

Feasibility and Cost of Telehealth Head and Neck Cancer Survivorship Care: A Systematic Review

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Emma De Ravin, BS^{1,2} , Maria Armache, MD³,
Frank Campbell, MA⁴, Kristin L. Rising, MD, MSPH^{5,6} ,
Brooke Worster, MD⁷ , Nathan R. Handley, MD, MBA⁸,
Christopher E. Fundakowski, MD³, David M. Coggnetti, MD³ , and
Leila J. Mady, MD, PhD, MPH⁹ 

Abstract

Objective. Evaluate the feasibility and cost-effectiveness of telehealth head and neck cancer (HNC) survivorship care.

Data Sources. Ovid MEDLINE, Embase, Scopus, CINAHL.

Review Methods. A systematic search for peer-reviewed feasibility studies on telehealth models for HNC survivorship care published between 2005 and 2021 was conducted using the terms “head and neck cancer” and “telehealth” and their synonyms. Inclusion criteria were studies on telehealth survivorship program interventions for HNC patients with quantitative feasibility outcome measures (eg, enrollment, retention, attrition/dropout rate, adherence/task completion rate, patient satisfaction, cost).

Results. Thirty-eight studies out of 1557 identified met inclusion criteria and were included for analysis. Feasibility outcomes evaluated were enrollment and attrition rates, adherence/task completion rates, patient satisfaction, and user feedback surveys in different survivorship domains. Patient enrollment ranged from 20.8% to 85.7%, while attrition ranged from 7% to 47.7%. Overall, adherence was 30.2% higher in the intervention group than in the control group (46.8% vs 16.6%). Studies with cost analysis found telehealth models of care to be statistically significantly less expensive and more cost-efficient than the standard model of care, with a \$642.30 saving per patient (n = 3). Telehealth models also substantially reduced work time saving per visit (on average, 7 days per visit).

Conclusion. While telehealth survivorship programs are feasible and cost-effective and are associated with improved patient outcomes, they might not be ideal for every patient. Further investigations are needed to understand the role of telehealth in survivorship care, given the variability in study design, reporting, measures, and methodological quality.

Keywords

feasibility studies, head and neck cancer, patient satisfaction, survivorship, telehealth

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The head and neck cancer (HNC) survivor population is substantial, estimated to include more than 430,060 patients in the United States alone,¹ and is expected to grow due to improved long-term survival rates.^{2,3} HNC can be a debilitating diagnosis, causing persistent functional, psychosocial, and cosmetic impairments.^{4–8} Given the functional and esthetic importance of the head and neck, malignancies of this region significantly affect patients' quality of life (QOL) secondary to the burden of disease, treatment, and financial toxicity.^{4–8} Despite augmented treatment efficacy with multimodality treatment regimens, HNC patients are facing greater treatment-related side effects, with a 500% increase in acute toxicities such as mucositis and dysphagia between 1991 and 2000.⁹ HNC survivors face a plethora of long-term treatment-related functional deficits including lymphedema, fibrosis, dysphagia, speech and communication difficulties, trismus, neck and shoulder dysfunction, xerostomia and mucositis, and anxiety, fatigue, and depression.^{4,6,10} As a result, patients often

¹Department of Otorhinolaryngology-Head and Neck Surgery, University of Pennsylvania, Philadelphia, Pennsylvania, USA

²Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania, USA

³Department of Otolaryngology-Head and Neck Surgery, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

⁴Penn Libraries, University of Pennsylvania, Philadelphia, Pennsylvania, USA

⁵Jefferson Center for Connected Care, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

⁶Department of Emergency Medicine, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

⁷Department of Hospice and Palliative Care, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

⁸Department of Medical Oncology, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania, USA

⁹Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Corresponding Author:

Leila J. Mady, MD, PhD, MPH, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, MD 21287, USA.

Email: lmady1@jh.edu

require long-term support and management of their symptoms both during treatment and throughout the cancer journey.

The importance of understanding and addressing life after cancer has been recognized nationally. Survivorship care is a discipline that aims to address the many short- and long-term medical, psychosocial, interpersonal, financial, and functional consequences of cancer and its therapies faced by survivors and their friends, families, and caregivers.² It requires frequent multidisciplinary follow-up visits to manage the physical and psychological implications of cancer and its treatment. The American Cancer Society established a focus on developing new models for the delivery of survivorship care as a research priority area,¹¹ and other professional societies and national organizations have followed suit. The American Head and Neck Society commissioned a committee on survivorship¹² and published a primer with an HNC treatment summary template.¹³ Additionally, the National Comprehensive Cancer Network published clinical practice guidelines¹⁴ and patient guidelines¹⁵ for cancer survivorship.

