Title: Cancer Symptom Recognition and Anticipated Delays in Seeking Care Among U.S. Adults

Authors and Affiliations:

1. Katharine A. Rendle, PhD, University of Pennsylvania, Perelman School of Medicine, Department of Family Medicine and Community Health
2. Elizabeth A. Sarma, PhD, National Cancer Institute, Division of Cancer Prevention, Cancer Prevention Fellowship Program
3. Samantha L. Quaife, PhD, University College London, Department of Behavioral Science and Health
4. Kelly D. Blake, PhD, National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program
5. Richard P. Moser, PhD, National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program
6. Jerry M. Suls, PhD, National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program
7. Heather M. Edwards, PhD, National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program
8. Sarah Kobrin, PhD, National Cancer Institute, Division of Cancer Control and Population Sciences, Healthcare Delivery Research Program

Corresponding Author:

Katharine Rendle, PhD, MSW, MPH
Department of Family Medicine and Community Health
University of Pennsylvania, Perelman School of Medicine
PPMC, Mutch Building, 51 N. 39th Street, Philadelphia PA 19104
Email: katharine.rendle@uphs.upenn.edu
Phone: 215-662-9147

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Abstract

Introduction: Early-stage diagnosis strongly predicts cancer survival. Recognition of potential cancer symptoms may improve survival by reducing time to seeking care.

Methods: Telephone interviews with a population-representative sample of English-speaking adults (aged 50 or older) in the United States (N=1,425) were conducted in 2014 using an instrument adapted from the International Cancer Benchmarking Partnership Awareness and Beliefs about Cancer survey. Anticipated time to seeking care for four cancer symptoms (persistent cough, rectal bleeding, mole changes, and breast changes) were assessed, and "delay" was defined as waiting two weeks or longer. Recognition of symptoms as potential cancer signs was assessed dichotomously. Multivariate logistic regression models were used to assess associations between symptom recognition and anticipated delay, adjusting for demographics, cancer experience, self-reported health, and healthcare access. Analyses were weighted and conducted in 2017.

Results: Symptom recognition varied but was relatively high across all symptoms (76.9%-95.5%). Anticipated delay varied by symptom and was the highest for persistent cough (41.2%) and lowest for rectal bleeding (9.1%). For rectal bleeding (aOR=2.65, 95% CI=1.31-5.36) and mole changes (aOR=3.30, 95% CI=1.48-7.33), anticipated delay was more likely among individuals who did not recognize the symptom as a warning sign. Adults with lower education levels ($P<0.05$) and African Americans ($P<0.05$) were less likely to delay for some symptoms.

Conclusions: Lack of symptom recognition was associated with anticipated delay in seeking care for some cancer symptoms. Differences in recognition and delays by symptom could be driven partly by screening messaging or by ambiguity and functional impact of each symptom.

Early-stage at diagnosis is a strong predictor of survival for most cancer types.[1] Population-based screening programs are designed to detect cancers before symptoms appear and therefore play a key role in early cancer detection. However, even in countries like the US and UK with population-based screening, the majority of cancers are not detected through screening.[2,3] Many adults do not receive adequate screening and, among those who are screened, cancers are missed and interval cancers occur. Consequently, the majority of diagnoses are made incidentally or following symptomatic presentation by the patient. To the extent that most cancers are not symptomatic until later stages, diagnoses resulting from symptomatic presentation often have worse prognosis.[2,4] Ensuring prompt care-seeking is therefore key to reducing cancer morbidity and mortality, yet delays in presentation are common and have been linked to individual, social, and structural factors, including age, education, marital status, and failure to recognize early cancer warning signs.[5-7]

Several international studies have sought to understand the relationship between cancer symptom awareness and care-seeking behaviors at the individual and population level.[8-10] As part of the International Cancer Benchmarking Partnership (ICBP), the Awareness and Beliefs about Cancer (ABC) survey was administered in 2011 across six countries to investigate how individuals' symptom awareness, cancer beliefs and care-seeking behaviors might contribute to international differences in cancer survival.[11,12] This work expanded upon studies from the UK documenting lack of symptom awareness as a common reason for delaying care among cancer patients[13,14] and low prevalence of cancer symptom awareness,[10,15,16] particularly among underserved groups.[16] While differences in symptom awareness did not explain international differences in cancer survival,[17] anticipated delay was associated with lack of symptom awareness across the six

countries[9] and within the UK.[10,18] Quaife and colleagues[18] found relationships between lack of recognition of lung, breast, and colorectal cancer symptoms and increased likelihood of patient delay; these relationships were consistent, independent of demographics and perceived healthcare access. Subsequent research has associated lower symptom awareness with regional differences in cancer survival,[19] and documented preliminary impact of symptom awareness campaigns on reducing stage at diagnosis.[20] In the US, little research has examined cancer symptom awareness and care-seeking.[19] To date, no population-based studies have examined US cancer symptom awareness and care-seeking across a range of cancer symptoms. Using population-based survey data modeled after the ICBP ABC instrument, this study builds upon international work by examining associations between cancer symptom recognition and anticipated time to seeking care in the US.

