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OBM Genetics

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Original Research

Investigating Interest in Cancer Predisposition Testing and Expanded Carrier Screening in Routine Gynecologic Care among Pregnancy Capable Individuals

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Academic Editor: Ying S. Zou

Special Issue: Use of Genetic Tests in the Context of Population Screening Strategies

OBM Genetics
2025, volume 9, issue 1
doi:10.21926/obm.genet.2501288

Received: May 28, 2024
Accepted: March 17, 2025
Published: March 25, 2025

Abstract

The goal of this qualitative study was to explore pregnancy capable individuals' perceptions of having cancer predisposition testing (CPT) and/or expanded carrier screening (ECS) during routine gynecologic care and how these perceptions differ across individuals. A thematic analysis was conducted based on qualitative data from 26 semi-structured interviews with women between 20 and 35 years of age at a single academic health center in the Mountain

West of United States. The analysis indicated that participants' interest in both types of genetic testing were related to (1) illness prevention and preparation, (2) uncertainty management, (3) family members' health and support, (4) cost, logistics, and privacy, and (5) demographics and current health status. Specific factors related to interest in CPT included experiences with cancer and relevance of cancer prevention and preparation, whereas specific factors impacting women's interest in ECS were family planning needs, awareness about children's health, and informed reproductive decision making. The findings add novel evidence to the potential of offering both CPT and ECS during routine, non-obstetrical care in gynecologic clinics. They also have important implications for developing tools to increase individuals' knowledge about CPT and ECS and to address their needs for informational and structural support as population screening efforts expand.

Keywords
Cancer predisposition testing; expanded carrier testing; interest; pre-pregnancy; gynecologic care; thematic analysis

1. Introduction

The advancement of next-generation genome sequencing technologies has made genetic testing more readily available to unaffected individuals [1]. Routine gynecologic care provides a crucial time for pregnancy capable individuals to be more aware and educated about their health and the health of future biological children [2, 3]. Among widely available genetic tests, cancer predisposition testing (CPT) and expanded carrier screening (ECS) are two types of genetic testing that may be salient and relevant to this particular group [4]. CPT is a specific type of genetic testing for detecting inherited cancer syndromes such as hereditary breast and ovarian cancer [5]; ECS is a multi-disease and pan-ethnic carrier screening program, ideally offered pre-pregnancy, to prospective parents to detect genetic diseases that may be unknowingly passed on to biological children [6, 7]. Both types of testing can provide comprehensive genetic information to unaffected individuals and facilitate their informed reproductive decision making and, if needed, cancer management [8]. The American College of Obstetricians and Gynecologists (ACOG) recommends that ECS is an acceptable carrier screening strategy and acknowledges assessing for hereditary cancer risk is within the roles of obstetrics/gynecology providers [9]. Current clinical guidelines are to ideally offer ECS for multiple conditions prior to pregnancy regardless of race, ethnicity, or family history [10]. Additionally, the collection of cancer family history is recommended as part of routine gynecologic care [11]. Thus, the integration of CPT and ECS into routine gynecologic care can be a cost-efficient and convenient practice to offer individuals pregnancy planning information and to identify those who have increased cancer risks as well as those who will benefit from enhanced cancer screening.

Despite its benefits, limited research has explored the potential of gynecology clinics as a setting for integrating genetic testing for multiple indications such as CPT and ECS. One study that focused specifically on Ashkenazi Jewish individuals' interests in the integration of CPT and reproductive carrier screening suggested that most participants would prefer to have CPT testing as an add-on test with reproductive carrier screening [12]. Further, the practice of integration of population-

based CPT and ECS has not yet been implemented in the United States [13], and the uptake of both tests individually is less than optimal [14, 15]. System-, clinician-, and patient-level factors likely contribute to the lower utilization. Individuals planning for pregnancy or who may become pregnant may be a harder-to-reach population than those who are pregnant, thus limiting clinical capacity to enhance their knowledge and awareness about genetic testing [14, 16]. Health care providers who do not practice in genetic counseling may have limited familiarity with either CPT or ECS, leading to underutilization and missed opportunities for integrating multiple genetic tests into practice [17, 18]. Additionally, lack of knowledge and motivation about genetic testing as well as beliefs that genetic testing is a way to tamper with the nature may contribute to the lower uptake of testing of the general public [6, 19]. Since both CPT and ECS are relevant testing for pregnancy capable individuals, it may be feasible and cost-effective to integrate both tests and family history assessment into routine gynecologic care. In order to plan such efforts, more in-depth understanding is needed to investigate their perceptions of having CPT and ECS in the context of routine gynecologic care.

