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Investigating Perceived Barriers and Challenges to Using Virtual Genetic Assistants Among Genetic Counselors

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INVESTIGATING PERCEIVED BARRIERS AND CHALLENGES TO USING VIRTUAL GENETIC ASSISTANTS AMONG GENETIC COUNSELORS

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ABSTRACT

Background: There is a shortage of genetic counselors working in direct patient care in the U.S. Virtual Genetic Assistants (VGA's) can be used to widen accessibility of genetic counseling services by perform various parts of a genetic counseling session and reduce the workload of genetic counselors. There is a lack of understanding about the views and experiences of genetic counselors that have used VGA's. This study investigates perceived barriers and challenges faced by genetic counselors using VGA's.

Methods: This study received status of exemption from review by the Sarah Lawrence College Institutional Review Board (IRB). A survey was developed consisting of Likert scale and free-text items. Likert scale questions were analyzed using non-parametric tests. Free-text responses were analyzed using open coding method and Delve software.

Results: Eleven participants completed the survey. The most common concerns cited by participants were 1.) inability to assess patient's understanding of the information provided by the VGA and 2.) lack of psychosocial counseling/rapport building. Participants cited email access, needing platform update, system error, patient uptake, and a lack of resources as primary barriers or challenges to integrating VGA's into practice. Participants reported that risk assessment and education for pre-test counseling as potential future uses of VGA's.

Conclusion: VGA's have the potential to streamline and improve efficiency of genetic counseling interactions. VGA's are generally viewed positively by genetic counselors with experience using these technologies. Future studies may incorporate in-depth interviews about the barriers or challenges of integrating VGA's into their practice. Having a clearer understanding of genetic counselors' experience with using VGA's will be critical for improving access to genetic counseling and increasing efficiency of genetic counseling sessions.

INTRODUCTION

Genetic counseling is a process that helps individuals learn about the medical, psychological, and familial implications of genetic diseases (National Society of Genetic Counselors' Definition Task Force, 2006). Through this process, genetic counselors aim to help individuals make informed decisions about genetic testing and management options for possible or present genetic conditions in a wide variety of clinical settings. There are currently more than 5600 certified genetic counselors in the U.S. (National Society of Genetic Counselors, 2021). However, there is a shortage of genetic counselors that are working in direct patient care, and supply and demand for genetic counseling are expected to reach equilibrium between 2024 and 2030 (Hoskovec et al., 2018).

Due to a shortage of genetic counselors working in direct patient care in the U.S., various technologies are currently being used by genetic counselors to improve their workflow and expand outreach to communities and individuals who may not otherwise be able to access genetic counseling services. In recent decades, rapid technological improvements in genomic sequencing have made genomic information more readily available for genetic counselors Genetic counselors have begun to integrate innovative technologies in genetic counseling sessions, such as, Genomic Understanding, Information and Awareness (GUÍA, Spanish for "guide"). GUIA is a recently developed web application that facilitates the delivery of genetic testing results and related clinical information to patients by incorporating a helpful narrative and visual programming (Suckiel et al., 2021). Genetic counselors are highly adaptive and open to implementing new technologies that will improve access to their services.

Chatbots have recently begun to be used in the field of health care. Chatbots are dialog systems that utilize natural conversations to deliver personalized interventions based on individual

preferences and emotional states. Chatbots are increasingly being used in a variety of fields such as business, governance, education, and health care to take on routine and demanding tasks of professionals (Zhang et al., 2020). In the field of health care, chatbots are viewed favorably by physicians for tasks such as scheduling appointments, locating health clinics, or providing medication information. However, many physicians reported concerns that chatbots cannot display human emotion or provide detailed diagnosis and treatment due to the individualized nature of patient care. In addition, some physicians believe that chatbots may inflict harm to patients if they do not accurately understand the diagnoses provided by chatbots. These studies suggest that physicians have variable concerns on the use of chatbots, depending on the specific tasks that are being performed (Palanica et al., 2019). By addressing these concerns and potential areas of improvement could potentially increase usage of chatbots and help to maximize the efficiency of health care professionals, while reducing workload and burnout.

In genetic counseling, chatbots and similar technologies are frequently referred to as Virtual Genetic Assistants (VGA's). VGA's have the potential to benefit the field of genetic counseling and streamline genetic counseling services. For example, Genetic Information Assistant (GIA) is a VGA platform that is already being used by several genetic testing companies to simulate conversations with patients regarding family history, guidelines for testing, and coordination of post-test follow-up appointments (Nazareth et al., 2021). VGA's can help to facilitate time-consuming and repetitive tasks and to alleviate the work burden of genetic counselors. As a result, genetic counselors can provide more services and reach more individuals and communities. Importantly, VGA's can enhance service quality for patients by allowing them to explore genetic information at their own pace and on their own time (Nazareth et al., 2021).

