tool in particular.	Electronic team- based communication tool	Patient Portals/ Loop	Interviews N= 6 (Patients), 12 (Doctors) 3-month pilot trial evaluating the tool. Interviews were thematically analyzed	Participants recognized that the challenge around care coordination is due to changes in the physician responsible for treatment. Participants expressed anxieties about the integration of EMRs into patient-physician relationships. Face-to-face meetings make cancer patients them feel more cared for by healthcare providers and those who resist want their results to be first verified by experts.
Bylund et al (2010) [25]	Exploring the effect of doctor-patient communication about cancer-related Internet Information on self-reported outcomes.	Outcomes reporting and doctor patient communication	Consumer health IT applications / INTERNET	Survey N= 267(Patients), 123(Doctors) Only codable conversations were focused on.	Patient-centered communication strategies have significant effects on participants' reported outcomes. These strategies help improve the satisfaction of participants and improve their involvement and interest. Clinicians that play an active role in encounters help to foster healing relationships.
Cook et al., (2016) [26]	Exploring the current e-mail communication practices and preferences of patients and physicians in oncology.	Technology communication impact	Consumer health IT applications / Email	Cross-sectional Survey N= 833(Patients), 79 (Doctors) Separate anonymous cross-sectional surveys were administrated to patients and physicians to ascertain current	Doctors expressed concerns about e-mails ((miscommunication (83%), legal issues (80 %), increase in workload (60%)), but they think it improves communication with patients (53%) and cost effectiveness (43%).

Citation	Objective	Study theme	HIT Type/ Technology name	Study design	Communication findings
				practices and preferences for e-mail communication by each group.	
Drewes et al (2016) [27]	Analyzing the correlation between sociodemographic factors, health status, use of media, and the willingness to use Internet and mobile apps to improve therapy management.	ehealth and mhealth for therapy management improvement	Consumer health IT applications / Ehealth and Mhealth	Questionnaires N=167(Patients), 0(Doctors) Questionnaires were developed to assess use of ehealth and mhealth in breast cancer patients	67.3% of the patients approve using the internet for therapy assistance. Two thirds were willing to use Internet for therapy improvement. Self-efficacy may be improved. The results of the survey confirmed the potential of new media to provide continuous patient-physician communication.
Noordman et al., (2019) [28]	Evaluating the usability, perceived usefulness, and actual use of listening time through the eyes of elderly patients with cancer and their oncological care providers.	Communication web-based technology	Consumer health IT applications / ListeningTime	Questionnaire N= 47 (Patients), 8 (Doctors) Usability y was measured with System Usability Scale and the perceived usefulness. Use, was examined using user statistics and log files that automatically generates files mapping the interactions between program and users.	The tool helped elderly patients better prepare for the clinical encounter with their providers and overcome communication barriers. It offers to cancer patients the emotional support they need after diagnosis or treatment and helps them overcome the difficulties in processing the providers' information.
Basch et al., (2007) [29]	Evaluating the impacts of an online PROs platform (Patient Reported Outcomes) on chemotherapy toxicity symptom monitoring and safety and satisfaction of the patients.	Patient- reported outcomes	Patient Portals/ PROs	Survey N= 100(Patients), 0(Doctors) Questionnaires were raised to evaluate the effectiveness of a technology platform and content for a patient symptom reporting portal.	High levels of patient satisfaction, clinician acceptance, and willingness of staff to base management decisions on patient-reported information were reported when using the patient reported outcomes online platform.
Berry et al., (2015) [30]	Evaluating the use of a fully automated web-based program (Electronic self- report assessment cancer) and exploring the intervention's impact on cancer symptom distress.	Cancer symptom distress management	Consumer health IT applications / ESRA-C	Cohort study N= 374 (Patients), 0 (Doctors) A randomized trial was conducted on cancer patients about to start a new anti- cancer therapy, that used ESR-C to self-report baseline SxQOL (symptoms and quality of life). They were given the opportunity to self-monitor when not in clinic and coaching on how to report to clinicians.	The intended effects of a Web-based, patient-centered intervention on cancer symptom distress were modified by intervention use frequency. Clinical and personal demographics influenced voluntary use. Better communication of symptoms to doctors was observed.
