Discussing Risks of Assisted Reproductive Technology: Current Practices in Genetic Counseling

Master’s Thesis

Presented to

The Faculty of the Graduate School of Arts and Sciences
Brandeis University
Graduate Program in Genetic Counseling
Gretchen H. Schneider, MS, CGC, Advisor

In Partial Fulfillment
of the Requirements for

Master’s Degree

by
Kayla Flamenbaum

May 2013
ACKNOWLEDGEMENTS

I would like to extend a heartfelt thanks to my primary advisor, Gretchen Schneider, for her continuous support, encouragement and feedback. Thank you also to my committee members, Diane Myles Reid and Dana Neitzel for bringing their invaluable expertise and perspective to this project. Additional thanks to Dr. Liz Cross for her help with the survey design, Dr. Ted Cross for his assistance with statistical analysis and genetic counselor participants for sharing their knowledge and insight.

I would also like to acknowledge the Brandeis University Genetic Counseling Program and its amazing faculty, including Judith Tsipis, Beth Rosen-Sheidley, and Missy Goldberg. Finally, to my classmates, family, friends and boyfriend, I am forever grateful for your endless support and love and could not have completed this project without you.

This project was funded through a grant from the Brandeis University Graduate School of Art’s and Sciences Master’s Research Fund.
ABSTRACT

Discussing Risks of Assisted Reproductive Technology: Current Practices in Genetic Counseling

A thesis presented to the Graduate Program in Genetic Counseling

Graduate School of Arts and Sciences
Brandeis University
Waltham, Massachusetts

By Kayla Flamenbaum

Approximately one percent of all infants born in the United States every year are conceived using assisted reproductive technology (ART). Although some risks associated with ART have been established, other potential risks are not yet fully understood. The purpose of this study was to ascertain what genetic counselors are communicating to patients regarding ART-related risks. We recruited 161 genetic counselors through NSGC and CAGC e-mail lists for participation in an online, anonymous survey. There was considerable variability in how often genetic counselors, even from the same practice area, discussed any risks of ART. Overall, participants who worked in prenatal or ART settings reported that they discussed the risks of ART significantly more often than participants from cancer, pediatric, adult or specialty clinics. In accordance with published guidelines, participants in all practice areas were more likely to initiate discussions about multiple gestation, congenital structural abnormalities and
chromosome abnormalities. However, participants were also more likely to bring up risks of imprinting disorders, despite a lack of conclusive data regarding this risk and less likely to bring up obstetrical and perinatal complications even though these risks have been well-established. According to participant responses, there was no significant difference between the overall frequency that patients in different practice areas asked about any risks of ART. There was variation, however, regarding how often patients in different practice areas asked about specific risks of ART. Patients reportedly asked about risks to the mother’s long-term health more frequently in adult/pediatric/cancer/specialty clinic settings than in prenatal/ART settings, but were more likely to ask about congenital structural abnormalities and multiple gestation in prenatal/ART settings. These findings suggest a need for genetic counselors in different practice areas to increasingly provide patients with consistent and up-to-date information regarding the risks of ART that is also reflective of their patients’ concerns.
# TABLE OF CONTENTS

- Introduction ......................................................................................... 1
- Methods ............................................................................................... 5
- Results ................................................................................................. 7
- Discussion ............................................................................................ 16
- Conclusion .......................................................................................... 24
- References ........................................................................................... 26
- Appendices .......................................................................................... 29
LIST OF TABLES

Table 1……………………………………………………………….…………..11

Free-text responses of information provided to pre-conception and post-conception patients regarding the association between ART and congenital structural abnormalities
LIST OF FIGURES

Figure 1…………………………………………………………………………………………...8

Reported frequencies of percentages of ART discussions during which
IVF/PGD, prenatal, adult, pediatric and cancer participants provided
information about associated risks

Figure 2………………………………………………………………………………………….10

Mean Likert scale responses describing how often participants reported
bringing up each of the above risks in ART/prenatal and
adult/cancer/pediatric genetic counseling sessions

