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Factors Associated With Oncologist Discussions of the Costs of Genomic Testing and Related Treatments

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Abstract

Background: Use of genomic testing is increasing in the United States. Testing can be expensive, and not all tests and related treatments are covered by health insurance. Little is known about how often oncologists discuss costs of testing and treatment or about the factors associated with those discussions.

Methods: We identified 1220 oncologists who reported discussing genomic testing with their cancer patients from the 2017 National Survey of Precision Medicine in Cancer Treatment. Multivariable polytomous logistic regression analyses were used to assess associations between oncologist and practice characteristics and the frequency of cost discussions. All statistical tests were two-sided.

Results: Among oncologists who discussed genomic testing with patients, 50.0% reported often discussing the likely costs of testing and related treatments, 26.3% reported sometimes discussing costs, and 23.7% reported never or rarely discussing costs. In adjusted analyses, oncologists with training in genomic testing or working in practices with electronic medical record alerts for genomic tests were more likely to have cost discussions sometimes (odds ratio [OR] = 2.09, 95% confidence interval [CI] = 1.19 to 3.69) or often (OR = 2.22, 95% CI = 1.30 to 3.79), respectively, compared to rarely or never. Other factors statistically significantly associated with more frequent cost discussions included treating solid tumors (rather than only hematological cancers), using next-generation sequencing gene panel tests, having higher patient volume, and working in practices with higher percentages of patients insured by Medicaid, or self-paid or uninsured.

Conclusions: Interventions targeting modifiable oncologist and practice factors, such as training in genomic testing and use of electronic medical record alerts, may help improve cost discussions about genomic testing and related treatments.

The costs of cancer care have been rising in the United States (1–4), increasing concerns about medical financial hardship for cancer patients and their families. Many cancer survivors have difficulty paying medical bills, face high levels of financial distress, and delay or forgo medical care because of cost (5–11). Recent trends in health insurance benefit design, including increasing patient cost-sharing, with higher deductibles, copayments, and coinsurance rates (12,13), can increase financial burden even among those with health insurance. Uninsured patients can be responsible for the entire cost of cancer care.

High patient out-of-pocket costs for cancer treatment have been the subject of many discussions in the scientific literature (1,12,14–17) and popular press (18–20). In 2009, the American Society of Clinical Oncology highlighted the important role of oncologists in discussions about the expected patient out-of-pocket costs of cancer care (21,22). The Institute of Medicine later identified these discussions as an element of high-quality care (22), and cost consciousness has been proposed as a core competency for medical education (23). Although oncologists generally agree about their responsibility for cost discussions (24), these discussions are rare (24,25). Nevertheless, most

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cancer patients desire discussions about expected out-of-pocket costs (24), highlighting an unmet need for informed treatment decision making in cancer care.

Discussions of patient out-of-pocket costs are especially relevant when considering the increasing availability of molecularly targeted therapies for specific tumor variants. As of 2016, more than 200 targeted therapies were available in the United States and more than 2000 are in late-stage development (26). More than half are in oncology. Targeted therapies have high list prices, frequently in excess of \$100 000 annually (27–29). Genomic tests to identify targetable variants can also be expensive (30) and are not always covered by health insurance. Even with health insurance coverage, cancer patients face cost-sharing for genomic testing and treatment, as high as 30% of the list price for tests and treatments (13). Discussions about expected costs of genomic testing and related treatments may inform treatment decision making and help cancer patients prepare for high expenses. However, little is known about how often oncologists discuss costs of genomic testing and related treatment with their patients or about the physician and/or practice factors associated with those discussions. In this study, we address these research gaps by analyzing data from a nationally representative survey of oncologists about their cost discussions with cancer patients and identify potentially modifiable factors associated with the frequency of cost discussions.