Given the potential impact of VGA's on the field of genetic counseling, it is critical to

understand how VGA's are viewed among genetic counselors that have used or currently use these technologies. A recent survey has shown that genetic counselors and genetic counseling students have various concerns about using chatbots in patient care (Wallis, 2020). However, this survey was completed mostly by genetic counselors and students who have not used these technologies in practice. To gain an in-depth understanding of barriers and challenges to using VGA's and potential areas for improvement in VGA's, it is critical to assess the common concerns addressed by the previous survey by asking general and targeted questions to genetic counselors that have prior experience with VGA's. To investigate whether genetic counselors that have prior experience with VGA's share similar concerns that were addressed by genetic counselors and students in the previous survey and understanding how they deal with those concerns, this study aims to identify areas of improvement for the use of VGA's in clinical care, which can help to streamline their incorporation into the field of genetic counseling.

METHODOLOGY

IRB Approval

The first author (YS) of this study completed the Collaborative Institutional Training Initiative (CITI) program for research, ethics, and compliance training. Subsequently, this study received status of exemption from review by the Sarah Lawrence College Institutional Review Board (IRB).

Questionnaire Development

A questionnaire was developed to understand perceived challenges and barriers to integrating VGA's among genetic counselors. The questionnaire included Likert scale And open-

ended questions.

Data collection

A full list of survey questions can be found in Appendix A. The questions include an eligibility question, demographic questions, questions on VGA usage, and Likert scale and free-text questions. All of the questions were created using Google Forms.

Participant recruitment utilized National Society of Genetic Counselors (NSGC) Student Research Survey E-blast that sends out email advertisement of the survey to genetic counselors enlisted by the website. In addition, the principal investigator of this study directly reached out to several genetic counselors that worked in genetic testing industries or have research experience related to VGA's to ensure an adequate number of participants. Two genetic testing companies that are known to use VGA's were also contacted. The managers for these institutions were asked to post the advertisement on their bulletin boards. The only eligibility criterium required to participate was that a genetic counselor used VGA's in their practice. No incentives were used to recruit participants for this study.

Analysis

A qualitative approach to data analysis was used. For Likert scale questions, the median was measured to understand the central tendency of data. For free text questions, analysis of data was performed using Delve coding software. Open coding was used to analyze the textual content of responses and to create categories from them. This open coding method utilized the research question to frame the categories that were created. In-vivo or verbatim coding was used for more simple responses.

RESULTS

Demographic information

In total, eleven individuals participated in the survey, and all of them reported their gender as female. One respondent (9.1%) reported being in the 20s, six respondents (54.5%) reported being in the 30s, and four respondents (36.4%) reported being in the 40s. Ten survey participants (90.9%) reported their race as white and one survey participant (9.1%) reported their race as "other". All survey participants reported living in the United States and in the following states: California, Illinois, Minnesota, Ohio, South Carolina, Texas, Virginia, and Washington. Six respondents (54.5%) reported their current primary specialty as cancer, two respondents (18.2%) reported their current primary specialty as prenatal, two respondents (18.2%) reported their current primary specialty as laboratory, and one respondent (9.1%) reported their current primary specialty as rare disease, peds, and adult. There were three respondents (27.3%) that reported practicing for 0 to 2 years, two respondents (18.2%) that reported practicing for 3 to 5 years, three respondents (27.3%) that reported practicing for 6 to 10 years, and three respondents (27.3%) that reported practicing for more than 10 years. All survey participants reported having some type of administrative support. Two respondents (18.2%) reported only having GCA's, five respondents (45.5%) reported only having office coordinator/administrative support, three respondents (27.3%) reported having both GCA's and office coordinator/administrative support, and one respondent (9.1%) reported having GCA's, office coordinator/administrative support, and volunteer help.

Table 1. Demographic information of survey participants

Demographic factor	n	%
Gender identity		
Woman	11	100
Age		
20 to 29	1	9.1%
30 to 39	6	54.5%
40 to 49	4	36.4%
Self-reported race/ethnicity		
White	10	90.9%
Other	1	9.1%
State of residence		
California	1	9.1%
Illinois	1	9.1%
Minnesota	1	9.1%
Ohio	2	18.2%
South Carolina	1	9.1%
Texas	2	18.2%
Virginia	2	18.2%
Washington	1	9.1%
Current primary specialty		
Cancer	6	54.5%
Prenatal	2	18.2%
Laboratory	2	18.2%
Other (rare disease, peds, and adult)	1	9.1%
Years of practice in current specialty		
0 to 2 years	3	27.3%
3 to 5 years	2	18.2%
6 to 10 years	3	27.3%
10+ years	3	27.3%
Administrative support		
GCA's only	2	18.2%
Office coordinator/administrative assistant only	5	45.5%
GCA's and office coordinator/administrative assistant	3	27.3%
GCA's, office coordinator/administrative assistant, and volunteer	1	9.1%