The coronavirus 2019 pandemic pushed telehealth to the forefront of healthcare delivery across multiple medical domains.¹⁶ Telehealth is an emerging model of care delivery that implements digital information and telecommunications systems to deliver healthcare, health education, and health information services remotely, with the goal of reducing costs and barriers to these resources while providing effective patient care.^{17,18} It comprises a variety of mechanisms of remote healthcare delivery, including synchronous and asynchronous consultations, video and audio technologies, telecommunications platforms (eg, email, text messaging, WeChat), mobile health (mHealth) applications or devices, and web-based/online portals.¹⁸ From surgery and oncology to psychiatry and preventive medicine, telehealth services have been rapidly adopted over the past 2 years, fueled by the need to minimize in-person interactions and travel and by federal stimulus packages enacted in March 2020 that expanded Medicare coverage of telehealth services.^{16,19} Remote (web-based) health encounters increase convenience and decrease costs for both patients and providers while helping to overcome barriers of distance and access to quality care.^{19–21} This is especially true for the expertise of specialists, who are often not evenly distributed geographically.²²

Cancer survivorship care is a healthcare domain that may particularly benefit from telehealth integration. Teleconsultations have the potential to enhance coordination and collaboration of the complex multidisciplinary (and often multi-institutional) teams necessary to care for the specialized needs of HNC patients; teams which often require physicians, nurses, nutritionists, speech pathologists, dentists, social workers, psychosocial oncologists, and physical therapists.^{23,24} The implementation of telehealth in survivorship care may also address the inequity of access to HNC specialists faced by patients living in remote locations, thus offering institutions the

ability to cast a wider geographic net.^{23,25} Finally, beyond geographic barriers, HNC patients face additional disease-specific barriers to care: HNC and its treatments can leave patients with facial disfigurement,^{26–28} speech dysfunction,²⁹ and psychological distress,³⁰ which can lead to their physical or social isolation.^{24,31,32} This isolation may be overcome with telehealth technologies that reach patients in the comfort of their own home.²⁴

While the tremendous potential for telehealth in cancer survivorship care is evident, there remains a paucity of evidence regarding the overall feasibility of telehealth models for HNC survivorship care. Our objective was to conduct a systematic review to evaluate the feasibility of telehealth survivorship care for HNC, focusing on peer-reviewed evidence of feasibility outcomes and cost-effectiveness of various telehealth interventions between 2005 and 2021. In this investigation, we focus on survivorship services which address the assessment and management of the physical and psychosocial effects of HNC and its treatment, health promotion, and care coordination. Though the diagnosis and surveillance of HNC and screening of secondary primary cancers are acknowledged components of comprehensive survivorship care, the role of telehealth in these activities is outside the scope of this study. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines³³ and Population, Intervention, Comparator, Outcome, Study (PICOS) design framework were implemented to formulate our research question and search strategy.

Methods

Database and Literature Search

The search methodology and study selection utilized in this review were constructed by the research team (E.D.R., M.A., and L.J.M.) in concert with an academic librarian (F.C.), and were conducted in accordance with the PRISMA guidelines.³³ The search strategy was constructed based on the PICOS framework as follows:

Population: Adult patients with HNC.

Intervention: Telehealth survivorship care, as defined by the implementation of any digital information or telecommunications systems to deliver survivorship care, including, but not limited to, both synchronous and asynchronous consultations, video and audio technologies, telecommunications platforms (eg, email, text messaging, WeChat), mHealth applications or devices, and web-based/online portals.

Comparator: Standard survivorship care (when possible).

Outcomes: Any quantitative feasibility outcome, including, but not limited to: enrollment, retention and attrition rates, rates of compliance or engagement, patient satisfaction, usability

ratings, task completion rates, cost, and acceptable agreement with the standard of care.

Study design: Randomized and nonrandomized studies with an $n > 1$.

We did not exclude studies lacking a comparator or control group to find as many relevant citations as possible.

An electronic search for all feasibility studies on telehealth models for HNC survivorship care was conducted using the Ovid MEDLINE, Embase, Scopus, and CINAHL databases from 2005 to 2021. A search for published, peer-reviewed studies was conducted using the terms “head and neck cancer” and “telehealth,” and their synonyms. Search queries were optimized for each specific database and can be found in full in Supplemental Appendix 1, available online.

Study Selection

Two independent raters (E.D.R. and M.A.) reviewed the titles and abstracts of the identified studies. Studies were included if they were peer-reviewed English language publications evaluating an electronic telehealth survivorship program for patients >18 years with HNC. Citations were excluded if they were a review, conference proceeding, opinion paper, or guideline. The text of the remaining studies was then reviewed in full by 2 independent reviewers (E.D.R. and M.A.). Additional exclusion criteria applied during the full-text review were if: (1) studies discussed a screening, diagnostic, or remote patient monitoring technology, (2) a designated survivorship program was not performed, or the article did not specify the survivorship program that was implemented, (3) a mixed (multiple tumor types) or irrelevant patient population was used (eg, esophageal or gastrointestinal cancers, retinoblastoma, and other ocular tumors), and (4) the study outcomes did not include a quantitative feasibility outcome. In all cases, discrepancies were resolved by consensus or via discussion with a third rater (L.J.M.).

Data Extraction

One reviewer (E.D.R.) extracted the following data from each article: study characteristics (first author, title, year of publication, country, funding source, study design), study aim, intervention details (survivorship program category, intervention type), patient population (sample size, patient inclusion and exclusion criteria), quantitative feasibility measures and outcomes (eg, enrollment, retention rate, attrition/dropout rate, compliance and engagement rate, positive or negative survey feedback, usability ratings, patient satisfaction, task completion rates, time-to-care, distance traveled, agreement with the standard of care), and quantitative treatment-related outcome measures and findings (eg, MD Anderson Dysphagia index [MDADI], health-related QOL, pain intensity or

symptom burden scores). Any additional feasibility outcomes that were presented were also recorded, and their results were collected. Primary and secondary outcomes of interest were intervention feasibility and cost-effectiveness, respectively. Data were abstracted into a standardized collection form and verified by a second reviewer (M.A.).

