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ORIGINAL ARTICLE

The impact of automated screening with Edmonton Symptom Assessment System (ESAS) on health-related quality of life, supportive care needs, and patient satisfaction with care in 268 ambulatory cancer patients

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Abstract

Purpose We aimed to assess the impact of implementing Edmonton Symptom Assessment System (ESAS) screening on health-related quality of life (HRQoL) and patient satisfaction with care (PSC) in ambulatory oncology patients. ESAS is now a standard of care in Ontario cancer centers, with the goal of improving symptom management in cancer patients, yet few studies examine impact of ESAS on patient outcomes.

Methods We compared ambulatory oncology patients who were not screened prior to ESAS site implementation (2011–2012), to a similar group who were screened using ESAS after site implementation (2012–2013), to examine between-group differences in patient HRQoL, PSC outcomes, and supportive care needs (Supportive Care Service Survey). Both no-ESAS ($n = 160$) and ESAS ($n = 108$) groups completed these measures: the latter completing them, along with ESAS, at baseline and 2 weeks later.

Results After assessing the impact of implementing ESAS, by matching for potentially confounding variables and conducting univariate analyses, no significant between-group differences were found in HRQoL or PSC. There was significant improvement in symptoms of nausea/vomiting and constipation, after 2 weeks. Lower symptom burden with decreased ESAS scores was significantly correlated with increased HRQoL. There were no between-group differences in knowledge of/access to supportive care.

Conclusions Significant correlation between change in ESAS and HRQoL implies ESAS could usefully inform healthcare providers about need to respond to changes in symptom and functioning between visits. This study showed no impact of early-ESAS screening on HRQoL or PSC. Further research should explore how to better utilize ESAS screening, to improve communication, symptom management, and HRQoL.

Keywords Edmonton Symptom Assessment System · Health-related quality of life · Patient satisfaction with care · Distress screening · Ambulatory oncology

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Background

The incidence of cancer diagnoses in Canada continues to rise [1], and cancer-related symptom burden is recognized as a significant problem in treatment and survivorship. Late effects of cancer include fatigue, musculoskeletal problems, decreased activity, and sexual dysfunction [2]. Prevalence estimates of psychological distress vary, but depression and anxiety are more likely to be reported among cancer patients than those among the general population [2, 3], with depressive symptoms occurring up to three times more often in patients in the first 2 years of cancer diagnosis, compared to patients

with no cancer diagnoses [4]. High levels of psychological distress in cancer have been correlated with worse health outcomes [5], quality of life (QoL), function [6], and reduced treatment adherence [7]. Cancer patients report that their symptoms are not adequately managed [8–11], particularly emotional distress [12, 13]. Symptom screening is now recommended as a standard of care in cancer centers in North America [8, 9, 14]. Most studies have not found any impact of screening, but there is some evidence of benefit [15–18].

As part of Cancer Care Ontario's (CCO) Quality & Performance Improvement Strategy [19], Regional cancer centers employ ESAS symptom screening in ambulatory care. ESAS has nine items designed to assess the severity of commonly reported symptoms experienced by cancer patients, including pain, fatigue, drowsiness, nausea, dyspnea, depression, anxiety, well-being, and loss of appetite [18]. The goals of ESAS are to facilitate interprofessional and patient-healthcare provider (HCP) communication about symptoms and to improve symptom management [20, 21]. Patient-HCP communication may promote therapeutic alliance [22] and increase patient knowledge/understanding, empowerment and self-management [23], and thus health outcomes. Patients with greater satisfaction with care have greater compliance [24], retain more information, and engage in more health-seeking behaviors [25].

Though ESAS is moderately reliable in screening [26], recent reviews suggest the need for further research to test reliability outside of test-retest in cancer populations [27] due to changes in symptoms during treatment. There are mixed results regarding the validity, sensitivity, and specificity of ESAS in measuring physical and emotional symptoms [16, 26, 27], possibly due to lack of uniform instructions and definitions to help patients complete the ESAS screening to accurately reflect their symptoms [28]. It is difficult to aggregate findings on its efficacy due to limited high-quality validation studies, the use of modified versions of ESAS [26], with mixed findings regarding psychometric properties and uniform cutoffs [26, 27, 29, 30]. The revised ESAS (ESAS-r) is now favored by palliative care providers and patients [30, 31]. Although ESAS is a tool widely used by oncology patients and HCPs in Ontario [19], few studies to date have examined the impact of ESAS on patient outcomes [14, 32, 33].