VGA usage

When survey participants were asked about VGA usage, six respondents (54.5%) reported having used Genetic Information Assistant (GIA), two respondents (18.2%) reported having used Natera's Educational Virtual Assistant (NEVA), one respondent (9.1%) reported having used Volpara Health, one respondent (9.1%) reported having used HealthFAX, four respondents (36.4%) reported having used Ambry's Virtual Assistant (AVA), and one respondent (9.1%) reported having used a VGA platform that was independently developed from her own clinic.
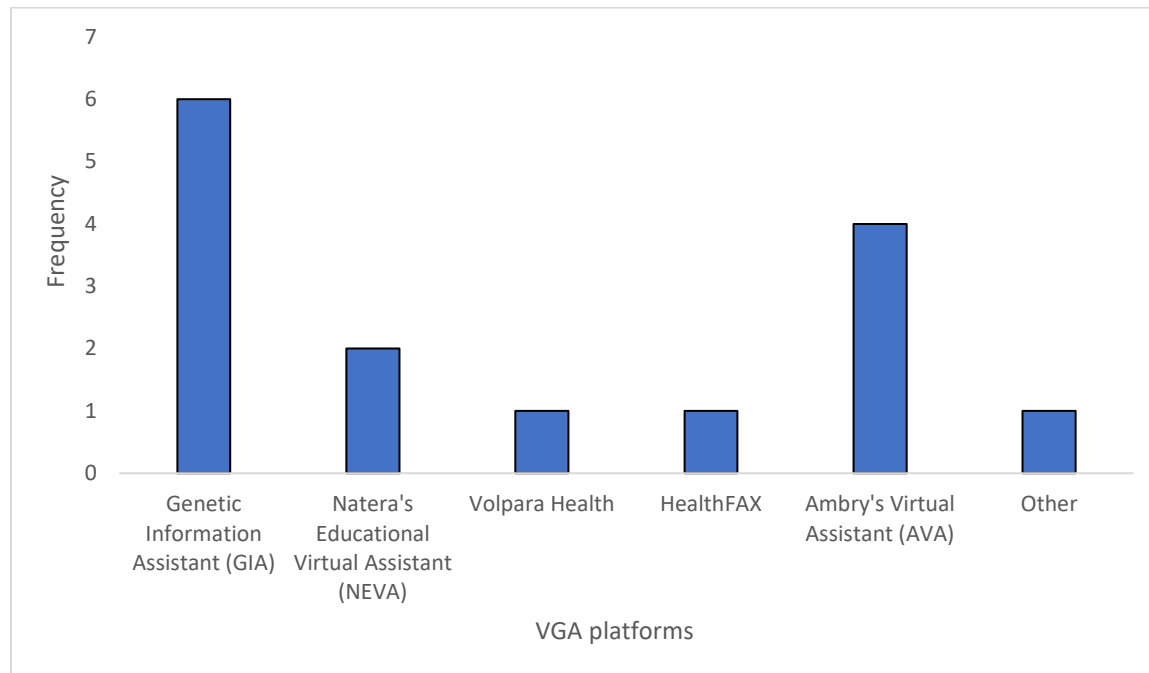

Figure 1. Different VGA platforms that were used by participants

When survey participants were asked about frequency of using VGA in their practice, ten out of eleven survey participants provided a response. Six respondents (60%) reported using VGA's daily in their practice, two respondents (20%) reported using VGA's a few times per week

in their practice, and two respondents (20%) reported using VGA's a few times per month in their practice.

