Symptoms and Needs Monitoring in Diverse Ambulatory Oncology Patients: Usage Characteristics and Impact on Emergency Room Visits and Hospitalization

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PURPOSE Symptoms and needs monitoring using patient-reported outcomes (PRO) is associated with improved clinical outcomes in cancer care. However, these improvements have been observed predominantly in non-Hispanic White patients using English assessments with high completion rates. The documented impact of such monitoring on system-level outcomes including emergency room (ER) visits and hospitalizations remains limited. We explored factors affecting the completion of PRO measures and evaluated clinical outcomes in an ambulatory oncology setting with a diverse racial, ethnic, and linguistic population.

METHODS A retrospective analysis (October 2019-February 2022) was performed for patients with cancer assigned to My Wellness Check (MWC), a patient-portal-administered and electronic health record–based PRO assessment that generates automated alerts to oncology providers. Patient demographics, clinical characteristics, and clinical outcomes were collected. Logistic regression models examined factors affecting the completion of MWC questionnaires. Cumulative incidence of ER visits and hospitalization were assessed by Cox proportional hazards regression models adjusting for demographics.

RESULTS We identified 9,553 patients; 43.1% (n = 4,117) answered one or more questions. Patients age 65 years or older (adjusted odds ratio [aOR], 0.77; $P < .0001$), male (aOR, 0.81; $P < .0001$), Hispanic/Latino ethnicity (aOR, 0.70; $P < .0001$), living without partners (aOR, 0.75; $P < .0001$), or receiving no treatment (aOR, 0.76; $P < .0001$) were less likely to answer MWC questionnaires. Patients who completed the entire MWC questionnaires had a reduced risk of an ER visit (adjusted hazard ratio, 0.78; $P < .0001$) and hospitalization (adjusted hazard ratio, 0.80; $P = .0007$) relative to patients who did not.

CONCLUSION Completing electronic health record–based PRO assessments was associated with significantly better clinical outcomes in a diverse cancer population. Specific patient groups were less likely to participate. Further research is needed to identify barriers to completing PRO measures and the long-term benefits of such programs.

INTRODUCTION

Patients with cancer and survivors often experience disease-related and treatment-related symptoms that are undetected or undertreated by clinical teams.[1,2] This population also faces a unique set of care needs and barriers to care (eg, transportation and need for more education) that, if not adequately addressed, can compromise adherence to care and result in poor outcomes. Furthermore, these needs often lack proper and systematic screening and provision of specialized cancer care.[3-5] Although clinician-reported outcomes can facilitate some of this care, administration of patient-reported outcome (PRO) assessments reflects any information (eg, symptoms or needs) sourced directly from the patient without a clinician's interpretation of the patient's response.[2] For complex symptoms such as fatigue and depression, PROs are more accurate than clinician observation, which are often not assessed, given time constraints within clinical care.[6,7] A systematic review demonstrates that health care providers feel PROs help identify specific issues of concern and result in more efficient use of their time.[8] Therefore, clinicians may benefit from PROs because their incorporation in care allows them to better understand patients' treatment experiences and provide an individualized treatment plan—an essential practice for precision medicine.

Systematic symptom monitoring during routine cancer care using PROs embedded within the electronic health record (EHR) is a suggested approach to improve symptom control by prompting clinicians to escalate

CONTEXT

Key Objective

Systematic patient-reported outcomes (PRO) monitoring during cancer care suggests improved clinical outcomes, mostly in clinical trials conducted largely in non-Hispanic White, English-speaking patients. This retrospective study assessed the usage of electronic health record–based PRO questionnaires with automated alerts to oncology providers and its impact on clinical outcomes. Outcomes included emergency room visits and hospitalization among racially, ethnically, and linguistically diverse population.

Knowledge Generated

Patients who were age 65 years or older, male, Hispanic, living without partners, or not receiving active treatment were less likely to answer PRO questionnaires. Patients who completed the questionnaires had a reduced risk of emergency room visits and hospitalization relative to those that did not complete them.

Relevance *(S.B. Wheeler)*

Real-world electronic health record–integrated PRO assessments with automated alerts to providers may improve clinical outcomes, but patient engagement in reporting is critical to achieve the clinical benefits of such programs.*

*Relevance section written by *JCO* Associate Editor Stephanie B. Wheeler, PhD, MPH.

symptom management promptly and enhance patient-clinician communication.[8,9] Recent randomized controlled studies suggest that using web-based symptom reporting with automated clinician alerts can result in better health-related quality of life, fewer emergency room (ER) visits, and superior quality-adjusted survival among patients with advanced cancer.[10-13]

