

Technology-assisted screening of patient-reported functional outcomes in the head and neck cancer population: What's the evidence?

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Abstract

Introduction

There is growing recognition that patient-reported outcome assessment tools are important components in the holistic clinical management of patients with head and neck cancer. Single administration of such tools can provide insight into the incidence and prevalence of the many multifaceted and debilitating functional deficits experienced by this population, while routine screening using patient-reported outcomes can assist in the early detection of “at-risk” patients and serve as a process for monitoring functional status over time. To assist the implementation of routine patient-reported outcome screening in clinical practice, an emerging body of literature has begun to explore the use of technology to help collect and summarise data in real-time for clinical use. The purpose of this review is to appraise the current evidence-base for the use of technology-assisted screening of functional patient-reported outcomes in the head and neck cancer population and to identify areas of future research need.

Materials and methods

Online databases were searched for relevant papers published up to October 2013. In total, 44 papers were identified and appraised for suitability for inclusion in this review. Following critical review, seven publications were included in the final analysis.

Results

Findings from the reviewed publications demonstrated that technology-assisted screening of patient-reported functional status is feasible and has the potential to accurately capture the functional concerns of patients along the cancer trajectory of care. However, at present, the majority of studies exhibit methodological limitations that currently restrict the application of the findings to the broader clinical context.

Conclusion

Technology-assisted screening of functional status in the head and neck cancer population may be a solution to assist routine collection of patient-reported outcomes and optimise supportive care intervention, though further systematic research is needed. These applications have the potential to be used across cancer diagnoses, with both patients and carers, and throughout the continuum of care.

Introduction

Patients with head and neck cancer (HNC) undergoing definitive radiotherapy with or without chemotherapy [(C)RT] experience a multitude of negative health outcomes—manifesting both as acute side-effects during treatment and perpetuating as chronic complications long-term

post-treatment. Debilitating sequelae, including impairments to swallowing and salivary function, changes in voice quality, unintentional weight loss, nutritional deficiency requiring alternative feeding, poor physical functioning, as well as fatigue and distress can have a debilitating impact on quality of life (QoL), creating considerable survivorship burden for these patients¹⁻³. Thus, minimising the impact of (C)RT and improving functional outcomes for this population is a priority issue in supportive cancer care.

To this end, international cancer agencies⁴⁻⁶ and researchers⁷ have recommended the regular involvement of allied health professionals, including speech-language therapists (SLTs), to provide supportive care during and following non-surgical treatment for HNC. This supportive care may extend indefinitely for those with chronic swallowing and/or nutritional impairments. Unfortunately, international surveys of clinical practice have demonstrated that there are insufficient specialist services available to deliver this recommended intervention, which has the propensity to deprive HNC patients of access to best-practice care^{8,9}. Thus, it is necessary to find an alternate service model whereby HNC patients most at-risk of swallowing impairment, malnutrition and distress have adequate access to supportive care intervention, within current staff and service constraints. A potential solution to assist in the early identification of and timely intervention for these patients is to implement routine screening during HNC treatment.

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In response to this recognised need for service delivery change, the past two decades have witnessed a shift towards the increasing use of patient-reported outcomes (PROs) in HNC management. This has facilitated the capture of subjective patient perspectives regarding not only the physical, but also the psychosocial effects of treatment, and has assisted in collating holistic and synergistic data to monitor overall patient function across the treatment continuum¹⁰. A number of PRO measures have been developed and validated as screening tools to monitor a range of clinical and functional outcomes, including symptom burden before beginning (C)RT¹¹; side-effects, swallowing and nutritional status, distress/anxiety and health-related QoL during treatment^{12–14}; and even global status change for patients in remission¹⁵. Such tools have been shown to be feasible in detecting clinically significant changes in patient function¹⁶, and are recognised as important secondary outcomes by treating oncologists¹⁷. However, the clinical applicability of PRO screening tools has been questioned, in relation to interpretability and the ability to draw clinical meaningfulness in a timely manner, particularly for clinicians unfamiliar with the tool¹⁷.