Survey participants reported using VGA's for various roles in their practices. Eight respondents (72.7%) reported using VGA's for family history intake or pedigree taking, six respondents (54.5%) reported using VGA's for medical history intake, four respondents (36.4%) reported using VGA's for risk assessment, one respondent (9.1%) reported using VGA's for obtaining informed consent, six respondents (54.5%) reported using VGA's for education on topics such as genetics or inheritance, five respondents (45.5%) reported using VGA's for test results disclosure, and one respondent (9.1%) reported using VGA's for setting up result disclosure appointment with a patient.
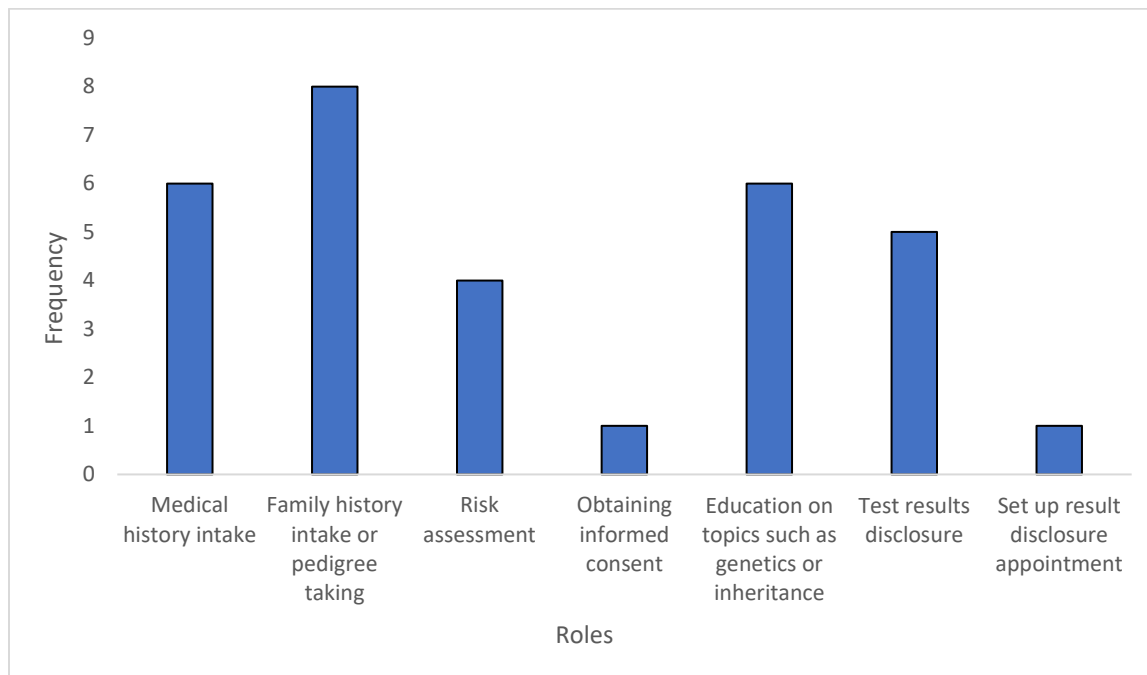

Figure 2. Different roles that VGA's perform in participants' practice

Likert scale questions

Survey participants were asked to complete a Likert scale questionnaire that required answering how often they have had specific concerns about the use of VGA's. The notations *Never (N), Rarely (R), Sometimes (S), Often (O), and Always /Almost always (A)* were used to represent the values of the Likert scale responses. Responses to these questions are illustrated in Figure 3.

Concerns about being unable to assess patient's understanding of the information provided by the chatbot had ordinal values $N = 2$, $R = 1$, $S = 2$, $O = 4$, and $A = 2$. The majority of participants expressed that they often have concerns about being unable to assess patient understanding of information provided by the chatbot (n=4).

Concerns about chatbot being mistaken for the genetic counselor/provider had ordinal values $N = 7$, $R = 2$, $S = 2$, $O = 0$, and $A = 0$. Most participants expressed that they have never had concerns about chatbot being mistaken for the genetic cousnselor/provider (n=7).

Concerns about chatbots having accurate or up-to-date information had ordinal values $N = 4$, $R = 2$, $S = 3$, $O = 2$, and $A = 0$. There was wide variability among participants who expressed chatbots as having accurate or up-to-date information.

Concerns about security or privacy had ordinal values $N = 5$, $R = 4$, $S = 1$, $O = 1$, and $A = 0$. Most participants have never or rarely had concerns about security or privacy.