Methods

Data and Sample

The study sample was obtained from the 2017 National Survey of Precision Medicine in Cancer Treatment, a nationally representative survey of medical oncologists conducted between February and May 2017 (31,32). The survey was sponsored by the National Cancer Institute, National Human Genome Research Institute, and the American Cancer Society and collected information on oncologists' sociodemographic and practice characteristics and use of genomic tests (32). Prior to fielding the survey, methodologists and clinical experts reviewed all content. Additionally, cognitive interviewing among practicing oncologists was conducted to ensure that questions were clearly worded and responses consistent with the intent of the questions. Oncologists were selected from the American Medical Association Physician Masterfile, which covers all licensed physicians in the United States. Practicing oncologists were selected using probability sampling, stratified by specialty, census region, size of metropolitan statistical area (MSA), and sex by age category. A total of 1281 practicing oncologists completed the survey via mail or online with a cooperation rate of 38.0%. We excluded oncologists who reported that they had not discussed genomic testing with patients or their families at all in the past 12 months ($n = 61$) and restricted our sample to the remaining 1220 oncologists who discussed genomic testing. More information about the survey design, sample weights, and analyses for nonresponse bias have been published elsewhere (31,32) and are summarized in the [Supplementary Methods](#) (available online). The survey protocol was reviewed by the Institutional Review Board (IRB) of RTI International, a nonprofit research organization. Survey data were deidentified and considered exempt by the National Institutes of Health IRB.

Measures

The measure of cost discussion frequency was based on the survey question, "In the past 12 months, when you or your staff discussed any form of genomic testing with your cancer patients or

their families, how often did you discuss the likely costs of the testing and related treatment?" Response options among oncologists who discussed genomic testing within the past 12 months were never, rarely, sometimes, and often. Responses were categorized as "rarely or never," "sometimes," and "often."

We selected measures of physician-, practice-, and area-level characteristics previously shown to be associated with guideline-concordant practice (33–36) or hypothesized to be associated with cost discussions. Oncologist characteristics included age, years since medical school graduation, sex, and self-reported race and ethnicity, types of tumors treated (hematological cancers only, solid tumors only, or both hematologic cancers and solid tumors), percentage of time providing patient care, medical school affiliation, training in genomic testing, and use of next-generation sequencing (NGS) gene panel tests in the past 12 months. Practice-level characteristics were MSA, geographic region, and self-reported practice type, implementation of genomic testing services within the practice (internal policies or protocols for use of genomic and biomarker testing; electronic medical record [EMR] alerts for genomic test recommendations for particular patients or drugs; genomic/molecular tumor board), patient insurance status in practice (proportion of patients insured by Medicaid, self-pay, or uninsured), and patient volume (ie, 1–99 unique patients per month or ≥ 100 unique patients per month).

Area-level characteristics of the county of the physician's practice location were obtained from the 2016–2017 Area Health Resources Files (37); these included county-level mean per capita personal income, percentage of individuals ages 25 years and older with at least 4 years of college, and median gross rent. Continuous measures of physician-, practice-, and area-level characteristics were categorized based on distributions within the sample. Exact wording of survey questions and response options are listed in [Supplementary Table 1](#) (available online).

Statistical Analyses

We calculated descriptive statistics for physician, practice, and area-level characteristics. Associations between physician-, practice-, and area-level characteristics and frequency of cost discussion were assessed using polytomous logistic regression models (38). A data-driven stagewise approach was used to identify physician-, practice-, and area-level covariates in developing parsimonious intermediate and final adjusted models. First, bivariable analyses were conducted to identify covariates statistically significantly associated with the frequency of cost discussions; those that were statistically significant at P less than .20 were included in one of three intermediate multivariable models of physician-, practice-, or area-level characteristics and cost discussions. The final multivariable model included covariates statistically significant at P less than .20 in any of the three intermediate models. Collinearity diagnostics were performed for the three intermediate and the final multivariable regression models. Statistical tests were two-sided, and statistical significance was defined as P less than .05. Analytic files were created with SAS 9.4 (SAS Institute, Cary, NC, USA) and analyses were conducted with STATA/IC 14.1 (StataCorp, College Station, TX, USA). Sample weights that accounted for the complex survey design and survey nonresponse were applied in all analyses.