However, several limitations and biases exist in the previous studies regarding generalizability. First, multiple studies were conducted with predominantly non-Hispanic/Latino patients using only English assessments, where the study population was specifically patients with cancer undergoing active treatments.[11-13] In more diverse communities, multiple determinants could influence the needs and clinical outcomes, such as race/ethnicity, preferred language, and phase of the cancer care continuum.[14] Second, research shows that improved outcomes are positively associated with PRO completion rates (73%-97.2%); however, these are limited to clinical trials.[10,15] Consequently, several centers have implemented routine EHR-based PRO monitoring with ongoing efforts, including engagement from stakeholders and integration of available information technologies to expand patient outreach to any ambulatory patient across the cancer treatment continuum.[4,16,17] For example, our group implemented an EHR-based PRO screening and referral system in ambulatory oncology clinics guided by the Exploration, Preparation, Implementation, and Sustainment model. The results showed the feasibility and acceptability of the implementation of the program.[4] However, there were a substantial number of patients who did not answer the PRO questionnaires, and the completion/response rate was lower than other populations who completed such questionnaires as part of a clinical trial.[16,17] Additional studies are needed to determine the factors associated with nonresponse and optimize care for diverse patients in ambulatory oncology.

The goal of this retrospective study was to compare patient characteristics and clinical outcomes between patients who answered the EHR-based PRO measures with those who did not in an ambulatory oncology setting with a diverse racial, ethnic, and linguistic population. Importantly, we also evaluated whether completion of the assessment was associated with more favorable system usage outcomes such as ER visits and hospitalizations.

METHODS

Program Description

The My Wellness Check (MWC) program is designed to assess and triage in real-time PROs of ambulatory oncology patients in the Sylvester Comprehensive Cancer Center (SCCC) at the University of Miami Miller School of Medicine. The details about the implementation process and the workflow are previously described.[4] The MWC program identifies patients with a confirmed cancer diagnosis via the EHR. The MWC program used an EHR-integrated algorithm that releases the MWC assessment via the patient portal 72 hours before the eligible patients' next appointment and assigns it no more than once in 30 days. Patients receive automated reminder texts or phone calls 72 hours before their visit. The questionnaire can be accessed in the patient portal through a computer, smartphone, or tablet device. Patients can complete the questionnaire at the clinic during their appointment; however, this was not available because of COVID-19 mitigation guidelines. Patient educational materials are available in the clinics and digitally on our website. A patient navigator was also available to assist patients via the phone.

Symptom Assessment and Best Practice Alerts

PROMIS-CAT domains (anxiety, depression, pain interference, fatigue, and physical function)[18-22] were used to

address emotional and physical symptoms commonly seen in oncology patients, while other items assessed nutritional, supportive, and practical needs (Appendix Tables A1 and A2, online only). All questionnaires were available in English and Spanish on the basis of the patient's stated language preference in the EHR. Assessments take 8-10 minutes to complete depending on patients' symptom severity, and patients can skip the questionnaires at any time. Patients' responses are immediately captured in the her, and automated alerts are sent to designated clinicians if the symptom was severe or practical/nutritional needs were endorsed. Specifically, patient responses with moderate or severe symptoms in pain interference (T-score $\geq$ 70), fatigue (T-score $\geq$ 70), or physical function (T-score $\leq$ 30) trigger alerts to the oncology clinic team. Moderate or severe elevation in depression (T-score $\geq$ 60) or anxiety (T-score $\geq$ 65), and endorsement of any supportive or practical needs trigger alerts to social work services, while endorsement of any nutritional needs triggers alerts to the nutrition/dietitian team. Alerts can be generated for each symptom; therefore, a single assessment can trigger multiple alerts. Designated clinicians address the alert within 72 hours of receipt with a coded disposition, such as general education provided and referral to cancer support services.

Data Collection

The study protocol was approved by the institutional review board at the University of Miami (eProst#20200984). Informed consent from patients was waived. Self-reported patient demographics, as well as clinical characteristics, such as cancer type/stage, treatment history, and Charlson comorbidity score,[23] were collected from the electronic data warehouse. Patients with any type of treatment (surgery, radiation therapy, chemotherapy, or hormone therapy) initiated within 1 year from the first MWC assignment were considered as recently receiving active treatment. The item-level responses and scores of the MWC questionnaires and related alerts with disposition were captured from the electronic data warehouse. Patients who initiated and responded to the MWC questionnaires were defined as responders, whereas patients who did not initiate the MWC questionnaires at all were defined as nonresponders. Among responders, those who completed the entire MWC questionnaire (full completers) were distinguished from those who completed a portion of a single assessment or some of all the assessments (partial completers). Referral to cancer support services (eg, psychiatry, psychology, nutrition, social work, cancer rehabilitation, exercise physiology, art therapy, massage therapy, and acupuncture) from oncology providers, hospital admissions and length of stay, and ER visits were also collected.

Statistical Data Analysis

Demographics and clinical characteristics were compared between responders versus nonresponders by using chi-squared tests or two-sample T-tests with Bonferroni correction for multiple comparisons. Key variables were evaluated by logistic regression to examine factors affecting the completion of the MWC questionnaires with prespecified levels of significance for univariate analysis ($P \leq .10$) and multivariate analysis ($P \leq .05$).

Descriptive statistics were calculated for the responses to the MWC questionnaires and dispositions of triggered alerts. The frequency of patients referred to cancer support services by oncology providers was calculated for both responders and nonresponders.