Risk of Bias Assessment

Study quality was assessed independently by 2 reviewers (E.D.R. and M.A.) using the mixed methods appraisal tool (MMAT),³⁴ a critical evaluation tool designed for the systematic appraisal of qualitative research, randomized controlled trials (RCTs), nonrandomized experimental studies (NRES), quantitative descriptive studies, and mixed methods studies. For each study design, the MMAT has 5 evaluation criteria, each rated “Yes,” “No,” or “Can't tell.” Ratings for each criterion were coded +1, -1, and 0, respectively, and summed to calculate an overall score for each study to provide a general assessment of its methodologic rigor, as previously described.³⁵ For RCTs and NRES, we rated “Did the participants adhere to the assigned intervention?” as “No” when adherence rates were below 50%; “complete outcome data” was defined by a dropout rate of less than 20%, as previously implemented in the literature.^{35,36}

Quality assessment scores were also visually displayed via a harvest plot, in which each bar corresponds to 1 article, with the height of each bar corresponding to the article's overall MMAT score, and the color of each bar indicating the telehealth intervention type. Programs were sorted into 3 groups—favors telehealth, no difference/no comparison or control group, and favors control—based on the feasibility results presented. Studies with mixed feasibility results or without a control group were placed in the “No difference/No comparison or control group” column, while those with feasibility results that favored the telehealth survivorship model (intervention) over the standard model of care (control) were placed in the “Favors telehealth intervention,” and vice versa.

Results

Study Selection

The systematic literature search identified 1557 studies; after deduplication, 816 studies remained for screening, and 82 full-text records were assessed for eligibility. Ultimately, 38 studies met the inclusion criteria and were included for analysis. A PRISMA flow diagram demonstrating search results and the study selection process can be found in **Figure 1**. Studies that might appear to meet inclusion criteria but were excluded upon full-text screening included: Schuit et al,³⁷ which was not specific to HNC patients; Giannoula et al,³⁸ which was a research protocol and thus excluded for wrong study design and

outcomes; and Cnossen et al,³⁹ which did not present any quantitative feasibility outcomes data.

Patient and Study Characteristics

Study characteristics are shown in Supplemental Appendix 2, available online. Overall, 2085 patients were included across the 38 studies. Studies were commonly conducted in the United States ($n = 12$, 32%), Australia ($n = 9$, 24%), the Netherlands ($n = 4$, 11%), and Canada ($n = 4$, 11%). Telehealth feasibility was assessed in multiple survivorship domains, including self-management and symptom burden management ($n = 13$, 34%), swallowing and dysphagia ($n = 8$, 21%), care delivery and follow-up ($n = 8$, 21%), voice or speech and language pathology ($n = 4$, 11%), physical therapy (PT)/physical activity ($n = 3$, 8%), and 1 study each on health information support and body image disturbance in HNC survivors. A variety of telehealth modalities were implemented; the most implemented technologies were mHealth applications/devices ($n = 11$, 29%), video telehealth services ($n = 9$, 24%), and web-based and online programs

($n = 8$, 21%). Telephone consultations/interventions and messaging-based interventions were investigated in 13% and 10% of the studies, respectively. Most of the studies were completed recently, with 76% conducted in the last 5 to 6 years. There were 11 (29%) RCTs and 18 (47%) NRES. Studies frequently recruited patients directly from clinics (55%), while 18% recruited in-hospital patients that were admitted or had recently undergone surgery for their HNC.

Feasibility Outcomes

The most common feasibility outcomes evaluated across the 38 included studies were enrollment and attrition rates, adherence/task completion rates, patient satisfaction, and user feedback surveys (Supplemental Appendix 3, available online).

Programs in the care delivery and follow-up, self-management/symptom burden, and physical activity/PT survivorship domains demonstrated weighted mean enrollment and attrition rates of 48.5% (range, 20.8%-85.7%) and 14.9% (range, 7%-47.7%), respectively.