Results

The majority of the 1220 oncologists who reported discussing genomic testing with patients within the past 12 months were

Table 1. Sample characteristics, National Survey of Precision Medicine in Cancer Treatment, 2017*

Sample characteristics	No.	Weighted %†
Total	1220	100.0
Physician characteristics		
Age, y		
<40	262	22.0
40–49	371	30.9
50–59	289	23.5
≥60	298	23.6
Years since medical school graduation		
7–14	293	25.0
15–24	372	30.9
25–34	272	21.9
35–51	283	22.2
Sex		
Male	877	65.9
Female	343	34.1
Race/ethnicity		
White, non-Hispanic	762	62.0
Other	458	38.0
Types of tumors treated		
Hematologic cancers only	140	11.7
Hematologic and solid	792	64.4
Solid tumors only	284	23.9
Percentage of time providing patient care		
5–75%	368	31.0
>76%	852	69.0
Affiliation with medical school or hospital	759	62.7
Formal training in genomic testing	680	56.2
Use of next-generation sequencing gene panel tests	913	74.5
Practice characteristics		
Practice type		
Solo	52	4.3
Single specialty	519	42.0
Multispecialty	540	44.8
Other	103	8.9
Located in metropolitan statistical area		
Small/Medium	179	14.1
Large	165	12.2
Very large	876	73.7
US geographic region		
Northeast	302	26.5
Midwest	286	20.9
South	419	34.8
West	213	17.8
Patient volume per month		
1–99	626	52.1
≥100	594	47.9
Primary practice provides internal policies or protocols for genomic tests	579	47.9
Primary practice has electronic medical record alerts for genomic tests	199	16.6
Primary practice provides genomic and/or molecular tumor board for genomic tests	439	36.2

(continued)

Table 1. (continued)

Sample characteristics	No.	Weighted %†
Proportion of patients insured by Medicaid ≥10% or self-pay or uninsured ≥10%	910	73.8
Area-level characteristics		
Mean per capita income		
>\$60 000	311	26.8
\$45 000–60 000	524	42.6
≤\$45 000	385	30.6
% persons ≥25 years with ≥4 years of college		
>45	247	20.8
30–45	584	48.3
≤30	389	30.9
Median gross rent		
>\$1000	467	40.8
\$850–1000	397	32.0
≤\$850	356	27.3

*Data from the 2017 National Survey of Precision Medicine in Cancer Treatment. Exact wording of survey questions and response options is listed in [Supplementary Table 1](#) (available online).

†Percentages weighted to account for complex survey design and survey nonresponse.

male and non-Hispanic white, treated both hematological cancers and solid tumors, and practiced in large MSAs ([Table 1](#)). Of the oncologists, 56.2% reported that they had received training in genomic testing, 74.5% of oncologists reported using NGS in the past 12 months, and 16.6% reported that their practice has EMR alerts for genomic test recommendations.

In response to the question about frequency of discussing the likely costs of testing and treatments with patients, 50.0% of oncologists reported having these discussions often; 26.3% reported sometimes; and 23.7% reported never or rarely discussing costs. The frequency of cost discussions varied by the types of tumors that oncologists treated: A total of 60.1% of those who treated only solid tumors reported often discussing costs with patients compared to 50.4% of those who treated hematological cancers and solid tumors and 27.9% of those who treated only hematological cancers ($P < .001$) ([Figure 1A](#)). Oncologists with formal training in genomic testing were more likely than those without this training to report discussing costs often (54.6% vs 44.1%, $P = .001$) ([Figure 1B](#)) as were those who used NGS tests in the past 12 months compared with those who did not (53.9% vs 38.7%, $P < .001$) ([Figure 1C](#)). Oncologists working in practices with EMR alerts for genomic test recommendations were more likely than those in practices without EMR alerts to report often (59.0% vs 48.2%, $P < .001$) discussing costs with their patients ([Figure 1D](#)).