Figure 3………………………………………………………………………………………….13

Mean Likert scale responses describing how often participants reported
patients asking about each of the above risks in ART/prenatal and
adult/cancer/pediatric genetic counseling sessions

Figure 4…………………………………………………………………………………………..14

Mean Likert scale responses describing how prepared participants felt
about discussing each of the above risks in ART/prenatal and
cancer/adult/pediatric genetic counseling sessions
INTRODUCTION

The first successful pregnancy conceived through assisted reproductive technology (ART) came to term in 1978. Since then, the use of ART has increased dramatically and has resulted in an estimated five million births worldwide (ESHRE, 2012). According to the American Society for Reproductive Medicine (2004), ART includes all procedures involving the handling of human oocytes and sperm, or embryos, with the intent of establishing a pregnancy. Typically, ART involves surgically removing eggs from a woman’s ovaries, combining them with sperm in the laboratory, and transferring resulting embryos into the woman’s uterus. This procedure, known as in vitro fertilization (IVF), can occur with or without intracytoplasmic sperm injection (ICSI), where a single sperm is injected directly into each mature egg. ICSI is performed in approximately 60% of ART procedures in the United States in order to increase the chance of successful fertilization (ASRM, 2011). Most ART cycles help infertile couples, single individuals or lesbian, gay and transgender couples to have biological children. However, couples or individuals at an increased risk of having a child with a genetic condition or chromosomal disorder may also seek out IVF +/- ICSI with preimplantation genetic diagnosis (PGD), which involves testing cell(s) removed from an oocyte, early cleavage-stage embryo or blastocyst prior to transfer in order to establish an unaffected pregnancy (ASRM, 2008).

Although complications following ART are rare, there are risks associated with
this technology (ACOG 2005). One well-established outcome of ART is an increased incidence of multiple gestation (ASRM, 2012; ACOG, 2006; Wright et al., 2009). In 2005, 49% of infants conceived through ART in the United States were born in multiple-birth deliveries, a frequency 15- to 20-fold greater than with spontaneous conceptions (Pinborg 2005, Wright et al., 2009). The obstetrical and perinatal risks associated with multiple gestation include higher rates of preeclampsia, gestational diabetes, preterm delivery, operative delivery, perinatal mortality and low birth weight (ASRM, 2012; Pinborg, 2005). Although single embryo transfer can reduce the risk of multiple gestation following ART, this strategy only accounts for approximately 15% of ART cycles (CDC, 2010).

Singleton pregnancies conceived through IVF and IVF-ICSI are also at an increased risk of obstetrical complications, including gestation hypertension, gestational diabetes, placenta previa and placental abruption (Jackson et al., 2004). Furthermore, retrospective and prospective studies indicate an increased risk of preterm delivery, low birth weight, NICU admission and perinatal mortality in singleton pregnancies conceived through ART (Jackson et al., 2004; Helmerhorst, et al., 2004; Schieve et al., 2004). It is currently unclear whether these increased risks are mostly attributable to the use of ART or to factors associated with the underlying infertility (ACOG, 2005).

Numerous studies have evaluated the association between ART and congenital structural abnormalities. However, there is a wide range of risk estimates reported in the literature. Registry data from the Netherlands did not demonstrate an increased incidence of birth defects in IVF pregnancies (Anthony et al., 2002) while data from a Western Australia registry identified major birth defects in pregnancies following IVF (9.0%) and
IVF-ICSI (8.6%) that was significantly increased compared with spontaneous conceptions (Hansen et al., 2002). Similarly, three meta-analyses, which combined results from a number of studies, revealed a significant increase in birth defects in children conceived by IVF or IVF-ICSI (Wen et al., 2012; Hansen et al., 2005; Klemetti et al., 2005). Specific birth defects that have been most strongly associated with ART include urogenital anomalies, musculoskeletal defects and cardiovascular defects (Reefhuis et al., 2009; Davies et al., 2012).