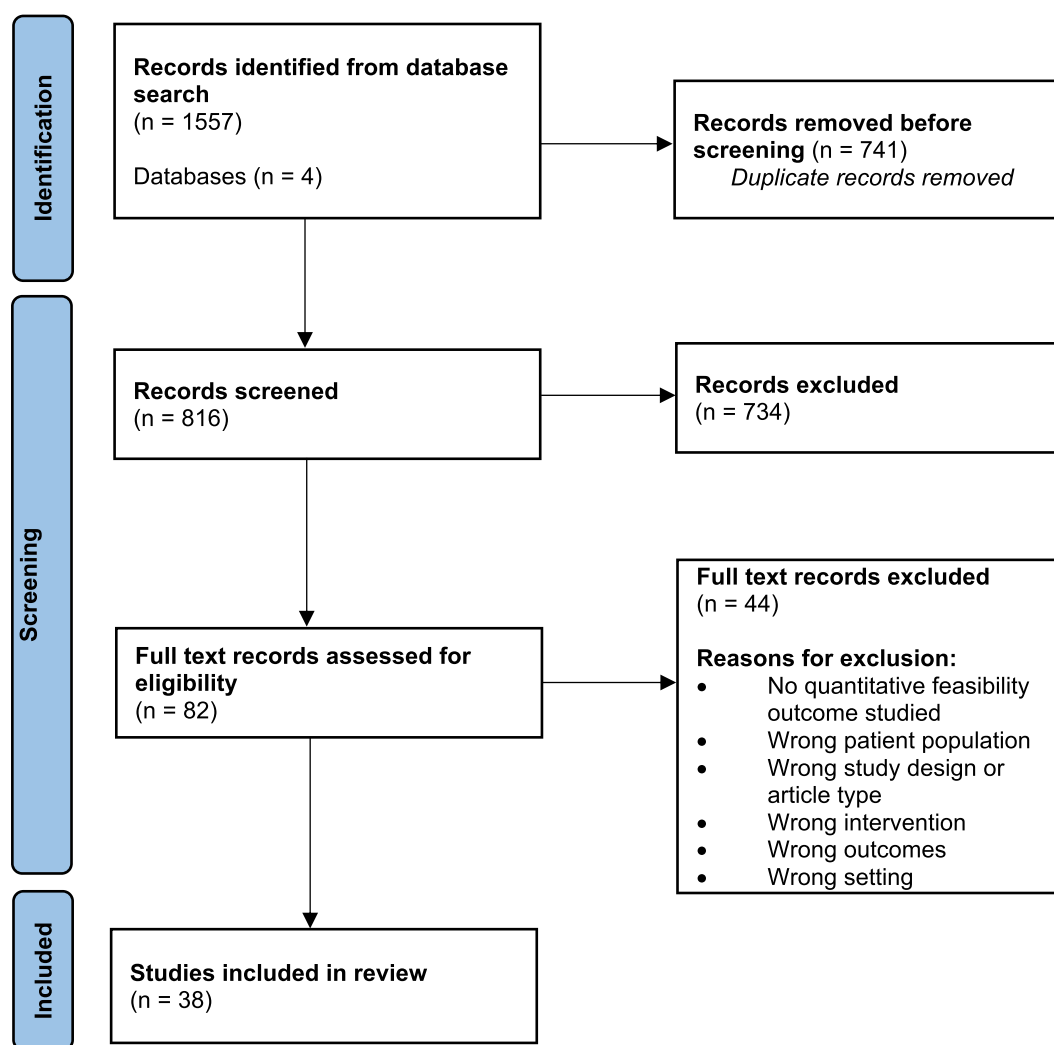


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram demonstrating literature search process and study selection.

The symptom management survivorship domain had the widest range in enrollment rates, with a low of 20.8% in a study pilot testing a web-based self-management tool (“Empowered Survivor”) that encouraged oral self-exams and head and neck strengthening exercises,⁴⁰ and a high of 85.7% in a study by Kilbourn et al⁴¹ that implemented a telephone-based coping and stress management intervention. The lowest mean attrition rate was in the care delivery/follow-up domain (12.2% vs 17.0% physical activity vs 20.6% self-management); Kilbourn et al⁴¹ reported the highest attrition rate of 47.7%.

Studies demonstrated good adherence, with an overall mean task completion rate of 70.7% (range, 19%-100%). Beyond task/session completion, device usage, and exercise participation, other methods of adherence quantification included a 10-point engagement scale (reported 9.1 by Wang et al⁴²) and usage grade (91%, $n = 51$ in Duman-Lubberding et al⁴³). Of the studies that implemented a control comparison group, mean adherence in the intervention and control groups were 46.8% and 16.6%, respectively, with an average of 30.2% higher adherence in the intervention cohort. One 2020 study by Manne et al⁴⁰ found that an e-health self-management intervention increased oral-self exam, swallowing exercise, and muscle exercise completion by 11%, 21.3%, and 22.3%, respectively, from baseline to patients' second follow-up 6 months later.

Studies also demonstrated good patient satisfaction with and positive feedback about telehealth models of survivorship care. The weighted mean patient satisfaction rate was 65.6% for the telehealth interventions. For those studies that reported a patient satisfaction score, patient satisfaction was high when assessed via the Functional Assessment of Chronic Illness Therapy Treatment Satisfaction questionnaire (mean 3.54/4),^{23,44} a 4-point (mean 3.5/4)^{42,45} or a 5-point (mean 3.86/5)⁴⁰ patient satisfaction score. Average usability ratings were high, with a weighted mean usability rating of 94.6%. Other studies highlighted that patients found the mHealth application “useful”⁴⁶ and that a web-based self-management intervention can help patients gain “increased understanding” of their diagnosis.⁴⁰ The included studies presented inconclusive results regarding whether patients preferred telehealth⁴⁷ or standard models of care.⁴⁸

Cost Utility of Telehealth Survivorship Model

Of the 38 included studies, only 5 (13.2%) included a cost analysis of the telehealth survivorship intervention described, with 3 of those 5 providing a statistical analysis of the cost savings incurred via the telehealth model when compared to standard of care (**Table 1**).^{44,49-52} Studies with cost analyses were found in the care delivery and follow-up, speech/voice, and swallowing/dysphagia survivorship domains, and each found the telehealth model of care to be less expensive than the standard model of care. The studies found that the telehealth models saved health

systems, on average, \$642.33 per patient ($n = 3$ studies), primarily derived from staff cost savings. One article by Mishra et al⁴⁹ reported that patients saved approximately \$111 and 7 days of work time per tele-follow-up visit. Patient savings were most commonly driven by decreased travel and parking costs.^{44,49,51} Of the studies that provided a statistical cost analysis, all 3 found significant savings in survivorship care provided via the telehealth model compared to the standard model of care ($p < .05$). Although Wall et al⁵² found that the telehealth model was significantly more expensive than a third, patient-directed, model of care, the telehealth model of care was nevertheless deemed more cost-effective than this patient-directed model: the telehealth model yielded clinically significantly superior QOL at the end of CRT, but for comparable costs (absolute cost difference of only \$54.30).