Several physician characteristics were statistically significantly associated with the frequency of cost discussions in the intermediate ([Supplementary Table 2](#), available online) and final ([Table 2](#)) multivariable models. Oncologists with more years since medical school graduation were more likely to often discuss the cost of genomic testing and related treatment with patients and their families than those who graduated less than 15 years prior to the survey. Compared with oncologists who treated only hematological cancers, those who treated both hematological cancers and solid tumors or who treated only solid tumors were more likely to often have cost discussions with their patients (odds ratio [OR] = 2.82, 95% confidence interval [CI] = 1.58 to 5.02 and OR = 4.01, 95% CI = 2.21 to 7.29,

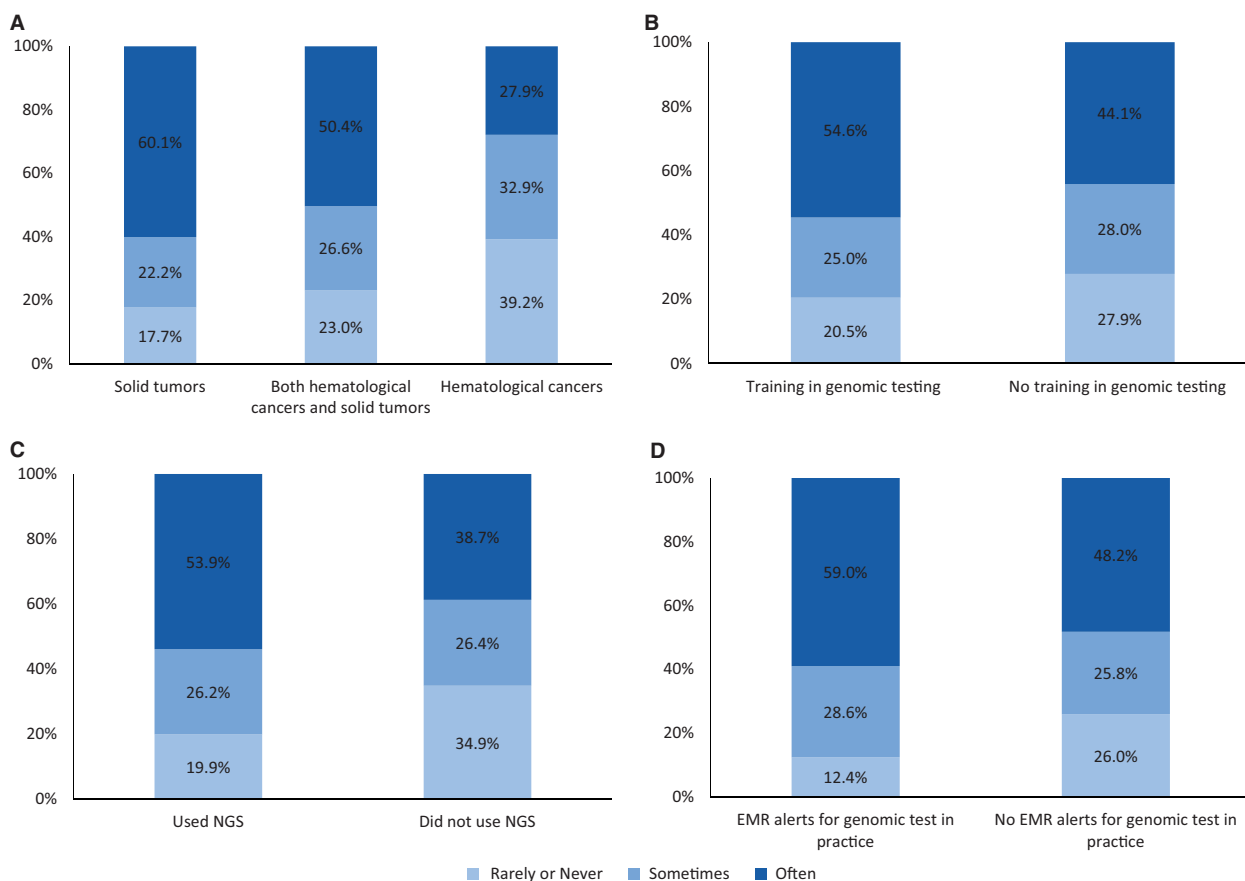


Figure 1. Oncologist and practice characteristics and frequency of discussions about costs of genomic testing and related treatment. **A)** By types of tumors treated ($P < .001$); **(B)** By training in genomic testing ($P = .001$); **(C)** by use of next-generation sequencing (NGS) gene panel tests ($P < .001$); **(D)** by whether practice has electronic medical records (EMR) with alerts for genomic tests ($P < .001$). Pearson χ^2 test was used to calculate the P values. All statistical tested were two-sided.

