Oncologists' Perceptions of Tumor Genomic Profiling and the Communication of Test Results and Risks

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Keywords

Oncologist · Tumor genomic profiling · Hereditary risk

Abstract

Tumor genomic profiling (TGP) identifies genetic targets for precision cancer treatments. The complexity of TGP can expose gaps in oncologists' skills, complicating test interpretation and patient communication. Research on oncologists' use and perceptions of TGP could inform practice patterns and training needs. To study this, a sample of oncologists was surveyed to assess TGP use, perceptions, and perceived skills in TGP interpretation/communication, especially in communication of hereditary risks. Genomic self-efficacy and TGP knowledge were also assessed. The goal sample ($n = 50$) was accrued from 12/2019 to 1/2020. Respondents were primarily medical oncologists (78%) with >10 (mean 17.7) years of practice experience. TGP use was moderate/high (median 50 [range 2–398]) tests/year. Most oncologists reported informal/no training in interpretation (72%) or communication (86%) of TGP results and risks. Genomic self-efficacy was high and was associated with higher use of TGP ($p = 0.047$). Perceptions of the benefits and limitations of TGP were mixed:

heterogeneity was seen by years of experience, TGP use, and knowledge. Most participants agreed that additional training in TGP communication was needed, especially in communication of hereditary risks, and that an online training tool would be useful (86%). We conclude that oncologists are frequently using TGP despite having mixed views about its utility and not feeling prepared to communicate risks to patients. Oncologists receive little education in interpreting TGP or communicating its results and risks, and would value training in this area.

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Introduction

The use of multigene tumor genomic profiling (TGP) to examine genes in a patient's tumor for targetable mutations is a cornerstone of personalized oncology. Cancer therapy decision-making for advanced lung cancer, colorectal cancer, melanoma, and several other cancers now includes TGP to assess tumors for mutations in actionable molecular pathways for which targeted therapies are available and to assess eligibility for clinical trials. On-

oncologists routinely use TGP to guide treatment decisions [1]. TGP may secondarily identify previously unrecognized germline risks such as mutations in BRCA1/2, and 13–15% of patients undergoing TGP will have a germline risk uncovered [2], with important implications for future cancer risks for the patient and their family members. The American Society of Clinical Oncology (ASCO) mandates communication of the risks of secondary hereditary findings from TGP to patients, ideally before TGP is conducted [3].

To communicate about TGP, oncologists require know-how in both molecular diagnostics and targeted therapies, but an understanding of how TGP may uncover germline risks. Studies of oncologists' perceptions of TGP have reported variability in subjective genomic self-efficacy in the skills required to use TGP [4–7] and concerns include lack of skills in the interpretation/communication of genetic results [5–7]. These challenges are magnified by poor patient understanding and health literacy limitations, especially in the area of genetics and among underserved and minority populations [8, 9]. Nonetheless, few resources or training tools specific to TGP understanding and use, or risk communication, exist for providers [10, 11].

Our study sought to assess oncologists' perceptions of clinical TGP and to identify predictors of positive and negative attitudes and practices. Rather than using a hypothetical scenario [4–6, 12, 13], we surveyed practicing oncologists using TGP routinely. Finally, with a focus on secondary hereditary risks, we assessed perceived need for further interpretation/communication training.

Materials and Methods

Study Design

A survey ($n = 50$) was administered electronically to a convenience sample of practicing oncologists ordering TGP after electronic informed consent was provided. The study was approved by the Fox Chase Cancer Center IRB.

Survey

Informed by formative semistructured interviews, the survey examined demographics, practice characteristics, TGP experience/perceived expertise, and training in TGP interpretation and communication. Genomic self-efficacy (5 items assessing TGP understanding, interpretation, results, and communication) and knowledge of TGP (7 items) were assessed by measures modified from previous research [14, 15]. Perceptions/behaviors related to TGP were assessed by items developed by the research team (e.g., communication with patients, benefits/limitations, and knowledge and training).

Sample

Medical and surgical oncologists who provide clinical care to adult cancer patients and who had recently ordered TGP testing were included. In collaboration with Caris Life Sciences, invitation emails containing information about the study, and a link to an electronic informed consent and the survey were sent to providers ordering TGP. Participants were offered a gift incentive for their time. The link was live 12/2019–1/2020 and was deactivated at goal accrual ($n = 50$).