To our knowledge, no prior qualitative research has examined the acceptability and feasibility of both genetic tests being offered in routine gynecologic care for pregnancy capable individuals. Research to date has mainly focused on the perceptions and outcomes of reproductive carrier screening among individuals with hereditary cancer syndromes, a population with complicated reproductive decision-making [20]. However, many pregnancy capable individuals are not aware of their hereditary risk for developing a condition (e.g., family history of cancer), which may result in missed opportunity to reduce cancer-related morbidity and mortality as well as unexpected reproduction outcomes [4]. Despite clinical recommendations of offering population-based carrier screening and assessment for cancer genetic testing to pregnancy capable individuals, ideally during pre-pregnancy, the current clinical practices are inconsistent across different health care providers and facilities, and these practices can be better informed with understanding women's attitudes toward and concerns about the testing [21]. To address this research gap, this study aimed to explore pregnancy capable individuals' perceptions of having both tests in the context of routine gynecologic care and to identify personal and psychosocial factors that influence their interest and behavioral intentions. Specifically, we proposed the following research question:

What are pregnancy capable individuals' perceptions of having CPT and ECS during routine gynecologic care?

2. Materials and Methods

2.1 Procedure

We conducted semi-structured in-depth interviews between July 2021 and January 2022 with pregnancy capable individuals in the U.S., aged between 20 and 35 years, who spoke English, were not pregnant at the time of data collection, were not diagnosed with cancer, and had not had previous genetic counseling or testing related to carrier screening or hereditary cancer. We purposively recruited individuals with no prior experience with carrier screening or hereditary cancer testing because we were particularly interested in these individuals' perceptions as patients who might be offered this type of testing in the future. Eligible participants were identified by a clinical research coordinator through the Department of Obstetrics and Gynecology at an academic

health center in the Mountain West of the U.S. They were then contacted by a research assistant in-person or via email or electronic patient portal based on their preference. An interview guide (Appendix A) was developed building upon prior research regarding pregnancy capable individuals' interest in genetic testing. Each participant provided verbal consent at the beginning of the interview and were presented brief background information about CPT and ECS (e.g., purpose of the tests). Then, open-ended questions were asked about participants' perceptions of each type of genetic testing, followed by questions addressing participants' interest (or lack thereof) in pursuing both tests as well as the reasons for their interest or disinterest. The second and third authors conducted the interviews, during which they asked follow-up or clarifying questions to elicit more information when needed. Participants were allowed to choose if they would like to have an in-person or virtual interview. In total, 26 women participated in the interviews and received a $25 incentive for their participation. Each interview lasted for about 30 minutes. Field notes were taken during the interviews. After 26 interviews, the study team assessed saturation of themes to have been reached [22, 23]. All interviews were audio recorded and transcribed verbatim.

2.2 Ethics Statement

This study protocol was reviewed and approved by the Institutional Review Board at the University of Utah (IRB_00140546). The study was approved with a waiver of documentation of informed consent. Participants reviewed an approved consent cover letter and provided verbal consent prior to participation.