In light of these shortfalls, recent research has suggested that the implementation of PRO-based screening tools into routine clinical practice may be assisted by the use of technology. Computer-assisted screening has the capacity to synthesise and display results in real-time, and allows clinicians to quickly focus on the aspects of care requiring priority and/or further investigation^{18,19}. Computerised screening of QoL has already been used in other cancer populations, including breast, lung and cancer pain clinics^{20,21}. This research has demonstrated that technology-assisted QoL screening is feasible and results in a more productive use of waiting room

time, greater efficiency of patient assessment processes and improved recognition of holistic aspects of patient care. Similarly, tele-monitoring of patients' symptoms throughout treatment has been shown to be feasible and well-accepted by patients to provide support and education to manage side-effects^{22,23}. However, the application of technology-assisted PRO screening to the HNC population is still in a nascent stage of development. Therefore, the purpose of this review is to critically analyse the current evidence for the use of technology-assisted screening of functional PROs in the HNC population, as a method of facilitating early detection and appropriate intervention for at-risk patients.

Materials and methods

PubMed, Medline, ScienceDirect, SpringerLink, CINAHL and Wiley databases were searched for electronic publications in English published in peer-reviewed journals up to October 2013. The following medical subject headings (MeSH) search terms were used: head and neck neoplasms, radiotherapy, chemoradiotherapy, deglutition and deglutition disorders. Additional search terms included head and neck cancer, patient reported outcomes, computerised screening, computerised monitoring, screening + technology/computer, swallowing, speech, nutrition, distress, quality of life and emotional well-being. Subsequently, the reference lists of identified studies were manually searched for additional relevant publications.

Studies were included if: (1) patients were adults diagnosed with HNC; (2) at least one functional endpoint relating to patient care was screened using a validated PRO (swallowing, nutrition, distress, anxiety, depression, health-related or general QoL); and (3) screening was conducted using a technology-assisted medium (including computer/tablet-based interface or web application). Of the 46 papers identified following initial

searching, 37 were excluded following perusal of their abstracts: 14 papers did not use technology-assisted methods, 21 were not specific to the HNC population, two were reviews/editorials and two did not use validated PRO measures. This left a total of seven studies eligible for inclusion in the final review (Table 1)^{24–30}. Six of the seven papers were investigated by two research groups.

Results

All papers that met the study criteria (Table 1) reported on participant cohorts with heterogeneous disease sites. All used variations of a touch-screen-based system, with three papers (authored by the same research group) describing a customised Microsoft Access program, and the remaining reporting various commercially developed self-designed systems (Table 1). Reported functionality in the systems consisted mostly of multiple-choice input and rating scales. Researchers of one study²⁸ reported their device to be “small and portable” suggesting a tablet-based application, while others described a more static desktop computer system²⁴. However, collectively, specific detail pertaining to the design and nature of the computerised screening medium was limited across the majority of studies.

The seven papers used a range of validated tools to screen patients' functional status electronically, including questionnaires examining: overall QoL, QoL aspects specific to HNC management—particularly in regards to speech and swallowing function; anxiety and depression, pain, general distress and distresses specifically related to treatment. All but one paper used two or three questionnaires in their screening tools.

While the studied cohorts, technology and questionnaires trialled were relatively consistent among the included papers, study methodology and purpose varied. The research objectives of the current evidence