This study examines the impact of ESAS (CCO had not yet introduced ESAS-r) on health-related QoL (HRQoL), patient satisfaction with care (PSC), and the relationship between change in ESAS and HRQoL scores. Supportive care service knowledge, utilization, and unmet needs were also examined in no-ESAS and ESAS groups at time 1 (T1).

Purpose and hypothesis

The purpose of this study is to assess whether ESAS screening had significant impact on patient outcomes. Participants in the ESAS group completed questionnaires at baseline and 2 weeks later, to allow sufficient time for communication and response to symptoms as a result of screening. This study explores differences between satisfaction and HRQoL in patients before and after ESAS screening was implemented. It was hypothesized that implementation of ESAS would result in (primary outcomes) improved symptom management and HRQoL, greater PSC, and (secondary outcomes) greater awareness of, and access to, supportive care.

Methods

This hospital ethics board approved the study comparing similar cohorts, before and soon after ESAS screening was implemented in ambulatory clinics in a regional cancer center. Consecutive patients in several disease sites were invited to participate and informed consent was obtained. A no-ESAS group (160 participants) was recruited before implementation of hospital-wide screening, and a ESAS group (108 participants) was recruited after staff training, soon after ESAS implementation. Please refer to Supplementary Fig. 1 for a method overview.

ESAS implementation

Staff training included one-on-one nurse training, followed by time-to-observe and model response in clinic. Nurses were introduced to the CCO evidence-based algorithms for responding to patients. Tools were created to streamline nursing documentation. During clinical care redesign, other team members were introduced to ESAS and their role in responding.

No-ESAS group: before ESAS implementation (2011–2012)

When patients checked in for their appointment, they were given an introductory study letter. If patients agreed, a researcher offered study participation. All participants completed study questionnaires (please refer to "Measures") during their appointment wait time; or mailed them back.

ESAS group: after ESAS implementation (2012–2013)

Soon after center-wide ESAS implementation, prior to their oncology appointment, patients were directed to ESAS kiosks to complete a computerized version of ESAS. Volunteers gave patients an introductory letter about the study. If patients agreed, a researcher offered study participation, excluding previous no-ESAS participants. Consenting participants completed the same study measures as the no-ESAS group at baseline (T1), and again 2 weeks later, participants were mailed the

same set of questionnaires (T2). Participants received up to two phone call reminders from the research team if questionnaires were not received by mail. Participants were free to withdraw from the study at any time, without impacting care.

Inclusion and exclusion criteria

Male and female patients, 18 years and over, in active treatment in oncology clinics (head and neck, genitourinary, gastrointestinal, lung, breast, and hematology), able to provide informed consent and complete study measures in English.

Cognitive impairments, debilitation such that participation would be burdensome for participants and/or safety concerns as determined by a researcher or staff or electronic patient record, were considered sufficient cause for exclusion/withdrawal. Participants who partook in no-ESAS were excluded from partaking in the ESAS group. No participants required withdrawal for safety concerns or urgent referral.

Measures

The *Demographics Questionnaire* contains basic patient information. This includes *age*, *gender*, *marital status*, *average income*, *disease-site group*, and *stage of cancer.*

HRQoL measures

The *European Organization for Research and Treatment of Cancer Quality of Life Questionnaire* (*EORTC-QLQ-C30*) is a self-report measure validated in oncology patients to assess HRQoL in the previous week [34]. It evaluates severity and frequency of emotional and physical symptoms using a 4-point scale, along with well-being. Higher scores reflect higher HRQoL for *global health status* (*GHS*) and *functional scales*, whereas higher symptom scores reflect higher severity.

PSC measures

The *Princess Margaret Hospital Patient Satisfaction Questionnaire* (*PMH/PSQ-MD-24*) has been validated and has good reliability in oncology patients. It assessed patient satisfaction with primary oncologist across two domains: *perceived physician support* and *physician disengagement* [35, 36].

The *European Organization for Research and Treatment of Cancer Outpatient Satisfaction with Radiation* and *Chemotherapy* (*EORTC-OUTPATSAT35 RT* and *CT*) self-report questionnaires measure patient satisfaction with quality of care/treatment, with domains related to doctors, nurses, and organization of care, and have been validated for use among ambulatory oncology patients [37] .