respectively). Formal training in genomic testing was associated with higher likelihood of having cost discussions often ($OR = 1.74$, 95% $CI = 1.25$ to 2.42). Oncologists who use NGS tests were more likely to have cost discussions with their patients often ($OR = 1.93$, 95% $CI = 1.34$ to 2.77) or sometimes ($OR = 1.59$, 95% $CI = 1.07$ to 2.37) instead of rarely or never.

Several practice-level characteristics were also statistically significantly associated with the frequency of cost discussions in intermediate (Supplementary Table 2, available online) and final (Table 2) models. Oncologists with EMR alerts for genomic testing in their practice were more likely than those without alerts to have cost discussions often ($OR = 2.22$, 95% $CI = 1.30$ to 3.79) or sometimes ($OR = 2.09$, 95% $CI = 1.19$ to 3.69) instead of rarely or never. Oncologists with higher patient volume were more likely to have more frequent cost discussions than those with lower patient volume. The frequency of cost discussions also varied by the health insurance status of patients in the practice. Oncologists with a higher percentage of patients insured by Medicaid, or who were self-pay or uninsured in their practice, were more likely to discuss cost often ($OR = 1.55$, 95% $CI = 1.09$ to 2.20) or sometimes ($OR = 1.60$, 95% $CI = 1.09$ to 2.36) instead of rarely or never. Lower area-level income was also associated with greater frequency of cost discussions.

Discussion

In this study, we used data from a nationally representative survey of oncologists conducted in 2017 to assess the frequency of

discussions about the costs of genomic testing and related treatments with the cancer patients in their practices. At the time of the survey, the costs of genomic testing to inform treatment ranged from \$300 to more than \$10 000 for available tests (30,39), and the list price of molecularly targeted therapies frequently exceeded \$100 000 annually (27–29), with some prices higher than \$350 000 (40). The Centers for Medicare and Medicaid Services had not yet issued a national coverage determination for genomic testing, and many private insurers did not cover genomic tests. Despite widespread attention to cost (18–20), designation of cost discussions as an important element of high-quality cancer care for all patients (14,17,21,22), and potentially high patient out-of-pocket costs, we found that only half of oncologists reported that they or their staff often discussed the costs of genomic testing and related treatment and nearly one-quarter reported never or rarely discussing costs. With rapid growth in the availability of genomic tests and targeted treatments for cancer and a large pipeline of treatments in development (26), improving provider discussions about expected out-of-pocket costs will be critical for ensuring informed patient treatment decision making and the opportunity to plan for treatment expenses and help address out-of-pocket costs by linking patients with available resources and ensuring high-quality cancer care.

We identified potentially modifiable physician- and practice-level factors associated with greater frequency of cost discussions, including oncologist training in genomic testing and EMR alerts for genomic testing within the practice. Training

Table 2. Factors associated with frequency of discussions about costs of genomic testing and related treatment*

