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Exploring genetic counselors' perceptions of usefulness and intentions to use refined risk models in clinical care based on the Technology Acceptance Model (TAM)

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Abstract

Pathogenic germline mutations in the *BRCA1* or *BRCA2* genes are associated with an elevated lifetime risk for breast (50–85% risk) and ovarian cancer (20–40% risk). Genome-wide association studies have identified over 100 genetic variants associated with modified breast and/or ovarian cancer risk in *BRCA1* and *BRCA2* carriers. Risk models generated based on these variants have shown that these genetic modifiers strongly influence absolute risk of developing breast or ovarian cancer in *BRCA* mutation carriers. There is a lack of understanding, however, about the clinical applicability and utility of these risk models. To investigate this gap, we collected survey data from 274 cancer genetic counselors (GCs) through the National Society of Genetic Counselors Cancer Special Interest Group. Questions assessed perceptions of usefulness and intentions of genetic

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Author Contributions

All authors contributed extensively to the work presented in this paper. C.H., L.S., D.D.K., S.H. and A.E.T. designed the survey and developed the initial study concept. C.H. conducted the survey. S.R.H., G.N.B., B.K., and D.D.K. performed data cleaning and the statistical analysis. C.H., S.R.N., A.E.T. and L.S. wrote the manuscript. All authors edited and approved the final version for publication.

Conflict of Interest

The authors declare they have no conflicts of interest.

Human Studies and Informed Consent:

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975 as revised in 2000. The project was reviewed and approved by the Institutional Review Board at the Ohio State University. Consent was obtained from all patients included in the study.

Animal Studies

No animal studies were carried out by the authors for this article.

counselors to use these refined risk models in clinical care based on the Technology Acceptance Model (TAM). We found that GCs' reactions to the estimates were largely positive, though they thought the possibility of changing management based on results was unlikely. Additionally, we found that more experienced GCs were more likely to consider refined risk estimates in clinic. Support also was provided for core predictions within the TAM, whereby the perceived usefulness (indirect effect est. = .078, 95% CI: [.038, .129]) and perceived ease of use (indirect effect est. = .078, 95% CI: [.038, .132]) of refined risk estimates were indirectly associated with intentions to use via attitudes.

Keywords

BRCA1; BRCA2; Genetic counselors; genetic modifiers; cancer risk; risk models; Technology Acceptance Model

Introduction

Pathogenic mutations in *BRCA1* and *BRCA2* (*BRCA1/2*) are associated with significantly increased lifetime risks of breast and ovarian cancers. In typical genetic counseling sessions lifetime cancer risk associated with a *BRCA1* or *BRCA2* mutation are presented as 50–85% for breast cancer and 20–40% for ovarian cancer (Antoniou et al., 2010; Begg et al., 2008).

Genome-wide association studies (GWAS) to identify modifiers of risk in *BRCA1/2* mutation carriers have shown that some of the variance in an individual's absolute cancer risk is due to common genetic variants. Since 2010, over 100 genetic variants that modify breast and/or ovarian cancer risks both in *BRCA1/2* mutation carriers and in the general population have been identified (Antoniou et al., 2012; Couch et al., 2013; Gaudet et al., 2010; Michailidou et al. 2017). Using these variants together in a polygenic risk model can provide more refined cancer risk estimates (Mavaddat et al. 2015; Hughes et al. 2018). Based on GWAS findings of over 20,000 *BRCA1/2* mutation carriers, polygenic risk models have been developed that can provide more personalized estimates for cancer risk (Kuchenbaecker et al. 2017). These studies indicate that at least 20% of *BRCA1/2* mutation carriers have estimated breast cancer risks significantly higher (i.e. 81–100% lifetime risk) or lower (i.e. 28–50% lifetime risk) than the usual quoted risks for mutation carriers (Antoniou et al., 2010; Couch et al., 2013; Gaudet et al., 2010; Kuchenbaecker et al. 2017). Refined risk profiles are currently unavailable clinically for *BRCA1/2* mutation carriers, but may have implications for *BRCA1/2* mutation carriers in terms of their risk management decision-making and perceptions of risk.