Time to ER visit and hospitalization were calculated in days from the first MWC assignment and the first event, respectively. The cumulative incidence function of ER visits and that of hospitalization were estimated by using the Kaplan-Meier method. The log-rank test was used to compare the outcomes between responders and nonresponders. Further analyses were performed using univariable and multivariable Cox proportional hazards regression, with adjustment for patient demographics and clinical characteristics. Post hoc sensitivity analysis was performed to exclude two patients who had a long follow-up period without any events but had preplanned hospitalization just before the end of the study period. Length of hospitalization was compared between responders and nonresponders by using two-sample T-test. Exploratory data analysis was conducted to compare clinical outcomes among full completer, partial completer, and nonresponder by using log-rank test followed by the Tukey-Kramer test. All P values were two-sided, and values < .05 will be considered statistically significant. Data management and statistical analysis were performed with SAS v9.4 (SAS Institute Inc, Cary, NC).

RESULTS

Patient and Clinical Characteristics

Between October 2019 and January 2022, 9,553 ambulatory cancer patients were assigned the MWC assessment at SCCC and 85% of them have logged into the patient portal at least once. The demographics of the study patients are shown in Table 1. Of these, 4,589 patients (48.0%) were age older than 65 years and 5,353 (56.0%) were female. A significant number of our patients were Hispanic/Latino (n = 5,278; 57.1%), and 36.5% of the whole study population reported Spanish as their preferred language and were therefore administered the MWC assessment in Spanish.

Of the 9,553 patients assigned the MWC assessment, 4,117 (43.1%) completed the MWC questionnaires fully or partially (responders). Compared with those who did not answer any of the MWC questionnaires (nonresponders), the responders significantly differed across several patient demographics and the treatment characteristics such as age, sex, and race/ethnicity (Table 1). Among responders, 2,760 (67.0%) patients with cancer completed all

TABLE 1. Patient Demographics

Patient Demographics	Total (N = 9,553)	Responder[a] (n = 4,117; 43.1%)	Nonresponder (n = 5,436; 56.9%)	P
Age, years, (No.) %				< .0001
< 65	4,964 (52.0)	2,296 (55.8)	2,668 (49.1)	
≥ 65	4,589 (48.0)	1,821 (44.2)	2,768 (50.9)	
Sex, (No.) %				< .0001
Male	4,200 (44.0)	1,702 (41.3)	2,938 (54.1)	
Female	5,353 (56.0)	2,415 (58.7)	2,498 (45.9)	
Race, (No.) %				< .0039
White[1]	8,380 (87.7)	3,653 (88.7)	4,727 (87.0)	
Black[1,2]	751 (7.9)	268 (6.5)	483 (8.9)	
Other[2]	289 (3.0)	144 (3.5)	145 (2.7)	
Not reported/refused	133 (1.4)	52 (1.3)	81 (1.5)	
Ethnicity,[b] (No.) %				.0005
Hispanic/Latino	5,278 (57.1)	2,163 (54.4)	3,115 (59.0)	
Non-Hispanic/Latino	3,971 (42.9)	1,810 (45.6)	2,161 (41.0)	
Preferred language, (No.) %				< .0001
English	6,067 (63.5)	2,871 (69.7)	3,196 (58.8)	
Spanish	3,486 (36.5)	1,246 (30.3)	2,240 (41.2)	
Marital status,[b] (No.) %				< .0001
Living with partner	5,624 (60.7)	2,582 (64.2)	3,042 (58.0)	
Living without partner	3,643 (39.3)	1,442 (35.8)	2,201 (42.0)	
Health insurance, (No.) %				.40
Insured	9,354 (97.9)	4,037 (98.1)	5,317 (97.8)	
Not insured	199 (2.1)	80 (1.9)	119 (2.2)	
Clinical characteristics				
Cancer stage, (No.) %				< .0001
Nonmetastatic (stages I-III)[2]	1,930 (20.2)	929 (22.6)	1,001 (18.4)	
Metastatic (stage IV)	442 (4.6)	199 (4.8)	243 (4.5)	
Unknown[2]	7,181 (75.2)	2,989 (72.6)	4,192 (77.1)	
Cancer type, (No.) %				< .0001
Breast[3,4]	1,907 (20.0)	903 (21.9)	1,004 (18.5)	
Hematology[5]	1,321 (13.8)	548 (13.3)	773 (14.2)	
Digestive system[3,7,8]	1,171 (12.3)	449 (10.9)	772 (13.3)	
Genital system, male[4,6]	1,114 (11.7)	444 (10.8)	670 (12.3)	
Head and neck[9]	811 (8.5)	333 (8.1)	478 (8.8)	
Genital system, female[5,6,7,9,10,11]	764 (8.0)	385 (9.4)	379 (7.0)	
Respiratory system	740 (7.8)	320 (7.8)	420 (7.7)	
Skin	383 (4.0)	166 (1.7)	217 (4.0)	
Urinary tract[11]	375 (3.9)	148 (3.6)	227 (4.2)	
Soft tissue	216 (2.3)	91 (2.2)	125 (2.3)	
Nervous system[10]	149 (1.6)	50 (1.2)	99 (1.8)	
Other[7]	382 (4.0)	187 (4.5)	195 (3.6)	
Unknown	220 (2.3)	93 (2.3)	127 (2.3)	

