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Depression Screening Using the Patient Health Questionnaire-9 Administered on a Touch Screen Computer

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Abstract

PURPOSE—To 1) evaluate the feasibility of touch screen depression screening in cancer patients using the Patient Health Questionnaire-9 (PHQ-9), 2) evaluate the construct validity of the PHQ-9 using the touch screen modality, and 3) examine the prevalence and severity of depression using this screening modality.

METHODS—The PHQ-9 was placed in a web-based survey within a study of the clinical impact of computerized symptom and quality of life screening. Patients in medical oncology, radiation oncology, and hematopoietic stem cell transplantation (HSCT) clinics used the program on a touch screen computer in waiting rooms prior to therapy (T1) and during therapy (T2). Responses of depressed mood or anhedonia (PHQ-2 cardinal depression symptoms) triggered additional items. PHQ-9 scores were provided to the oncology team in real-time.

RESULTS—Among 342 patients enrolled, 33 (9.6%) at T1 and 69 (20.2%) at T2 triggered the full PHQ-9 by endorsing at least one cardinal symptom. Feasibility was high, with at least 97% completing the PHQ-2 and at least 96% completing the PHQ-9 when triggered and a mean completion time of about 2 minutes. The PHQ-9 had good construct validity. Medical oncology patients had the highest percent of positive screens (12.9%) at T1, while HSCT patients had the highest percent (30.5%) at T2. Using this method, 21 (6.1%) at T1 and 54 (15.8%) at T2 of the total sample had moderate to severe depression.

CONCLUSION—The PHQ-9 administered on a touch screen computer is feasible and provides valid depression data in a diverse cancer population.

Keywords

cancer; oncology; depression; screening; transplant; computer

INTRODUCTION

Depression is one of the most common psychiatric conditions following cancer diagnosis and during cancer treatment. Prevalence estimates have ranged widely from about 3% to over 50%, with most estimates falling between 10-25%, depending on the method of ascertaining depression, study population, and timing of assessments [1]. Patients undergoing chemotherapy appear to have higher rates of depression [2]. Depression prevents habituation to aversive symptoms and adversely influences symptom burden [3], cognition [4], quality of life [5-7], family functioning [8,9], and possibly survival [10]. It also has a negative effect on treatment adherence and health behaviors such as smoking and alcohol use [11,12]. Studies have documented that depression is often under-recognized in cancer patients, particularly among severely depressed [13-15], despite growing evidence of effective treatment strategies [16-18].

Effective treatment of depression first requires accurate detection and diagnosis. Unfortunately, few health professionals routinely screen cancer patients for depression with validated instruments, citing lack of time and training as major barriers [19]. While practice guidelines such as those published by the NCCN call for routine screening for distress, including depression [20], there is little consensus regarding how and when to screen for clinically significant depression in cancer patients. While short distress instruments have been found to have good negative predictive value, they lack specificity and positive predictive value as depression screeners [21]. Brief screening that more clearly identifies clinically significant “cases” of depression as well as measures depression severity, with results made available to clinicians in real time using data displays that are clinically meaningful, may have particular value in the clinical setting. Similarly, using computers equipped with touch screens has the potential advantage of providing a cost-effective way of managing large volumes of data with few personnel resources while making the data available in real time for review by clinicians. Several studies have documented the reliability of electronic assessment formats when compared with paper and pencil administration [22-25]. European investigators [26] have reported feasibility and enhanced patient-provider communication regarding quality of life and symptom issues in clinical visits when using QOL questionnaires delivered on touch screens and subsequent results placed in the patient’s medical record.

A few depression measures, including the 13-item Beck Depression Inventory-Short Form (BDI) [27], the 14-item Hospital Anxiety and Depression Scale (HADS) [22,25,28], and the 5-item Mental Health Inventory (MHI-5) [28], have been incorporated into electronic, touch screen formats; however, few studies have examined the clinical feasibility and utility of such formats both before and during cancer therapy or across different oncology settings. Assessing the feasibility and clinical impact of electronic depression screening with immediate clinician feedback in cancer patients is important because paper-and-pencil depression screening alone has shown minimal effects on improving intervention rates and depression outcomes in other medical settings [29]. Screening that facilitates integrated treatment and follow-up appear to be most effective [30].