Supportive care measures

The *Supportive Care Service Survey* (*SCSS-21*) was designed by Sunnybrook Health Sciences Centre personnel to assess patient knowledge, use of available supportive care services, and unmet needs. It asks whether patients know about and/or have utilized a given service and, if not, whether they would have been interested in using these services.

Statistical methods

Statistical analyses were performed using Statistical Analysis System (SAS V9.4): two-sided tests were performed and were deemed significant if $p \leq 0.05$. Two post hoc within-subject power calculations [38] were conducted by considering mean change in the EORTC-QLQ-C30 *GHS* and *Emotional Functioning* score between no-ESAS and ESAS (T2). Assuming a 10-point difference for *GHS* between groups and a standard deviation of 20, 126 patients ($n_{\text{no-ESAS}} = 63$, $n_{\text{ESAS}} = 63$) were to be included ($\alpha = 0.05$, $\beta = 0.80$). In case of null findings, the difference between no-ESAS and ESAS (T2)—a conservative 5-point difference—was assumed for the *Emotional Functioning* subscale, and in the no-ESAS standard deviation of 22, 608 ($n_{\text{no-ESAS}} = 304$, $n_{\text{ESAS}} = 304$) patients were needed to detect a significant difference ($\alpha = 0.05$, $\beta = 0.80$).

Impact of ESAS on HRQoL, PSC, and supportive care

Descriptive statistics, with means, standard deviations, and percentages, were calculated for all demographic variables, including *age*, *gender*, *marital status*, *average income*, *disease-site group* and *stage of cancer*. Between-group differences were examined for HRQoL and PSC. Univariate comparisons between two groups (no-ESAS and ESAS) on demographic, clinical variables, HRQoL, PSC, and supportive care knowledge/utilization (SCSS-21) were conducted by applying two independent sample *t* tests and chi-square tests. Two selected groups of 29 patients were matched post hoc, for *gender*, *age group*, *cancer site*, and *stage of cancer*, for further analysis due to confounding factors possibly impacting the results. Further, a longitudinal analysis using a mixed-model examined *perceived physician disengagement* and *perceived physician support* variables of PSC, with ESAS *total score* at T1 as the independent variable, controlling for *age*, *gender*, and *time*. Independent sample *t* tests were computed to assess differences between no-ESAS and ESAS groups (at T1) in terms of supportive care knowledge/utilization (*SCSS-21*).

Relationship between change in ESAS scores and change in HRQoL

Pearson correlation coefficients were calculated to assess the relationships between ESAS and HRQoL at T1 and the relationship between change in ESAS (*physical*, *emotional*, and *total* scores) and change in HRQoL (*physical* and *emotional functioning* and *GHS*) at T1 and T2 in the ESAS group. For further validation, longitudinal analysis using mixed model examined *GHS* and *physical*/*role*/*emotional*/*social* functioning variables of HRQoL, with ESAS *total score* at T1 as the independent variable, controlling for *age*, *gender*, and *time*.

Missing data analysis

For all the scales used in the analysis, when at least half of the items from a scale were answered, overall scores were calculated based upon the items completed, by mean imputation. The standard scoring equation was modified by applying only completed items and the corresponding number of items. When at least half of the items were not answered or for any missing single-item measure, the scale score was set to missing.

Results

A total of 268 participants were recruited for the study. One hundred and sixty (59.7%) participated in the no-ESAS group (prior to ESAS site implementation), and 108 participants (40.3%) were in the ESAS group (after ESAS site implementation). The data from all 268 patients were included in the analysis. The questionnaire completion/response breakdown is found in Table 1. Five participants from the ESAS group did not complete and/or return any of the questionnaires at T2 (attrition rate of < 5%). Descriptive statistics of demographic information are displayed in Table 2. Mean ESAS scores for ESAS group at recruitment and 2 weeks later (T1,T2) are displayed in Supplementary-Table 1. Two paired t tests were conducted for *age* and *average income*, while chi-square tests were conducted for *gender*, *marital status*, *disease-site group*, and *stage of cancer*. Likelihood ratio chi-square tests found *gender*, X^2 $(1,N = 268) = 28.88$, and *disease-site group*, X^2 $(7,N = 259) = 126.30$, were significantly different between groups ($p < 0.0001$; Table 2).

Prevalence and type of distress

Of the 108 participants who completed ESAS at T1, approximately 24% ($n = 26$) reported moderate-severe *anxiety* and 17% ($n = 18$) moderate-severe *depression* (ESAS scores 4–10). The reported level of psychological distress in this sample is similar to other available aggregated data of cancer outpatients in Ontario, which list prevalence rates for moderate-severe anxiety/depression at approximately 21.1/16.2%, respectively [39].