A recent Australian population-wide cohort study compared the incidence of birth defects among pregnancies conceived through ART and among spontaneous pregnancies, conceived both in women with and without a history of infertility. The unadjusted incidence of any birth defect in pregnancies involving ART (8.3%) was increased compared to spontaneous pregnancies (5.8%). However, when researchers adjusted for patient factors (e.g., maternal age, parity, fetal sex, maternal race/ethnicity) only the increased incidence of birth defects associated with IVF-ICSI remained significant. Additionally, a history of infertility was associated with an increased incidence of birth defects in both pregnancies conceived spontaneously and through ART (Davies et al., 2012).

Researchers are currently investigating a number of additional risks potentially associated with ART. There appears to be an increased likelihood of de novo chromosome abnormalities in pregnancies conceived through IVF with ICSI, but further research needs to better determine the etiology and extent of this risk (Van Steirteghem, et al., 2002). Studies published thus far have not identified ART as an independent risk factor for adverse neurodevelopmental outcomes, such as autism spectrum disorders.
(Koivurova et al., 2003; Place and Englert, 2003; Schieve et al., 2004). However, due to methodological limitations, research assessing these risks has only been able to provide preliminary information. Animal, in-vitro and case-control studies have also suggested a possible association between ART and imprinting disorders, such as Beckwith Wiedemann syndrome (BWS) and Angelman’s syndrome (Cox et al., 2002; Halliday et al., 2004). Data thus far has been inconclusive, however, due to small case sample sizes. Finally, concerns have been raised about the potential for ART to have long-term and non-pregnancy related effects on the mother’s health (e.g. an increased risk of cancer, diabetes), but, to date, no studies have provided evidence for this association.

It is not uncommon for genetic counselors in prenatal and ART clinics to work with patients who are either considering ART or who have conceived using ART. Additionally, as the use of preimplantation diagnosis (PGD) has become more prevalent, genetic counselors in all practice areas have been increasingly discussing ART with patients. While numerous studies have assessed pregnancy outcomes associated with ART, there is currently no literature reporting what risks health care providers are discussing with patients, specifically within the genetic counseling setting. The study described here used an online survey to ascertain what genetic counselors are communicating to patients regarding both the well-established and potential risks of ART as well as the risks that patients are asking about most often. By characterizing these conversations, we sought to assess whether patients seen in different practice areas are receiving consistent and up-to-date information about that is also reflective of their own concerns regarding these risks.
METHODS

Study design

This study consisted of an online survey (Appendix A) that asked genetic counselors about conversations they have had with patients regarding the risks of ART. We surveyed participants who saw patients primarily in a prenatal, IVF or PGD setting about their ART-related discussions with patients both considering the procedure (pre-conception patients) and in a pregnancy conceived through ART (post-conception patients). However, participants who saw patients primarily in an adult, cancer, pediatric or specialty clinic setting only answered questions about their ART-related discussions with pre-conception patients.

The seven risks investigated in this survey were based on those cited frequently in the recent literature (ACOG, 2005; SOGC, 2006; Reddy et al., 2007) and included risks of: i) multiple gestation, ii) adverse perinatal and obstetrical outcomes, iii) imprinting disorders, iv) congenital structural abnormalities, v) de novo chromosome abnormalities, vi) abnormal childhood growth and development and vii) maternal long-term health problems (eg cancer, diabetes). Using Likert scales, we asked participants to rate how often they initiated discussions about these risks of ART, how often patients asked about these risks, how prepared they felt to discuss these risks and how challenging they felt it was to provide information to patients about these risks. Based on conflicting data in the literature regarding the association between structural congenital abnormalities and ART, we also used open-ended questions to explore discussions about this particular risk in
more detail. Finally, we asked participants to indicate which resources they have used to obtain up-to-date information regarding ART-related risks and which additional resources would be helpful in providing further guidance on how to discuss the risks of ART.

**Participant recruitment and data collection**

The Institutional Review Board (IRB) at Brandeis University approved the study protocol. We distributed an electronic recruitment notice (Appendix B) through the National Society of Genetic Counselors (NSGC) and Canadian Association of Genetic Counsellors (CAGC) e-mail lists. Genetic counselors who discussed ART with patients in any clinical setting were eligible to participate in the study. We collected survey responses for a total of six weeks using an anonymous, web-based survey, designed and administered through Qualtrics.