2.3 Data Analysis

The first three authors applied thematic analysis methods to analyze the data using Dedoose [24]. All coders had extensive training in qualitative research methods and had research expertise in health communication about genetic counseling and testing. During the time of data analysis, the first author was a postdoctoral research fellow at the academic health center; the second author was a doctoral candidate in communication; the third author was a study coordinator. We acknowledged that our job roles and academic training background might to some extent influence how we interpreted and made sense of the qualitative data. Each coder first read through the transcripts thoroughly and discussed their initial impressions about the data. Then, all coders separately coded five randomly selected transcripts and generated lists of initial codes. Coders held three meetings to discuss these initial codes and to develop an initial codebook. In the third step, all three coders independently coded three randomly selected transcripts by using the initial codebook. Initial calculated inter-coder reliability was relatively low (Krippendorff's $\alpha = 0.55$). Thus, coders engaged in extensive discussions to resolve discrepancies and modify the codebook [25]. At each stage of the data analysis, the fourth and fifth authors, who were a cancer genetic counselor and a professor in communication respectively, provided feedback to further refine the codebook. One transcript was then randomly selected to allow coders to independently apply the updated codebook, resulting in acceptable agreement (Krippendorff's $\alpha = 0.85$). Lastly, each coder applied the finalized codebook to independently code the remaining transcripts. After coding all transcripts, the team engaged in extensive discussions to consolidate the codes into overarching themes. In the next section, themes are presented to address the research question. Appendix B included the list of consolidated criteria for reporting qualitative studies (COREQ) [26].

3. Results

3.1 Participant Characteristics

Participants had a median age of 28 years old (range = 20-35). Most participants were White (n = 17, 65.4%), non-Hispanic (n = 18, 69.2%), had a college degree or higher (n = 17, 65.4%), and resided in urban areas (n = 22, 75.9%). Most participants did not have biological children (n = 19, 73.1%). About half of the participants did not plan to become pregnant in the next year (n = 13, 50%), whereas nine participants (34.6%) planned for pregnancy and four (15.4%) were not sure. As a part of the thematic analysis, we coded the degree to which participants were interested in CPT and ECS as well as the timing of each testing. Most participants expressed strong interest in CPT and ECS and would be willing to have the tests in the next year if made available to them (Table 1).

Table 1 Frequency of participant reported interest in CPT and ECS.

	Not interested n (%)	**Unsure n (%)**	**Somewhat interested n (%)**	**Interested n (%)**
"How interested would you be in receiving cancer genetic testing as part of a routine appointment with your gynecologist?"	2 (8%)	0 (0%)	1 (4%)	23 (88%)
"How interested would you be in receiving cancer genetic testing in the next year?"	0 (0%)	0 (0%)	1 (4%)	25 (96%)
"How interested would you be in receiving this carrier testing as part of a routine appointment with your gynecologist?"	1 (4%)	2 (8%)	0 (0%)	23 (88%)
"How interested would you be in carrier testing in the next year?"	4 (15%)	0 (0%)	1 (4%)	21 (81%)

3.2 Qualitative Themes

Thematic analysis indicated that there are both common and specific factors related to respondents' interest in CPT and ECS. Thus, we reported these categories of factors separately. Themes and associated exemplar quotes are presented below and in Table 2.

Table 2 Themes and example quotes from participants.

Theme	**Example quote**
Common factors related to women's interest in CPT and ECS	
Illness prevention and preparation	Participant 2: "I just think with all of the people in my life who have been passing away and losing their loved ones and things like that, I would like to probably be more prepared and just always know. If I could be more prepared in any way for myself and for my spouse and for my children, I think that's just something I would prefer to do."

Uncertainty management	Participant 9: "It would be potentially quite scary, especially knowing that not everything is set in stone at that point. It's all just a chance. I think for me it wouldn't mentally put me at the most peace of mind, unless everything was super green light where no results came up versus if results came up. I think it would be important to know you don't want to—I would never want to create a scenario for my kid that would be harmful or adverse and more stress in our life, but at the same time, I would want to put blinders up not knowing too."
Family members' health and support	Participant 2: "I have children, and so I think it's important to have the world set up for them… If I were able to know that I had this marker for cancer and there was a way to treat it, or if there wasn't a way to treat it, then I feel like I would be able to get things in line to be able to have them okay for my child to continue in life and prepare them. I think that would be important."
Concerns about logistics, testing procedures, and legal implications	Participant 17: "With how medical insurance is in the US right now, I probably wouldn't just because they would find some sort of clause that they could slip into it to be able to get that information and not cover certain things or raise premiums because you had this genetic thing."
Women's own health and demographics	Participant 14: "Yeah, I think it goes back to my age right now. As I grow older, I'm realizing how important it is to take care of yourself, the younger that you are just seeing from my parents, my grandparents and myself right now, things that I didn't do when I was younger. I'm saying, well I might have not done them before, but I can still start."
Specific factors related to women's interest in CPT	
Cancer prevalence and relevance	Participant 3: "It's something that's pretty relevant to me because I do have a lot of family members on my maternal side. They have all had and/or died of a certain type of cancer and then so my aunts have undergone genetic screening. At this point, I am not able to undergo it because my immediate aunts haven't had the cancer yet, if that makes sense."
Cancer prevention and preparation	Participant 13: "I don't want to die. I don't want to go through cancer treatment. It sounds miserable. Yeah. If I could prevent being sick and having to go through cancer, I would."