Impact of ESAS on HRQoL, PSC, and supportive care before matching for confounding variables

Descriptive statistics of HRQoL (EORTC-QLQ-C30) outcomes are shown in Supplementary Table 2. No-ESAS and ESAS T1 mean scores for HRQoL are similar to those cited in

Table 1 Number of participants to have fully completed each questionnaire

Questionnaire	No-ESAS ($n = 160$)	ESAS time 1 (T1), $n = 108$	ESAS time 2 (T2), $n = 103$
Edmonton Symptom Assessment System (ESAS)	NA	106	83
European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC-QLQ-C30)	157	108	102
The European Organization for Research and Treatment of Cancer Outpatient Satisfaction with Chemotherapy/Radiation (EORTC-OUTPATSAT35 CT/RT)	141	100	103
The European Organization for Research and Treatment of Cancer Outpatient Satisfaction with Chemotherapy (EORTC-OUTPATSAT35 CT)	65	44	44
The European Organization for Research and Treatment of Cancer Outpatient Satisfaction with Radiation (EORTC-OUTPATSAT35 RT)	76	56	59
Princess Margaret Hospital Patient Satisfaction Questionnaire (PMH/PSQ-MD-24)	152	102	NA
Supportive Care Service Survey (SCSS-21)	159	105	103
Demographics	160	108	NA

Symptom assessment: ESAS; Health-related quality of life (HRQoL): EORTC-QLQ-C30; Patient satisfaction with care (PSC): EORTC-OUTPATSAT35-CT, EORTC-OUTPATSAT35-RT, PMH/PSQ-MD-24; Supportive care: SCSS-21

Table 2 Descriptive statistics for demographic information

Demographic information (p value)		No-ESAS ($n = 160$) Mean (SD) or n (%)	ESAS ($n = 108$) Mean (SD) or n (%)
Age (0.12)		58.33 (16.06)	61.19 (12.99)
Gender* (< 0.0001)	Male	94 (58.75%)	28 (25.93%)
	Female	66 (41.25%)	80 (74.07%)
Marital status (0.509)	Partner	115 (77.18%)	78 (73.58%)
	Single	34 (22.82%)	28 (26.42%)
Disease-site group* (< 0.0001)	Breast	23 (15.13%)	45 (42.06%)
	Gastro-intestinal	3 (1.97%)	27 (25.23%)
	Genitourinary	32 (21.05%)	1 (0.93%)
	Gynecology	0 (0%)	6 (5.61%)
	Hematology oncology	40 (26.32%)	5 (4.67%)
	Head and neck	34 (22.37%)	10 (9.35%)
	Lung	1 (0.66%)	8 (7.48%)
	Melanoma	19 (12.50%)	5 (4.67%)
Stage of cancer (0.059)	Early	60 (46.51%)	35 (40.70%)
	Advanced	45 (34.88%)	23 (26.74%)
	Distal metastases	24 (18.60%)	28 (32.56%)
Average income (0.20)		45,328.19 (23,987.46)	41,717.07 (19,675.04)

p values are shown in parentheses

n sample size, *SD* standard deviation

*The variable that is significantly associated with ESAS; the p value < 0.05 from the two independent sample t tests and chi-square test

previous studies considering HRQoL in oncology [40]. Descriptive statistics for PMH/PSQ-MD-24 and EORTC-OUTPATSAT35 PSC outcomes for radiation/chemotherapy are shown in Supplementary Table 3 and Tables 3 and 4, respectively. No-ESAS and ESAS T1 *overall satisfaction* mean scores on the EORTC-OUTPATSAT35 were approximately 10 points higher than those cited in previous studies considering PSC in oncology [40]. The univariate analysis

Table 3 Descriptive statistics (mean, standard deviation) for EORTC-OUTPATSAT35-CT/RT