Sample characteristics	Unadjusted (sometimes vs never or rarely) OR (95% CI)	Unadjusted (often vs never or rarely) OR (95% CI)	Adjusted† (sometimes vs never or rarely) OR (95% CI)	Adjusted† (often vs never or rarely) OR (95% CI)
Physician characteristics				
Age, y				
<40	Referent	Referent	—	—
40–49	0.94 (0.60 to 1.48)	1.27 (0.85 to 1.90)	—	—
50–59	1.04 (0.64 to 1.67)	1.39 (0.91 to 2.13)	—	—
≥60	1.09 (0.67 to 1.76)	1.54 (1.00 to 2.38)	—	—
Years since medical school graduation				
7–14	Referent	Referent	Referent	Referent
15–24	1.07 (0.70 to 1.65)	1.17 (0.80 to 1.72)	1.08 (0.68 to 1.70)	1.21 (0.78 to 1.87)
25–34	1.17 (0.72 to 1.90)	1.62 (1.06 to 2.49)	1.35 (0.80 to 2.26)	2.28 (1.40 to 3.71)
35–51	1.14 (0.71 to 1.83)	1.53 (1.00 to 2.33)	1.24 (0.73 to 2.12)	1.97 (1.19 to 3.25)
Sex				
Female	Referent	Referent	—	—
Male	0.99 (0.69 to 1.42)	1.07 (0.78 to 1.46)	—	—
Race/ethnicity				
White, non-Hispanic	Referent	Referent	—	—
Other	0.89 (0.64 to 1.24)	0.78 (0.58 to 1.05)	—	—
Types of tumors treated				
Hematologic cancers only	Referent	Referent	Referent	Referent
Hematologic cancers and solid tumors	1.37 (0.87 to 2.17)	3.07 (1.93 to 4.88)	1.31 (0.75 to 2.30)	2.82 (1.58 to 5.02)
Solid tumors only	1.49 (0.85 to 2.63)	4.77 (2.78 to 8.19)	1.47 (0.81 to 2.69)	4.01 (2.21 to 7.29)
Percentage of time providing patient care				
<76	Referent	Referent	—	—
≥76	1.08 (0.75 to 1.54)	0.97 (0.71 to 1.33)	—	—
Affiliation with medical school or hospital				
No	Referent	Referent	—	—
Yes	0.99 (0.71 to 1.40)	0.89 (0.66 to 1.20)	—	—
Formal training in genomic testing				
No	Referent	Referent	Referent	Referent
Yes	1.22 (0.87 to 1.69)	1.68 (1.26 to 2.25)	1.15 (0.80 to 1.66)	1.74 (1.25 to 2.42)
Uses next-generation sequencing gene panel tests				
No	Referent	Referent	Referent	Referent
Yes	1.74 (1.21 to 2.51)	1.11 (0.85 to 1.45)	1.59 (1.07 to 2.37)	1.93 (1.34 to 2.77)
Practice characteristics				
Practice type				
Solo	Referent	Referent	Referent	Referent
Single specialty	1.23 (0.50 to 3.03)	0.91 (0.44 to 1.90)	1.18 (0.43 to 3.18)	0.75 (0.33 to 1.71)
Multispecialty	1.11 (0.45 to 2.72)	0.73 (0.35 to 1.52)	1.11 (0.40 to 3.07)	0.61 (0.26 to 1.41)
Other	0.68 (0.24 to 1.91)	0.49 (0.21 to 1.13)	0.78 (0.26 to 2.37)	0.50 (0.19 to 1.29)
Located in metropolitan statistical area				
Small/Medium	Referent	Referent	—	—
Large	1.19 (0.63 to 2.25)	1.00 (0.55 to 1.82)	—	—
Very large	0.69 (0.43 to 1.12)	0.75 (0.48 to 1.17)	—	—
US geographic region				
Northeast	Referent	Referent	Referent	Referent
Midwest	1.32 (0.82 to 2.14)	1.61 (1.05 to 2.45)	1.25 (0.74 to 2.11)	1.60 (0.98 to 2.62)
South	1.05 (0.69 to 1.59)	1.04 (0.72 to 1.51)	0.93 (0.57 to 1.52)	0.98 (0.62 to 1.53)
West	1.28 (0.75 to 2.17)	1.82 (1.16 to 2.86)	1.28 (0.72 to 2.29)	1.92 (1.15 to 3.21)
Patient volume per month				
1–99	Referent	Referent	Referent	Referent
≥100	1.46 (1.05 to 2.04)	1.79 (1.33 to 2.40)	1.35 (0.94 to 1.92)	1.53 (1.11 to 2.10)

(continued)

Table 2. (continued)