(continued on following page)

TABLE 1. Patient Demographics (continued)

Patient Demographics	Total (N = 9,553)	Responder[a] (n = 4,117; 43.1%)	Nonresponder (n = 5,436; 56.9%)	P
Treatment history,[b] No. (%)				
Surgery	4,485 (54.2)	2,128 (58.1)	2,357 (51.1)	**< .0001**
Radiation	3,212 (38.8)	1,514 (41.3)	1,689 (36.8)	**< .0001**
Chemotherapy	4,978 (60.2)	2,216 (60.5)	2,762 (59.9)	.58
Hormone therapy	2,782 (33.6)	1,281 (35.0)	1,501 (32.6)	**.02**
Current status, No. (%)				
Receiving active treatment	6,285 (76.9)	2,894 (79.0)	3,391 (73.6)	**< .0001**
Years since cancer diagnosis, mean (SD)	3.1 (3.1)	3.0 (3.0)	3.3 (3.1)	**< .0001**
Charlson comorbidity index, mean (SD)	6.1 (3.7)	6.2 (3.7)	6.1 (3.7)	.24

NOTE. Groups with different numbers show a statistically significant difference after Bonferroni correction.[1-11] Bold indicates P values < .05.
Abbreviation: SD, standard deviation.

[a]Responder is defined as patient who answered any part of questionnaire at least once.

[b]Denominators vary because of missing data. Ethnicity, n = 3,973 and n = 5,276; marital status, n = 4,024 and n = 5,243; treatment history and active treatment, n = 3,662 and n = 4,610 for responder and nonresponder, respectively.

assessments in the entire MWC questionnaires (full completer), and 1,357 (33.0%) patients with cancer completed a part of a single assessment or some of all the assessments (partial completer). The completion rate of each questionnaire among partial completers was as follows: anxiety, 86%; depression, 71%; pain interference, 71%; fatigue, 68%; physical functioning, 66%; supportive or practical needs, 62%; and nutritional needs, 12%.

Factors Affecting Completion of the PRO Questionnaires

The univariable and multivariable logistic regression analyses conducted to assess predictors of MWC questionnaire completion are shown in Table 2. After multivariate analysis, patients age 65 years or above (adjusted odds ratio [aOR] 0.76; 95% CIs, 0.69 to 0.84; $P < .0001$), male sex (aOR, 0.78; 95% CI, 0.71 to 0.86; $P < .0001$), Hispanic/Latino ethnicity (aOR, 0.72; 95% CI, 0.68 to 0.80; $P < .0001$), no partner (aOR, 0.74; 95% CI, 0.68 to 0.82; $P < .0001$), or no active treatment (aOR, 0.76; 95% CI, 0.68 to 0.86; $P < .0001$) were less likely to answer the MWC questionnaires. Of note, the response rate of Hispanic/Latino single men age older than 65 years was only 30%.

Referrals to Address Symptoms and Care Needs

Among 4,117 responders, 555 patients had 941 physical symptom alerts (pain interference, fatigue, or physical function). From these physical symptom alerts being triggered to the medical oncology clinic team, 31 referrals (3.3%) were sent to cancer support services. For emotional symptom alerts (anxiety and depression), 743 patients had a total of 1,293 alerts being triggered to the social work team, and 160 referrals (12.4%) were sent to cancer support services. There were 801 patients with 976 supportive or practical needs alerts being triggered to social workers and 1,160 patients with 1,513 nutritional needs alerts being triggered to dietitians. The proportion of alerts completed

within the 72-hour window was 83.7% for emotional alerts, 68.4% for supportive or practical needs alerts, 25% for physical alerts, and 81.8% for nutritional needs alerts.

Although oncologists were given opportunities to refer responders to cancer support services on the basis of these physical symptom alerts, they were also able to send the same type of referrals for both responders and nonresponders upon their visit on the basis of the oncologist's judgment. When compared with nonresponders, more responders were referred to cancer support services by their oncologists. For example, 10.3% of responders were referred to social work, whereas none of the nonresponders were referred to social work upon their visits. The same trend was seen in referrals sent to cancer rehabilitation, nutrition support services, psychiatry, psychology, acupuncture, and other cancer support services (Fig 1).