Concern for a lack of psychosocial counseling/rapport building had ordinal values $N = 3$, $R = 1$, $S = 1$, $O = 4$, and $A = 2$. There was wide variability among participants who expressed having concern for a lack of psychosocial counseling/rapport building.
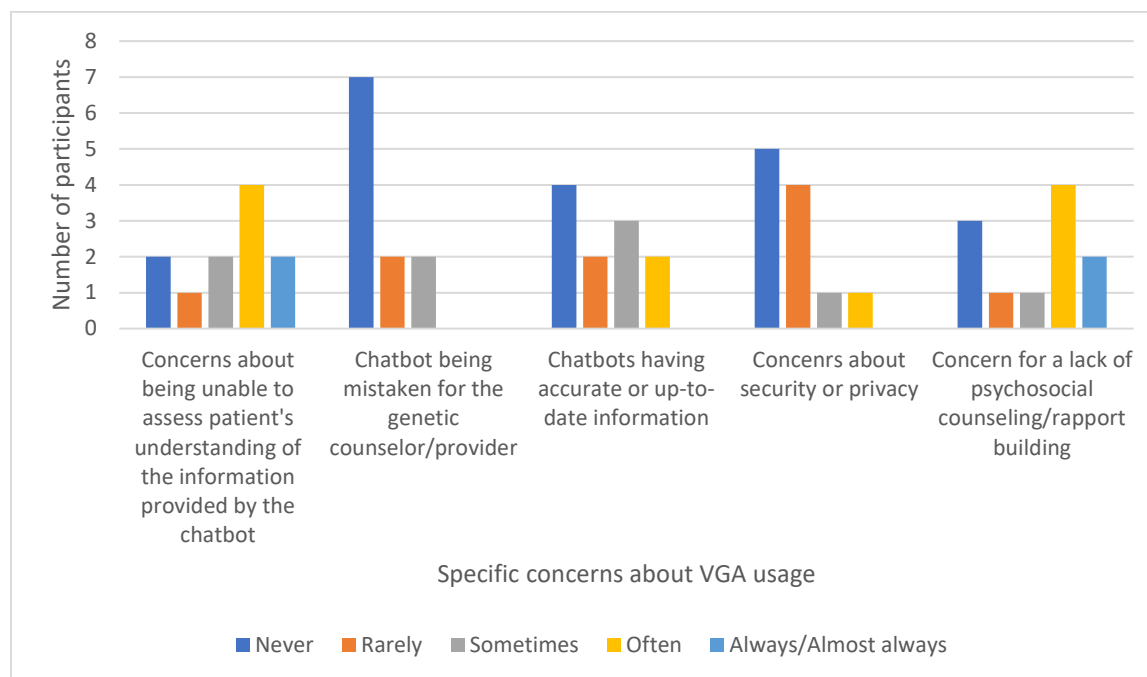
Figure 3. Likert scale questionnaire about different concerns that genetic counselors may have to using VGA's

Survey participants were also asked to rate how likely they are to recommend using VGA's to a colleague or a company. Ratings of very unlikely (VU), unlikely (U), neutral (N), likely (L), and very likely (VL) were used to represent values of Likert scale responses. Likelihood of recommending using VGA's to a colleague or company had ordinal values of VU = 0 , U = 1, N = 3, L = 4, and VL = 3. Most participants expressed that they are likely or very likely to recommend using VGA's to a colleague or company.
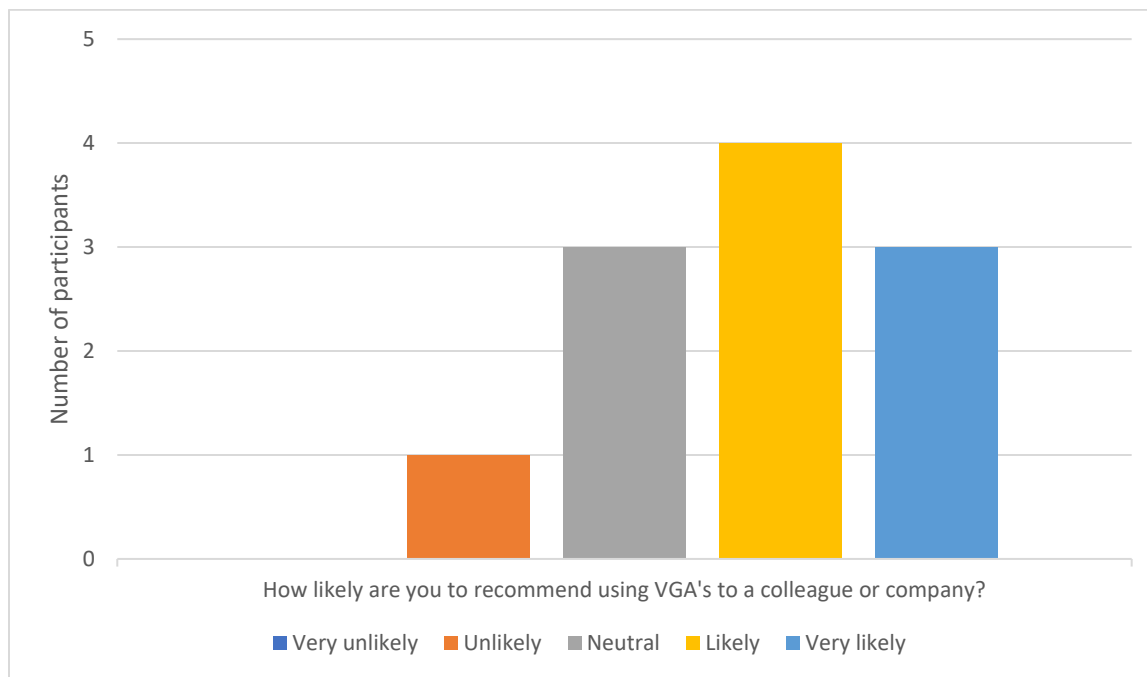
Figure 4. Likert scale questionnaire about how likely a person would recommend using VGA's to a colleague or company

Free text questions

When survey participants were asked to share any barriers or challenges that they have faced in the integration of VGA's in their practice, nine out of eleven participants (82.8%) responded. The responses and their respective codes that were generated are listed on table 2.