Sample characteristics	Unadjusted (sometimes vs never or rarely) OR (95% CI)	Unadjusted (often vs never or rarely) OR (95% CI)	Adjusted† (sometimes vs never or rarely) OR (95% CI)	Adjusted† (often vs never or rarely) OR (95% CI)
Practice provides internal policies or protocols for genomic testing				
No	Referent	Referent	Referent	Referent
Yes	1.14 (0.82 to 1.58)	1.35 (1.01 to 1.81)	1.06 (0.70 to 1.59)	1.25 (0.86 to 1.79)
Practice has electronic medical record alerts for genomic testing				
No	Referent	Referent	Referent	Referent
Yes	2.32 (1.38 to 3.90)	2.56 (1.59 to 4.12)	2.09 (1.19 to 3.69)	2.22 (1.30 to 3.79)
Practice has genomic and/or molecular tumor board for genomic testing				
No	Referent	Referent	Referent	Referent
Yes	1.08 (0.76 to 1.54)	1.31 (0.96 to 1.78)	1.19 (0.74 to 1.90)	1.47 (0.96 to 2.25)
Proportion of patients insured by Medicaid ≥ 10% or self-pay or uninsured ≥ 10%				
No	Referent	Referent	Referent	Referent
Yes	1.70 (1.14 to 2.47)	1.47 (1.07 to 2.02)	1.60 (1.09 to 2.36)	1.55 (1.09 to 2.20)
Area-level characteristics				
Mean per capita income				
>\$60 000	Referent	Referent	Referent	Referent
\$45 000–60 000	1.43 (0.95 to 2.14)	1.98 (1.39 to 2.82)	1.12 (0.65 to 1.92)	1.84 (1.09 to 3.09)
≤\$45 000	1.61 (1.05 to 2.45)	1.59 (1.09 to 2.33)	1.08 (0.56 to 2.07)	1.55 (0.81 to 2.97)
% persons ≥25 years with ≥4 years of college				
>45	Referent	Referent	Referent	Referent
30%–45	1.63 (1.06 to 2.51)	1.68 (1.16 to 2.42)	1.57 (0.91 to 2.71)	1.27 (0.75 to 2.16)
≤30	2.01 (1.27 to 3.18)	1.71 (1.14 to 2.55)	1.96 (0.98 to 3.90)	1.19 (0.62 to 2.28)
Median gross rent				
>\$1000	Referent	Referent	—	—
\$850–1000	1.14 (0.77 to 1.67)	1.07 (0.77 to 1.50)	—	—
≤\$850	1.50 (0.99 to 2.27)	1.80 (1.24 to 2.61)	—	—

*N = 1220. Data from the National Survey of Precision Medicine in Cancer Treatment. All analyses account for complex survey design and survey nonresponse. CI = confidence interval; OR = odds ratio.

†Final multivariable model included year of graduation, types of tumors treated, training in genomic testing, next-generation sequencing use, practice type, US geographic region, primary practice provides internal policies or protocols, electronic medical record alerts, practice has genomic and/or molecular tumor board for genomic testing, patient insurance status, area-level per capita income, and college education.

and alerts may reflect more attention to genomic testing and related treatment and greater familiarity with their costs. Other aspects of physician expertise in treating patients, including treating solid tumors (for which most genomic panel tests are available, therefore, physicians who treat them may be more familiar with their costs), higher patient volume, and longer time since medical school graduation were also associated with greater frequency of cost discussions. These findings are consistent with other research showing that physician expertise—measured as training, specialty, patient volume, and/or years in practice—is associated with treatment recommendations (41), as well as aspects of treatment cost-consciousness, which includes the importance of cost savings, awareness of patient out-of-pocket costs, and discussions of financial burden (42). Provider- and practice-level interventions, such as training, electronic reminders, and peer comparisons, have been shown to be effective in improving recommendations for cancer screening and other services (43–45). Better understanding of the relative influences of expertise, training, and use of EMR technology on cost-consciousness and, ultimately, patient out-of-pocket costs is needed. In addition, identification and/or adaptation of interventions to address potentially modifiable

factors to increase the frequency of discussions of patient costs associated with genomic testing and related treatments is an important area for future research.

Prior research has shown that insufficient physician time, discomfort with talking about treatment costs, limited knowledge of costs, and lack of price transparency for specific treatments may be barriers to physicians engaging with patients and family members in conversations about the expected out-of-pocket and other costs of cancer care (24,46–48). Oncologists may not be the providers best suited for all discussions about the expected costs of care (49); however, they can be responsible for ensuring that these conversations take place with a member of the care team within their practice. Normalization of cost discussions with all cancer patients, regardless of health insurance coverage or apparent resources, will be necessary to avoid stigmatization as well as underidentification of medical financial hardship, which is prevalent even among those with private health insurance coverage (50,51).