**Data analysis**

We analyzed quantitative data with IBM SPSS 19.0.0 and used a thematic approach to analyze qualitative data. For comparative analyses, we divided participants into two groups based on their practice areas. Participants in the “prenatal/ART” group were those who indicated that they discussed ART primarily in a prenatal, IVF or PGD setting. We placed participants who indicated that they discussed ART primarily in an adult, cancer, pediatric or specialty clinic setting in the “adult/pediatric/cancer/ specialty clinic” group. Additionally, for the “prenatal/ART” group, we compared ART discussions in pre-conception versus post-conception sessions.
RESULTS

**Participant demographics**

There were 161 survey respondents, the vast majority of whom were female (97.5%) and practiced in the United States or Canada (98.1%). More than half of the participants (51.6%) reported having between 2-10 years of genetic counseling experience, while 26.7% had greater than 10 years and 21.7% had less than two years. Participants discussed ART in six different clinical settings: prenatal (53.4%), cancer (15.5%), IVF and/or PGD (14.3%), pediatric (8.7%), adult (5.0%) and specialty clinics (3.1%). The majority of prenatal/ART participants discussed ART in both pre-conception and post-conception sessions (62.8%). The remaining prenatal/ART participants only discussed ART in either pre-conception (29.2%) or post-conception (8.0%) sessions.

**Discussions about ART and associated risks**

Almost half of all participants discussed ART with patients 1-3 times per month (46.6%), while 32.9% discussed ART less than once per month and 20.5% discussed ART at least once a week. Prenatal/ART participants discussed ART with patients more often than participants from adult/pediatric/cancer/specialty clinics (t=3.5, p=0.001). We asked participants to indicate the percentage of their ART-related discussions in which they included information about any of the risks associated with ART. Figure 1 summarizes the distribution of responses in ART, prenatal, adult, pediatric and cancer settings. On average, participants reported that they provided information about any risks of ART in 55.3% of their discussions with patients (N=136). However, this mean
percentage increased from the cancer group (31.1% ± 8.8%) to the pediatric (42.9%, ± 12.9), adult (60.0% ± 12.9), prenatal (60.6%, ± 4.1), and IVF/PGD group (78.3%, ± 6.5) group, in that order. Tukey post-hoc analysis revealed that the increase of 29.53% from the cancer to prenatal group was statistically significant (p=0.038) as well as the increase of 47.2% from the cancer to IVF/PGD group (p=0.001). Within the prenatal/ART group, there was no significant difference between the mean percent of ART discussions that included information about associated risks in pre-conception (mean = 64.1%) versus post-conception sessions (mean=60.2%).

**Figure 1.** Reported frequencies of percentages of ART-related discussions during which IVF/PGD, prenatal, adult, pediatric and cancer participants provided information about any associated risks
Specific risks brought up by participants

We asked participants to indicate how often they initiated discussions about individual ART-related risks according to the following 5-point Likert scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always. Figure 2 illustrates the mean Likert scale response for each risk of ART in prenatal/ART (pre-conception), prenatal/ART (post-conception) and adult/pediatric/cancer genetic counseling settings. Participants in all practice areas were more likely to initiate discussions about multiple gestation (Likert mean = 3.3), congenital structural abnormalities (Likert mean = 3.01), chromosome abnormalities (Likert mean = 3.0) and imprinting disorders (Likert mean = 2.76). Participants were less likely to initiate discussions about obstetrical and perinatal complications (Likert mean = 2.05), risks to the mother’s long-term health (Likert mean = 2.04) and risks to childhood growth and development (Likert mean = 1.99).