Methods

Computer-assisted telephone interviews with a population-representative sample of English-speaking adults (aged 50 or older) in the US (N=1,425) were conducted using an instrument adapted from the ICBP ABC survey.[11] The original ICBP ABC survey underwent substantial cognitive testing and test-retest reliability checking.[11] For the US-version, minor changes were made to ensure language and response codes were appropriate for the US-context. For example, demographic questions on educational attainment and ethnic group were adapted to match US census categories and references to the National Health Service were removed. To account for the rising number of cell-phone only households,[21] landline and cell-phone households were randomly sampled from regions across the US using two approaches. For landline sampling, households were selected using plus-digit dialing, which systematically takes a random selection

of telephone numbers from national telephone directories and replaces the last two digits with randomly-generated numbers. This approach increases coverage of the population by including non-listed telephone numbers, resulting in better representativeness. Households were eligible if at least one person aged 50 or older lived there. The Rizzo method was used to randomly select an individual in the household when more than one person was eligible.[22] For cell phones, it was not possible to use plus-digit dialing due to restrictions on calling cellular numbers in the US. Therefore, telephone numbers were selected at random from a database of 1,000-block records held by Survey Sampling International. Data were collected by Ipsos MORI's Social Research Institute (a UK-based research company who administered the original ICBP ABC survey) from August-October 2014. All activities were reviewed for ethical approval by the National Cancer Institute's Office of Human Subjects Research Protections. To equalize selection probabilities and compensate for non-coverage and non-response, survey design weights and non-response weights were developed and applied to the survey data. Design weights accounted for probability of interview selection within the household. Non-response weights for key demographic variables (age, gender, region, highest level of education, and race) were applied using 2012 American Community Survey data to account for differences between the study sample and US population.

Anticipated time to seeking care for potential cancer symptoms. Anticipated time to seeking physician-based care for four cancer symptoms was assessed: persistent cough, rectal bleeding, breast changes (females only), and changes in mole appearance. Cancer prevention for each associated cancer is recommended in the US (lung, colorectal, breast, and skin) and routine screening is recommended for all except skin. Respondents were instructed to indicate how long,

from first noticing each symptom, they would wait to go to the doctor; responses were categorized into: immediately, up to 1 week, 1<2 weeks, 2<3 weeks, 3<4 weeks, more than a month, and would not contact doctor. To compare results to previous analyses in other countries, responses indicating seeking care from non-physicians (e.g. pharmacists) were excluded (persistent cough: n=24; rectal bleeding: n=12; breast changes: n=6; and mole changes: n=9), and "delay" was defined "delay" as waiting two weeks or longer to seek care.[10,18]

Recognition of potential cancer symptoms. Recognition of the following four symptoms were assessed: persistent cough or hoarseness, unexplained bleeding, unexplained lump or swelling, and change in the appearance of a mole. For each symptom, the interviewer asked: Do you think [insert symptom] could be a sign of cancer? Responses were categorized dichotomously (No/Don't Know or Yes), and refusals were coded as missing.

Covariates. Data were collected on age [categorized by Medicare (federal health insurance program) eligibility: under 65 years or 65 years or older], sex, partner status (single or married/cohabitating), race (white, black, or other), education (no bachelor's degree or bachelor's degree or above), cancer experience (none, friend/family member only, self), and self-reported health (very good/good/fair or poor/very poor). Following the original ABC survey,[11] ease of healthcare care access was also assessed using the following question: How easy, or difficult, is it for you to get to see a doctor if you have a symptom that you think might be serious? Response options included very good, good, fair, poor, or very poor.

*Analysis***.** Univariate and bivariate analyses were used to describe and explore predictors of anticipated delay and recognition of cancer symptoms. Multivariate logistic regression models were used to test associations between anticipated delay and recognition of the related cancer symptom, adjusting for all covariates. Analysis was modeled after the approach of Quaife and colleagues,[18] who examined care-seeking in a sample of UK adults, in order to compare the context of the US to the UK. All analyses were weighted for non-response and survey design, and performed using Stata 13.1. All statistical tests were two-sided and a P value of <0.05 was considered statistically significant. Data were analyzed in 2017.