We selected the Patient Health Questionnaire-9 (PHQ-9) depression scale as our screening measure for several reasons [31,32]. The PHQ-9 parallels the nine diagnostic symptom criteria that define DSM-IV major depressive disorder (MDD). The format and temporal framework of the items also correspond to the DSM-IV criteria and can facilitate the follow-up review of symptoms and diagnostic process. At only 9 items, the PHQ-9 is shorter than most depression screening measures. Unlike most other measures of depression, the PHQ-9 was developed, tested and refined for use with medical patients. This is important because the criterion validity was established in a population with high rates of other physical symptoms and associated non-specific psychological distress. It has also demonstrated acceptability among non-psychiatric

patients and among busy primary care providers [31-33]. It is sensitive to change and treatment effects [34], making it a valid longitudinal clinical tool. Experience with the PHQ-9 in medical settings has been broad, including use in patients with cancer [35], diabetes [36], renal failure [37], HIV [38], stroke [39], brain injury [40], and spinal cord injury [41].

This study builds on our ongoing broader goal to develop an electronic patient interface that will facilitate clinical communication and care in the cancer setting [42]. The specific aims of this study were: 1) to test the feasibility of depression screening with the PHQ-9 on touch screen in medical oncology, radiation oncology, and hematopoietic stem cell transplantation (HSCT) clinic populations before and during cancer treatment, 2) to evaluate the construct validity of the PHQ-9 administered by touch screen, and 3) to examine the prevalence and severity of depression in the three clinic populations using this screening modality.

METHODS

Sample

Research participants for the Electronic Self-Report Assessment - Cancer (ESRA-C) study were recruited from the Seattle Cancer Care Alliance (SCCA), a consortium between the University of Washington Medical Center, Fred Hutchinson Cancer Research Center, and Children's Hospital and Regional Medical Center in Seattle, Washington. The SCCA cared for 3,609 new patients during fiscal year 2006 with the majority (85%) originating from Washington State. Eligibility criteria for the current study comprised the following: new patients who were being evaluated for medical oncology therapy, radiation therapy or hematopoietic stem cell transplantation (HSCT), at least 18 years of age, able to communicate in English, and competent to understand the study information and give informed consent.

Between April 2005 and November 2006, 698 eligible patients were invited to participate in the study, with 509 (72.9%) patients providing written consent. To date, 342 of these patients have completed both a baseline (T1) and a follow-up survey (T2; the remaining 167 patients were still awaiting their T2 survey) and represent the sample for these analyses.

Procedures

Clinic scheduling staff or registered nurses asked patients if they were willing to meet with a member of the ESRA-C research team during a normally scheduled visit to discuss participating in a study about improving methods for evaluating patient symptoms and quality of life. Patients who met with research staff received a more in-depth explanation per IRB approved informed-consent procedures. Baseline assessments (T1) were administered prior to initiating treatment.

Approximately 6-7 weeks after beginning treatment, patients were surveyed a second time (T2). After patients completed each survey, the study coordinator viewed a "Safety Net Review Screen" indicating whether any survey responses for severe distress, suicidal ideation (>0 on PHQ-9 item i), depression (total PHQ-9 score >10), or pain had exceeded threshold values. If any of these thresholds were exceeded the coordinator communicated this information to the clinical team and documented that action on a secured web page within the survey platform.

Further procedures in the larger ESRA-C study included the following [43]. After the T2 assessment, patients were randomized into an intervention or control group. For patients assigned to the intervention group, a two page graphical summary of their responses was printed and placed on top of the chart and an audio-recorder was placed in the exam room to record the clinical interaction. For patients assigned to the usual care control group, no graphical summary was provided prior the audio-recorded clinical interaction. Outcomes of interest include differences between groups in: patient and physician satisfaction, response shift,

clinical topics addressed and documented during the clinical encounter, symptom and quality of life outcomes, and interventions and referrals initiated. Results from the intervention study will be reported in subsequent papers.