Because genetic testing is typically ordered by a medical professional, and healthcare providers commonly provide and implement current risk management recommendations in tandem with *BRCA1/2* mutation carriers, it is important to understand whether refined risk assessments would be adopted by the clinical genetics community, if available. Genetic counseling is the practice of helping people understand and adapt to genetic contributions to disease, and genetic counselors (GCs) have become a vital link connecting patients and providers to genetic expertise and testing options (National Comprehensive Cancer Network, 2016; Nelson et al., 2014; Smerecnik, Mesters, Verweij, de Vries, & de Vries, 2009). The

purpose of this study was to investigate the attitudes and intentions of GCs to use refined risk estimates in the clinical setting.

Study Theoretical Framework

In this study we draw on the Technology Acceptance Model (TAM; Davis, Bagozzi, & Warshaw, 1989) to predict GCs' intentions to use a refined risk assessment. The TAM (Figure 1) is based on the Theory of Reasoned Action (TRA; Ajzen, 1991), which proposes that user intentions and their actual use of a certain technology is directly predicted by user attitudes. Attitudes, in turn, are shaped by perceptions of the technology's usefulness (i.e., whether the technology will increase job performance and productivity) and ease of use (i.e., the extent to which the technology is effortless; Davis et al., 1989; Strudwick, 2015). A variety of external variables are also proposed to distally influence attitudes and intentions via perceived usefulness and ease of use (Davis et al., 1989). External variables examined here include knowledge (actual) of genetic risk modifiers and perceived complexity of the refined risk estimates. The perceived complexity construct was incorporated into a modified TAM (Gardner & Amoroso, 2004) as a predictor of proposed usefulness and behavioral intention.

Given the responsibility GC's have to present genetic testing options to patients and to interpret and communicate test results to patients and other providers, GC's views of emerging technologies could inform discussions about whether new technologies may be accepted for use in clinical practice. Although the TAM has not previously been used to predict uptake of new genetic technologies, a meta-analysis has shown that "TAM is a powerful and robust predictive model" (King & He, 2006, p. 751). Furthermore, studies examining technology uptake among GCs have identified aspects of new testing methodologies that are most important to GCs, several of which relate to TAM variables (Horsting et al., 2013; Machini et al., 2014). Such studies have suggested that factors like the cost of testing, ability to interpret results, reasonable and effective informed consent processes, and the presence of specific management guidelines to take action upon receipt of results influence views about genetic testing options; all of these particular attributes could be related to "ease of use," a well-described variable in the TAM. Perceived usefulness, the other primary variable in the TAM, may similarly be associated with the perceived clinical utility of testing and patient access to available testing (provided that options are safe, reliable, and effective). While the authors drew the conclusion that genetic counselors' attitudes toward the new technologies depended primarily on these factors, which echo TAM variables (Horsting et al., 2013; Machini et al., 2014), prior studies investigated tests already available in use by GCs in clinic (unlike the present study). Therefore, there is much to learn about the factors that influence GCs to indicate intent to use or not use technologies such as refined risk estimates based on genetic risk modifiers.

Based on the TAM (Figure 1), we hypothesized that GCs' attitudes towards the use of refined risk estimates would mediate the effects of perceived usefulness (Hypothesis 1; H1) and perceived ease of use in clinical settings (H2) on GC intentions to use refined risk estimates. We also proposed that the perceived usefulness of the estimates would mediate the effect of ease of use on attitudes towards their use (H3). Finally, we predicted that existing

knowledge regarding genetic risk modifiers would be positively associated with perceived usefulness (H4) and perceived ease of use (H5), whereas perceived complexity would be negatively associated with perceived usefulness (H6) and ease of use (H7), which would mediate their effects on attitudes and intentions to use refined risk estimates.

Methods

We conducted an online survey of U.S.-based cancer GCs using a National Society of Genetic Counselors (NSGC) Cancer Special Interest Group (SIG) directory. The Institutional Review Board at The Ohio State University approved this study. We sent a recruitment e-mail to 956 GCs in the specific SIG directory, containing a link to an informed consent statement and online survey (Supplemental materials 1). Our response rate was approximately 28.7% (n=274) after removing incomplete or duplicate data.

Measures

Unless noted, measures were based on and modified for the GC context from those used by Gardner and Amaroso (2004) and were measured on a 1 (strongly disagree) to 5 (strongly agree) Likert-type scale.

Intentions to use refined risk estimates.