Table 2. Open coding of responses to the question: please share any barriers or challenges you have faced in the integration of VGA's into your practice.

Responses	Codes
Cannot speak to this as it was integrated before I arrived. I only access the chatbot scripts when the research project using it is active (currently it is not active, waiting for more results)	n/a

Patients who have low internet literacy and who <u>do not have email addresses</u>	Email access
we currently use this to triage cancer patients, but there are patients <u>it misses (those who do not fit common NCCN guidelines,</u> but would otherwise be referred) (i.e. kidney cancer 45 and under, familial melanoma, familial leukemia)	Need platform update
Patients get frustrated with multiple requests, when the info they <u>input does not save,</u> have to edit almost all of them as new info is available after they do it	System error
<u>Lack of patient completion and interest</u> in VGA's - not saving the time like it should be	Patient uptake
<u>Uptake</u> by patient families	Patient uptake
Build out of comprehensive responses takes significant <u>time and resources</u>	Resources
Some patients <u>don't check their email,</u> the GIA invite for family history intake looks like a spam email, sometimes there are glitches and the <u>patient's information isn't saved</u>	Email access, System error
<u>Cost</u>, need to <u>update platform, integration with electronic medical record system</u>	Resources, Need platform update

When survey participants were asked to share an interaction where they used VGA's in their practice and were concerned about their utility, nine out of eleven participants (82.8%) responded. The responses and their respective codes that were generated are listed on table 3.

Table 3. Open coding of responses to the question: in a few words, please describe an interaction where you used VGA's in your practice and were concerned about their utility.

Responses	Codes
Have not been concerned about the utility.	No concern
Patients utilizing the low-risk pregnancy VGA and having a follow-up session and not retaining information provided by the VGA	Education ability
there are limitations in who it detects. Also, patients do not always understand all of the terms used or how questions are phrased. For example, one of the chatbots I use asks if the patient has cancer – as such, many patients do not list their personal prior history of cancer. For medical history, one of the questions is "what is your menopausal status?" and many patients don't know what that means.	Language used within VGA
Patients have declined genetic testing in chatbot and then no show their genetic counseling appointment. Aggravating as the person would have more and better information from the GC than the chatbot to decide whether to proceed	n/a
Results release for unaffected individuals for understanding residual cancer risk and recommendations based on family history – VGA does not always discuss this and make it clear to patients.	Education ability
I don't have an example of this	n/a
Limited responses to some questions can leave patients more confused	Education ability

Getting family history before the appointment	n/a
I am currently using this as a triage tool to evaluate all-comers to an oncology clinic to determine who meets NCCN criteria for genetic counseling/testing based on self-reported personal and family history of cancer. However, there are limitations. (1) sometimes <u>patients don't understand certain questions, and cannot seek further clarification,</u> which may result in inaccurate risk assessment, and (2) the testing indications in the chatbot are not all-encompassing (i.e. kidney cancer and melanoma testing indications are missing) and so <u>certain patients will be missed</u> who do not meet the more common guidelines for testing.	Language used within VGA, Platform update

When survey participants were asked to share any potential uses of VGA's that are not currently being used in practice, four out of eleven people responded. The responses and their respective codes that were generated are listed on table 4.

Table 4. Open coding of responses to the question: please share any potential uses of VGA's that are not currently being used in practice.

Responses	Codes
<u>Risk assessment, referral order</u>	Risk assessment, Referral order
None that I can think of at this tim, beyond additional information available for patient access (further detail regarding test types,result types, etc.)	n/a
On a research basis, we are evaluating the use of VGA's for basic educational concepts for pre-test counseling, then provide opportunities for patients to meet with a live	Education for pre-test counseling

GC for further info (or to decline meeting with a live GC) prior to submitting a sample for testing.	
N/A	n/a

DISCUSSION

This study looked at various challenges and barriers that genetic counselors experienced when using VGA's. Despite the challenges and barriers that were reported from the participants, genetic counselors in this study were likely to recommend using VGA's to colleagues.Additionally, these data illustrate that the two most common VGA platforms that survey participants are currently using or have used is GIA and AVA. The VGA platforms perform various functions including but not limited to medical history taking, family history or pedigree taking, patient education on basic genetics concepts, and test results disclosure.