Specific factors related to women's interest in ECS	
Family planning needs	Participant 25: "Me personally, no, because I'm not planning on having children."
Knowledge and awareness about children's health	Participant 4: "I think that it would be meaningful in that information is key. Understanding what type of a life a child could have with a genetic predisposition or genetic risks would help us understand, and help us make a decision whether or not to procreate."
Decision making about pregnancy	Participant 15: "If I knew that I had a higher chance of having a child with cystic fibrosis, I don't necessarily think that would prevent me from choosing to have kids, but that it would just help me mentally prepare and be ready if my child was born with that disease… I think I would just—I would be in a better position to handle that rather than knowing I had the chance to know and then my child was born and I was like, oh, I wasn't even—I don't even know how to emotionally wrap my head around this new concept."

3.2.1 Common Factors Related to Women's Interest in CPT and ECS

Illness Prevention and Preparation. The benefit of genetic testing for illness prevention and preparation was reported as one of the most prominent factors that affected individuals' interest in both CPT and ECS. Participants commented that to have CPT and ECS meant that they would be able to "mentally prepare for challenges," to be "more engaged in making sure that there is that screening happening at the right cadence," and that they would be their "own health advocate in terms of talking with doctors." Participant 14 typified this theme by saying "I think what I'd most want to learn is if there's anything abnormal so that I could start doing stuff now to make sure that I'm gonna have the best health I could possibly have."

Uncertainty Management. Participants noted that information offered by CPT and ECS would help them manage their uncertainty and "lessen some of the anxiety" about the onset of illness, as both tests can serve as a "confirmation" for their health status and give them "piece of mind." Participant 8 illustrated this point by saying that, "there is no information as too much information." Most participants felt that the knowledge and awareness gained from CPT and ECS would empower them to "make an informed decision" and to deal with health issues more effectively. Having genetic testing would help women to be more aware of their health and thus to feel a greater sense of control when making informed health care decisions. Participant 24 shared, "I think it's just like to avoid the surprise when you find out something that is not treatable… I think it would be better for me to know before I start having the symptoms or before I have all this."

Although most participants preferred more information from genetic testing, there were also participants who believed that knowing too much about their health would engender greater anxiety and stress as the information would make them "mentally struggle dealing with it."

Participant 9 stated, "I think there's a quality of life of not knowing, kind of being more in the moment. So that's why I would say somewhat interested."

Family Members' Health and Support. Participants noted that they were motivated to have both CPT and ECS as these tests could enable them to be more informative about their family members' health. Participant 2 expressed that "If I could be more prepared in any way for myself and for my spouse and for my children, I think that's just something I would prefer to do." Many participants shared that they would share their genetic test results with family members to ensure that they "know that these tests are available" and are "on the same page about all of it."

Additionally, some participants mentioned partner support as being an important factor influencing their decisions about having both CPT and ECS. Participant 8 shared, "I think the only thing that would make me less interested is if my husband didn't want me to, or he didn't want to find out. I think that would weigh maybe that emotion piece of it." Particularly for ECS, partner's willingness to get tested was a crucial factor influencing women's interest in ECS: "We would both be willing to do it if I find that variant in my gene information then we will want my husband to do it too to make sure that our kid is safe." (Participant 24).

Concerns about Logistics, Testing Procedures, and Legal Implications. For many participants, concerns about logistics, testing procedures, and legal implications of genetic test results were main barriers to their interest in having CPT and ECS. Although genetic testing is likely to be covered by insurance when individuals meet testing criteria, cost is seen as a "mitigating factor," as some believed that "genetic testing is not covered by insurance and just having to pay for that out of pocket" (Participant 6). Relatedly, they also had concerns over the implications of genetic test results for insurance eligibility. For example, Participant 17 was worried about "if insurance knew the results" and had "the whole concern of privacy and profiting off of people's suffering."