Study Quality Analysis

Quality analysis of the included studies was performed using the MMAT, and an overall score (range -5 to 5) was calculated for each study. The quality of the included studies ranged from -3 to 5 , with the most common overall score being 3 ($n = 18$, 47.4%). The mean overall score was $2.8 (\pm 1.5)$. Results of the quality assessment can be found in **Figure 2** and in the harvest plot in **Figure 3**.

Discussion

Given the need for and importance of HNC survivorship care, and the recent growth in telehealth models of healthcare delivery, we aimed to evaluate the overall feasibility of telehealth survivorship care for patients with HNC. Based on the outcomes provided in the 38 included studies, we were able to assess telehealth survivorship care via 5 main feasibility outcomes (enrollment, patient and provider satisfaction, adherence, and attrition), cost-effectiveness, and treatment-related outcomes. Results from this scoping review suggest that telehealth programs focused on HNC survivorship are cost-effective and have acceptable enrollment rates (48.8%), adequate adherence (70.7%) and patient satisfaction (65.6%), and high usability ratings (94.6%). These models of care are also associated with improved physical and psychosocial cancer-specific symptoms associated with disease and treatment.

Enrollment

There was a wide range of enrollment rates (20.8%-85.7%) across included studies. It is important to note, however, that all but one of these studies had enrollment rates between 64% and 85.7%, consistent with acceptance rates previously published in the literature.⁵³ The study with the lowest enrollment rate (20.8%)⁴⁰ was a pilot study that implemented 2 settings for patient enrollment: outpatient oncology clinics and the New Jersey State Cancer Registry. There were much lower enrollment rates

Table 1. Cost Savings of Telehealth Survivorship

First author, year	Survivorship program category	Cost outcome measure	Cost outcome	Conclusions
Mishra, 2009 ⁴⁹	Care delivery and follow-up	Mean costs saved per visit Mean work-time saved (days)	~\$111 (range, 56-556) 7 (4-12)	
Lyu, 2016 ⁵⁰	Care delivery and follow-up	Total cost savings per patient	\$15.9 (WFU \$13.5 vs TFU \$29.4)	
Burns, 2017 ⁵¹	Speech/voice	Total costs saved per referral Costs saved breakdown	\$99.56 \$58.53 in service costs, \$16.31 in travel costs, \$23.74 in time/wages saved	Statistically significantly cheaper to provide intervention via the telehealth MOC vs standard MOC (12% health service cost savings, $p = .0058$).
Collins, 2017 ⁴⁴	Speech/voice	Total healthcare cost saved per patient The total societal cost saved per patient	\$10 \$174	Statistically significant cost saving per person ($p = .002$) was observed in the telehealth MOC, largely driven by decreased travel and parking costs.
Wall, 2019 ⁵²	Swallowing/dysphagia	Costs saved breakdown Cost differential per patient (vs clinician-directed model)	\$68 in staff costs, \$164 in travel costs saved (\$58 in service costs added) \$1901.10 saved	SwallowIT was significantly less expensive than the clinician-directed model ($p < .001$), but significantly more expensive than the patient-directed model ($p < .001$).
		Cost differential per patient (vs patient-directed model)	\$54.30 lost	

Abbreviations: MOC, model of care; TFU, telephone follow-up; WFU, WeChat follow-up.

Qualitative Studies	Qualitative approach appropriate?	Data collection methods adequate?	Findings adequately derived from data?	Results interpreted sufficiently by data?	Coherence in data, analysis, and interpretation?	Overall score
Head, 2009	😊	😊	😊	😊	😊	5
Quantitative Randomized Controlled Studies	Appropriate randomization?	Comparable groups at baseline?	Complete outcome data?	Appropriate blinding?	Participant adherence?	Overall score
Lyu, 2016	😊	😊	😊	😊	😊	5
Burns, 2017	😊	😊	😊	😊	😊	5
Burns, 2017	😊	😊	😊	😊	😊	5
Collins, 2017	😊	😊	😊	😊	😊	5
Wall, 2017	😊	😊	😊	😊	😊	5
Di, 2018	😊	😊	😊	😊	😊	5
Badr, 2019	😊	😊	😊	😊	😊	5
Wall, 2019	😊	😊	😊	😊	😊	5
Wang, 2019	😊	😊	😊	😊	😊	5
Quantitative Non-randomized studies	Representative of target population?	Are the measurements appropriate?	Complete outcome data?	Confounders accounted for?	Intervention administered as intended?	Overall score
Ward, 2007	😊	😊	😊	😊	😊	5
Mishra, 2009	😊	😊	😊	😊	😊	5
Head, 2011	😊	😊	😊	😊	😊	5
Burns, 2012	😊	😊	😊	😊	😊	5
Crossen, 2014	😊	😊	😊	😊	😊	5
Crossen, 2016	😊	😊	😊	😊	😊	5
Duman-Lubberding, 2016	😊	😊	😊	😊	😊	5
Sosa, 2017	😊	😊	😊	😊	😊	5
Zini, 2019	😊	😊	😊	😊	😊	5
Graboyes, 2020	😊	😊	😊	😊	😊	5
Hogan, 2020	😊	😊	😊	😊	😊	5
Manne, 2020	😊	😊	😊	😊	😊	5
Wang, 2020	😊	😊	😊	😊	😊	5
Constantinescu, 2021	😊	😊	😊	😊	😊	5
Longobardi, 2021	😊	😊	😊	😊	😊	5
Teckie, 2021	😊	😊	😊	😊	😊	5
VanCleave, 2021	😊	😊	😊	😊	😊	5
Quantitative Descriptive Studies	Relevant sampling strategy?	Sample representative of target population?	Appropriate measurements?	Low risk of nonresponse bias?	Appropriate statistical analysis?	Overall score
Wall, 2016	😊	😊	😊	😊	😊	5
Wang, 2019	😊	😊	😊	😊	😊	5
Mixed methods Studies	Adequate rationale for mixed methods design?	Different components integrated?	Integration of qualitative and quantitative?	Divergences or inconsistencies addressed?	Components of study adhere to quality criteria?	Overall score
VanDenBrink, 2005	😊	😊	😊	😊	😊	5
Kilbourn, 2013	😊	😊	😊	😊	😊	5
Bender, 2016	😊	😊	😊	😊	😊	5
Wall, 2017	😊	😊	😊	😊	😊	5
Starmer, 2018	😊	😊	😊	😊	😊	5
VanCleave, 2019	😊	😊	😊	😊	😊	5
Constantinescu, 2019	😊	😊	😊	😊	😊	5
MacDonald, 2020	😊	😊	😊	😊	😊	5
Stewart, 2021	😊	😊	😊	😊	😊	5