Results

The total sample size was 1,425 adults, block sampled from five US regions (unweighted sample: North East 19.1%, Midwest 22.0%, South 36.2%, West 10.9%, California 11.8%). Of the 5,397 landline numbers where eligibility was confirmed, 1,839 households had at least one member aged 50 or older, of whom 1,325 agreed to participate, 462 refused, and 52 only partially completed the survey (interview rate 72.1%). Of the 1,284 cellphone numbers where eligibility was confirmed, 159 individuals were aged 50 or older, of whom 100 agreed to participate, 44 refused, and 12 only partially completed the survey (interview rate 64.1%). In comparison to population estimates based on census data, the unweighted sample had greater representation of older women (23.9% vs 16.3%), college-educated adults (46.8% vs 28.7%), and non-Hispanic White adults (84.3% vs 76.0%), which were balanced in analysis using non-response weights.

Recognition of early cancer warning signs was high across all symptoms, but greatest for unexplained lump (95.5%), followed by changes in mole appearance (93.4%), unexplained bleeding (89.6%), and persistent cough (76.9%). Across all four cancer symptoms, in bivariate models, higher education was significantly associated with symptom recognition (Table 1). African Americans were significantly less likely than other racial groups, in bivariate models, to identify unexplained lump ($P<0.01$) or change in mole appearance ($P<0.01$) as potential cancer symptoms. Women were more likely to recognize unexplained bleeding ($P<0.01$) or change in mole appearance ($P<0.05$) than men in bivariate models. No significant relationships were found between self-reported health or healthcare access and recognition of any cancer symptom. Table 1 provides full details of the bivariate correlates of cancer symptom recognition.

The prevalence of anticipated delay (>2 weeks) varied across symptoms and was the highest for persistent cough (41.2%), followed by mole changes (33.1%), breast changes (14.7%), and rectal bleeding (9.1%). For all symptoms except rectal bleeding, there were significant associations in bivariate models between higher education and greater anticipated delay (Table 2). Adults who reported difficulty accessing a doctor had significantly higher odds of anticipated delay in seeking care for rectal bleeding ($P<0.05$) and breast changes ($P<0.05$). These adults also more commonly reported delays in seeking care for mole changes, but this association was not statistically significant. Older adults reported fewer anticipated delays for all symptoms except breast changes (Table 2). There were no significant associations between self-reported health or cancer experience for any symptoms. Table 2 provides full details of bivariate correlates of anticipated delays.

Figure 1 shows that for each cancer symptom, anticipating delay (>2 weeks) for care-seeking was more common among those adults who did not recognize the symptom as a potential cancer warning sign. These differences were statistically significant for rectal bleeding ($P<0.05$) and mole changes ($P<0.01$). In multivariate analyses, the likelihood of anticipated delay in care-seeking was significantly greater among those individuals who did not recognize the symptom as a potential sign of cancer, after adjusting for potential confounders, for rectal bleeding (aOR=2.65, 95% CI=1.31-5.36) and mole changes only (aOR=3.30, 95% CI=1.48-7.33). Across all symptoms except breast changes, African Americans were significantly less likely to delay than other races (Table 3). Adults with a college degree or higher were significantly more likely to delay care-seeking for persistent cough (aOR=1.41, 95% CI=1.04-1.92) and mole changes (aOR=1.46, 95% CI=1.07-1.99). For rectal bleeding and breast changes only, those who reported difficulty accessing a doctor were significantly more likely to delay care-seeking than those who reported ease in accessing a doctor (rectal bleeding: aOR=2.44, 95% CI=1.09-5.47; mole changes: aOR=2.97, 95% CI=1.41-6.25).

Discussion

To the authors' knowledge, this was the first population-based study in the US to examine associations between recognition of potential cancer symptoms and anticipated time to seeking care. Similar to previous studies in other countries,[9,10,18] our results indicated that for some, but not all, cancer symptoms, lack of symptom recognition was associated with anticipated delay in seeking physician-based care. Many other factors could affect symptom recognition and rapid care seeking including the level of public messaging for different types of cancer and cancer prevention, the impact of the symptom on daily life, or the specificity (or ambiguity) of the

symptom. For example, for breast changes, there has been substantial public health messaging around potential warning signs and screening. Therefore, it was not surprising to see higher rates of knowledge for this symptom and lower anticipated delay.