Clinical Outcomes

Fewer patients in the responder group visited the ER compared with those in the nonresponder group (30.5% vs. 37.6% at 720 days, $P = .02$; Fig 2A). The proportion of patients hospitalized was lower in responders than in nonresponders, but it was not statistically significant (24.3% in responders, 28.2% in nonresponders at 720 days, $P = .22$; Fig 2B). Notably, responders were significantly at reduced risk of ER visit (HR 0.81, $P = .0002$) and reduced risk of hospitalization (HR 0.83, $P = .001$) after adjusting for relevant confounding factors (Table 3). Additionally, responders had a significantly shorter length of hospitalization compared with nonresponders (5.8 days v 7.0 days, $P = .004$). Hospital discharge dispositions are shown in Appendix Table A3 (online only). The results of post hoc sensitivity analysis after two cases were excluded had similar results to those on the basis of the primary analysis.

TABLE 2. Factors Affecting Response to the Patient-Reported Outcome Questionnaires

Characteristics	Univariate Analysis			Multivariate Analysis		
	OR	95% CI	*P*	OR	95% CI	*P*
Age ≥ 65 (*v* age < 65) years	0.76	0.71 to 0.82	**< .0001**	0.77	0.70 to 0.84	**< .0001**
Male sex (*v* female)	0.83	0.76 to 0.90	**< .0001**	0.81	0.74 to 0.89	**< .0001**
Non-White (*v* White)	0.84	0.73 to 0.91	**.02**	0.70	0.60 to 0.81	**< .0001**
Hispanic/Latino (*v* non-Hispanic)	0.83	0.76 to 0.90	**< .0001**	0.74	0.68 to 0.81	**< .0001**
Spanish speaker (*v* English speaker)	0.62	0.57 to 0.68	**< .0001**	—	—	—
No partner (*v* living with partner)	0.77	0.71 to 0.84	**< .0001**	0.75	0.69 to 0.82	**< .0001**
No health insurance (*v* insured)	0.88	0.66 to 1.18	.41	—	—	—
CCI ≤ 2 (*v* CCI > 2)	0.95	0.86 to 1.03	.22	—	—	—
Metastatic cancer (*v* early cancer)	0.88	0.72 to 1.09	.24	—	—	—
No active treatment (*v* on active treatment)	0.74	0.67 to 0.82	**< .0001**	0.76	0.68 to 0.86	**< .0001**
Year since cancer diagnosis	0.97	0.96 to 0.98	**< .0001**	0.99	0.97 to 1.00	.10

NOTE. Bold indicates *P* values < .05.
Abbreviations: CCI, Charlson comorbidity index; OR, odds ratio.

Via exploratory analyses, we found that ER visits were significantly delayed in the full completers compared with partial completers (*P* = .03) and nonresponders (*P* = .01; Fig 3A). Also, full completers were at 22% reduced risk of an ER visit and at 20% reduced risk of hospitalization compared with nonresponders after adjusting for covariates (Fig 3B). However, there was no significant difference in risk of an ER visit or hospitalization between partial completers and nonresponders (Table 3).

DISCUSSION

To date, this is one of the largest studies to demonstrate the clinical benefits of PRO measures in ambulatory oncology in a real-world setting. The current study is unique in terms of a diverse patient population, which included a relatively high proportion of Hispanic/Latino (57.1%), and patients across the cancer care continuum. The results demonstrate that 43.1% of patients with cancer fully or partially completed the MWC questionnaires, whereas 56.9% did not complete questionnaires at all. Patients with cancer who completed MWC questionnaires had lower risks of ER visits and hospitalization, and a shorter length of hospital stay than those who did not complete questionnaires. Our findings are significant because it supports optimizing the health care system from traditional care to one where patients are engaged to improve their experience and outcomes of cancer care through PROs.

Patients with cancer age 65 years or older, Hispanic/Latino, male, having no partner, or who were not
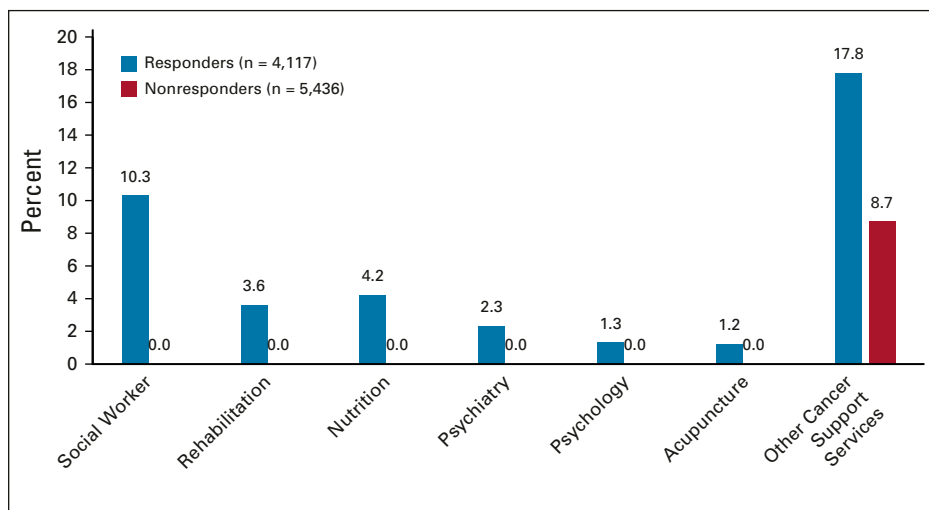