Besides cost and insurance, some respondents also felt unease about how the health care system would use their genetic information. Participant 26 expressed her concern that "It would make me less interested if the hospital or doctors or scientists are using it for their own benefit." However, other participants had greater trust in genetic testing offered by health care providers compared to that from direct-to-consumer genetic services. Participant 3 shared that she doesn't have privacy concerns "if it was done through a physician where I can count on HIPAA and everything like that to protect that information."

Additionally, a few participants reported that they had insufficient understanding about the typical procedure of genetic testing, which might diminish their interest in CPT and ECS. For example, Participant 22 had concerns over what genetic testing involves: "I would like to know, like, what it involved, like do we take blood?... Is it part of a pap smear? What's the process of the genetic testing? Is there any side effects…"

Demographic Characteristics and Health Status. Lastly, participants shared that their own health status and demographic characteristics (e.g., age, sex) affected their interest in CPT and ECS. Age was commonly described as influencing pregnancy capable individuals' preferences for both CPT and ECS. Participant 10 shared that she would be interested in knowing carrier information as "I feel like I am at that age where in the next few years I'll probably want to have kids."

Concerns about illnesses salient to women also increased participants' intention to have genetic testing. For example, Participant 18 indicated that she has "pretty serious issues with uterus and

ovaries" so that she would want to find out more about uterine or ovarian cancer. Additionally, unique life experiences also triggered some respondents' interest in genetic testing. Participant 23 shared that "my mom is adopted, and we don't know much about genetics, and what we could possibly carry. Learning absolutely anything would be beneficial to me."

3.2.2 Specific Factors Related to Interest in CPT

Besides common factors that influenced participants' interest in CPT and ECS, our analysis also yielded several specific factors that were described as affecting their interest in CPT or ECS separately. For CPT, these factors were related to perceptions of cancer.

Cancer Prevalence and Relevance. Participants noted that the prevalence of cancer in their family and friends as well as their family history of cancer would prompt them to be interested in CPT. Participant 8 shared that "I think it's a very well-known thing, and I know for me it does run high in my family, so it'd be something that I do want to know if this is something that runs in me." When asked about relative importance of the tests, some participants preferred CPT to ECS as they felt that cancer was more of a pressing concern to them at present, as illustrated by Participant 5: "the cancer testing seems more relevant to me and my health versus some hypothetical situation at this point."

Cancer Prevention and Preparation. Additionally, participants expressed that information gathered from CPT would encourage them to take actions to prevent cancer or to plan for cancer. Participant 24 stated, "it'll kind of bring me to an alert mode and it would be very helpful to have that information and it would mean that I would definitely—take control for the situation that would—that would bring a lot of peace of mind." However, some participants held hesitance toward CPT as they were not sure if the information was accurate. Participant 20 shared that "I would be interested, but it would be scary, because I don't know if it's accurate or not, but I think it would be nice to know before I'd get the cancer, to prevent it."

3.2.3 Specific Factors Related to Interest in ECS

Family Planning Needs. The first specific factor that influenced participants' interest in ECS was their family planning needs. Most participants shared that their conception status took precedence as they decided whether to have ECS or not. Participant 1 said, "It's a hard question because I'm not sure if I want kids and so part of me would be like, 'Oh, it doesn't matter.' If I'm not gonna have kids, then I don't care to get tested. If I ended up deciding on that then I would definitely want to know those things." This factor was also discussed by Participant 26, who said, "Since I'm not actively planning to be a parent, that really doesn't relate to me at the moment."

Knowledge and Awareness about Children's Health. Participants also reported that the desire to be more aware about their children's health and to know more about any genetic mutations that would affect their children motivated them to be interested in ECS. For example, Participant 23 said, "We just wanna ensure the health of our children. I would love to know that even if it doesn't affect my health but affects my children. I don't think anything would make me less interested in knowing the health of my kids."