Score calculation
😊 = +1 😊 = 0 😊 = -1

Figure 2. Results of the quality assessment of the included studies using the Mixed Methods Analysis Tool (MMAT), grouped by study design.

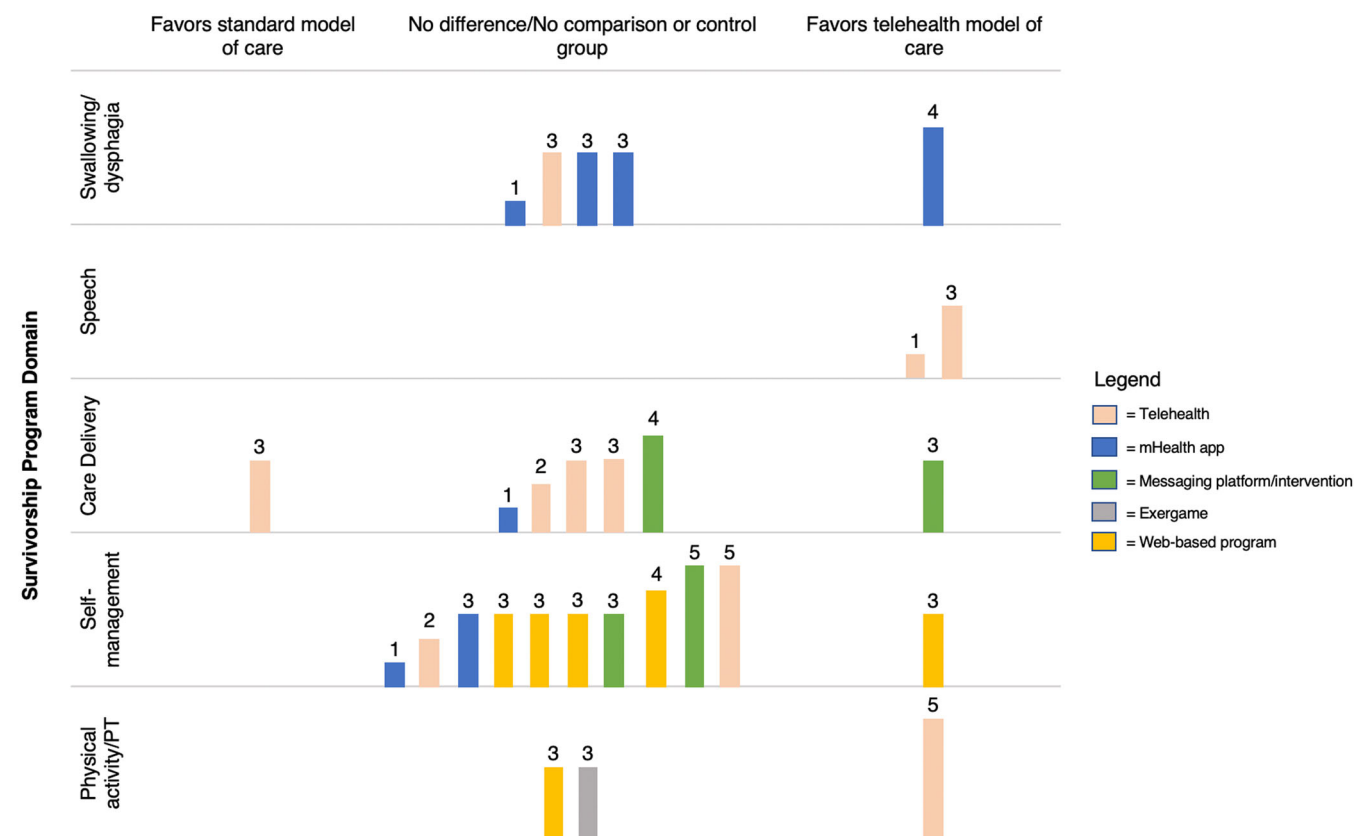


Figure 3. Harvest plot demonstrating the overall feasibility of telehealth survivorship programs by survivorship domain. mHealth, mobile health; PT, physical therapy.

through the state cancer registry, which decreased the study's overall enrollment rate to far below those demonstrated in the author's prior studies and in the literature. This demonstrates the importance of recruitment location and suggests that enrollment at a patient's treatment center may contribute to increased interest and participation in remote survivorship care services.