Survey Instruments

The ESRA-C program was developed and tested to be understandable by patients with at least an 8th grade reading ability [44]. The technical aspects and navigability of the program have been described elsewhere [42,45,46].

During the first survey session (T1), patients were presented with an introductory screen followed by demographic questions. Patients were then presented with four validated questionnaires during both T1 and T2 survey sessions: the Symptom Distress Scale (SDS) [47], the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30 v.3 [48], a single item Pain Intensity Numerical Scale, and the nine-item Patient Health Questionnaire-depression scale (PHQ-9) [32].

Depression Screening—The Patient Health Questionnaire 9-item depression scale (PHQ-9) was used to screen for depressive symptoms based on DSM-IV diagnostic criteria [31,32,49]. The PHQ-9 has excellent internal and test-retest reliability as well as criterion and construct validity in medical samples [31-33,49].

The PHQ-9 is a self-report measure that asks if the subject had been bothered by the following problems in the past two weeks: a) little pleasure or interest in doing things, b) feeling down, depressed, or hopeless, c) sleeping too little or too much, d) feeling tired or having little energy, e) poor appetite or overeating, f) feelings of worthlessness or guilt, g) concentration problems, h) psychomotor retardation or agitation, and i) thoughts of suicide (“Thoughts that you would be better off dead or of hurting yourself in some way”). Subjects were asked to rate how often each symptom occurred: 0 (not at all), 1 (several days), 2 (more than half the days), or 3 (nearly every day). In addition to in-person self-report or interviewer administration, the PHQ-9 has been validated for administration over the telephone [33,34,50].

As an initial screen for clinically significant depression and to minimize patient burden, we used the presence of at least one cardinal symptom of a) anhedonia or b) depressed mood present at least half the days as a triggering for the full nine-item PHQ-9. This method for initial screening with the PHQ-2 has been validated in prior studies of medical patients [51,52]. To provide further data on depression symptoms among distressed subjects, the full nine-item PHQ-9 was also triggered if certain responses on the QLQ-C30 (i.e., scores >3 on the scale of 1-4 for the Emotional Dysfunction or Cognitive Dysfunction subscales or Sleep Disturbance item) or SDS (i.e., scores >3 on the scale of 1-5 for the Outlook, Concentration, or Sleep items) were endorsed.

We examined several methods of scoring the PHQ-9. Probable major depressive disorder (MDD) can be ascertained based on at least 5 symptom endorsed “more than half the days” (suicidal ideation could be “several days”), with at least one being a “cardinal symptom,” i.e., either a) anhedonia or b) depressed mood. Other depressive disorder (ODD), or minor depression, can be ascertained based on a requirement of 2 to 4 symptoms endorsed, with at least one being a cardinal symptom. Scores can also be based on the sum of the 9 item scores. Kroenke, et al. [32] suggested cut-points to identify mild (5-9), moderate (10-14), moderately severe (15-19), and severe (≥ 20) depression. If 1 or 2 of the 9 items were not answered, we imputed the values by assigning the mean of the answered items to the missing items. If more than 2 items were missing, we reported the scale as not completed, but still reported that the scale was triggered.

Data Analysis

Two-tailed independent groups t-tests and ANOVAs with $\alpha=0.05$ were used to examine differences between groups on continuous variables. Chi-square tests were conducted for dichotomous or ordinal variables.

Feasibility was examined using computerized data on percent of subjects who completed the PHQ-2 screener, percent who completed the remaining items on the PHQ-9 when triggered, and time to complete the full PHQ-9 instrument.

Construct validity of the PHQ-9 was determined by calculating the Pearson correlation between the PHQ-9 total score and various domains of the QLQ-C30 and SDS that were hypothesized to be convergent or discriminant. In this and the administration time analyses, data were examined among all patients at T1 who triggered a full PHQ-9 by cardinal symptoms, QLQ-C30, or SDS criteria.