FIG 1. Supportive services use among responders and nonresponders. Other cancer support services: Music therapy, massage therapy, pastoral care, art therapy, and resource center and wig services.
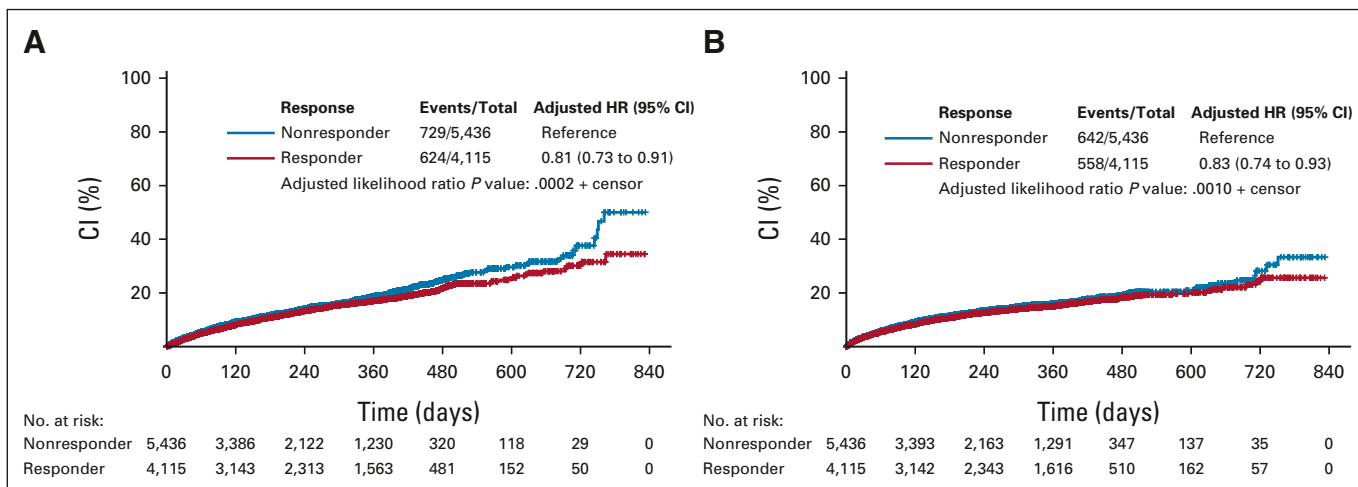
FIG 2. Cumulative incidence of (A) emergency room visits and (B) hospitalizations.

receiving active treatments were less likely to complete the MWC questionnaires. It is important to note that patients with cancer can suffer from symptoms and side effects related to cancer and its treatments for many years after primary treatment is completed.[24] Older patients with cancer are more likely to have frailty and comorbidities, which may exacerbate their symptoms.[25-27] Lack of partner/spouse may also negatively affect patients'

TABLE 3. Univariable Analysis and Multivariable Analysis of Cumulative Incidence of ER Visit and Hospitalization

	Univariate Analysis			Multivariate Analysis		
Variables	HR	95% CI	P	HR	95% CI	P
ER visit						
Responder (v nonresponder)	0.88	0.79 to 0.98	**.02**	0.81	0.73 to 0.91	**.0002**
Full responder (v nonresponder)	0.83	0.73 to 0.94	**.003**	0.78	0.69 to 0.88	**< .0001**
Partial responder (v nonresponder)	0.99	0.85 to 1.15	.88	0.89	0.77 to 1.04	.14
Age ≥ 65 (v age < 65) years	0.84	0.75 to 0.94	**.002**	0.83	0.74 to 0.93	**.0009**
Male (v female)	1.94	0.93 to 1.16	.51	1.04	0.93 to 1.17	.48
No health insurance (v insured)	1.73	1.25 to 2.40	**.001**	1.61	1.16 to 2.23	**.005**
CCI > 2 (v CCI ≤ 2)	3.10	2.61 to 3.67	**< .0001**	2.97	2.50 to 3.53	**< .0001**
Metastatic disease (v early stage)	1.78	1.41 to 2.26	**.0006**	1.47	1.15 to 1.87	**.002**
Active treatment (v no active treatment)	2.60	2.17 to 3.10	**< .0001**	2.36	1.96 to 2.83	**< .0001**
Years since cancer diagnosis	0.95	0.93 to 0.96	**< .0001**	0.97	0.95 to 0.99	**.001**
Hospitalization						
Responder (v nonresponder)	0.93	0.83 to 1.04	.22	0.83	0.74 to 0.93	**.001**
Full responder (v nonresponder)	0.88	0.78 to 1.01	.06	0.80	0.70 to 0.91	**.0007**
Partial responder (v nonresponder)	1.03	0.88 to 1.21	.70	0.88	0.75 to 1.03	.12
Age ≥ 65 (v age < 65) years	0.75	0.67 to 0.85	**< .0001**	0.74	0.66 to 0.84	**< .0001**
Male (v female)	1.21	1.08 to 1.35	**.002**	1.25	1.11 to 1.41	**.0002**
No health insurance (v insured)	1.68	1.19 to 2.38	**.003**	1.49	1.05 to 2.11	**.02**
CCI > 2 (v CCI ≤ 2)	4.55	3.68 to 5.63	**< .0001**	4.21	3.40 to 5.22	**< .0001**
Metastatic disease (v early stage)	2.07	1.62 to 2.66	**< .0001**	1.58	1.23 to 2.03	**.0003**
Active treatment (v no active treatment)	6.47	4.93 to 8.51	**< .0001**	5.54	4.20 to 7.30	**< .0001**
Years since cancer diagnosis	0.90	0.88 to 0.92	**< .0001**	0.94	0.92 to 0.96	**< .0001**