Satisfaction and Usability

Patient satisfaction was generally high, with a weighted mean satisfaction rate of 65.6%. In most studies, patients and clinicians reported higher satisfaction with the telehealth model of care compared to the standard model of care.^{23,44,54} Paradoxically, in 1 study, most patients (90.6%) were more satisfied with in-person specialist follow-up than telehealth, with less than one-third (26%-32%) agreeing they would be satisfied with telehealth-based follow-up options.⁵⁵ In this study, patients who were most satisfied with a telehealth model of care were patients who were further out from their diagnosis and patients who used the internet as a health resource. Other factors associated with greater satisfaction were higher education and health literacy.⁵⁵ Conversely, sociodemographic factors such as age and sex, clinical factors, and QOL metrics were not associated with mean overall satisfaction.⁴² This study emphasizes the need for individualized models of care. Although most research demonstrates significant patient and provider satisfaction with telehealth options, there is variability in perceptions and satisfaction with different models of care.

Usability ratings were high (85%-100%), demonstrating that telehealth survivorship programs are accessible to their target population. Percentage usage per patient was not associated with age, income, years of education, tumor stage, and percent poverty in the patient's zip code (intended to be a surrogate measure of the patient's socioeconomic status), although years of education and associated with poverty by zip code showed a trend towards significance.⁵⁶

Adherence

Included studies demonstrated a high overall adherence rate (70.7%) to telehealth survivorship programs. Compared to the standard of care, adherence rates were higher in the intervention groups implementing a telehealthcare model. Adherence to prophylactic swallowing exercises in HNC patients undergoing chemoradiotherapy is generally low, as treatment toxicities make intensive practice difficult. In a study assessing the telehealth service "SwallowIT," overall adherence rates were no more than 25%; however, "SwallowIT" and the clinician-directed models of care had higher adherence rates than patient-directed models of care. This reinforces the idea that adherence may be improved when patients have access to service models with greater structure and support, increasing their motivation and encouragement.⁵⁷ Another

study reported a similarly low adherence rate (29%), however, this rate was comparable to that in clinician-directed exercises.^{58,59} The home-based swallowing mobile system (mHealth) swallowing system demonstrated high adherence to the exercise regimen (84% in week 1 to 72% in week 6) and significant improvement in composite, emotional, and physical MDADI subscales.⁶⁰ Although clinician-centered care may hypothetically enforce patient adherence to treatment, these results show that telehealth models may be as effective.

Attrition

Attrition rates ranged from 7% to 47.7%.^{24,34,36,39,43,61,62} Of note, the study with the highest attrition rate (47.7%) was an outlier as compared to the rest of the studies, in which attrition rates varied between 7% and 17.6%. This outlier study, published by Kilbourn et al,⁴¹ assessed the feasibility of a telephone-based intervention to improve HNC symptom management and psychosocial care. Patients that were more likely to drop out of the study were commonly younger, divorced or never married, and employed full-time or on disability. When adopting a telehealth model of care, it is crucial to understand the sociodemographic factors influencing compliance and overall access to care and to tailor content and mode of delivery accordingly.

Other studies had high variability in reasons for attrition. Duman-Lubberding et al reported multiple reasons for patient dropout, including cancer recurrence, entering palliative care, comorbid illness, family circumstances, tiredness, and the inability to reach the patient by phone.³⁶ Interestingly, only 1 patient dropped out of this study due to circumstances related to the intervention in question: insufficient Internet skills. Reasons for attrition cited in other studies included poor compliance, missed appointments, relatives' absence, and unplanned surgery.^{43,62} One additional reason for dropout was the need to transfer a patient for an in-person visit, which highlights the need for a flexible mode of practice delivery, and emphasizes the role and potentially higher efficiency of a hybrid model of care.⁶²

Efficiency and Cost-Effectiveness

Telehealth was also shown to be more efficient than the standard model of care, allowing direct and multidisciplinary interaction between patients and various specialists (ie, clinicians, and speech pathologists). Telehealth survivorship programs were generally less costly and more cost-effective than in-person visits, although some studies showed only modest savings.^{44,50} Additionally, there was substantial work time saving per visit (on average, 7 days per visit).⁴⁹ This is specifically crucial in the HNC population, which has higher medical expenses and out-of-pocket costs as compared to patients with nonhead and neck malignancies.⁶¹ These costs persist beyond the treatment period due to morbidity, long-term functional

deficits, and unemployment.⁶¹ Telehealth may be integrated as a tool to help reduce the financial burden of HNC cancer. This highlights an important area requiring further research.