Data on depression rates and severity across the three clinic sites are presented at T1 and T2. These data are presented to compare with prior and future epidemiological studies and to build on the validity data. As stated by Goldstein and Simpson, “the assessment of the validity of a diagnosis cannot be accomplished in one study...it is an ongoing process that requires multiple studies, using different samples, across different settings.”[53] SPSS v. 13 was used for all analyses.

RESULTS

Characteristics of the 342 study subjects are presented in Table 1. The tables show the separate results for the three clinical services and the total sample.

Feasibility of the PHQ-9 by touch screen

The PHQ was administered without difficulty in the vast majority of cases, with 334 (97.7%) at T1 and 332 (97.1%) at T2 completing both items on the PHQ-2 screener (two patients at T2 completed only one item, but still triggered the full PHQ-9). Among patients whose PHQ-2 score triggered the full PHQ-9, 32/33 (97.0%) at T1 and 66/69 (95.7%) at T2 completed the entire PHQ-9 (100% completed at least 7 of the 9 items at each time point). Table 2 shows that mean PHQ-9 administration time was significantly longer for patients: 60 years or older, at least moderately depressed, and being treated in the medical oncology clinic. Administration times averaged 2.5 minutes or less in all categories.

Validity of the PHQ-9

To assess the validity of using the cardinal symptoms (PHQ-2) as an initial screen for clinically significant depression, we compared patients who triggered the full PHQ-9 using the cardinal symptoms (9.6% at T1, 20.2% at T2) with patients who triggered the full PHQ-9 with only the QLQ-C30 or SDS criteria (37.1% at T1, 29.5% at T2). This larger, second group endorsed significant distress or dysfunction, but did not endorse anhedonia or depressed mood on the PHQ-9. Whereas 21/33 (64%) at T1 and 54/69 (78%) at T2 of the patients who triggered the full PHQ-9 with the cardinal symptom criteria had depression severity in the moderate to severe range (score >10), only 10/127 (8%) at T1 and 22/101 (22%) at T2 who triggered the PHQ-9 with the QLQ-C30 or SDS criteria had at least moderate depression (positive predictive value). Of all patients at T1 or T2 who triggered the PHQ-9 by the QLQ-C30 or SDS criteria, only 2 patients at T2 had higher than moderate depression (score >15). Forty-three percent during T1 and 26% during T2 were in the minimal (score 0-4) range. The mean PHQ-9 scores were 5.3 at T1 and 6.6 at T2 for the QLQ-C30 and SDS triggers. Only 5 (4%) at T1 and 2 (2%) at T2 endorsed “several days” of suicidal ideation.

Construct validity was examined using Pearson correlations of the PHQ-9 total score with QLQ-C30 and SDS domains during T1 (Table 3). Results showed strong correlations with most domains predicted to converge with depression severity, the lowest being pain intensity, whereas correlations were low in domains predicted to discriminate from depression (i.e., bowel problems, breathing problems, and fever/chills).

Results of depression screening with the PHQ-9

PHQ-9 data for T1 and T2 are presented in Table 4. Among patients at T1, 33 (9.6%) endorsed at least one of the first 2 items on the PHQ-9 (depressed mood or anhedonia) as present for more than half the days in the past 2 weeks, thus triggering the full PHQ-9, while 69 (20.2%) triggered the full PHQ-9 at T2. Medical oncology patients reported the highest percent of positive screens at T1 (12.9%; $p<.05$), whereas HSCT patients had the highest percent of positive screens at T2 (30.5%; $p<.005$).

Mean PHQ-9 scores ranged from 11 to 13, indicating moderate depression, for all clinics at both time points among those triggering the full PHQ-9. Among the 16 patients who triggered the full PHQ-9 at both T1 and T2, change scores were greatest for the HSCT patients (mean=2.7, SD=7.1, median=4.5).