Three items queried whether individuals would use the refined risk estimate in counseling with BRCA mutation carriers if it were available (e.g., “I would use the risk estimate with BRCA mutation carriers” and “I would use the estimate in as many situations as possible with BRCA mutation carriers.”) on a 1 (strongly disagree) to 5 (strongly agree) scale. The sum of the three items was used in the analyses (Cronbach’s $\alpha=.84$; $M=11.08$, $SD=2.15$).

Attitudes towards risk estimates.

Attitude measures were based on those used to test the Planned Risk Information Seeking Model (Kahlor, 2010), which incorporates aspects of the TRA. The items were based on Ajzen’s (2002) recommendations for building a questionnaire to assess the Theory of Planned Behavior, which fully incorporated the TRA, and are specifically suited for the information management context. Furthermore, exploratory factor analysis (Kahlor, 2010) and confirmatory factor analysis (Hovick, Kahlor & Liang, 2014) previously validated the one-factor structure of the items. Individuals indicated the degree to which they felt the information would be worthless/valuable, bad/good, harmful/beneficial, not helpful/helpful, foolish/wise, unproductive/productive, and not useful/useful on a 1–10 semantic differential scale. The sum of the items was used in the analyses (Cronbach’s $\alpha=.97$; $M=44.09$, $SD=13.31$).

Perceived usefulness.

Six items were used to measure perceived usefulness on a 1 (strongly disagree) to 5 (strongly agree) scale including “the refined risk estimate would make it easier to counsel BRCA mutation carriers,” “the refined risk estimate would enable me to communicate risk more quickly” and “the refined risk estimate would enhance my effectiveness as a genetic

counselor”. The sum of the 6 items was used in the analyses (Cronbach’s $\alpha=.82$; $M=18.64$, $SD=3.41$)

Perceived ease of use.

Ease of use was measured with five items assessing how easy GCs perceived the risk information would be to use in counseling (e.g., “the risk estimate would be easy to incorporate into counseling” and “using this new risk information in counseling would be easy for me.”) on a 1 (strongly disagree) to 5 (strongly agree) scale. The sum of the 5 items was used in the analyses (Cronbach’s $\alpha=.87$; $M=17.86$, $SD=3.17$)

Knowledge.

We examined existing knowledge regarding risk modifiers using six original items developed for this study. Participants indicated whether the items were true, false or don’t know. Items included (1) “The risk of disease in an individual with a Mendelian disorder caused by a pathogenic mutation in a single gene can be modified by additional genetic and environmental risk factors,” (2) “In general, family history is more informative for estimating disease risks to an individual than risk estimates based on low-penetrance alleles,” (3) “The lifetime risk of breast cancer for *BRCA1* and *BRCA2* carriers is typically quoted as 50–75%. For some individuals the actual risk may be higher or lower than the quoted range,” (4) “Genome-wide association studies have uncovered hundreds of low-penetrance variants that modify risk of complex diseases,” (5) “Genome-wide association studies have uncovered nearly 100 low-penetrance variants that modify breast cancer risk in the general population,” and (6) “Genome-wide association studies have identified variants that can modify cancer risk in *BRCA1* and *BRCA2* mutation carriers.” Each item was scored as being correct (1) or incorrect (0) and the 6 items were summed to provide a knowledge score for each participant (range=0 to 6; $M=4.62$ $SD=1.05$).

Perceived complexity.

Four items measuring perceived complexity assessed whether the risk estimate was too complex and would take up too much time in counseling on a 1 (strongly disagree) to 5 (strongly agree) scale. Items included, “I believe that patients would have difficulty understanding the refined risk estimate” and “It would take up too much of my time during counseling to use the refined risk estimate.” The sum of the 4 items was used in the analyses (Cronbach’s $\alpha=.86$; $M=9.94$, $SD=2.75$).

Individual and Practice Characteristics.

We collected several demographic variables including race/ethnicity, age and gender. Years in GC practice was assessed on a 1 (1–4 years) to 5 (>20 years) scale, as well as GC’s work setting (with options ranging from a university medical center to a diagnostic laboratory). The type of genetic testing offered in clinic where GCs were employed was also assessed [with options ranging from single panel testing to single nucleotide polymorphism (SNP) profiling].

Reactions to refined risk estimates.