Clinical outcome\group		EORTC-OUTPATSAT35-CT			EORTC-OUTPATSAT35-RT		
		No-ESAS Mean (SD)	ESAS (T1) Mean (SD)	ESAS (T2) Mean (SD)	No-ESAS Mean (SD)	ESAS (T1) Mean (SD)	ESAS (T2) Mean (SD)
Doctors	Technical skills	83.67 (17.80)	82.44 (18.29)	77.48 (18.90)	82.01 (19.88)	79.18 (17.94)	78.56 (18.90)
	Interpersonal skills	81.17 (21.38)	79.85 (20.63)	71.64 (23.06)*	78.28 (21.33)	73.73 (22.08)	72.03 (23.01)
	Information	81.03 (20.91)	75.46 (19.44)	69.30 (22.36)*	78.11 (22.64)	73.66 (21.30)	72.90 (22.93)
	Availability	66.11 (25.88)	62.66 (20.54)	56.88 (23.46)	73.47 (23.65)	68.21 (22.68)	66.90 (23.70)
Nurses	Technical skills	84.74 (21.39)	78.46 (21.04)	79.77 (20.70)	84.43 (18.37)	82.46 (19.57)	81.55 (20.01)
	Interpersonal skills	82.07 (22.15)	75.54 (20.96)	75.09 (21.18)	82.76 (17.98)	79.88 (20.21)	78.39 (22.42)
	Information	78.30 (22.89)	70.95 (22.93)	66.48 (25.15)*	79.00 (20.84)	73.75 (24.45)	72.21 (27.58)
	Availability	79.64 (22.35)	74.49 (23.73)	73.67 (23.95)	81.84 (20.56)	78.20 (21.32)	75.54 (24.23)
Services and care organization	Exchange of information	74.79 (22.53)	69.97 (19.60)	67.63 (22.16)	78.16 (20.59)	70.83 (19.63)*	69.54 (25.50)*
	Information provided	73.90 (21.72)	67.95 (18.20)	65.31 (20.38)*	75.81 (20.83)	70.55 (20.13)	68.59 (23.95)
	Waiting time	63.39 (20.70)	59.49 (20.62)	61.41 (24.33)	68.55 (23.04)	60.08 (20.13)*	63.80 (27.56)
	Environment	62.58 (18.70)	60.53 (19.27)	63.91 (23.05)	62.23 (22.67)	62.29 (20.61)	66.11 (22.75)
Overall satisfaction		82.50 (16.79)	78.13 (18.94)	78.57 (21.79)	81.42 (18.07)	81.82 (16.98)	79.55 (19.89)

SD standard deviation

*The p value < 0.05 from the two independent sample t tests, indicating significant difference from the mean value in the no-ESAS group

Table 4 Correlation between ESAS Total and HRQoL at T1

Clinical outcome\group		*r*	*p*
Global health status		− 0.61*	< 0.0001
Functional scales	Physical functioning	− 0.54*	< 0.0001
	Role functioning	− 0.34*	0.0004
	Emotional functioning	− 0.62*	< 0.0001
	Cognitive functioning	− 0.52*	< 0.0001
	Social functioning	− 0.38*	< 0.0001
Symptom scales and items	Fatigue	0.65*	< 0.0001
	Nausea and vomiting	0.32*	0.0008
	Pain	0.29*	0.0025
	Appetite loss	0.50*	< 0.0001

*The *p* value < 0.01 from the Pearson correlation analysis, indicating a significant correlation

results of ESAS implementation on HRQoL, PSC, and supportive care may be found in Supplementary Table 3 and Tables 3 and 4. There were some significant findings for *HRQoL* (*dyspnea*) and *PSC* (*radiation*: *perceived physician support*, *exchange of information*, *wait time*; *chemotherapy*: *doctor's interpersonal skills*, *information*), but due to significant group differences, only matched data is reported.

For the *SCSS-21*, independent sample *t* tests were conducted to compare group means of supportive care knowledge/utilization and unmet needs between the no-ESAS and ESAS groups at T1. Results showed supportive end-of-life care needs (*end-of-life want*) were significantly higher in ESAS group ($t = -2.16$, $p = 0.032$, $d = 0.31$; Supplementary Table 4). Due to insufficient sample size, results were not considered in matched analysis.

After matching for confounding variables

Two groups of 29 patients were matched post hoc, by *gender*, *age*, *site*, and *stage of cancer*, from the no-ESAS and ESAS groups (Supplementary Table 5). Results show no significant differences between HRQoL outcomes from the matched no-ESAS and ESAS groups ($d = 0.02$), but there was significant improvement in symptom scales of nausea/vomiting ($d = 0.15$) and constipation ($d = 0.67$) at T2 ($p < 0.05$; Supplementary Table 6). There was no between-group difference in PSC in both EORTC-OUTPATSAT35 and PMH/PSQ-MD-24 (Supplementary Tables 7, 8, and 9). For the mixed-model, there were no significant associations between ESAS *total score* and *perceived physician support* ($t = 1.24$, $p = 0.22$, $d = 0.29$) or *perceived physician disengagement* ($t = -0.94$, $p = 0.35$, $d = 0.22$).