The majority of patients triggering the full PHQ-9 at T1 ($n=33$) had depression severity in the mild (33%) or moderate (39%) range, while the majority of patients triggering the PHQ-9 at T2 ($n=69$) had depression in the moderate (46%) or moderately severe (23%) range. Only 3% during T1 and during T2 were in the minimal range. Thirty percent at T1 and 38% at T2 who triggered the full PHQ-9 met the strictest criteria for probable major depressive disorder (MDD) based on at least 5 symptoms endorsed “more than half the days” (suicidal ideation could be “several days”), with at least one being a cardinal symptom. Sixty-four percent at T1 and 52% at T2 who triggered the full PHQ-9 met criteria for other depressive disorder (ODD), which is synonymous with ‘minor depression.’ Over 10% of all HSCT patients at T2 ($n=118$) endorsed moderately severe or severe depression and 12% met criteria for major depression. Suicidal ideation (PHQ-9 item i) was endorsed at least several days in 5 (15%) at T1 and 6 (9%) at T2 among those who triggered the full PHQ-9, with all endorsing “several days” except one radiation oncology patient endorsing “nearly every day” at T1.

DISCUSSION

This is the first study to examine the feasibility and validity of touch screen depression screening using the Patient Health Questionnaire-9 (PHQ-9), a commonly used depression screening tool in primary care and other medical settings. We found that the PHQ-9 administered in the waiting room on a touch screen computer was feasible for patients undergoing cancer treatment in medical oncology, radiation oncology, and stem cell transplantation clinics. Using the first 2 cardinal symptoms of the PHQ-9 yielded ‘positive’ screens in about 10% of patients prior to treatment (T1) and about 20% during treatment (T2). As expected, depressive symptoms were more common and more severe during treatment, where aversive symptoms are most pronounced. Using this initial screen appears to identify the majority of patients with moderate to severe depression and, by definition, screens patients for DSM-IV defined major or minor depression. Screening positive on the PHQ-2 more specifically identified patients with clinically significant depression, compared to the SDS and QLQ-C30.

Depression rates from this modality appear consistent with prior epidemiologic findings [1]. Whereas HSCT patients had the lowest rate of depressive symptoms during T1, possibly because of a high level of habituation to their diagnosis and hope by the time they arrive for their transplant, they have the highest rate at T2, which represents about the mid-point of their

transplant course Our finding of 25.5% with moderate to severe depression after transplant was similar to the 27% found by Lee et al, who also used the PHQ-9 [35]. In radiation oncology patients, our finding that 12.9% had at least moderate depression at T2 is consistent with Hahn et al's finding that 15% had significant depression using the BDI [54] and Leopold et al's finding that 12% had major depression using the PRIME-MD [55]. Finally, our finding that 9.6% of medical oncology patients receiving chemotherapy reported at least moderate depression is similar to the 9% of distress "cases" determined using the Present State Examination by Cull et al. [28]. Coyne et al's [56] finding of 7% minor depression derived from the Structured Clinical Interview for DSM-IV (SCID) in breast cancer outpatients is also similar to our 7.7% minor depression rate at T2 in medical oncology. The higher rate of depression among medical oncology patients at T1 may represent the effect of a relatively recent diagnosis.

Convergent validity of the PHQ-9 in this mixed cancer population was confirmed by high correlations of depression severity with physical, role, emotional, cognitive and social functioning, global health/QOL, and overall symptom distress, domains known to be associated with depression. We did expect a higher correlation of depression severity with pain severity. The PHQ-9 discriminated well from domains expected to have low correlations with depression severity, although a certain level of correlation was expected given the known bidirectional association between depression and somatic symptoms.

Times for completing the entire PHQ-9 averaged about 2 minutes, indicating that it can be easily completed while the patient is in the waiting room. Elderly and medical oncology patients took longer to complete the PHQ-9, likely due to less experience with computers [27]. The finding that patients who are at least moderately depressed take longer is consistent with psychomotor retardation that often accompanies depressive states.