NOTE. Bold indicates P values < .05.

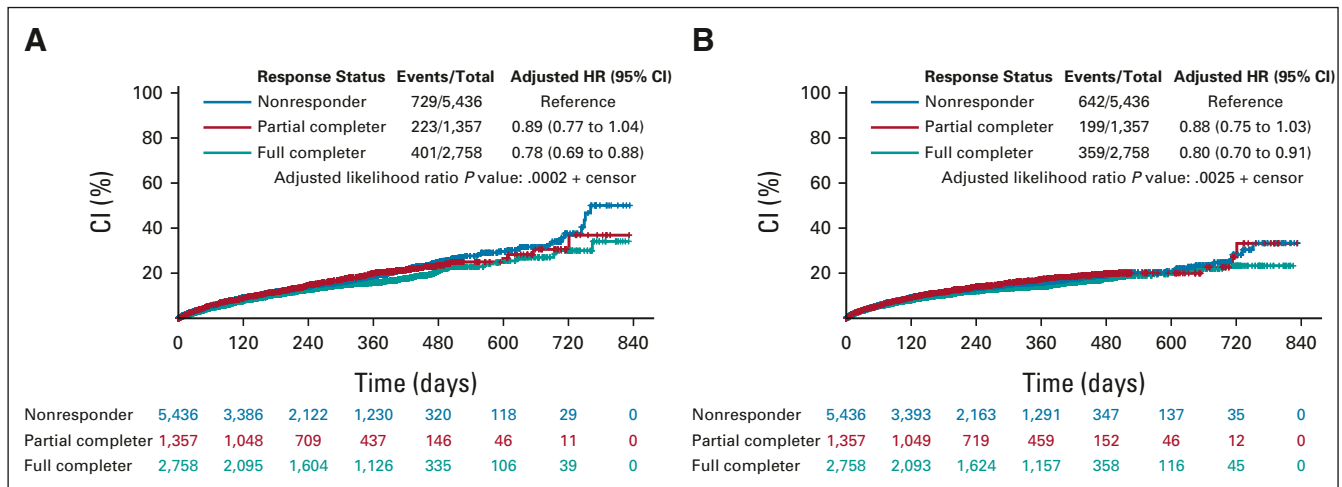Abbreviations: CCI, Charlson comorbidity index; ER, emergency room; HR, hazard ratio.

FIG 3. Clinical outcomes by questionnaire completion status: (A) emergency room visits and (B) hospitalizations.

symptoms and health-related quality of life because a partner/spouse often plays a supportive role as a caregiver in the patient's cancer treatment and survivorship by monitoring symptoms.[28] Therefore, it is particularly important to target populations with a higher level of nonresponse in PROs to receive appropriate, timely interventions and obtain self-monitoring skills via PROs. A previous study also demonstrated that patient characteristics such as non-White ethnicity and non-English language preference had lower acceptability of a PRO questionnaire among Canadian patients with cancer.[29] Although there is evidence of ethno-cultural influences on willingness to complete PRO questionnaires, mediating factors are not yet understood. Language may not play as major a role as the MWC questionnaire was available in the patient's preferred language. Rather, questionnaire materials require a tailored interface and content according to cultures in the specific patient population.

We observed that more responders were referred to cancer support services compared with nonresponders. The MWC program facilitated patient-clinician conversations about their symptoms and needs, which resulted in referrals to cancer supportive services promptly. Specialists receiving these referrals could then provide patients with evidence-based resources to address their needs. These patient-centered approaches resulted in improved system-level outcomes, including fewer ER visits, fewer hospitalizations, and a shorter length of hospital stay. Our findings are consistent with past clinical trials where the systematic integration of PRO measures in the oncology clinic is associated with fewer ER visits and hospitalizations.[9,11] A meta-analysis also reported that PROs are an independent prognostic factor for overall survival across cancer populations.[30] In addition to this existing evidence, we found that the clinical benefits were observed when patients completed the MWC questionnaires in their entirety; however, it was not significant for patients who completed a portion of the questionnaires. Our finding may suggest the importance of comprehensive assessment using multiple domains of patient-reported symptoms, as well as the importance of needs assessments that could capture underlying problems before they become symptomatic.