Chou et al., (2020) [31]	Examines social media SM users' attention to simulated Facebook posts related to cancer and identifies message features associated with increased attention.	Social Media impact	Consumer health IT applications / Facebook	Mixed methodology (experimental, surveys, interviews) N= 53 (Patients), 0(Doctors) Stimuli conditions included message format (narrative/non-narrative), information veracity, source (organization / individual), and cancer topics with eye- tracking system included	Cancer-related messages on SM can help understand the behavior of the cancer patients, which might facilitate the flow of information shared between patients and oncologists.
Alpert et al., (2019) [32]	Understanding communicative behaviors and perceptions of the patient portals and how it is utilized in oncology in depth.	Electronic medical records through online portals	Patient Portals/ --	Semi-structured interviews N=35(Patients), 13 (Doctors) Semi structured interview with predetermined open-ended questions	At a functional level, when armed with their test results and medical information on the portals, patients expressed a sense of confidence and empowerment enabling more active communication and felt like collaborating with oncologists.

Citation	Objective	Study theme	HIT Type/ Technology name	Study design	Communication findings
Alpert et al., (2018) [33]	Understanding attitudes about the portal's adoption for oncology and identifying the advantages and disadvantages of using the portal to communicate and view medical information.	Patient portals impact on communication	Patient Portals/ --	Semi-structured interviews N= 35(Patients), 13 (Doctors) In-depth semi structured interviews were conducted. Interviews were recorded, transcribed, and thematically analyzed to identify critical incidents and general attitudes encountered by participants about personal and professional life experiences about using the portal	Patient portals in oncology can potentially alter the way diagnoses are delivered and how patients and oncologists communicate. Patients experienced more distress when using online portals. Lack of oncologists' involvement led to lack of knowledge about portal functionality. Perception of portals as communication tools varies by user type.
Asan et al., (2018) [34]	Learning the perceptions of the use of EHRs before, during, and after clinic visits with patients.	Information sharing	Electronic medical record systems/ Electronic Health Records	Semi-structured interviews N= 0(Patients), 11 (Doctors) Semi structured interviews were conducted, and the transcripts were coded using inductive content analysis.	EHRs facilitate information transfer among multiple providers and provide quick, easy access to records, which is a facilitator to information exchange and communication between doctors and cancer patients.
Collado-Borrell et al., (2018) [35]	Understanding the ICT usage profile in hematology-oncology patients to identify their needs and determine their level of interest in these technologies as a means of managing their disease.	Disease management	Consumer health IT applications / Information and communication technologies	Questionnaires N= 611(Patients), 0(Doctors) The questionnaire has 3 blocks: sociodemographic characteristics, use of ICTs when searching for health-related information and preferences for health apps.	Hematology-oncology patients are interested in finding health-related information via ICTs using smartphones and apps. These apps are used as a communication channel between patients and health professionals, and they facilitate access to information.
Haase et al., (2012) [36]	Using a qualitative approach, in-depth interviews were conducted with 16 members of a multidisciplinary colorectal oncology team and volunteers at a large Cancer Center.	Communication in patient-centered care	Patient Portals/ Oncology Interactive Navigator	Semi-structured interviews N= 0(Patients), 16(Doctors) Face-to-face interviews were conducted to discuss perceptions of the tool. And the use of OIN was tracked	OIN was perceived as a means to build healthcare provider-patient trust and to enhance communication, and also plays a catalyst role for communication and support between patient and his family.
Lu et al., (2011) [37]	Examining how psychological variables predict use of an online health consultation among low-income breast cancer patients and vice versa.	Online consultation service	Remote Patient Monitoring (Telehealth) / AskAnExpert	Survey N= 231(Patients), 0(Doctors) After 16 weeks of access to the service with Comprehensive Health Enhancement Support System CHESS "Living with Breast Cancer" program. Doctor patient data were collected pre and post-test and psychological data was analyzed.	Greater use of the service improved patients' perception of health self-efficacy, participation in health care, and doctor-patient relationship. Thus, online health consultation can serve as an effective complement to help breast cancer patients feel more confident to participate actively in their healthcare, more involved in making decisions about their treatments, and enhance their relationships with their doctors, creating a good of communication-based environment. The tool was proved to improve the doctor-patient relationship significantly from (2.88 to 3.188 mean score) before and after use for highly engaged patients and a good improvement for low engaged ones. More participation in healthcare was remarked and more perceived health self-efficacy.