Relationship between ESAS scores and HRQoL at T1 and change in ESAS and HRQoL scores

Pearson correlation coefficients were calculated to determine the relationship between HRQoL and ESAS scores at T1. Results are summarized in Table 4 and Supplementary Table 10.

Results showed that ESAS *total* score and ESAS *functional* and *symptom* subscales were correlated with most dimensions of HRQoL at T1 and T2 (Supplementary Tables 10 and 11). ESAS *total score* was highly negatively correlated with *GHS*

Table 5 Correlation between change in ESAS total, psychological, and physical subscales with change in HRQoL at T1 and T2

Outcome\correlation and *p* values		ESAS (total)		ESAS (physical)		ESAS (psychological)	
		r	*p*	*r*	*p*	*r*	*p*
Global health status		− 0.39*	0.0004	− 0.35*	0.0015	− 0.34*	0.0020
Functional scales	Physical Functioning	− 0.31*	0.0051	− 0.39*	0.0003	− 0.13	0.25
	Role functioning	− 0.25*	0.024	− 0.22*	0.048	− 0.23*	0.038
	Emotional functioning	− 0.41*	0.0002	− 0.23*	0.043	− 0.55*	< 0.0001
	Cognitive functioning	− 0.17	0.13	− 0.16	0.17	− 0.15	0.20
	Social functioning	− 0.30*	0.0069	− 0.21	0.062	− 0.35*	0.0017
Symptom scales and items	Fatigue	0.29*	0.0088	0.25*	0.028	0.28*	0.012
	Nausea and vomiting	0.35*	0.0018	0.33*	0.0032	0.29*	0.0099
	Pain	0.33*	0.0026	0.34*	0.0020	0.25*	0.030
	Dyspnea	0.45*	< 0.0001	0.43*	< 0.0001	0.37*	0.0009
	Insomnia	0.27*	< 0.045	0.15	0.18	0.36*	0.0013
	Appetite loss	0.23*	0.045	0.09	0.38	0.34*	0.0025
	Constipation	− 0.092	0.45	− 0.046	0.70	− 0.13	0.28
	Diarrhea	0.26*	< 0.05	0.30*	0.0062	0.14	0.22
	Financial difficulties	0.098	0.40	0.12	0.31	0.046	0.69

*The *p* value < 0.05 from the Pearson correlation analysis, indicating a significant correlation

Table 6 Results of mixed-model on QOL subscale using ESAS and demographics for ESAS group

	Global health		Physical functioning		Role functioning		Emotional functioning		Cognitive functioning		Social functioning	
	Estimate	*p*	Estimate	*p*	Estimate	*p*	Estimate	*p*	Estimate	*p*	Estimate	*p*
Intercept	73.22	< 0.0001	105.13	< 0.0001	81.31	< 0.0001	73.78	< 0.0001	80.16	< 0.0001	66.38	< .0001
Age	− 0.01	0.92	− 0.17*	0.03	0.19	0.16	0.29*	0.01	0.21*	0.03	0.42*	0.00
Gender (F = 1)	− 2.07	0.40	− 1.58	0.48	− 2.36	0.54	− 0.93	0.75	− 3.54	0.22	− 2.05	0.61
Time (T1 = 1)	− 0.10	0.96	− 0.53	0.78	− 2.83	0.41	2.31	0.37	3.12	0.22	1.30	0.71
ESAS Total Score	− 0.91*	< 0.0001	− 0.64*	< 0.0001	− 0.71*	< 0.0001	− 0.99*	< 0.0001	− 0.73*	< 0.0001	− 0.92*	< 0.0001

*Significant association with QOL subscale

(*r* = − *0.61*, *p* < *0.0001*) and *emotional functioning* (*r* = − *0.62*, *p* < *0.0001*). ESAS *physical subscore* was negatively correlated with *GHS* (*r* = − *0.58*, *p* < *0.0001*), while *physical functioning* (*r* = − *0.56*, *p* < *0.0001*) and ESAS *psychological subscore* were negatively correlated with *GHS* (*r* = − *0.51*, *p* < *0.0001*) and *emotional functioning* (*r* = − *0.77*, *p* < *0.0001*).