In addition to assessing GCs intentions, we also assessed perceptions of usefulness and reactions to example risk estimates using several single-item, original measures measured on a 1–5 Likert scale. Items included how valuable refined estimates based on genetic modifiers would be to *BRCA1/2* mutation carriers and GCs, as well as the extent to which the ability to stratify risk would change risk management suggestions for patients. The investigators developed these original measures because no validated measures currently exist for this construct. GCs were also shown an example refined risk estimate (i.e., “The 5% of *BRCA2* mutation carriers, like you, at lowest risk, have a lifetime ovarian cancer risk of 28% compared to 69% for the 5% of carriers at highest risk.”) and asked the degree to which the information (a) is relevant to BRCA mutation carriers, (b) would be useful to BRCA mutation carriers (c), will help BRCA mutation carriers make decisions and (d) is difficult to understand.

Data Analyses

Data were analyzed in R version 3.4.3 and SPSS version 24.0. Descriptive statistics (frequencies, means and standard deviations) were utilized for evaluation of demographic characteristics. We examined direct and indirect relationships between TAM variables to assess mediation predictions. Per Baron and Kenny (1986), linear regression models were tested to assess direct relationships between cognitive and behavioral intention variables in the TAM. All models controlled for gender (1=male, 0=female) and years of genetic counseling experience (dummy coded with 0–4 years as the reference category). A goal sample size of 240 was set a priori (from an assumed target population size of 600) to achieve 95% power to detect an effect size $f^2 = .054$ (between a small (0.02) and medium (0.15) effect) in a linear regression predicting intentions ($\alpha = .05$). This corresponded to an R^2 value of 0.052 in univariable regression and an R^2 of 0.051 in multivariable regression where the R^2 between intentions and the other covariates is 0.1.

Although clinical studies often explore direct relationships between model variables following Baron and Kenny (1986), this method does not allow for an assessment of their indirect relationships and underlying mediation processes (Zhang et al., 2016). Therefore, to assess mediation predictions (H4–H7), indirect effects (i.e., the degree to which proposed mediators account for the relationship between independent and dependent variables) were calculated using the PROCESS Macro (Hayes, 2018). The indirect effect estimates how much two cases that differ by one unit on the explanatory variable (X) are estimated to differ on the response variable (Y) via the effect of X on a mediator (M) which in turn influences Y. Mediation effects were estimated by fitting two models, one which regresses M on X ($M = \beta_0 + \beta_1 X + e_M$, where β_0 and β_1 are regression coefficients and e_M is the error term with $e_M \sim N(0, \sigma_M)$) and a second model which regresses Y on both X and M ($Y = \alpha_0 + \alpha_1 X + \alpha_2 M + e_Y$, with α_0 , α_1 , and α_2 the regression coefficients and $e_Y \sim N(0, \sigma_Y)$). The product $\beta_1 \alpha_2$ is then an estimate of the indirect effect of X on Y via M. All estimates of indirect effects were also adjusted for gender and years of experience by including them as covariates in the models stated above. PROCESS utilizes a bootstrapping technique to calculate indirect effects (Preacher & Hayes, 2004; Preacher & Hayes, 2008). With this

technique over 1,000 random samples are taken of the data and indirect effects estimates are calculated for each sample (Hayes, 2009), which are used to generate a 95% bias-corrected and accelerated confidence interval (BCa; Hayes, 2012). One limitation of this approach is that the estimates of indirect effects do not provide meaningful insights in effect size (e.g., small versus large) practically or theoretically; furthermore, the value of effect size measures in mediation analyses is limited (Hayes, 2018).

Results

Demographics.

Demographic data for participants is reported in Table I. Study participants were primarily female, Caucasian and below the age of 40. Over 70% of GCs surveyed had been in practice less than 10 years ($n=193$) and the majority graduated from a genetic counseling program between 2000 and 2016 (83.45%; $n=227$). Most GCs (over 75%) worked in a University medical center, private or public hospital, or medical facility. Within these settings, nearly all clinics offered single gene testing and panel testing (>95%).

Reactions to refined risk estimates.