Furthermore, the measures of median for the Likert scale questionnaire indicate that the two most predominant concerns that survey participants had were concerns about being unable to assess patient's understanding of the information provided by the VGA and concern for a lack of psychosocial counseling/rapport building. Additionally, the median for the last Likert scale questionnaire suggests that survey participants are more likely than not to recommend using VGA's to colleagues or companies.

When comparing data from the Likert scale questionnaire regarding various concerns with using VGA's to the original table from Wallis' study, it is notable that the most frequently cited concern in Wallis' study matches the one of the most frequently cited concerns in this study (concern about being unable to assess patient's understanding of the information provided by the chatbot). However, the second most frequently cited concern in Wallis' study was the least

frequently cited concern in this study (concerns about chatbot being mistake for the genetic counselor/provider). Given that Wallis' study mostly included participants that have not had any experience with using VGA's, the concern about VGA's being mistaken as the genetic counselor was not a concern by genetic counselors who use these technologies in practice.

Codes that were generated from participants' responses to being asked to share any challenges or barriers to integrating VGA's revealed five major areas of difficulty with integrating VGA's in the participants' practice. These include email access, needing platform update, system error, patient uptake, and resources. To streamline the integration of VGA's into genetic counselors' practice, it seems important to confirm that the patient has email access before making an appointment with VGA's. Because of the need for access to email/computer/smart phone for use of VGA's, caution should be used to ensure that VGA's do not exacerbate existing health disparities between socioeconomic groups. Additionally, updating the platform to include the ability to manually change new or unique criteria for triaging patients and prompt reporting of any glitches or errors may further ease the integration of VGA's into genetic counselors' practice.

Codes that were generated from participants' responses to being asked to share an interaction where they were concerned about the utility of VGA's revealed three major areas of improvement for VGA's. These include, education ability, language used within VGA, and platform update. To improve patient experience with VGA's, it seems important to use simpler and clearer language to provide the best educational experience for patients and provide opportunities to contact genetic counselors for any remaining questions. Interestingly, the Likert scale questionnaire showed that some participants were concerned about the inability to assess patients' understanding. The experiences that are outlined in free text responses may be intimately connected to their concerns. Additionally, it seems important to update the VGA platform to meet

the needs of the clinic. Interestingly, some participants had concerns about VGA's having accurate or up-to-date information. The experiences of participants outlined in this free text question may also reflect the concerns that were reported in the Likert scale questionnaire.

Codes that were generated from participants' responses to being asked to share any potential uses of VGA's that are not currently being used in practice revealed three themes. These include risk assessment, referral order, and education for pre-test counseling. Given that some respondents reported that risk assessment and referral order were part of their experience when using VGA's, it seems that some VGA platforms that don't already have risk assessment or referral order options may benefit from utility add-ons. One participant discussed the possibility of providing basic educational concepts for pre-test counseling and then providing opportunities for patients to meet with a genetic counselor for further clarification about the educational materials provided by the VGA. It may be helpful to investigate possible psychosocial implications for using this type of approach to genetic testing.

Limitations

The presented study has several limitations. There were only eleven survey participants that completed the study and some questions (e.g., free text questions) did not have a 100% response rate from the participants. The small sample size restricts the ability to generalize data gathered from the study to the broader genetic counseling community that uses VGA's. Additionally, the demographic information of the survey participants indicated that 100% of the survey participants identify as female, live in the United States, and have administrative support. The demographics of survey participants could potentially have biased the results of the study and may not be generalizable to genetic counselors practicing in different geographic locations,

identifying as male, or from different racial or ethnic backgrounds.

The open coding of the responses gathered from the survey participants required subjective interpretation of the interviewer. Therefore, parts of a response that were deemed to be important or pertinent may not have been fully captured because the subjective interpretation of one person may not be enough to identify all relevant codes. Additionally, some responses used vague language and did not contain enough detail for interpreting the meaning of the responses. For example, when survey participants were asked to describe an interaction where they used VGA's in their practice and were concerned about their utility, one participant said the following,

"Patients have declined genetic testing in chatbot and then no show their genetic counseling appointment. Aggravating as the person would have more and better information from the GC than the chatbot to decide whether to proceed"

It is difficult to assess if this respondent was implying that there was a specific utility built in the chatbot that caused the patient to decline genetic testing or if the patient declined genetic testing due to other reasons.

Future directions

Based on the responses from the survey participants in this study, future research may focus on updating VGA platforms and including risk assessment and referral orders as add-ons for VGA's that do not already have those options available. Additionally, providing basic educational materials for pre-test counseling may streamline the workflow of genetic counselors and leave

more time for post-test counseling, but the psychosocial implications of this practice may be the focus of next research.