The results of our study should be interpreted in the context of several limitations. First, this study is a retrospective study from a single institution that is not randomized; therefore, it is difficult to account for all potential confounding factors. Because of the retrospective nature, the data may have some missingness and inaccuracies. Some patient demographics, such as race and ethnicity, were self-reported, and other patient demographics including education level and other socioeconomic status were largely missing. Furthermore, other clinical characteristics, such as performance status and enrollment in hospice, were limited. These factors may also affect questionnaire completion. Second, reasons for an ER visit and hospitalization could not be accurately procured retrospectively. We also only captured ER visits and hospitalizations within our health system and thus, events outside of our health network are missing. Third, our study population may be biased. Moreover, literacy level and digital device ownership were not assessed. Therefore, barriers for patients who have limited accessibility to a digital device or the internet, and those who have lower literacy, may not be well represented in the study. Finally, we did not capture whether patients were assisted in the completion of the MWC questionnaire. Therefore, the extent to which completion may have been facilitated by a family member or caregiver is unknown.

Future studies should address barriers to patient engagement in PRO monitoring including technology literacy and accessibility, cognitive capacity, and disease-related characteristics. As many communities may face challenges in the implementation of a program like MWC, the development of platforms that require less bandwidth connectivity (eg, text options) and a simpler design should be evaluated.

Finally, to broaden participation in future PRO research, a policy that addresses such limitations is needed.

In conclusion, MWC, an EHR-based PRO screening and referral program, was associated with significantly better clinical outcomes, including decreased ER visits and hospitalizations in a diverse population of ambulatory oncology patients. However, certain demographic groups did not engage in this beneficial program. Future research is needed to address the barriers and optimize the delivery and design of EHR-based PROs to encourage the participation of these diverse groups, and hence, promote the development of a culturally informed program.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Disclosures provided by the authors are available with this article at DOI https://doi.org/10.1200/JCO.22.01038.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Symptoms and Needs Monitoring in Diverse Ambulatory Oncology Patients: Usage Characteristics and Impact on Emergency Room Visits and Hospitalization

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated unless otherwise noted. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/jco/authors/author-center.

Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians (Open Payments).

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No other potential conflicts of interest were reported.

APPENDIX

TABLE A1. PROMIS-CATs Item Banks and Range of Administered Items

Domain	Item Bank	No. of Items in the Item Bank	No. of Items to be Administered[a]
Anxiety	PROMIS Bank v1.0	29	4-12
Depression	PROMIS Bank v1.0	28	4-12
Pain interference	PROMIS Bank v1.1	95	4-12
Fatigue	PROMIS Bank v1.0	40	4-12
Physical function	PROMIS Bank v2.0 (English) PROMIS Bank v1.2 (Spanish)	165	4-12

[a]The items are assigned until a SE of two or less has been reached or 12 items were answered.

TABLE A2. Nutritional Needs Assessment and Supportive or Practical Needs Assessment Checklist

Available Options in Needs Assessment
Nutritional Needs Assessment
I would like for a treatment team member to contact me for help with (check all that apply):
General nutrition counseling related to oncology
Difficulty losing weight/unintentional weight gain
Information on vitamins, supplements, and herbs
Constipation
Loss of appetite
Loss of 10 pounds or more without trying in the past 30 days
Nausea/vomiting more than 2-3 days
Difficulty with taste
Diarrhea
Difficulty chewing or swallowing
Issues with my ostomy
Issues with my feeding tube
Supportive or Practical Needs Assessment
I would like for a treatment team member to contact me for help with (check all that apply):
No needs at this time
Support to help me cope with my illness and/or manage stress
Financial/insurance concerns about my health care
Transportation resources
General education and information
Advance directives: medical actions to be taken if my health prevents me from making decisions (living will, power of attorney, health care surrogate)
Family problems/family health concerns
Sexual health concerns
Housing needs/concerns
Oncofertility (ability to have children)
Work/school concerns
Spiritual/religious concerns
Childcare

TABLE A3. Hospital Discharge Dispositions

Discharge Disposition	Total, No. (%)	Nonresponder, No. (%)	Responder, No. (%)
Home/self-care	677 (56.4)	342 (53.3)	335 (60.0)
Home under care of organized home health service	374 (31.2)	200 (31.2)	174 (31.2)
Skilled nursing facility	12 (1.0)	12 (1.9)	0 (0)
Short-term general hospital	2 (0.2)	2 (0.3)	0 (0)
Inpatient rehabilitation facility	29 (2.4)	20 (3.0)	9 (1.6)
Expired	23 (1.9)	13 (2.0)	10 (1.8)
Hospice—home	29 (2.4)	19 (3.0)	10 (1.8)
Hospice—medical facility	35 (2.9)	26 (4.0)	9 (1.6)
Left against medical advice	5 (0.4)	3 (0.5)	2 (0.4)
Not available	14 (1.2)	5 (0.8)	9 (1.6)
Total No. of discharge dispositions	1,200	642	558