While rates of symptom recognition were relatively high across the population and similar to the UK,[18] prevalence of anticipated delays in seeking care varied greatly depending on the symptom. Anticipated delays for rectal bleeding were the lowest across symptoms, which may be partly driven by the functional impact on daily life; whereas delays in care-seeking for persistent cough may be shaped more by the ambiguous, or seemingly trivial,[23] nature of the warning sign. Coughing can be indicative of other health problems, such as the common cold, and may therefore not be perceived as a health issue in need of urgent physician care, but rather amenable to self-management.[24] Additionally, although routine cancer screening for a variety of cancers is recommended in the US,[25] many people continue to be underscreened, especially in lung cancer for which screening uptake is estimated to be lower than 5% across the eligible population.[26] Regardless of the status of these other, variably influential factors, symptom identification and prompt care seeking will continue to be important. Campaigns and interventions to increase public awareness of symptoms and reduce barriers to rapid care are needed. Lastly, similar to some studies outside the US,[8,27] this study found that anticipated delay was associated with higher educational attainment and non-minority groups". The counterintuitive association between higher education and delay might reflect higher levels of perceived ability to interpret symptoms and seek information online prior to seeking medical care.[33] With regard to race, other studies have shown that while minority populations might report lower levels of *anticipated* delay,[16] this association does not necessarily remain when *actual* time to care is examined.

Actual time to care is influenced by a range of external barriers such as health insurance, or other cancer related-factors such as cancer fatalism or illness perception that may impact care-seeking when actual symptoms occur[35-37].

Although most people recognized mole changes as a cancer warning sign, lack of recognition was nevertheless associated with greater delay in care-seeking. This indicates that additional public health campaigns may be needed to further increase public knowledge. This finding fits well with studies showing skin cancer knowledge to be associated with greater sun protection behavior.[28] However, even among those who did recognize the importance of mole changes, close to a third anticipated delaying care-seeking. This low level of concern about the symptom suggests that additional factors may also be important influencers of care-seeking for mole changes. For instance, people may know that change in the appearance of a mole is a potential sign of cancer but may not perceive the sign as serious or needing immediate attention.[29,30] Moreover, structural factors may promote delay, such as access to a dermatologist, which may be an out-of-pocket expense, particularly for patients without access to health insurance. Geographic density of dermatologists varies widely,[31] meaning access may be more limited for those not living near many, or any, dermatologists. Given the rising melanoma incidence among older adults,[32] and the unlikelihood of rapid changes in the availability of dermatologists, more research is warranted to identify modifiable factors that influence delay in care-seeking for mole changes.

The current study, which has a cross-sectional design, is limited in its ability to make causal conclusions about the relationship between symptom awareness and delay in help-seeking. There

are limitations to measuring anticipated delay rather than actual time to care. Though studies examining actual time to care-seeking for cancer symptoms also show that lack of symptom recognition is associated with a greater delay,[14] anticipated delays may be shorter than actual delays.[8] Indeed, the processes of noticing a symptom, appraising it as potential cancer sign, and then deciding to seek medical care are likely to be more complex than recognizing a symptom in the research context.[23] For example, there is some mixed evidence from the UK that while those with lower education anticipate less delay, they may be less likely to suspect a symptom is cancer.[27,33] Thus, additional research is needed to examine the effect of symptom recognition on actual, rather than anticipated, care-seeking behaviors for different US groups. Strengths of the current study include the large population-based sample and assessment of recognition of specific symptoms (rather than general symptom awareness) and anticipated delay for each, which may be more accurate given the known variability in help-seeking across different symptoms. Additionally, a strength of the study is that it allows for direct international comparisons about cancer symptom awareness and delays across countries rather than indirect comparisons because it administered the ABC survey.

Conclusions

Since most cancers are diagnosed symptomatically, in the US as in other countries,[2] identifying modifiable factors to reduce delay in care-seeking for potential cancer symptoms is important in promoting earlier diagnoses and better outcomes. This study provides the first evidence that the US population recognizes cancer symptoms as well as the populations of countries with national healthcare systems. In addition to recognition of cancer warning signs, future studies should examine other factors, such as beliefs about cancer[9] and specific barriers to care,[34] that are likely

298 to influence care-seeking for potential cancer symptoms. Public health interventions focused on
299 increasing awareness of timely care for cancer symptoms may also be necessary.

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References

1. McPhail S, Johnson S, Greenberg D, Peake M, Rous B. Stage at diagnosis and early mortality from cancer in England. *Br J Cancer.* 2015;112(Suppl 1):108-115.
2. Elliss-Brookes L, McPhail S, Ives A, et al. Routes to diagnosis for cancer - determining the patient journey using multiple routine data sets. *Br J Cancer.* 2012;107(8):1220-1226.
3. White A, Thompson TD, White MC, et al. Cancer screening test use - United States, 2015. *Morbidity and Mortality Weekly Report.* 2017;66(8):201-206.
4. Hofvind S, Geller B, Skaane P. Mammographic features and histopathological findings of interval breast cancers. *Acta Radiol.* 2008;49(9):975-981.
5. Macdonald S, Macleod U, Campbell NC, Weller D, Mitchell E. Systematic review of factors influencing patient and practitioner delay in diagnosis of upper gastrointestinal cancer. *Br J Cancer.* 2006;94(9):1272-1280.
6. Mitchell E, Macdonald S, Campbell NC, Weller D, Macleod U. Influences on pre-hospital delay in the diagnosis of colorectal cancer: A systematic review. *Br J Cancer.* 2008;98(1):60-70.
7. Ramirez AJ, Westcombe AM, Burgess CC, Sutton S, Littlejohns P, Richards MA. Factors predicting delayed presentation of symptomatic breast cancer: A systematic review. *Lancet.* 1999;353(9159):1127-1131.
8. McCutchan GM, Wood F, Edwards A, Richards R, Brain KE. Influences of cancer symptom knowledge, beliefs and barriers on cancer symptom presentation in relation to socioeconomic deprivation: A systematic review. *BMC Cancer.* 2015;15:1000.