Informed Reproductive Decision Making. Lastly, participants shared that ECS could assist with their informed decision making about pregnancy. When asked if they would prefer to have ECS before or during pregnancy, most participants shared that they would prefer to have it before pregnancy, which could strengthen their reproductive autonomy and enable them to make informed decisions about pregnancy. Participant 8 stated, "Because I am the type of person that if I found out later, after the pregnancy or even during the pregnancy I just know my emotions well enough that it would hit me different… Yeah, 100 percent I would want to know in the beginning." Similarly, Participant 19 shared that having ECS pre-pregnancy would make her "mentally a lot calmer and not so stressed" and reassure her that her kids will be "completely safe and healthy." Participant 13 expressed that if she and her partner both had the same gene, she might decide not to have kids: "I think almost the humane thing to do would not to have that child if they were going to suffer or not live a good life and not live a life that a kid should have."

4. Discussion

This qualitative study aimed to obtain insights into factors affecting interest or disinterest in undergoing CPT and ECS among pregnancy capable individuals. These findings contribute to the literature about pre-pregnancy genetic testing in two important ways. First, pregnancy capable individuals' perceptions of receiving multiple types of testing and their preferences of when to have the testing have been understudied, and our study offered individuals' personal accounts to address this gap. According to current clinical practices, CPT is generally not offered as a part of routine gynecologic care and ECS is more commonly offered during pregnancy than pre-pregnancy. Participants in our study expressed strong interest in having CPT and ECS pre-pregnancy, providing empirical support for the potential integration of CPT and ECS into routine gynecologic care. Second, we identified common factors affecting pregnancy capable individuals' interest in CPT and ECS and compared specific factors associated with their interest in each test, offering a nuanced perspective to informing genetic testing during routine gynecologic care visits for individuals of reproductive age and highlighting the need to provide them with pre-test education about the tests.

We found several personal and psychological factors that participants described as affecting their interest in CPT and ECS, including concerns about illness prevention and preparation, uncertainty management, family members' health and support, and worries about cost, logistics, and privacy. These identified factors affecting pregnancy capable individuals' acceptance of CPT and ECS are in concordance with previous research that investigated the public opinions about genetic testing [27]. Our data suggested that both CPT and ECS could help participants manage uncertainty associated with illness and pregnancy through acquiring genetic risk information. However, some experienced dilemmas of wanting to have more genetic information and worrying about the inherent uncertainty associated with such information. Due to this concern, they might choose to decline genetic testing as they believed more information would not necessarily help reduce uncertainty but inadvertently increase their anxiety. This finding is consistent with previous research that examined how concerns about heightened anxiety and worry resulting from genetic screening may turn away potential ECS and CPT recipients [28-30]. Thus, health care providers who offer CPT or ECS to women should respect their personal preferences and acknowledge their varying perceptions of uncertainty and capacity to cope with it [3, 31].

We found that perceived family support is an important factor influencing women's interest in receiving CPT and ECS, especially for ECS, as couples need to engage in joint decision-making to act upon ECS results. These findings corroborate with extant literature highlighting partner resistance being one major obstacle for women to undergo pre-pregnancy ECS [28, 32]. Additionally, participants' accounts in this study help contextualize quantitative evidence from previous research regarding pregnancy capable individuals' concerns associated with cost, insurance coverage, privacy, and legal implications of testing as barriers to having CPT and ECS [33]. Thus, systemic support, such as educational materials being offered at routine gynecologic visits, should be developed to help relieve these concerns [34]. Given that some participants reported trust in information about CPT and ECS acquired from health care providers, especially their gynecologists, offering education and genetic testing through an ongoing patient-clinician relationship as part of routine care may also help to allay concerns about testing.