Analysis

Quantitative surveys were analyzed using SPSS v. 25 (2017). Associations of demographic and practice characteristics were tested using χ^2 and t tests for bivariate and continuous data, respectively. Genomic self-efficacy and knowledge items were summed and treated as continuous variables (median score 18 [range 9–25]) and a binary variable (total correct ≤ 5 as “low knowledge,” ≥ 6 as “high knowledge”), respectively. Agreement with TGP perception and attitude statements developed by our team was measured using a 10-point agreement scale (“strongly disagree” = 0 to “strongly agree” = 10). Univariate and/or bivariate statistical comparisons of TGP perceptions were conducted, including two-sided, two-sample t tests ($\alpha = 0.05$) to evaluate mean differences among groups. Reported p values are based on the assumption of equal variances between samples (e.g., low vs. high knowledge score). ANOVA was used to examine variability in perceptions by clinical experience (≤ 10 years, 11–20 years, and 21+ years).

Results

Respondents included medical (78%), gynecologic (14%), and surgical oncologists (8%). The mean age was 45 years; 66% were male. Oncologists self-identified race/ethnicity as white (52%), Asian (35%), African American (6%), and Latino (6%). Over two-thirds (70%) were from an academic or academic-affiliated practice. Clinical experience (years since graduation from medical school) varied from 7 to 39 (mean 17.7) years. The majority of oncologists were moderate to heavy users of TGP: mean/median number of TGP ordered in the past year was 82/50 tests (range 2–398), respectively, and 96% had experience ordering a multigene TGP (>300 genes). Most (84%) had patients with germline findings on TGP, but 60% said they did not order subsequent hereditary testing themselves.

Subjective and objective measures were used to gauge TGP understanding and perceived expertise. Oncologists had mixed views of the adequacy of their genomics training: 46% reported gaps in their education related to TGP. Education in the interpretation of TGP results was only informal for 56% respondents. Training in interpretation/communication of secondary hereditary risks was absent or informal (86% reporting “none” or “informal only”). Despite training gaps, oncologists rated their ge-

Table 1. Oncologists' genomic self-efficacy related to TGP testing.

I understand how TGP works, <i>n</i> (%)	
Disagree or strongly disagree	5 (10)
Neutral	2 (4)
Agree or strongly agree	43 (86)
I can explain all the risks and benefits of TGP to patients, <i>n</i> (%)	
Disagree or strongly disagree	6 (12)
Neutral	3 (6)
Agree or strongly agree	41 (82)
I can explain to a patient how MSI is determined on a TGP, <i>n</i> (%)	
Disagree or strongly disagree	9 (18)
Neutral	7 (14)
Agree or strongly agree	34 (68)
I have adequate knowledge to discuss the secondary hereditary risks of TGP with patients, <i>n</i> (%)	
Disagree or strongly disagree	8 (16)
Neutral	8 (16)
Agree or strongly agree	34 (68)
I can explain the differences between a polymorphism, a VUS, and a pathogenic variant to a patient, <i>n</i> (%)	
Disagree or strongly disagree	5 (10)
Neutral	10 (20)
Agree or strongly agree	35 (70)

TGP, tumor genomic profiling; MSI, microsatellite instability; VUS, variant of uncertain significance.

nomics knowledge as “better” or “much better” than other oncologists in their community (72%) and their practice (52%), respectively. The median knowledge score correct was 6 (range 3–7), with 48% scoring <6.

Participants' confidence in their TGP expertise was high (Table 1): 86% agreed that they understood how TGP works and 82% that they could explain all risks/benefits to their patients. Genomic self-efficacy was lower on items related to explaining MSI testing (68%), discussing secondary risks of TGP (68%), and explaining differences of frequently encountered genetic results (70%) like variants of uncertain significance. Those who used TGP less often had lower genomic self-efficacy (sum score 18.36 vs. 20.55, $p = 0.047$); however, no association between knowledge or years of clinical experience and genomic self-efficacy was identified.

Provider perceptions of TGP were stratified by testing volume (<50 vs. ≥ 50 tests annually), clinical experience (≤ 10 years, 11–20 years, and 21+ years), and knowledge (low vs. high). Items with significant and borderline significant differences are reported in Table 2. Significant variability in perceptions and attitudes toward TGP were observed, particularly among oncologists with lower versus higher knowledge scores. Oncologists with low knowledge scores had largely negative views of TGP, agreeing more strongly with perceived barriers to TGP (“Findings

can be difficult to explain to patients”: 8.25 low versus 6.38 high knowledge [$p = 0.012$]), and less strongly with perceived benefits (“TGP will improve quality of life”: 5.71 low versus 7.12 high knowledge [$p = 0.048$]). Overall, participants with low knowledge had higher agreement with 11/21 (52.4%) *barriers* statements (8/11 significantly associated, 3/11 borderline significance), while low knowledge was associated with higher agreement with only 1/13 (7.7%) ($p = 0.05$) *benefits* statement. More experienced oncologists also agreed more strongly with several TGP benefits: for example, “Can make patients eligible for clinical trials” ($p = 0.045$). Finally, variability by knowledge and experience was also seen in attitudes about the need for education/training in interpretation/communication of TGP. Oncologists with low knowledge scores agreed more strongly with the need for additional training (“Physicians need more education/training on how to communicate about TGP with patients and family members”: 9.54 low versus 8.23 high knowledge [$p = 0.011$]), while the least experienced (≤ 10 years) and most experienced oncologists (21+ years) expressed higher preference for a web-based resource to support education/training in TGP than mid-career oncologists (11–20 years): “I would prefer an online training tool over in-person training to learn how to discuss TGP with patients” ($p = 0.039$).