9. Pedersen AF, Forbes L, Brain K, et al. Negative cancer beliefs, recognition of cancer symptoms and anticipated time to help-seeking: An international cancer benchmarking partnership (ICBP) study. *BMC Cancer.* 2018;18(1):363.
10. Robb K, Stubbings S, Ramirez A, et al. Public awareness of cancer in Britain: A population-based survey of adults. *Br J Cancer.* 2009;101(Suppl 2):18-23.
11. Simon AE, Forbes LJ, Boniface D, et al. An international measure of awareness and beliefs about cancer: Development and testing of the ABC. *BMJ Open.* 2012;2(6).
12. CR-UK. International Cancer Benchmarking Partnership. 2010; https://www.cancerresearchuk.org/health-professional/data-and-statistics/international-cancer-benchmarking-partnership-icbp. Accessed 20 July 2018.
13. Chapple A, Ziebland S, McPherson A. Qualitative study of men's perceptions of why treatment delays occur in the UK for those with testicular cancer. *Br J Gen Pract.* 2004;54(498):25-32.
14. Smith LK, Pope C, Botha JL. Patients' help-seeking experiences and delay in cancer presentation: A qualitative synthesis. *Lancet.* 2005;366(9488):825-831.
15. Stubbings S, Robb K, Waller J, et al. Development of a measurement tool to assess public awareness of cancer. *Br J Cancer.* 2009;101 (Suppl 2):13-17.
16. Waller J, Robb K, Stubbings S, et al. Awareness of cancer symptoms and anticipated help seeking among ethnic minority groups in England. *Br J Cancer.* 2009;101 (Suppl 2):24-30.
17. Forbes LJ, Simon AE, Warburton F, et al. Differences in cancer awareness and beliefs between Australia, Canada, Denmark, Norway, Sweden and the UK (the International

Cancer Benchmarking Partnership): Do they contribute to differences in cancer survival? *Br J Cancer.* 2013;108(2):292-300.

18. Quaife SL, Forbes LJ, Ramirez AJ, et al. Recognition of cancer warning signs and anticipated delay in help-seeking in a population sample of adults in the UK. *Br J Cancer.* 2014;110(1):12-18.

19. Niksic M, Rachet B, Duffy SW, Quaresma M, Moller H, Forbes LJ. Is cancer survival associated with cancer symptom awareness and barriers to seeking medical help in England? An ecological study. *Br J Cancer.* 2016;115(7):876-886.

20. Kennedy MPT, Cheyne L, Darby M, et al. Lung cancer stage-shift following a symptom awareness campaign. *Thorax.* 2018. [E-published ahead of print June 27, 2018].

21. Blumberg SJ, Ganesh N, Luke JV, Gonzales G. Wireless substitution: State-level estimates from the National Health Interview Survey, 2012. *Natl Health Stat Report.* 2013(70):1-16.

22. Rizzo L, Brick JM, Park I. A minimally intrusive method for sampling persons in random digit dial surveys. *Public Opinion Quarterly.* 2004;68(2):267-274.

23. Whitaker KL, Macleod U, Winstanley K, Scott SE, Wardle J. Help seeking for cancer 'alarm' symptoms: A qualitative interview study of primary care patients in the UK. *Br J Gen Pract.* 2015;65(631):e96-e105.

24. Macleod U, Mitchell ED, Burgess C, Macdonald S, Ramirez AJ. Risk factors for delayed presentation and referral of symptomatic cancer: Evidence for common cancers. *Br J Cancer.* 2009;101 (Suppl 2):92-101.