Our findings add to the growing literature that routine depression screening by touch screen administration both prior to and during active cancer treatment and in diverse cancer settings is feasible and provides valid results. The recent Institute of Medicine report notes that, as in our larger ESRA-C survey, depression is only one of the psychosocial domains that should be routinely addressed during cancer care [57]. Moreover, a positive screen from self-report measures should always be followed by a thorough clinical assessment. We note that the percent of frequent computer use is increased from about 40% (weekly or daily) in our pilot work in radiation oncology to about 65% (often or very often), reflecting the increasing familiarity of our clinical population with computers.

Several limitations of this study need mentioning. Using our triggering criteria, we only screened about 50% of patients with the full PHQ-9 at each time point. As a result, we were unable to determine the overall sensitivity, specificity, or predictive value of the 2-item screening method. This preliminary screening method, however, has been established as a valid initial screen in other medical populations [51,52]. Whether or not to use the entire PHQ-9 will likely depend on the clinical setting and acceptable patient burden. Our study population was a relatively affluent and educated sample with high rates of computer experience. Feasibility may be lower in samples of lower socioeconomic status.

The ESRA-C study will generate data regarding provider satisfaction with the ESRA-C output and the impact of PHQ-9 depression screening on provider behavior (e.g., initiation of depression treatment, referral to mental health specialty care) or depression outcomes. This promising method of depression screening should be tested in other diverse patient populations.

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Table 1

Patient Characteristics

	Medical Oncology (n=155)	Radiation Oncology (n=69)	HSCT (n=118)	Total (N=342)
Age:	58.6 (12.5)	53.7 (14.7)	49.0 (13.0)	54.3 (13.8)
Mean (SD)	59 (20-86)	54 (18-83)	51 (19-75)	55 (18-86)
Median (range)				
Gender:	80 (51.6%)	33 (47.8%)	72 (61.0%)	185 (54.1%)
Male, n (%)				
Marital Status:	105 (67.7%)	53 (76.8%)	76 (64.4%)	234 (68.4%)
Married or Partnered, n (%)	1 (0.6%)	1 (1.4%)	2 (1.7%)	4 (1.2%)
Missing				
Race:	140 (90.3%)	63 (91.3%)	105 (89.0%)	308 (90.1%)
White	5 (3.2%)	5 (7.2%)	2 (1.7%)	12 (3.5%)
Asian	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pacific Islander	6 (3.9%)	0 (0.0%)	1 (0.8%)	7 (2.0%)
Black	2 (1.3%)	1 (1.4%)	3 (2.5%)	6 (1.8%)
American Indian	0 (0.0%)	0 (0.0%)	7 (5.9%)	11 (2.0%)
Multiple Races	2 (1.3%)	0 (0.0%)	0 (0.0%)	2 (0.6%)
Missing				
Ethnicity:	3 (1.9%)	2 (2.9%)	2 (1.7%)	7 (2.0%)
Hispanic/Latino, n (%)	5 (3.2%)	4 (5.8%)	3 (2.5%)	12 (3.5%)
Missing				
Education:	106 (68.4%)	47 (68.1%)	88 (74.6%)	241 (70.5%)
Post-secondary education, n (%)	3 (1.9%)	0 (0.0%)	1 (0.8%)	4 (1.2%)
Missing				
Annual Income:	19 (12.3%)	9 (13.0%)	12 (10.2%)	40 (11.7%)
\$18,000 or less	23 (14.8%)	3 (4.3%)	20 (16.9%)	46 (13.5%)
\$18,001-35,000	19 (12.3%)	7 (10.1%)	56 (47.5%)	46 (13.5%)
\$35,001-55,000	80 (51.6%)	44 (63.8%)	10 (8.5%)	180 (52.6%)
\$55,001 or more	14 (9.0%)	6 (8.7%)		30 (8.8%)
Missing				
Work Status:	55 (35.5%)	35 (50.7%)	16 (13.6%)	106 (31.0%)
Working	33 (21.3%)	18 (26.1%)	74 (62.7%)	125 (36.5%)
Not working	67 (43.2%)	16 (23.2%)	27 (22.9%)	110 (32.2%)
Retired	0 (0.0%)	0 (0.0%)	1 (0.8%)	1 (0.3%)
Missing				
Home Computer Experience	29 (18.7%)	13 (18.8%)	15 (12.7%)	57 (16.7%)
Never or rarely	26 (16.8%)	6 (8.7%)	17 (14.4%)	49 (14.3%)
Sometimes	99 (63.9%)	50 (72.5%)	85 (72.0%)	234 (68.4%)
Often or very often	1 (0.3%)	0 (0.0%)	1 (0.8%)	2 (0.6%)
Missing				
Work Computer Experience	35 (22.6%)	13 (18.8%)	18 (15.3%)	66 (19.3%)
Never or rarely	15 (9.7%)	3 (4.3%)	10 (8.5%)	28 (9.9%)
Sometimes	101 (65.2%)	44 (63.8%)	78 (66.1%)	223 (66.7%)
Often or very often	4 (2.6%)	9 (13.0%)	12 (10.2%)	25 (7.3%)
Missing				
Cancer Diagnoses:	Prostate: 25 (16.1%)	Head and Neck: 18 (26.1%)	Leukemia: 56 (47.5%)	Leukemia: 59 (17.2%)
Most common diagnoses, n (%)	Lung: 23 (14.8%)	Breast: 16 (23.2%)	Lymphoma: 38 (32.2%)	Lymphoma: 54 (15.8%)
	Colorectal: 19 (12.2%)	Prostate: 6 (8.7%)	Myeloma: 22 (18.6%)	Prostate: 31 (9.1%)
	Lymphoma: 13 (8.4%)	Skin: 5 (7.2%)	Myelodysplasia: 1 (0.8%)	Lung: 26 (7.6%)
	Ovarian: 8 (5.2%)	Lung: 3 (4.4%)	Testicular: 1 (0.8%)	Myeloma: 26 (7.6%)
	Other: 67 (43.2%)	Other: 21 (30.4%)	Other - 0 (0.0%)	Other : 146 (42.7%)
Number of days between T1 & T2	44.9 (33.0)	51.6 (33.7)	51.7 (18.9)	48.6 (29.2)