As shown in Table II, several participants believed the refined breast and ovarian cancer risk estimate based on genetic modifiers would be valuable to *BRCA* mutation carriers (Mode = 3; Scale = 1 (not valuable) - 5 (extremely valuable); 49.63% - 4) and to GCs (Mode = 3; 51.82% - 4), but were moderate in thinking it would change risk management suggestions for patients (Mode = 3; Scale = 1 (would not change) - 5 (would greatly change); 26.64% - 2). In response to a sample refined risk estimate, most GCs agreed/strongly agreed that the information in the risk estimate was relevant (Mode = 4; Scale = 1 (strongly disagree) to 5 (strongly agree); 81.75% - 4) and would be useful to carriers (Mode = 4; 69.34% - 4) and could help *BRCA* mutation carriers make decisions (Mode = 4; 53.65% - 4). Furthermore, most (Mode=2, 72.99% - 2) disagreed/ strongly disagreed the risk estimates were difficult for GCs to understand.

As shown in Table III, factors associated with intentions to use refined risk estimates included more positive attitudes and perceptions of usefulness, as well as lower perceived complexity ($p < .05$). Factors correlated with significantly more positive attitudes included greater perceptions of usefulness as well as lower perceived complexity ($p < .05$). As expected, lower perceived complexity was associated with greater ease of use and perceived usefulness (alongside ease of use; $p < .05$); knowledge was unassociated with these two variables ($p > .05$). Although GCs with the most counseling experience (10+ years) reported significantly *lower* perceived usefulness than those with 0–4 years, GCs with 5 or more years of experience reported higher intentions to use refined risk estimates than those with less than five years ($p < .05$). Taken together, model variables explained nearly 42% of the variance in GCs intention to use the refined risk estimates.

Mediation Analyses.

Indirect effects were calculated to assess study mediation hypotheses. Perceived usefulness (est. = .078, 95% CI: [.038, .129]) and perceived ease of use (est. = .078, 95% CI: [.038, .

132)) were indirectly associated with intentions to use via attitudes. An indirect effect of ease of use on attitudes via usefulness also was detected (est. = .729, 95% CI [.441, 1.047]), providing support for our core mediation predictions in TAM (H1–H3 supported). Attitude was also shown to mediate the effects of perceived usefulness on intentions (est. = .078, 95% CI [.038, .129]).

Indirect effects of external factors (knowledge and perceived complexity) on attitudes and intentions were assessed to test H4–H7. No indirect effects of knowledge (via perceived usefulness or ease of use) on attitudes (est. (ease of use) = .174, 95% CI [–.014, .605] and est. (usefulness) = .536, 95% CI [–.005, 1.198]) or intention to use the refined risk estimates (est. (ease of use) = .047, 95% CI [–.004, .123] and est. (usefulness) = .097, 95% CI [–.007, .214]) were detected (H4 and H5 unsupported). An indirect effect of perceived complexity on attitudes (est. = –.712, 95% CI [–1.079, –.413]) and intentions (est. = –.131, 95% CI: [–.193, –.079]) was detected via perceived usefulness (H6 supported), but not via ease of use on attitudes (est. = .055, CI: –.372, .517]) or intentions to use refined risk estimates (est. = –.045, 95% CI [–.128, .041]; H7 unsupported).

Discussion

The goal of this study was to assess GCs' awareness of and interest in refined risk estimates based on genetic risk modifiers, as well as their intentions to use the estimates based on the TAM. Reactions to these risk estimates were only mildly enthusiastic, with GCs trending toward a higher likelihood to use but generally lacking a strong endorsement for clinical use of risk estimates. Additionally, GCs did not think the estimates would have a large impact on risk management suggestions. Furthermore, we found support for TAM's main predictions (H1–H3 supported), with model variables explaining nearly 42% of the variance in intentions to use refined risk estimates.

Practice Recommendations

Our results indicate that GCs who perceived that the risk estimates would be useful and easy to use had more positive attitudes towards their use, which was associated with greater intentions to use them in clinical practice. These findings suggest that to increase the likelihood of GCs using estimates of risk based on genetic risk modifiers clinically, the refined risk estimates may need to be easy to use and to incorporate into genetic counseling, as well as clear and easily understandable. Thus, formative research and pretesting (Atkin & Freimuth, 2001) of refined risk estimates to assess patient and GC understanding and usefulness is important prior to incorporation of this technology into clinical settings. Furthermore, targeted messages to GCs regarding the potential usefulness of refined risk estimates and their value and usefulness in practice may help positively influence attitudes towards risk estimates and interest in use.