25. Moyer VA. Screening for lung cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2014;160(5):330-338.

26. Jemal A, Fedewa SA. Lung cancer screening with low-dose computed tomography in the United States-2010 to 2015. *JAMA Oncol.* 2017;3(9):1278-1281.
27. Davies H, Marcu A, Vedsted P, Whitaker KL. Is lower symptom recognition associated with socioeconomic inequalities in help-seeking for potential breast cancer symptoms? *Psychooncology*. 2017.
28. Day AK, Wilson CJ, Hutchinson AD, Roberts RM. The role of skin cancer knowledge in sun-related behaviours: a systematic review. *J Health Psychol.* 2014;19(9):1143-1162.
29. Walter FM, Humphrys E, Tso S, Johnson M, Cohn S. Patient understanding of moles and skin cancer, and factors influencing presentation in primary care: A qualitative study. *BMC Fam Pract.* 2010;11:62.
30. O'Shea SJ, Rogers Z, Warburton F, Ramirez AJ, Newton-Bishop JA, Forbes LJ. Which symptoms are linked to a delayed presentation among melanoma patients? A retrospective study. *BMC Cancer.* 2017;17(1):5.
31. Glazer AM, Farberg AS, Winkelmann RR, Rigel DS. Analysis of Trends in Geographic Distribution and Density of US Dermatologists. *JAMA Dermatol.* 2017;153(4):322-325.
32. Holman DM, Freeman MB, Shoemaker ML. Trends in melanoma incidence among Non-Hispanic Whites in the United States, 2005 to 2014. *JAMA Dermatol.* 2018;154(3):361-362.
33. Marcu A, Lyratzopoulos G, Black G, Vedsted P, Whitaker KL. Educational differences in likelihood of attributing breast symptoms to cancer: A vignette-based study. *Psychooncology*. 2016;25(10):1191-1197.

34. Donnelly C, Quaife S, Forbes L, Boylan J, Tishelman C, Gavin A. Do perceived barriers to clinical presentation affect anticipated time to presenting with cancer symptoms: An ICBP study. *Eur J Public Health.* 2017;27(5):808-813.

35. Vrinten C, Wardle J, Marlow LAV. Cancer fear and fatalism among ethnic minority women in the United Kingdom. *Br J Cancer*. 2016;114(5):597-604.

36. Leventhal H, Diefenbach M, Leventhal EA. Illness cognition: Using common sense to understand treatment adherence and affect cognition interactions. *Cognit Ther Res*. 1992; 16(2):143-163.

Figure 1: Legend

Title

Figure 1. Recognition and anticipating >2 weeks before care-seeking for each related cancer symptom.

Legend

White Bar: Symptom Unaware

Black Bar: Symptom Aware

Table 1. Weighted bivariate correlates of recognizing that a specific symptom might indicate cancer

Variable	Total Sample (N=1425)	Persistent cough	Unexplained bleeding	Unexplained lump (females only)	Change in mole appearance
	n (%)	n (%)	n (%)	n (%)	n (%)
Recognized as cancer symptom	-	1147 (76.9)	1305 (89.6)	905 (95.5)	1359 (93.4)
Sex					
Female	942 (53.5)	764 (78.6)	**876 (92.6)****	-	**907 (95.7)***
Male	483 (46.5)	383 (74.9)	**429 (86.2)**	-	**452 (90.7)**
Age					
50-64	687 (56.0)	551 (75.5)	631 (89.2)	410 (95.4)	663 (93.6)
65-99	736 (43.9)	595 (78.7)	673 (90.1)	494 (95.7)	694 (93.1)
Marital Status					
Single	684 (36.9)	538 (74.4)	618 (88.4)	**487 (92.7)***	644 (91.0)
Married/Cohabiting	726 (62.3)	597 (78.3)	674 (90.5)	**410 (97.5)**	700 (94.7)
Race					
White	1185 (77.3)	961 (78.1)	1083 (90.1)	**757 (96.7)****	**1143 (95.6)****
Black	119 (9.7)	92 (75.0)	109 (85.2)	**80 (86.0)**	**108 (87.3)**
Other	92 (10.5)	69 (66.7)	85 (89.9)	**52 (96.3)**	**79 (81.5)**
Education					
No Bachelor's degree	734 (69.3)	**569 (75.2)***	**662 (88.9)***	**501 (94.3)*****	**688 (92.6)****
Bachelor's degree or above	667 (28.9)	**562 (82.1)**	**623 (93.5)**	**390 (99.1)**	**652 (97.3)**
Cancer experience					
None	235 (17.5)	**159 (58.5)*****	210 (85.8)	**138 (89.1)***	**214 (85.9)****
Yes, but not self	882 (62.2)	**727 (80.5)**	812 (90.6)	**577 (96.6)**	**856 (95.7)**
Yes, self	299 (19.9)	**253 (81.1)**	276 (89.9)	**185 (95.7)**	**281 (92.8)**
Accessing Doctor					
Very/Somewhat Easy	1226 (82.9)	986 (76.7)	1129 (90.5)	790 (95.7)	1177 (94.5)
Very/Somewhat Difficult	175 (14.7)	143 (79.7)	158 (89.5)	99 (93.9)	160 (89.7)
Self-Reported Health					
Fair/Good/Very Good	1309 (90.0)	1054 (76.1)	1200 (89.5)	835 (96.0)	1253 (93.4)
Poor/Very Poor	110 (9.5)	87 (82.4)	99 (89.6)	64 (90.2)	100 (92.8)

Note: Totals vary due to missing data. Design-adjusted F statistics were used to assess the association between care-seeking for a specific symptom and correlate for each model. Categories reflect the specific wording of the survey item. All percentages are weighted. Boldface indicates statistical significance (*p<0.05, **p<0.01, ***p<0.001).