There was a significant difference between the overall mean frequency that prenatal/ART participants and adult/pediatric/cancer participants initiated discussions about ART risks (t = 2.9, p = 0.005). As illustrated in Figure 2, prenatal/ART participants initiated discussions about all of the risks more often than participants in adult/pediatric/cancer settings. Prenatal/ART participants brought up the risks of perinatal and obstetrical complications more often in pre-conception than in post-conception sessions (t = 3.31, p = 0.002). However, there was no significant difference between how often prenatal/ART participants initiated discussions about the other six risks in pre-conception versus post-conception sessions.
Figure 2. Mean Likert scale responses describing how often participants reported bringing up each of the above risks in ART/prenatal and adult/cancer/pediatric genetic counseling sessions. Likert Scale Values: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always.

**Risks of congenital structural abnormalities**

We asked prenatal/ART participants who indicated that they discussed risks of congenital structural abnormalities to describe, in free-text format, what, if any, risk estimates they provided patients. Sixty-six participants answered this question of whom, eight (12.1%) indicated that they deferred to reproductive endocrinologists or ART specialists to discuss the specific risks of congenital structural abnormalities associated with ART. Information provided by the remaining respondents about the association between ART and congenital structural abnormalities is included in Table 1. The largest proportion of these respondents (39.7%) used a blanket statement such as “there may be an increased risk over the general population”, while nearly 30% provided specific risk estimates to their patients. Three participants reported informing patients that there is no association between ART and congenital structural abnormalities.
Table 1. Free-text responses of information provided to pre-conception and post-conception patients regarding the association between ART and congenital structural abnormalities

<table>
<thead>
<tr>
<th>Information Provided about Risks of Congenital Structural Abnormalities</th>
<th>Frequency (N=58)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precise risk unknown due to conflicting studies in medical literature</td>
<td>12</td>
<td>20.8</td>
</tr>
<tr>
<td>Blanket statement (i.e. there may be an increased risk over risk in general population)</td>
<td>23</td>
<td>39.7</td>
</tr>
<tr>
<td>There is no increased risk of congenital structural abnormalities</td>
<td>3</td>
<td>5.2</td>
</tr>
<tr>
<td>Only discuss risk if there is an abnormal ultrasound finding</td>
<td>3</td>
<td>5.2</td>
</tr>
<tr>
<td>Specific risk estimates provided:</td>
<td>17</td>
<td>29.3</td>
</tr>
<tr>
<td>30 - 40% increase over risk in general population</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>2.6-3.9% risk</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>4% risk</td>
<td>4</td>
<td>6.9</td>
</tr>
<tr>
<td>4-7% risk</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>4-11% risk</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>2- 3 fold increase over risk in general population</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>5-6 % risk</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>6-8% risk</td>
<td>5</td>
<td>8.6</td>
</tr>
<tr>
<td>9%</td>
<td>1</td>
<td>1.7</td>
</tr>
</tbody>
</table>

We also asked these participants (N=66) to describe, in free-text format, which, if any, specific congenital structural abnormalities they discussed with patients and what, if any, recommendations they made for patients who were pregnant as a result of ART. Twenty participants reported that they discussed specific congenital structural abnormalities with patients, with the majority (60.0%) indicating they only mentioned the risk of congenital heart defects. Seven participants (35.0%) discussed the risks of cardiac and urogenital abnormalities and one participant (5.0%) brought up the risks of heart
defects, cleft lip/palate and spina bifida. Of the twenty participants who outlined screening recommendations, almost half (45.0%) indicated that they recommended a fetal echocardiogram, six (30.0%) recommended a fetal anatomy scan and five (25.0%) recommended both a fetal anatomy scan and echocardiogram.