* Other diagnoses include: Head and Neck, 23 (6.7%); Colorectal, 20 (5.8%); Breast, 17 (5.0%); Cervical, 9 (2.6%); Pancreatic, 9 (2.6%); Skin, 9 (2.6%); Other, 8 (2.3%); Ovarian, 8 (2.3%); Uterine, 8 (2.3%); Esophageal, 7 (2.0%); Liver, 7 (2.0%); Endometrial, 6 (1.8%); Bladder, 3 (0.9%); Testicular, 3 (0.9%); Sarcoma, 2 (0.6%); Vaginal, 2 (0.6%); Brain, 1 (0.3%); Myelodysplasia, 1 (0.3%); Renal Cell, 1 (0.3%); Thymus, 1 (0.3%); Vulvar, 1 (0.3%).

Table 2

Administration time of PHQ-9 by computer touch screen among subjects triggering full PHQ-9 by any means at T1*

		Mean time in minutes (SD)	P value
Age	Under 60	1.70 (.80)	.001
	60+	2.31 (1.09)	
Depression score	PHQ-9<10	1.81 (0.92)	.039
	PHQ-9≥10	2.21 (0.94)	
Clinical Service	Medical Oncology	2.25 (1.10)	.000
	Radiation Oncology	1.64 (0.72)	
	HSCT	1.50 (0.46)	

* One patient excluded due to missing PHQ-9 items. N=159.