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Table 1 Studies included for review detailing study design, the number of participants, site and treatment of disease, patient-reported outcome measures used and the timing/method of electronic screening								
First author	Year	Study design*	N	Site of disease	Treatment (Tx)	PRO measures	Technology	Screening time-points
Crossen ²⁴	2012	Descriptive case series: pre-test/post-test	67	Oral cavity, oropharynx, hypopharynx, larynx	Surgery, RT ^a , ChemoRT ^b , multimodality	EORTC QLQ-C30 ^c EORTC QLQ-H&N35 ^d HADS ^e	"OncoQuest" Touch screen computer-based system	Pre-Tx (time of diagnosis) 1 month post-Tx
de Bree ²⁵	2008	Descriptive case series: pre-test/post-test	196	NR ^f	NR	EORTC QLQ-C30 EORTC QLQ-H&N35 HADS	Touch screen computer-based system + perceptions questionnaire	Pre-Tx (time of diagnosis) 3, 6, 9, 12, 18 months post-Tx
Ghazali ²⁶	2012	Cross-sectional study	204	Oral cavity, oropharyngeal, other	Free-flap surgery, RT	PCIg UWQoLh	Touch screen computer-based system	18 months ^{**} post-diagnosis
Maher ²⁷	2013	Cross-sectional study	436	Mixed (>5 sites)	NR	Numerical Pain Rating Scale Distress Thermometer PSYCH-6	"QUICA-TOUCH" touch screen computer-based system	Before receiving prognostic information or Tx
Millsopp ²⁸	2006	Cross-sectional study	41	NR	Surgical and non-surgical (unspecified)	UWQoL	Touch screen system + semi-structured interview	At time of medical consultation (unspecified)
Rogers ²⁹	2009	Cross-sectional study	123	Oral cavity, oropharynx, salivary gland, other	Free-flap surgery, primary RT, multimodality	PCI UWQoL	Touch screen computer-based system	Immediately prior to medical consultation
Verdonck-de Leeuw ³⁰	2009	Descriptive case series: pre-test/post-test	55	Oral/oropharynx, larynx/hypopharynx, other	Surgery, RT, ChemoRT, multimodality	EORTC QLQ-C30 EORTC QLQ-H&N35 HADS	"OncoQuest" Touch screen computer-based system	Pre-Tx (time of diagnosis) 4.2 months ^{**} post-Tx

^aRadiotherapy; ^bradiotherapy with concomitant chemotherapy; ^cEuropean Organisation for Research and Treatment of Cancer Quality of Life Core questionnaire; ^dEuropean Organisation for Research and Treatment of Cancer Quality of Life Head and Neck Specific questionnaire; ^eHospital Anxiety and Depression Scale; ^fNot reported; ^gPatient Concerns Inventory; ^hUniversity of Washington Quality of Life questionnaire.
*Based on NHMRC Levels of Evidence descriptors.
**Denotes median screening time-point.

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base were classifiable into two categories: (1) to evaluate the viability of administering computer-assisted data collection^{25,28} and/or (2) to determine the prevalence of particular functional deficits using an electronic screening method^{24,26,27,29,30}. The majority of the studies used single-use, cross-sectional sampling methods at varying time-points post-treatment. The remaining three studies used a pre/post-(C)RT treatment testing design to monitor change in patient function over time. Only one study²⁵ reported multiple post-treatment assessment points.

Due to the nature of these objectives, a common limitation in the included studies was that the data obtained from the electronic screening systems was not translated to inform supportive care intervention. Only one study²⁶ actively explored the use of computerised screening to detect and facilitate referrals for multidisciplinary care—in which 26% of patients identified as having speech/swallowing difficulties post-screening were previously not known to the treating SLT, and with a proportion requiring referral for subsequent intervention. The authors concluded that the use of this electronic screening paradigm could provide a ‘safety net’ to detect patients who would otherwise fail to receive necessary follow-up for their functional difficulties. Unfortunately, the other six papers reported no data regarding the frequency of follow-up or referrals made to address the results obtained from the screening process. Authors of two studies^{27,30} recognised this issue as a methodological shortfall of their research. One paper²⁵ reported that their electronic system had the capacity to generate a graphical summary of patients’ scores, which could be sent to the treating physician for routine clinical use. However, it did not discuss how the results of the questionnaires impacted the nature of patient care. Thus, the current scope for technology-assisted PRO screening to influence

clinical decision making in the multidisciplinary care of HNC patients is limited in the existing evidence base.