Table 2. Oncologists' perceptions of TGP-related communication, benefits and limitations, and professional training (0 = strongly disagree, 10 = strongly agree)

Perceptions of TGP testing	Low knowledge score (n = 24)	High knowledge score (n = 26)	p value	≤10 years practice experience (n = 11)	11–20 years practice experience (n = 25)	21+ years practice experience (n = 14)	p value	Low TGP use (n = 22)	High TGP use (n = 28)	p value
<i>TGP-related communication</i>										
I tell patients about the possibility of getting information on secondary hereditary risks of TGP testing when I recommend it	8.27	8.13	0.625	8.64	7.76	8.50	0.552	7.57	8.91	0.069 ^B
During the informed consent process, cancer patients should be given the option to opt out of receiving potential germline genetic findings from TGP	8.58	7.15	0.059 ^B	7.91	7.40	8.57	0.432	7.75	7.95	0.772
I prefer to talk to patients myself if secondary hereditary risks are identified on TGP	6.04	6.35	0.744	8.09	5.4	6.14	0.069 ^B	6.39	5.95	0.640
<i>TGP benefits and limitations</i>										
TGP can make patients eligible for clinical trials	10.00	10.12	0.788	9.09	10.28	10.43	0.045 ^A	9.93	10.23	0.487
TGP provides new treatment options for their cancer	8.75	9.19	0.317	7.91	9.36	9.14	0.027 ^A	8.89	9.09	0.657
TGP will improve quality of life	5.71	7.12	0.048 ^A	6.45	6.88	5.64	0.347	6.00	7.00	0.167
TGP might benefit society or help others	7.45	7.82	0.642	7.91	7.64	7.79	0.946	7.21	8.41	0.062 ^B
TGP looks at too many genes that are irrelevant	7.63	5.04	0.006 ^A	4.55	6.92	6.50	0.145	6.39	6.14	0.793
Sometimes a gene mutation is found that you do not know what to do with	8.67	7.04	0.013 ^A	6.64	8.56	7.43	0.058 ^B	7.79	7.86	0.909
Findings can be difficult to explain to patients	8.25	6.38	0.012 ^A	6.27	7.96	6.86	0.169	7.36	7.18	0.820
TGP reports have too much information—it is difficult to get what you need	6.50	4.92	0.061 ^B	5.27	5.92	5.57	0.830	6.0	5.27	0.397
TGP testing provides false hope to patients who think it will lead to a new treatment	7.50	5.62	0.028 ^A	7.00	6.64	5.92	0.670	6.25	6.86	0.488
TGP testing may suggest germline mutations which require conversations patients are not ready to have	5.96	4.46	0.070 ^B	5.82	5.28	4.50	0.528	5.21	5.14	0.926
Too much time and energy is required of doctors and staff to adequately conduct TGP	5.75	3.85	0.020 ^A	4.73	5.04	4.29	0.749	4.86	4.64	0.794
Patients may feel guilt for putting family members at risk if a germline mutation is found	5.75	4.50	0.096 ^B	4.91	4.84	5.71	0.601	5.29	4.86	0.582
Patients may fear that genetic results could negatively impact their family members (denied life insurance, etc.)	6.17	4.54	0.031 ^A	5.36	5.32	5.29	0.998	5.32	5.32	0.997
Because of literacy issues, patients may not understand TGP results	8.71	7.00	0.009 ^A	7.27	8.04	7.86	0.678	7.57	8.14	0.409
Patients think TGP is a more valuable tool than I do	7.67	5.81	0.015 ^A	6.18	7.20	6.21	0.446	6.18	7.36	0.132
<i>TGP knowledge and professional training</i>										
I do not feel that I have the training to sift through all the information from TGP tests	6.25	3.96	0.007 ^A	4.45	5.36	5.00	0.719	5.18	4.91	0.760
I feel knowledgeable enough about TGP testing to properly explain it to patients	8.21	9.12	0.092 ^B	8.82	8.56	8.79	0.908	8.54	8.86	0.550
Physicians need more education and training on how to communicate about TGP with patients and family members	9.54	8.23	0.011 ^A	9.00	8.48	9.43	0.306	8.68	9.09	0.443
I would prefer an online training tool over an in-person training to learn how to discuss TGP testing with patients	8.17	7.65	0.532	8.45	6.92	9.21	0.039 ^A	8.21	7.50	0.386
An online educational tool is likely to be ignored by physicians	7.00	6.81	0.249	6.00	7.92	5.79	0.025 ^A	6.79	7.05	0.740
TGP, tumor genomic profiling. ^A $p < 0.05$. ^B $0.05 < p < 0.1$.										