The correlations between change in ESAS scores and change in HRQoL are shown in Table 5. Change in ESAS *total score* was moderately negatively correlated with change in *GHS* (*r* = − *0.39*, *p* = *0.0004*) and change in all other HRQoL *functional* subscales except for *cognitive functioning* (*r* = − *0.17*, *p* = *0.13*). Change in ESAS *psychological subscore* was negatively correlated with change in *GHS* (*r* = − *0.34*, *p* = *0.002*), change in emotional functioning, and change in all functional subscales except for *physical functioning* (*r* = − *0.13*, *p* = *0.25*) and *cognitive functioning* (*r* = − *0.15*, *p* = *0.20*).

Results of the mixed-model analysis are found in Table 6. ESAS *total score* was significantly associated with all HRQoL variables (*p* < .0001), such that one ESAS *total score* increase was associated with point drops of 0.91 (*GHS*), 0.64 (*physical functioning*), 0.71 (*role functioning*), 0.99 (*emotional functioning*), 0.73 (*cognitive functioning*), and 0.92 (*social functioning*). No significant differences were found between T1 and T2 for HRQoL, while *age* was significantly associated with *physical functioning* (*p* = 0.03), *emotional functioning* (*p* = 0.01), *cognitive functioning* (*p* = 0.03), and *social functioning* (*p* < 0.01).

Conclusions and clinical implications

When participants were matched for gender, age, cancer site, and stage, there were significantly less nausea/vomiting and constipation in the ESAS group at T2, implying that greater attention was paid to some physical symptoms.

Despite staff training in symptom assessment/management, the present study found that in early stages after implementation, ESAS screening did not lead to improved HRQoL, PSC, or knowledge of/access to supportive care. Two explanations include lack of clarity around ESAS terms and individual patient differences in how numerical values are interpreted [31, 41, 42]. For example, patients report mild symptoms to fall in the range of "0–8" and moderate symptoms to fall in the range of "0–10" [43]. "Anxiety" and "depression" are identified by patients as the most difficult items to interpret [41]; some confuse depression with non-pathological and contextual sadness [26]. Patients also report ambiguity/difficulty with the terms "well-being" [31, 41, 42]. "Tiredness" and "drowsiness" are often interpreted as meaning the same thing [28], and patients report confusion when responding to "appetite" [28, 41]. These findings emphasize the importance of uniform instructions prior to using ESAS [28], and that lessons learned—such as differing cutoffs—should be incorporated into ESAS utilization, if it is to be an effective instrument to improve outcomes. Other studies indicate that while ESAS may be reliable, it may be ineffective if used without prior interprofessional oncology team [8] or patient training [41], use of targeted cutoffs for each symptom [29], and standardized response pathways.

Our results illustrate a potential for increasing the clinical utility of ESAS and demonstrate adequate validity for ESAS *total* score and *physical* and *psychological* subscores using the EORTC-QLQ-C30. A high correlation between ESAS *total* score and *GHS* and between the ESAS *psychological* subscore and *emotional functioning* is noted. Further, changes in ESAS *total* score and *physical* and *psychological* subscores were significantly correlated with changes in similar domains of HRQoL. Mixed-model analyses replicated this significant association between ESAS *total* and all subscales of the EORTC-QLQ-C30, suggesting that ESAS scores for individual patients during treatment or survivorship may be a good clinical predictor of change in HRQoL and should be addressed.

This study supports the need for observing and integrating lessons learnt when implementing the use of a standardized tool like ESAS to clinical care, including seeking relevant patient and staff feedback. The findings from this study also support the current literature [41] and an unpublished review manuscript considering clinical utility of ESAS, suggesting need for standardized use and response to ESAS by the oncology team [8], to initiate symptom management conversations and

determine patient referral and follow-up. To improve the utility and accuracy of ESAS, patient and interprofessional team training is recommended. As a result of this study, the authors are currently incorporating lessons learned from previous implementation projects and reports of patient and staff feedback, to further explore evidence-based, routine response pathways as a response to ESAS.

Future directions

Future research is needed on improving interprofessional team symptom assessment/management and patient training in the use of ESAS and could explore the relationship between HCP response to screening and ER/unplanned admission rates. Research studying distress screening could focus on individual site groups, to address site-specific symptoms and improve buy in. While ESAS was the reasonable first choice as a broad symptom assessment tool with provincial implementation underway, future patient-centered studies should also consider symptom assessment tools with disease- and treatment-specific modules that can be appended to the general symptom list, such as the MD Anderson Symptom Inventory [44].