Brooks et al., (2020) [38]	Understanding how the ESAS shapes communication between patients and providers by exploring patients' and	Symptoms follow up	Remote Patient Monitoring (Telehealth) / ESAS	Semi-structured interviews N= 18(Patients), 13 (Doctors) Patient and provider ESAS scores were obtained by medical chart	The tool was beneficial in enhancing symptom communication by cancer patients and control by doctors.

Citation	Objective	Study theme	HIT Type/ Technology name	Study design	Communication findings
	caregivers' experiences using the ESAS and assessing the level of agreement in symptom assessment between patients and palliative care physicians.			review. Intraclass correlation coefficients were used to assess the level of agreement between patient-completed ESAS scores and provider- completed ESAS scores.	
Childes et al., (2017) [39]	Describing the characteristics and experiences of individuals who use technology to support telephone or face-to-face communication after laryngectomy.	Verbal communication alternative	Consumer health IT applications / SGD-TTY	Survey N= 17(Patients), 0 (Doctors) Online questionnaire was used to identify potential participants. 17of them were included for in-depth survey. Open-ended responses were summarized	A subset of people used technology to support verbal communication very successfully after laryngectomy. A score of frequency and self-perceived success of communication was calculated to test the technology use's impact on the patients. Good results were scored for both devices (88% and 94 %).
Alpert et al., (2019) [40]	Determining the importance of secure messaging to cancer patients and identifying the important attributes of patient-centered communication.	Patient centered communication	Patient Portals/SM	Focus groups N= 22(Patients), 0 (Doctors) Five focus groups were conducted	Secure messaging is becoming a viable communication option for patients and clinicians. Patient-centered communication is highly efficient not only for face-to-face visits but also for electronic communication.
Solomons et al, (2018) [41]	Examining knowledge and emotional outcomes and attitudes regarding cancer telegenetic services.	Telecommunication access to care	Remote Patient Monitoring (Telehealth) / CRPC	Survey N= 174: 68 in-person and 106 remote (Patients)	Ease of access to healthcare as cancer Telegenetic services are more available and attendance doesn't require missing work or other needs. Costs also are optimized with the telehealth service, and problems related to geographical issues of access are solved. But building rapport and conveying empathy by the counselor is negatively impacted by telemedicine.
Wu et al, (2020) [42]	Studying telehealth's impact on shared decision making during the Covid-19 period.	Shared decision making	Remote Patient Monitoring (Telehealth) / VALUE	Focus group N= 14 (Patients)	VALUE helped improve the situation by relieving emotional burdens. It helped establish clinician-family relationship and facilitate efficient communication with the family.
Head et al, (2011) [43]	Exploring how a telehealth intervention can improve patient-provider communication by using telemessaging device intervention.	Patient centered communication	Remote Patient Monitoring (Telehealth) / Buddy	Survey N= 46 (Patients)	The intervention helped patients feel more informed about what is expected from them and their treatments, reminded them of things to watch for, kept them up to date with the updates, and helped them improve self-management of emotions and symptoms. It also helped them figure out what decision to make in each step and feel safer.
Berry et al, (2011) [44]	Determining the effect of the electronic self-report assessment cancer (ESRA-C) on the quality of life issues discussed between patients and clinicians.	Patient centered communication	Consumer health IT applications / ESRA-C	Mixed methodology (surveys, video-recording) N= 327 (Patients)	Electronic measurement of patients' symptoms had a positive impact on patient-clinician communication compared to traditional settings.
Pedrosa et al, (2016) [45]	Assessing the effect of a telemedicine system on pediatric oncology treatments in real time.	Web based tool	Remote Patient Monitoring (Telehealth) / St Jude- IMIP	Interviews N= 163 (Patients)	Integration of telemedicine into twinning programs facilitates communication about interventions, leading to improved outcomes of pediatric patients with cancer.