Table 2. Weighted bivariate correlates of anticipated delay to care-seeking if experiencing specific symptom*

Variable	Persistent cough	Rectal bleeding	Breast changes (females only)	Mole changes
	n (%)	n (%)	n (%)	n (%)
Anticipated Delay	611 (41.2)	128 (9.1)	143 (14.7)	461 (33.1)
Recognize as cancer symptom?				
No	131 (45.6)	**20 (18.6)***	5 (16.1)	**32 (57.0)****
Yes	478 (40.0)	**108 (8.1)**	137 (14.6)	**429 (31.7)**
Sex				
Female	411 (41.2)	78 (8.4)	-	**277 (28.9)***
Male	200 (41.2)	50 (9.9)	-	**184 (38.0)**
Age				
50-64	311 (41.2)	**69 (10.8)***	68 (13.9)	**264 (37.0)****
65-99	300 (41.3)	**58 (6.7)**	75 (15.7)	**196 (28.1)**
Marital Status				
Single	285 (40.2)	63 (8.9)	76 (15.1)	199 (29.1)
Married/Cohabiting	315 (41.3)	64 (9.2)	66 (14.4)	259 (35.3)
Race				
White	**544 (45.3)*****	112 (9.4)	123 (14.8)	394 (33.8)
Black	**22 (17.3)**	4 (2.0)	4 (6.7)	25 (20.9)
Other	**35 (31.2)**	10 (14.2)	10 (20.9)	32 (37.5)
Education				
No Bachelor's degree	**287 (38.4)****	53 (8.3)	**68 (13.0)***	**222 (30.6)***
Bachelor's degree or above	**318 (47.6)**	74 (11.2)	**72 (19.8)**	**234 (38.5)**
Cancer experience				
None	89 (35.6)	19 (7.8)	27 (17.3)	76 (39.3)
Yes, but not self	383 (40.7)	77 (8.8)	90 (14.7)	287 (32.4)
Yes, self	135 (47.7)	32 (11.1)	24 (12.7)	94 (30.3)
Accessing Doctor				
Very/Somewhat Easy	527 (41.7)	**102 (7.5)***	**117 (12.8)***	392 (32.1)
Very/Somewhat Difficult	76 (37.7)	**24 (16.1)**	**25 (26.9)**	63 (38.5)
Self-Reported Health				
Fair/Good/Very Good	564 (42.2)	115 (8.7)	132 (14.9)	421 (32.9)
Poor/Very Poor	46 (33.3)	13 (13.4)	11 (14.7)	40 (36.7)

Note: Totals vary due to missing data. Design-adjusted F statistics were used to assess the association between care-seeking for a specific symptom and correlate for each model. Categories reflect the specific wording of the survey item. All percentages are weighted. See Table 1 for Total Sample. Boldface indicates statistical significance (*p<0.05, **p<0.01, ***p<0.001).

Table 3. Weighted multivariate correlates of anticipated delay before seeking care for potential cancer symptom