**Patient inquiries about risks associated with ART**

We asked participants to indicate how often patients inquired about individual ART-related risks according to the following 5-point Likert scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always. Figure 3 illustrates the mean Likert scale response for each risk of ART in the prenatal/ART (pre-conception), prenatal/ART (post-conception) and adult/pediatric/cancer counseling settings. Overall, participants reported that patients were more likely to ask about multiple gestation (Likert mean = 2.97), congenital structural abnormalities (Likert mean = 2.00), chromosome abnormalities (Likert mean = 1.84) and risks to the mother’s long-term health (Likert mean = 1.84). While there was no significant difference between the overall frequency that prenatal/ART patients versus adult/pediatric/cancer patients reportedly asked about the risks associated with ART (t=0.21, p=0.835), there were differences between how often patients in these practice areas asked about some of the specific ART-related risks. Patients reportedly asked about risks to their own long-term health more often in adult/pediatric/cancer settings than in prenatal/ART settings (t=4.15, p<0.0005), but asked about multiple gestation (t=3.34, p=0.001) and congenital structural abnormalities (t=1.99, p=0.049) more often in prenatal/ART settings. Furthermore, patients asked about risks to their own long-term health more often in cancer genetic counseling sessions than in any other practice area (t=2.10, p < 0.0005). There was no significant difference
between the overall frequency that prenatal/ART patients reportedly asked about the risks of ART in pre-conception versus post-conception sessions (t=1.81, p=0.08).

![Figure 3](image)

**Figure 3.** Mean Likert scale responses describing how often participants reported patients asking about each of the aboverisks in ART/prenatal and adult/cancer/pediatric genetic counseling sessions. Likert Scale Values: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always.

*Estimates of preparedness*

We asked participants to indicate how prepared they felt to discuss individual ART-related risks according to the following 5-point Likert scale: 1 = Very Prepared, 2 = Prepared, 3 = Somewhat prepared, 4 = A little bit prepared, 5 = Not at all prepared.

Figure 4 illustrates the mean Likert scale response for each risk of ART in the prenatal/ART (pre-conception), prenatal/ART (post-conception) and adult/pediatric/cancer genetic counseling settings. Of the seven risks assessed in this study, participants in all practice areas felt more prepared to discuss multiple gestation (Likert mean = 2.12), imprinting disorders (Likert mean =2.54), chromosome abnormalities (Likert mean = 2.67) and congenital structural abnormalities (Likert mean
Prenatal/ART participants felt more prepared to discuss the risks of ART than adult/pediatric/cancer participants ($t=2.28$, $p=0.025$), while there was no significant difference between how prepared prenatal/ART participants felt during pre-conception versus post-conception sessions. Additionally, we noted a positive correlation between how prepared participants felt to discuss ART-related risks and how often they brought up these risks ($r=0.38$, $p < 0.005$).

**Figure 4**. Mean Likert scale responses describing how prepared participants felt about discussing each of the above risks in ART/prenatal and cancer/adult/pediatric genetic counseling sessions. Likert Scale Values: 1 = Very Prepared, 2 =Prepared, 3 = Somewhat prepared, 4= A little bit prepared, 5 = Not at all prepared

**Challenges associated with ART risk discussions**

We asked participants to rate how challenging they felt it was to discuss the risks of ART with patients according to the following 5-point Likert scale: 1 = not at all challenging, 2 = a little bit challenging, 3 = neutral, 4 = challenging, 5 = extremely challenging. The majority of all participants (63.4%) were neutral or thought that discussing the risks of ART was a little bit challenging, while 28% thought that it was
challenging or extremely challenging and 8.5% thought that it was not challenging. Using Pearson’s correlation, we noted a negative correlation between how challenging participants felt it was to discuss ART-related risks and how often they provided information about these risks ($r = -0.3$, $p = 0.005$). There was no significant difference in perceived challenges of discussing the risks of ART between prenatal/ART participants versus adult/pediatric/cancer/specialty clinic participants or between prenatal/ART participants in pre-conception versus post-conception sessions.