This study's finding of strong relationship between changes in ESAS and HRQoL scores implies a positive clinical impact of tracking/responding to change in symptom scores to allow HCPs to identify and clinically utilize meaningful changes in ESAS scores.

Limitations

Due to mandated time-sensitive ESAS implementation, this study utilized a two-stage cross-sectional data collection design comparing similar cohorts before and after implementation of ESAS screening rather the more rigorous randomized controlled trial. Comparing ESAS (T1) and T2 2 weeks later has the potential to be confounded by impact of intervening cancer treatment. This study was not looking at whether symptoms improved at T2; instead, T1/T2 was used to see if there was a signal for HRQoL, when comparing between no-ESAS with ESAS implementation. The logic here was that if ESAS T2 was included, this would give HCPs the time to respond to ESAS distress scores.

The post hoc matched group analysis was conducted to reduce potentially confounding variables of *gender* and *disease-site group*, which differed between groups. In addition, patient's average incomes were estimated by postal code using a 2006 database. This data may not have accurately reflected income at recruitment, due to change in employment status. The missing responses for EORTC-OUTPATSAT35 outcomes in radiation/chemotherapy may also have biased results.

A potential concern in this study was a limited statistical power, due to the modest matched sample size ($N = 58$; $n_{\text{no-ESAS}} = 29$, $n_{\text{ESAS}} = 29$), which may have limited the significance of some of the statistical comparisons. A post hoc power analysis revealed that based on the means of the primary outcome (*HRQoL GHS*; refer to Supplementary Table 6) and the between-group comparison effect size observed in the present study ($d = 0.02$), an N of approximately 86,970 would be needed to obtain statistical power ($\alpha = 0.05$, $\beta = 0.80$). This example highlights that reporting statistical significance alone is not adequate for readers to completely understand the findings. Effect size (the magnitude of difference between groups; not influenced by sample size) should also be considered. Despite concern about a power issue, this study still found statistically significant differences with the current sample (i.e., constipation and nausea/vomiting at T2), with a moderate effect size for constipation ($d = 0.67$) and (marginally) small effect size for nausea/vomiting ($d = 0.15$).

At the same time as introducing ESAS screening, the cancer center underwent a clinical care redesign based on the LEAN principles in ambulatory nursing. Initially, there was concern that redesign could have been a confounding variable. After extensive discussion with nursing management, it was determined that the concerns were unwarranted: there was no actual reallocation of nurses, reduction in shifts, impact on wait times, or reduction in one-on-one time with patients with the redesigned model-of-care. There was simply a change from doctor-nurse partnership-based care to site-based care with all oncologists present in one clinic and nurses distributed across clinics to provide care as needed.

A potential concern was that nurses or physicians did not review ESAS for each participant. However, it is within scope of practice for nurses (and in accordance with the competencies outlined by the Canadian Association of Nurses in Oncology) to assess/address symptom distress. Interventions are based on the evidence-based algorithms developed by CCO for interprofessional clinical practice. Nurses were to share their assessments with physicians. Then, after the physician's own assessment (informed by the nurses ESAS assessment), medical interventions were ordered by the physicians, if required. Nurses were also able to initiate referrals on behalf of patients to members of the psychosocial team (dietitian, social worker, psychologist). Much of the patient's psychosocial needs were addressed by nurses, leaving physicians free to focus on treatment-related issues.

QoL instruments have been criticized for not reflecting patient experience or impact of a symptom score, limiting the clinician's ability to capture the important factors influencing a patient's life and the degree and impact of impaired functioning for that individual [45]. This study employed a specific HRQoL patient reported outcome (PRO) measure relevant to the population which assesses not just severity of a symptom, but the impact on the person's function. In addition, ESAS, a simple PRO, administered in real time, embeds a patient-centered focus of symptom change over time, which the current study evaluates.

Participants were also recruited from heterogeneous cancer sites/treatment modalities and had varied prognoses, and patients with cognitive deficits were excluded. These factors may have confounded results and reduce ability to generalize findings to specific site groups/treatment type. That said, our study was meant to focus on the effect of ESAS implementation throughout the center, not on site-specific or treatment-related symptoms. While this study cannot be replicated in Ontario, due to past province-wide implementation, a replicated study is possible and would be effective in hospitals out of province or country, where ESAS has yet to be implemented.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Disclaimers The views expressed in the submitted article are the authors' own.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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