The influence of external factors in the TAM, specifically knowledge and perceived complexity on attitudes and intentions via perceived usefulness and ease of use, received less consistent support in this study. Knowledge of risk modifiers appeared to have little direct or indirect influence on attitudes or on intentions to use the refined risk estimates. This may

have been due to the fact that knowledge was moderately high ($M = 4.62$ $SD = 1.05$). Perceived complexity, however, was negatively associated with perceived usefulness, which was associated with attitudes and intentions. Our results suggest that perceptions of estimates being too complex may negatively impact uptake of the technology. Specifically, the more complex that GCs perceived the risk estimates to be, the less useful they perceived the estimates to be, and the lower their attitudes and intentions to use the refined risk estimates. Thus, risk communicators must think carefully about the use of plain language and less complex formats that will allow for easy comprehension of risk estimates.

Our results show perceived usefulness to be a consistent mediator of the effects of external factors on attitudes and intentions. Furthermore, our findings suggest that GCs existing knowledge of risk modifiers may be less influential than their perceptions of the complexity of the information for use with patients on attitudes and behaviors intentions. Prior studies have also illustrated the importance of perceived usefulness within the TAM, as found here. As noted in one previous study, “if one could measure only one independent variable [in TAM], perceived usefulness would clearly be the one to choose.” (King & He, 2006, p. 746). Our results suggest that for uptake of refined risk estimates in clinical practice to occur in practice, it must be clear to GCs the value of these new technologies and they must believe that these new technologies will enhance their genetic counseling practice.

GCs with more years of experience also reported greater intention to use refined risk estimates. Consequently, as more and new GCs enter the workforce, refined risk estimates could be integrated more slowly into the clinical realm due to lack of comfort using the estimates among new graduates. One conjecture for this finding are that counselors with more experience are more confident in their ability to counsel patients about complex results or that they may have seen dramatic changes in types of information available for use in counseling and may be more accustomed to incorporating new testing methodologies into their counseling practice, though existing literature is limited on the subject.

Research Implications

These findings support research (King & He, 2006) showing TAM to be a viable theoretical framework for predicting technology use and extend its’ applicability to the genetics context. In particular, our research highlights the key role of perceived usefulness in the uptake of new technologies. Future research must begin to explore the factors that lead GCs to view a new technology as useful or not, to better understand how to communicate with GCs about new and emerging technologies. It is important to explore whether patients perceptions of the usefulness of new technologies match those of GCs and assist them in understanding their risk and decision-making regarding risk reduction behaviors. Further studies may also investigate the feasibility of implementation considering cost and availability for patients of different ethnic backgrounds. Finally, because this study looked only at *intentions* to use new technologies, it will be important to test whether TAM model variables predict actual use if and when refined estimates of risk based on risk modifiers become available for clinical use.

Limitations

Although this study looks at the factors that may impact uptake of a potential new genetic testing technology, using a theory-based approach, there are several limitations. The methods used to collect these data only allowed us to reach GCs who were members of NSGC; therefore, we are unable to generalize to the larger GC population. The nature of questions posed is a limitation of this study, as we did not directly measure actual clinical practice, but asked about hypothetical situations and risk estimates. Furthermore, not all measures were previously validated and some were limited in their ability to fully capture complex model constructs such as knowledge. Additionally, we cannot entirely rule out the possibility that statistical calibration of variables skewed some of our results. Other statistical approaches (such as latent variable structural equation modeling) would have allowed us to test relationships in the TAM simultaneously, but the methodology used here allowed for the calculation of direct and indirect effects.

The effect of influential observations is a risk in most statistical modeling and is not a limitation specific to this study. Additional studies are needed to help replicate findings reported here (particularly mediation analyses) and build a stronger case for the use of the TAM within the context of new genetic technologies. Future studies also must examine a broader array of factors (particularly perceived barriers) that might impact actual and intended use.

Conclusions

Genetic counselors showed some intent to use refined risk estimates, though they thought results would be unlikely to alter management. Results also provided support for core predictions in TAM and illustrate a new application of theory within the genetics context.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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The authors confirm that the work was conducted to fulfill a degree requirement or as part of training.

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Figure 1:
An adaptation of the Technology Adoption Model (TAM) for this study is illustrated.