The included papers also varied in the extent to which the online delivery system was validated. As previously discussed, many were simply feasibility studies or focused on the prevalence of functional deficits in their respective patient cohorts. No studies explicitly focused on establishing the sensitivity and/or specificity of this novel service delivery model to examine true diagnostic equivalence as compared to the standard administration of the questionnaires (i.e. face-to-face paper-based)³¹. Two studies^{24,30} attempted to compare the prevalence of functional deficits detected by electronic screening to those obtained through direct or paper-based methods, as a gauge of the reliability of the computerised tools. However, both of these studies used historical controls from other research with varying inclusionary criteria and assessment methods which restricts the conclusions that can be drawn. Furthermore, the majority of studies stated that the computerised screening tools were quick and easy to complete, with four papers specifying the time on average for patients to complete the questionnaires (mean 8.175 min; range 7–9 min). However, as all studies lacked a direct comparison to the standard paper-based versions, they failed to quantify the time equivalence for using the online method.

Finally, with regard to the evaluation of consumer perceptions, only three of the seven papers included data relating to patients’ appraisal of the computerised assessment process. Collectively, patients’ perceptions of the computerised tools were largely very positive, and the systems were deemed simple to use. Semi-structured interviews conducted by Millsopp and colleagues²⁴ indicated that despite over 75% of the cohort having never used a computer, the majority of patients thought that they would prefer the computerised screening

method compared to a standard paper-based version. Another study revealed that the patients were also willing to complete as many questionnaires as was deemed necessary when using the system²⁸. Research by Rogers et al.²⁹ also showed that most patients thought completing the screening tool made a difference to the nature of the face-to-face consultation, including that it made it “a bit more personal”, “remind[ed] them of the points they want discussed” and “allow[ed] the consultation to get straight to the point”. This suggested that the use of technology-assisted screening of patient-reported concerns could potentially allow targeted face-to-face discussion on the most relevant issues and provide more efficient use of outpatient clinic time. This was a sentiment shared by a number of the papers; however, no study rigorously explored the impact of screening on service change—no data was presented relating to the timeliness of referrals for follow-up multidisciplinary care, numbers of unnecessary consultations that were avoided, or health economic analysis of this model of care as compared to standard face-to-face consultation. Furthermore, no included study to date examined clinician perceptions of the use of computerised PRO screening.

Discussion

The purpose of this review was to coalesce the current evidence for the use of technology-assisted screening of PROs in the HNC population. Critical analysis of seven publications revealed that touch-screen-based systems are a feasible and insightful way of screening for patient-reported functional status and have the potential to optimise the efficiency and holistic care approach of HNC outpatient clinics. However, many of the included studies have similar methodological shortfalls, and these currently limit the assurance that ‘at-risk’ patients are being effectively triaged and referred

on for appropriate face-to-face intervention—which is a desired purpose of this innovative service delivery model²⁵.

While the current body of literature is limited, the heterogeneous nature of the HNC patient cohorts studied is a relative strength. This supports that technology-assisted screening could be viable for use in the routine clinical setting, which reflects a similar diversity in population. The variety in PRO measurements used to address multiple areas of potential functional deficit is also strength of the current research. This has positive indications that other PRO tools, which use similar simple multiple choice ratings/scales, could be successfully translated into an online environment—thus further broadening the scope of what can be addressed by computerised screening. Equally, this has implications for multidisciplinary care, whereby avenues for future research could include a suite of online screening tools addressing a wide range of functional PROs, depending on the needs of the patient, to make further advances in synergistic care for this population along the treatment continuum.

The consistent use of touch-screen-based computerised systems to facilitate the electronic monitoring of PROs among the included studies is aligned with broader literature, which deems touch-screen technology to be an effective tool to gather patient-related functional status information^{32,33}. While a number of studies reported using systems built by commercial software companies, all equipment appeared to be individualised and self-designed for the purpose of the study. An overall lack of specificity in the papers' methodologies about the functions of the systems hence limits the studies' repeatability to validate findings as well as the current capacity to facilitate roll-out and uptake into routine clinical practice elsewhere. This limitation is not surprising given that

research into application of technology-assisted PRO screening in the HNC population is still emerging, and is likely to be addressed as the body of evidence continues to grow.