Table 3

Construct validity of PHQ-9 among subjects triggering full PHQ-9 by any means at T1 *

	Pearson's Correlation with PHQ-9 Total Score
CONVERGENT VALIDITY	
EORTC QLQ-30C	
Physical Functioning	-.458**
Role Functioning	-.457**
Emotional Functioning	-.537**
Cognitive Functioning	-.532**
Social functioning	-.388**
Global Health Status / QOL	-.540**
SDS Total (n=146)	.711**
Pain Intensity	.287**
DISCRIMINANT VALIDITY	
SDS	
Constipation/bowel pattern (n=155)	.367**
Breathing (n=158)	.296**
Fever/chills (n=157)	.136

* One patient excluded due to missing PHQ-9 items. N=159 unless otherwise noted.

**
P<.01

Table 4
PHQ-9 depression characteristics among subjects triggering full PHQ-9 by at least one cardinal depression symptom

	Medical Oncology (n=155)			Radiation Oncology (n=69)			HSCT (n=118)			Total (N=342)		Tests of difference by clinical service	
	T1	T2		T1	T2		T1	T2		T1	T2	T1	T2
Triggered Full PHQ9													
<i>Missing</i>	20 (12.9%)	21 (13.5%)		8 (11.6%)	12 (17.4%)		5 (4.2%)	36 (30.5%)		33 (9.6%)	69 (20.2%)	P=.047	P=.002
PHQ-9 sum score	4 (2.6%)	4 (2.6%)		1 (1.4%)	0 (0.0%)		3 (2.5%)	4 (3.4%)		8 (2.3%)	8 (2.3%)		
<i>Mean (SD)</i>	11.3 (5.3)	12.8 (4.8)		11.8 (6.1)	12.8 (4.1)		13.0 (4.7)	12.4 (3.9)		11.7 (5.3)	12.6 (4.2)	P=.82	P=.92
PHQ-9 change score													
<i>Mean (SD)</i>			(n=7)			(n=5)			(n=4)				P=.80
<i>Median (range)</i>			1.4 (4.5)			0.4 (3.8)			2.7 (7.1)				
PHQ-9 severity			2.0 (-4.0 to 10.0)			0.0 (-4.0 to 6.0)			4.5 (-7.2 to 9.0)				
<i>Minimal (0-4)</i>	0 (0.0%)	1 (0.6%)		1 (1.4%)	0 (0.0%)		0 (0.0%)	1 (0.8%)		1 (0.3%)	2 (0.6%)	P=.86	P=.88
<i>Mild (5-9)</i>	8 (5.2%)	5 (3.2%)		2 (2.9%)	3 (4.3%)		1 (0.8%)	5 (4.2%)		11 (3.2%)	13 (3.8%)		
<i>Moderate (10-14)</i>	7 (4.5%)	9 (5.8%)		3 (4.3%)	5 (7.2%)		3 (2.5%)	18 (15.3%)		13 (3.8%)	32 (9.4%)		
<i>Moderately Severe (15-19)</i>	3 (1.9%)	3 (1.9%)		1 (1.4%)	3 (4.3%)		0 (0.0%)	10 (8.5%)		4 (1.2%)	16 (4.7%)		
<i>Severe (20+)</i>	2 (1.3%)	3 (1.9%)		1 (1.4%)	1 (1.4%)		1 (0.8%)	2 (1.7%)		4 (1.2%)	6 (1.8%)		
Met MDD criteria	5 (3.2%)	8 (5.2%)		3 (4.3%)	4 (5.8%)		2 (1.7%)	14 (11.9%)		10 (2.9%)	26 (7.6%)	P=.56	P=.10
Met ODD criteria	14 (9.0%)	12 (7.7%)		4 (5.8%)	6 (8.7%)		3 (2.5%)	18 (15.3%)		21 (6.1%)	36 (10.5%)	P=.61	P=.86
Suicidal Ideation												P=.38	P=.051
<i>Several days or more (%)</i>	4 (2.6%)	0 (0.0%)		1 (1.4%)	3 (4.3%)		0 (0.0%)	3 (2.5%)		5 (1.5%)	6 (1.8%)		

MDD=Major Depressive Disorder, ODD=Other Depressive Disorder