Discussion

Diagnostic assessment of patients' tumor genomics has become an integral part of the therapeutic evaluation for cancer. Effective communication of the findings and risks of TGP to patients, including secondary hereditary results, is fundamental to using this technology. The use of TGP was moderate to high in our sample, supporting the relevance of our survey. However, while oncologists expressed confidence in their TGP knowledge and skills, confidence related to the interpretation and communication of more complex TGP results like secondary hereditary risks or MSI was lower. Oncologists saw benefits to TGP in supporting clinical trial eligibility and informing treatment, but also agreed that TGP results are difficult to explain and difficult to understand for patients. Negative perceptions of TGP were largely associated with low knowledge, while perceptions of the need for additional training in TGP communication and of an online tool as the optimal mode of delivering this proposed training were associated with low knowledge and clinical experience, respectively.

Several studies have examined oncology providers' perceived utility of TGP, their perceived preparedness and confidence to use TGP in their oncology practices, and their uptake of this testing technology. However, many were conducted prior to the wide-scale introduction of TGP into standard-of-care, while others represent small qualitative studies and are less helpful in understanding practice with TGP now commercially available for 5+ years [4–6, 12, 16–18]. The National Survey of Precision Medicine in Cancer Treatment (data collected 2017, published in 2018 and 2020) [1, 19] reported similar findings to this study: that oncologists are actively using TGP to guide treatments and determine trial eligibility, and they express moderate-to-high confidence to effectively use TGP. Interestingly, use of TGP in this study was associated with younger age, training in genomics, and higher practice volumes, and was found to parallel predictors of confidence in multi-variable models, with large practice volumes and genomics training being most strongly associated with genomic confidence. However, we did not find that higher knowledge or more practice experience was associated with genomic confidence but did find that low genomic confidence was associated with lower TGP use. Unlike our study, this study also did not query provider attitudes toward TGP. Thus, oncologists' perceptions of the many negative aspects of TGP testing, particularly relative to poor patient understanding due to test complex-

ity and challenges in results communication, are a novel and important finding of our research. Further, our findings demonstrating significant variability in views of TGP testing by knowledge, TGP testing volume, and years of experience in practice are also novel, and provide insight into which factors most strongly influence attitudes toward TGP.

Gaps in oncologists' training relative to clinical genetics place the promise of precision oncology in jeopardy [4, 13, 19]. The need to incorporate an ever-expanding list of complex diagnostic tools into practice requires oncologists to constantly seek guidance and training, but this is largely done informally. Ultimately, each new test carries unique communication needs. Professional organizations (e.g., ASCO), insurance providers, and industry (e.g., genetic testing laboratories and pharmaceutical companies) are all relevant stakeholders when it comes to insuring oncologists are adequately trained to use and interpret expensive diagnostic tools such as TGP to guide cancer therapy, and efforts to develop and provide education for providers should be a partnership that includes these groups as well as practicing oncologists. Education in this area is ripe for both didactic and case-based training approaches that can be developed into Internet-based training modules and conference-based case discussions. For TGP, the relevance and challenges of secondary germline results for both patients and oncologists have been weighed [2, 3, 20]. Our study is the first to examine attitudes and perceptions among oncologists actively using TGP, and to specifically query perceived skills and attitudes toward managing secondary hereditary results.

Future research should build on these findings to further characterize oncologists' concerns about TGP and then develop interventions to help them navigate the communication challenges posed by complex genetic technologies. Specifically, interventions to foster improved communication about the secondary genetic results of TGP are imminently needed.

Statement of Ethics

The study was reviewed and approved by the Fox Chase Cancer Center Research Review Committee and the Institutional Review Board (Study 18-8006). All participants provided electronic informed consent prior to participation in this Internet-based survey research. The requirement for written informed consent in lieu of electronic informed consent was waived by the Fox Chase Cancer Center Institutional Review Board.

Conflict of Interest Statement

The authors have no conflicts of interest to disclose related to the research presented here.

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Author Contributions

Conceptualization: M.J.H. and S.B.B.; data curation: P.D., Y.C., and J.B.; formal analysis: M.J.H., P.D., and S.B.B.; funding acquisition: M.J.H. and S.B.B.; investigation: M.J.H. and S.B.B.; methodology: M.J.H. and S.B.B.; project administration: Y.C. and J.B.; writing-original draft: M.J.H.; writing-review and editing: M.J.H., P.D., Y.C., and S.B.B.

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