Initiating a discussion about the expected out-of-pocket costs of genomic testing and related treatment is a necessary first step but is not sufficient to ensure that patients and their families can make fully informed decisions about treatment

options. Less is known about the content and quality of cost discussions, which are especially important given the high costs of cancer treatment. Price transparency tools are increasingly available (52–56), and EMRs could be leveraged to provide information about prices at the point of care (57). Provider training materials and practice guides have been developed to address physician discomfort with cost-of-care discussions and limited knowledge about costs (58,59). Training materials also address aspects of discussion content beyond patient out-of-pocket costs for medical care, such as expenses for transportation to and from medical care, childcare and eldercare, housing, and food (58). Because patients may not be able to work during treatment, minimizing lost wages and maintaining access to employer-sponsored health insurance are additional topics that are increasingly recommended for informed decision making (58,60–62). Team-based approaches to cost discussions may help address barriers related to physician time. Identifying the member(s) of the care team best suited for these discussions, if not the oncologist, along with best practices for content of discussions and integrating cost conversations throughout treatment into workflow (63) will be important for future intervention research.

We also found that patient characteristics and area-level socioeconomic conditions for the practice location were associated with the frequency of cost discussions. Oncologists in practices with a higher percentage of patients with Medicaid coverage or who were self-pay or uninsured, and those practicing in areas with lower per-capita income, were more likely to report more frequent cost discussions than were oncologists with lower proportions of Medicaid or uninsured patients or who practice in higher-income areas. Although low-income and uninsured patients are most likely to experience medical financial hardship (9,11,33,51,64–68), accumulating research suggests that private health insurance coverage and higher socioeconomic status do not eliminate the risk of hardship. Even privately insured cancer survivors report problems paying medical bills, experiencing stress related to medical bills, or delaying or forgoing care because of cost (50,51,69), and nearly 30% of cancer survivors ages 18–64 years report multiple types of medical financial hardship as a result of their cancer diagnosis, treatment, or lasting effects of treatment. Thus, discussions about the expected costs of cancer care are important for all patients.

Despite the strength of being one of the first studies to address the frequency of cost discussions about genomic testing and related treatment in a large, population-based, nationally representative sample of oncologists, our study has several limitations. The survey data are cross-sectional, and we report associations between physician-, practice-, and area-level characteristics and frequency of cost discussions, rather than causality. The survey response rate was low. Although we used sample weights to adjust for survey design and nonresponse in all analyses, it is possible that responders and nonresponders differed on some characteristics. Information about provider and practice characteristics was based on self-report and is susceptible to biases related to recall and social desirability. However, given the attention to the cost of cancer care by professional societies (21,22) and the scientific and popular press (14–17), social desirability bias would suggest that our estimates overstate the frequency of cost discussions. Despite use of cognitive testing prior to fielding the survey, some questions were fairly broad (eg, training in genomic testing) and may have had varying interpretations by oncologists.

The survey question about the frequency of cost discussions did not differentiate between tests for single gene variants,

gene expression, or NGS gene panels. Additionally, the survey did not include questions about whether patients were responsible for the costs of genomic testing at the oncologist's primary institution. Anecdotal reports suggest that some manufacturers and academic institutions provide patients with financial support for genomic testing. However, it is less clear that financial support is similarly available for targeted therapies should a cancer patient be found to have a relevant variant. Finally, the survey on which this study was based was conducted in 2017, and genomic testing and targeted treatments are rapidly evolving, as are changes in insurance coverage and associated patient costs. We do not expect underlying associations between oncologist and practice factors and the frequency of cost discussions to change, however.

In conclusion, we found that physician and practice factors are associated with frequency of discussing the costs of genomic testing and related treatments by oncologists. In the context of rising costs of cancer care, interventions targeting modifiable physician and practice factors may help increase the frequency of physician-patient cost discussions, contributing to more informed patient decisions and higher-quality cancer care.

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