We also identified several specific factors affecting individuals' interest in having either CPT or ECS. Consistent with extant research [28, 35], reproduction needs emerged as a major reason for having ECS for individuals of reproductive age, and knowledge and awareness of children's health obtained from ECS was a key motivator for having ECS. Our findings added further evidence that pregnancy capable individuals preferred to elect ECS pre-pregnancy than during pregnancy, although some of them were not aware of the relevance of ECS if not actively planning for pregnancy. Future research should expand on this to further investigate individuals' preferences for the timing of ECS as it relates to their age, life stage, and pregnancy plans given that this information will help inform and optimize the clinical implementation of population-based ECS. Since ECS is not universally offered pre-pregnancy despite clinical recommendations, these findings suggest that it may reach to a broader population of pregnancy capable individuals if ECS was offered during routine gynecologic care visits, as pre-pregnancy is a more feasible and preferred time window to address women's reproduction concerns and enhance their reproductive choices than during pregnancy [36]. Again, it should also be noted that participants who were not planning for pregnancy were less sure about the relevance of ECS. Similarly, consistent with previous research suggesting that perceived cancer risks might heighten Ashkenazi Jewish individuals' interest in having *BRCA1/2* testing during reproductive career screening [12], we found that pregnancy capable individuals' interest in CPT was greater among those who had family history of cancer. While there is potential for synergy in developing interventions to offer both tests, it is also important that these interventions allow patients to make decisions independently about each type of testing.

As for the practical implications of the findings, educational programs about genetic testing incorporating CPT and ECS during routine gynecologic care visits should be developed to address individuals' concerns and misperceptions about testing. As suggested by the findings, materials should be developed providing information about cost, privacy, discrimination, and legal implications of genetic test results, as well as testing procedure and clinical implications. Further education would be helpful in aiding pregnancy capable individuals to make informed decisions about whether testing is appropriate for them. Sufficient systemic (e.g., pre-test education and post-test counseling) and financial (e.g., insurance coverage) support as well as involving family members, particularly partners, in the counseling process will be beneficial to help pregnancy capable individuals navigate testing options and address feelings of anxiety. Lastly, given that individuals vary in their uncertainty management preferences, family planning needs, and concerns

about privacy and logistics, health care providers should respect their personal values and beliefs to facilitate their informed decision making about pre-pregnancy genetic testing.

4.1 Study Limitations

Although our findings provide insights into pregnancy capable individuals' perceptions of CPT and ECS if being offered during pre-pregnancy, they should be interpreted considering several limitations. First, participants did not have prior experience with genetic counseling or testing. Future research could compare the perceptions about having ECS and CPT in routine gynecologic visits of individuals who already had these types of genetic testing. Second, all participants were recruited from a single academic health center site and the diversity of their demographic backgrounds was limited. All participants were presumed to be cis-gender women, and the findings may not be generalized to individuals who self-identify with other genders but receive gynecologic care. Third, not all participants were planning for pregnancy at the time of the interview, which may affect their perceptions of and interest in ECS. Fourth, although we emphasized that there were no right or wrong answers at the beginning of each interview, social desirability biases could have affected participants' responses to questions pertaining to reasons for their interest in CPT and ECS. This limitation may be manifested in the literature showing that despite reported evidence of women's acceptability of and interest in pre-pregnancy genetic testing, actual uptake rate remains lower than prenatal testing [14]. Future research should further examine structural and individual constraints to the implementation of CPT and ECS in routine gynecologic care.

5. Conclusions

In conclusion, we identified common and specific factors affecting pregnancy capable individuals' interest in electing CPT and ECS as part of routine gynecologic care. These factors encompassed individuals' illness prevention and preparation, uncertainty management, perceptions of their own and family members' health, concerns over cost, privacy, and discrimination, and specific considerations about cancer prevention and reproductive decision making. Our findings add novel evidence to the potential of offering both CPT and ECS during routine gynecologic care visits and support development of educational tools to address the informational needs for CPT and ECS of pregnancy capable individuals.

Author Contributions

Concept and design: WK, KAK. *Data acquisition, analysis, and interpretation:* LZ, MAK, BMD. *Drafting of the manuscript:* LZ. *Critical revision of the manuscript for important intellectual content:* All authors. *Funding acquisition:* WK, KAK. *Supervision:* WK, KAK. Author LZ confirms that she had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All of the authors gave final approval of this version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding

We acknowledge support of funds in conjunction with grant P30CA042014 awarded to Huntsman Cancer Institute and to the Cancer Control and Population Sciences Program at Huntsman Cancer Institute.

Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

The data used in this study are available upon request from the corresponding author.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Appendix A: Semi-structured interview guide.
2. Appendix B: COREQ checklist.

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