Treatment-Related Outcomes

Several studies assessed improvement in different treatment-related, functional, and psychosocial metrics in patients using telehealth options for survivorship (Supplemental Appendix 4, available online). Studies reported an improvement in different QOL assessments under telehealth models which were similar or superior to standard models of care.^{23,56,63,64} Furthermore, Head et al⁵⁶ demonstrated a significant correlation between the frequency of telehealth usage and physical and emotional subscale scores in QOL assessment tools during treatment. Telehealth applications were also associated with amelioration of the psychosocial, cognitive, and behavioral functions, such as a reduction in body image disturbance, anxiety, and depression.^{62,65}

Moreover, telehealth models of survivorship care were associated with an improvement in cancer-specific symptoms such as radiation-related fibrosis (eg, enhanced mandibular function, higher minimal interincisal opening); cancer-related fatigue, pain, appetite loss, dependence, and other physical outcomes such as cardiorespiratory fitness, balance, muscle strength, and shoulder forward flexion; as well as significant decreases in physiological care needs as compared to control groups.^{60,63,66-68} Patients in telehealthcare programs also had lower incidence and severity of treatment-related sequelae such as oral mucositis, xerostomia, and nasal obstruction.⁶³ Considering the burden and severity of HNC, these results underline the validity, effectiveness, and potential superiority of telehealth survivorship programs in improving patients' functional and psychosocial disabilities and QOL.

Digital Readiness

In this growing digital health revolution, fast internet access has been linked to social determinants of health.⁶⁹ Inequalities in access and use of technology among vulnerable and underserved patients with cancer have exacerbated the social and economic barriers to healthcare delivery and well-being. There is decreased access to technologies among racial and ethnic minorities, persons with disabilities, rural populations, older age groups, and individuals with lower socioeconomic status—a phenomenon referred to as the “digital divide.”⁷⁰ Elderly patients and patients with lower educational attainment are less willing to participate in telehealth visits, while patients of racial and ethnic minority heritages are less likely to use patient portals to manage their care. Patients with low economic status also have inadequate and inconsistent access to digital devices or the internet.^{71,72} Non-English-speaking patients struggle with digital healthcare due to language barriers.⁷³

The use of telehealth and patient-centered technologies may be a means to reach underserved communities,

especially in rural settings.⁷⁴ Yet, several barriers must be understood and mitigated. Educational level and health literacy have been identified as potential barriers and should be systemically evaluated. Content and format should be tailored to target appropriate digital and health literacy levels and to mitigate language and cultural barriers. While most studies have failed to assess and analyze potential barriers in disparate populations, specific tools to assess patients' readiness and willingness to participate in telehealth models of care should be established, and personalized programs should be developed to meet underserved populations' needs. An evaluation system to understand such factors may help inform clinicians of patients' access to technology, digital readiness, and specific needs. Such a tool might be used to identify barriers to care and guide management.⁷⁵ Finally, bandwidth and proper equipment must be provided to underserved communities by the government and policymakers to address the digital divide.⁷⁴

Limitations

While these results are promising, there are multiple limitations to this study. It was difficult to summarize all the findings and draw vigorous conclusions due to divergences in study design, methodology, type of intervention, and outcomes assessed. There is variability in reporting, in terms of outcome measures and tools used, limiting our ability to analyze the data comprehensively using statistical analysis. This furthermore limited our ability to directly compare telehealth interventions and modalities (such as telepractice vs eHealth applications, synchronous visits vs self-guided applications) and, therefore, to provide more conclusive information as to which telehealth programs are most effective. Most included studies had a small sample size and no comparator group, and patients had to own a smartphone or have access to the internet. These factors contribute to a selection bias and limit the external validity of our results. Methodological quality was weak due to confounding bias in nonrandomized trials, a lack of appropriate blinding in randomized trials, and a lack of adequate analysis of divergence and inconsistencies in mixed studies (**Figure 2**). Studies with larger, more diverse cohorts and robust design and methodologic techniques are needed to draw conclusions in support of telehealth survivorship programs.

Conclusion

Telehealth survivorship programs are feasible, cost-effective, and associated with improved patient outcomes. However, they might not be accessible or ideal for every patient. HNC care delivery models, including telehealth survivorship programs, should be individualized and tailored based on a patient's demographics, specific needs, and digital literacy. Further investigations are necessary to better understand where telehealth and virtual care models fit in the framework of cancer survivorship.

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This review was not registered on PROSPERO. The review protocol is available on request from the corresponding author, and the full search methodology and search terms utilized are available in Supplemental Appendix 1, available online.

Authors Contributions

Emma De Ravin, conceptualization, data curation, formal analysis, writing—original draft, writing—review and editing; **Maria Armache**, conceptualization, data curation, formal analysis, writing—original draft, writing—review and editing; **Frank Campbell**, study design, conceptualization, writing—review and editing; **Kristin L. Rising**, investigation, project supervision, writing—review and editing; **Brooke Worster**, investigation, project supervision, writing—review and editing; **Nathan R. Hadley**, investigation, project supervision, writing—review and editing; **Christopher E. Fundakowski**, investigation, project supervision, writing—review and editing; **David M. Cagnetti**, investigation, project supervision, writing—review and editing; **Leila J. Mady**, conceptualization, investigation, project supervision, writing—review and editing.

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ORCID iD

Emma De Ravin  <https://orcid.org/0000-0002-1076-1941>

Kristin L. Rising  <https://orcid.org/0000-0003-3882-4956>

David M. Cagnetti  <https://orcid.org/0000-0001-7039-3055>

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