Some challenges or barriers to integrating VGA's into practice were discussed in the study. To improve integration of VGA's into genetic counselors' practice, VGA's may need to update its platform, correct any system errors, make sure that patients have email access prior to introducing them to VGA's, and further investigate why some patients choose not to use VGA platforms. Importantly, disseminating information about the utility and benefits of VGA's could assure genetic counselors that VGA's do not worsen genetic counselors' workflow but could actually improve their practice and therefore help to mitigate any health disparities that exist by providing more time for genetic counseling services to those that may not have adequate access. These steps will be crucial for increasing patient uptake of VGA's and for streamlining its incorporation for genetic counselors that use VGA's. Future research may also involve in-depth interviews that clarify any vague statements about concerns made towards VGA's.

APPENDIX

Appendix A
Eligibility question
1. Have you used virtual genetic assistants (VGA's) and/or chatbots in your practice?
    a. Yes > Continue to demographic questions
    b. No > Participation ineligible

Demographic questions
1. What is your gender identity?
    a. Woman
    b. Man
    c. Non-binary person
    d. Prefer not to say
    e. Other (please specify)
2. What is your age?
    a. 20 to 29
    b. 30 to 39
    c. 40 to 49
    d. 50 to 59
    e. 60+
3. What is your race or ethnicity?
    a. American Indian or Alaskan Native
    b. Asian
    c. Black or African American
    d. Native Hawaiian or Other Pacific Islander
    e. White or Caucasian
    f. Prefer not to say
    g. Other (please specify)
4. In what country do you reside?
    a. USA
    b. Canada
    c. Other (please specify)
5. If living in USA, in what state do you currently reside
    a. [Scroll down option of 50 different states]
6. What is your current primary specialty?
    a. Adult or General genetics
    b. Cancer
    c. Pediatrics
    d. Prenatal
    e. Laboratory
7. How many years have you been practising in your current specialty?
    a. 0 to 2 years
    b. 3 to 5 years
    c. 6 to 10 years
    d. 10+ years

8. Do you have administrative support in your role?
   a. Yes
   b. No
9. Which of the following administrative support do you have?
   a. GCA's
   b. Office coordinator/administrative assistant
   c. Volunteers
   d. Other (please specify)

Questions on VGA usage
1. What VGA platforms have you used? Select all.
   a. GIA
   b. NEVA
   c. ROSA
   d. EDNA
   e. Other (please specify)
2. How often do you use VGA's in your practice?
   a. Daily
   b. A few times per week
   c. A few times per month
   d. A few times per year
3. What roles do VGA's perform in your practice? Select all.
   a. Medical history intake
   b. Family history intake or pedigree taking
   c. Risk assessment
   d. Obtaining informed consent
   e. Providing insurance information
   f. Education on topics such as genetics or inheritance
   g. Test results disclosure
   h. Other (please specify)

Likert scale questions
1. How often have you had any of the following concerns about the use of VGA's? [Available options include: Never, Rarely, Sometimes, Often, Always/Almost always]
   a. Concerns about being unable to assess patient's understanding of the information provided by the chatbot
   b. Chatbot being mistaken for the genetic counselor/provider
   c. Chatbots having accurate or up-to-date information
   d. Concerns about security or privacy
   e. Concern for a lack of psychosocial counseling/rapport building
2. How likely are you to recommend using VGA's to a colleague or company? [Available options include: Very unlikely, Unlikely, Neutral, Likely, and Very likely]

Free text questions
1. Please share any barriers or challenges you have faced in the integration of VGA's into your practice.

2. In a few words, please describe an interaction where you used VGA's in your practice and were concerned about their utility.
3. Please share any potential uses of VGA's that are not currently being used in practice.

Optional interview
1. Would you be open to being contacted for a brief follow-up phone call to elaborate on your survey response?
   a. Yes > Contact information
   b. No > End of survey

Appendix B

Table 20. Survey participants' main concerns about offering a chatbot to their patients

	Frequency	Percent
-Being unable to assess patient understanding of the information included in the chatbot	133	63.6
-The chatbot being mistaken for the genetic counselor/provider	27	12.9
-Accurate/up to date information	17	8.1
-Compliance with hospital legal and ethical guidelines	7	3.3
-Ease of use	7	3.3
-Privacy/HIPAA	5	2.4
-Electronic Medical Record integration	5	2.4
-Ability to access chatbot with necessary technology/internet access	5	2.4
-Ability to access chatbot in a language other than English	2	1
-Appropriate language level of chatbot script for patients (6th grade reading level)	1	0.5
Total	**209**	**100**

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