Table I

Participant Individual and Clinical Characteristics (N=274)

Participant Characteristics	n	%
Age		
20–29 years	112	40.88
30–39 years	96	35.04
40–49 years	35	12.77
50+ years	31	11.31
Gender		
Male	15	5.47
Female	259	94.53
Race		
Caucasian	251	91.61
Other Race	23	8.39
Years in Practice		
1–4 Years	127	46.35
5–9 Years	66	24.09
10+ years	81	29.56
Participant Clinical Characteristics	n	%
Clinical Setting		
University Medical Center	81	29.56
Private Hospital/Med Facility	77	28.10
Public Hospitals/Med Facility	66	24.09
Diagnostic Laboratory	19	6.93
Health Maintenance Organization	10	3.65
Other	21	7.65
Services Offered in Clinic		
Single gene testing	268	97.81
Panel Gene Testing (well-validated genes)	265	96.72
Panel Gene Testing (less well-characterized genes)	266	97.08
Exome Testing	32	11.68
Somatic Tumor Profiling	26	9.49
Microarray copy Number Profiling	12	4.38
Whole Genome Sequencing	6	2.19
SNP Profiling	1	0.36

Table II*Reactions to refined risk estimates (N=274)*

Question		Level	n	%
How valuable do you think a refined breast and ovarian cancer risk estimate based on genetic modifiers would be to	BRCA Mutation Carriers	1 (not valuable)	3	1.09
		2	26	9.49
		3 (moderately valuable)	109	39.78
		4	78	28.47
		5 (extremely valuable)	58	21.17
	Genetic Counselors	1 (not valuable)	7	2.55
		2	24	8.76
		3 (moderately valuable)	101	36.86
		4	84	30.66
		5 (extremely valuable)	58	21.17
To what extent do you think the ability to stratify risk change risk management would impact recommendations or suggestions made to patients?		1 (would not change)	30	10.95
		2	43	15.69
		3 (may change)	162	59.12
		4	32	11.68
		5 (would greatly change)	7	2.55
The information presented in the risk estimate is relevant to BRCA mutation carriers.		Strongly disagree	4	1.46
		Disagree	8	2.92
		Neutral	38	13.87
		Agree	159	58.03
		Strongly Agree	65	23.72
The information presented in the risk estimate would be useful to BRCA mutation carriers.		Strongly disagree	6	2.19
		Disagree	11	4.01
		Neutral	67	24.45
		Agree	142	51.82
		Strongly Agree	48	17.52

Table III

Results of Multiple Regression Analyses Predicting Usefulness, Ease of Use, Attitudes and Intentions to Use Refined Risk Estimates (N=274)

	Ease of Use		Perceived Usefulness		Attitudes		Intention to Use Estimates	
	<i>B</i> (<i>SE B</i>)	<i>p</i>	<i>B</i> (<i>SE B</i>)	<i>p</i>	<i>B</i> (<i>SE B</i>)	<i>p</i>	<i>B</i> (<i>SE B</i>)	<i>p</i>
Male ¹	0.169 (0.665)	0.800	0.559 (0.801)	0.486	-2.530 (3.112)	0.417	-0.834 (0.451)	0.065
5-9 years' experience ²	0.254 (0.377)	0.501	-0.340 (0.454)	0.455	-1.884 (1.766)	0.287	0.024 (0.256)	0.926
10+ years' experience ²	0.029 (0.359)	0.936	-1.307 (0.433)	0.003	-0.111 (1.710)	0.948	0.736 (0.247)	0.003
Knowledge	0.069 (0.145)	0.632	0.161 (0.175)	0.358	1.139 (0.679)	0.094	0.037 (0.986)	0.707
Perceived Complexity	-0.733 (0.055)	<0.001	-0.264 (0.086)	0.002	-1.336 (0.339)	<0.001	-0.141 (0.050)	0.005
Ease of Use			0.362 (0.074)	<0.001	-0.081 (0.298)	0.786	0.063 (0.043)	0.145
Perceived Usefulness					1.300 (0.238)	<0.001	0.198 (0.036)	<0.001
Attitudes							0.034 (0.009)	<0.001
<i>F</i> (<i>df</i>)	37.281 (5,268)	<0.001	15.759 (6, 267)	<0.001	14.141 (7, 266)	<0.001	23.633 (8, 265)	<0.001
R ²	0.410		0.262		0.271		0.416	

Note.

¹ 1=Male, 0=Female,

² comparison group: 0-4 years