Variable	Persistent cough (n=1268)		Rectal bleeding[a] (n=1265)		Breast changes (n=848)		Mole changes (n=1294)	
	aOR (95% CI)	*p*	aOR (95% CI)	*p*	aOR (95% CI)	*p*	aOR (95% CI)	*p*
Recognize as cancer symptom?								
Yes	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
No	1.42 (0.93 - 2.16)	.10	**2.65 (1.31 - 5.36)**	**.007**	1.45 (0.47 - 4.49)	.51	**3.30 (1.48 - 7.33)**	**.003**
Sex								
Female	1.00 (ref)		1.00 (ref)		-	-	1.00 (ref)	
Male	0.88 (0.63 - 1.23)	.44	0.94 (0.55 - 1.59)	.81	-	-	1.18 (0.85 - 1.64)	.32
Age								
50-64y	1.23 (0.88 - 1.72)	.22	**2.03 (1.25 - 3.32)**	**.005**	0.75 (0.44 - 1.30)	.31	**1.55 (1.10 - 2.18)**	**.01**
65-99y	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Marital Status								
Single	1.20 (0.86 - 1.67)	.28	1.27 (0.78 - 2.09)	.34	1.17 (0.71 - 1.93)	.53	0.86 (0.61 - 1.20)	.37
Married/Cohabiting	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Race								
White	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Black	**0.24 (0.12 - 0.50)**	**<.001**	**0.16 (0.05 - 0.54)**	**.003**	0.41 (0.10 - 1.63)	.20	0.45 (0.21 - 0.93)	.03
Other	0.52 (0.27 - 1.02)	.06	1.35 (0.54 - 3.41)	.52	1.33 (0.45 - 3.91)	.60	0.87 (0.46 - 1.65)	.67
Education								
No Bachelor's degree	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Bachelor's degree or above	**1.41 (1.04 - 1.92)**	**.03**	1.55 (0.97 - 2.47)	.07	1.57 (0.98 - 2.53)	.06	**1.46 (1.07 - 1.99)**	**.02**
Cancer experience								
None	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Yes, but not self	1.25 (0.78 - 1.90)	.36	1.15 (0.51 - 2.58)	.74	0.92 (0.43 - 1.95)	.83	0.74 (0.46 - 1.19)	.21
Yes, self	**1.96 (1.14 - 3.38)**	**.02**	1.55 (0.63 - 3.79)	.34	0.86 (0.35 - 2.11)	.74	0.73 (0.43 - 1.25)	.26
Accessing doctor								
Somewhat/Very Easy	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Somewhat/Very Difficult	0.92 (0.55 - 1.53)	.74	**2.44 (1.09 - 5.47)**	**.03**	**2.97 (1.41 - 6.25)**	**.004**	1.42 (0.88 - 2.30)	.15
Self-reported health								
Fair/Good/Very Good	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Poor/Very Poor	0.85 (0.48 - 1.48)	.56	0.99 (0.36 - 2.71)	.99	0.91 (0.40 - 2.07)	.83	1.06 (0.59 - 1.89)	.85

Note: Sample sizes are different across models due to missing data. Breast changes model includes females only. aOR = adjusted odds ratio; CI = confidence interval. Boldface indicates statistical significance (*p<0.05, **p<0.01, ***p<0.001).
[a]Rectal bleeding model fit (F(9,1275) = 5.105, P > .001); no indication of poor model fitness for other models.

418 Figure 1
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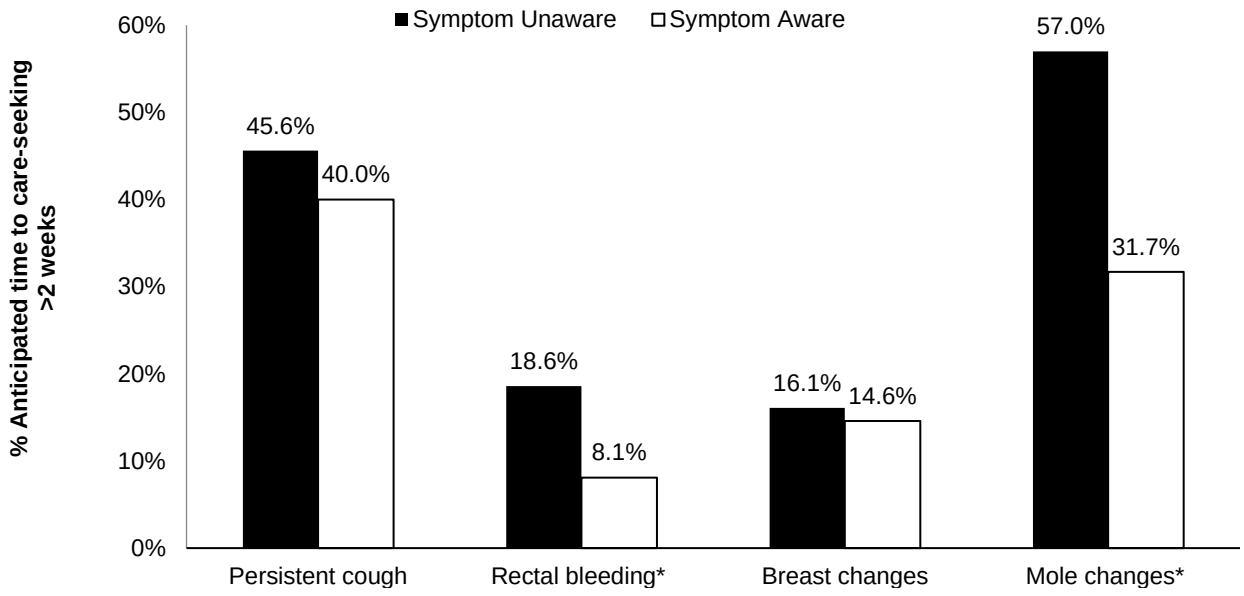

Note: Asterik indicates a significant difference between symptom aware and unaware at P < .05.

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