The primary limitation observed across the majority of studies conducted to date was a lack of comparison and validation of findings with more conventional assessment methods. While it is acknowledged that the analysed studies have used validated measures or portions of multiple validated measures in their screening tools, researchers in the broader telemedicine paradigm have argued that diagnostic equivalence needs to be investigated and confirmed when the medium in which the measures are delivered has changed³¹. Ideally, a novel technology-assisted screening method should be compared against the current gold standard³¹. In this case, the gold standard is the conventional paper-based version or a face-to-face assessment with a relevant health professional by which the questionnaire was originally validated. Future methodologies need to use direct comparisons of data collected on both modalities (traditional gold standard and new technology-assisted methods), ideally in a blinded manner, to confirm the validity and sensitivity of electronic screening tools.

Another limitation of the existing research is the lack of systematic validation of how the information obtained from online screening was used to assist patient management. As previously stated, screening systems should be designed for the purpose of triaging patients and identifying aspects of a patient's care that requires further investigation³⁴. Therefore, ensuring that relevant members of the multidisciplinary HNC team are alerted based on the data obtained from screening is an essential area of future development. Some of the analysed papers specified parameters or cut-off points for their electronic systems to deem whether a condition

(e.g. distress) was 'present' or 'absent'. Perhaps a more clinically intuitive method would be defining parameters to determine the need for referrals for further clinical assessment and management. Exploration as to what is deemed a "clinically relevant change" in function, based on data obtained from screening tools, is a contentious issue and as such requires extensive further research¹⁶. In the meantime, however, once again, an equivalence methodology needs to be used, comparing the traditional method of practice and referral to that resulting from online screening, thus evaluating if the nature of clinical action taken following online screening is similar to traditional clinical practice. Moreover, levels of agreement between clinical judgement and detection by electronic screening could be investigated, as well as information regarding clinicians' judgements of suitable screening parameters as grounds for making referrals. Such research will help to refine the clinical meaningfulness and applicability of future screening systems and ensure that the data collected can be accurately used to direct multidisciplinary care.

Finally, for screening to be effective, it must use methods that are acceptable to patients and clinicians^{35,36}. Unfortunately, the current investigations are limited in their analysis of consumer perceptions and future research, therefore, requires a more comprehensive focus on the views of all stakeholders (i.e. patients, carers and staff), to negate any potential barriers to clinical implementation. Consideration of the economic feasibility of this new service delivery model as compared to current standard practice is also an essential area of future analysis, to facilitate the uptake of electronic screening into routine clinical care.

Conclusion

This review has critically appraised the current evidence for the use of technology-assisted screening of

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functional PROs in HNC patients, and their potential for facilitating accurate and prompt detection of, and intervention with, at-risk patients. Collective analysis has demonstrated that this novel service-delivery model is a viable triage tool and has the potential to inform and optimise supportive care intervention. This has positive implications for HNC patients who face often substantial functional difficulties both during treatment and long into the survivorship phase. It also has great potential for supporting carers, who may also be experiencing considerable distress or QoL disturbance as a result of their family member undergoing HNC management. The recognised limitations of the existing literature can be used to develop future feasibility studies with discriminating methodological rigour and focus on the clinical applicability of screening systems. Addressing such limitations is an avenue for further research and is necessary if technology-assisted screening is to be effectively and efficiently implemented in routine clinical practice.

Abbreviations list

CINAHL, Cumulative Index to Nursing and Allied Health Literature; (C)RT, chemoradiotherapy; HNC, head and neck cancer; MeSH, medical subject heading; PRO, patient-reported outcome; QoL, quality of life.

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