**Provider resources**

We provided participants with a list of resources and asked them to indicate which ones they have used to obtain up-to-date information regarding ART-related risks. Of the 106 respondents, more than half indicated that they have consulted with genetic counselor colleagues (71.8%) or have referred to the medical literature (62.1%). Less than half of the respondents reported using the ACOG Committee Opinion (37.9%), the ASRM Fact Sheet (30.4%) or the SOGC guidelines (9.7%). Prenatal/ART participants reported using resources significantly more often than adult/pediatrics/cancer participants ($t=2.4$, $p = 0.02$). Additionally, we noted a positive correlation between the use of resources and how prepared participants felt to discuss the risks of ART ($r = 0.399$, $p < 0.0005$). We also asked participants to indicate which resources would help provide additional guidance on how to discuss the risks of ART. Of the 104 respondents, the majority indicated that a published guideline focused on discussing ART risks with patients (81.73%) and patient education materials (64.46%) would be the most valuable resources. Three participants (7.69%) indicated that no additional resources would be helpful.
DISCUSSION

Demographics

In 2012, there were 2700 full NSGC members, of whom 144 (5.3%) responded to our survey. The remaining seventeen survey respondents were CAGC members. Consistent with demographics reported in the NSGC 2012 Professional Status Survey (PSS), the majority of participants were female, worked in the United States or Canada and reported having less than 10 years experience. Compared with the NSGC membership as a whole, prenatal and ART genetic counselors were overrepresented in the present sample, while cancer, adult and pediatric genetic counselors were underrepresented. This is not surprising given that many prenatal and ART genetic counselors regularly discuss ART with patients and therefore may have been inclined to participate in this study. Likewise, the underrepresentation of cancer, adult and pediatrics in our cohort may be an indication that genetic counselors in these settings do not discuss ART with patients as frequently as prenatal /ART genetic counselors.

Variability in percentage of discussions that include information about risks of ART

Participants reported a wide range (from 0% to 100%) in the percentages of their ART discussions during which they provided patients with information about any ART-related risks. Prenatal/ART participants provided information about ART-related risks more often than participants from adult/pediatric/cancer/specialty clinics, likely because prenatal/ART genetic counselors typically discuss ART in more detail than genetic counselors who work in other practice areas. However, participants from the same
practice areas still indicated differences in how often they discussed any of the risks of ART. Interestingly, this study found a positive correlation between how prepared participants felt to talk about ART-related risks and the frequencies at which they discussed these risks, but found a negative correlation between how challenging participants felt it was to talk about ART-related risks and the frequencies at which they discussed these risks. Therefore, differences in reported levels of preparedness and perceived challenges in this study likely contributed to the variability in how often participants discussed risks associated with ART.

Specific risks discussed by participants and patients

Participants from all practice areas initiated discussions about multiple gestation more often than any other risk assessed in this study. This reflects the fact that multiple gestation is a well-established and significant risk associated with ART. Additionally, there are a number of published guidelines that stress the importance of informing couples about the significantly increased risk of multiple gestation associated with ART (ACOG, 2005; SOGC, 2006; Reddy et al., 2007; ASRM, 2012). This study also found that participants were more likely to bring up the risks of congenital structural abnormalities, chromosomal disorders and imprinting disorders. While published guidelines typically recommend discussing risks of congenital structural abnormalities and chromosome abnormalities with patients, recommendations to discuss imprinting disorders are not as prevalent, most likely due to inconclusive research in this area (ACOG, 2005; SOGC, 2006; Reddy et al., 2007). The tendency for genetic counselors to discuss risks of imprinting disorders with patients despite limited data, likely reflects the attention that this concern has received in both the ART and genetics fields. Additionally,
over half of the participants (57%) felt “prepared” or “very prepared” to discuss
imprinting disorders with patients and this relatively high level of preparedness may have
contributed to the increased frequency at which participants brought up this risk.

The majority of participants (73.5%) reported that they “never” or “rarely”
brought up obstetrical and perinatal complications despite published recommendations
about informing patients of these risks (ACOG, 2005; SOGC, 2006; Reddy et al., 2007).
It is possible that participants tended to defer to obstetricians to discuss these particular
risks with patients. Participants may have also not been as familiar with the ACOG
(2005) and SOGC (2006) guidelines, which address obstetrical and perinatal
complications, as these guidelines do not specifically target genetic counselors. In fact,
less than half of all participants reported using these guidelines as resources.
Furthermore, over half of all participants (65.1%) felt “a little bit prepared” or “not at all
prepared” to discuss obstetrical and perinatal complications with patients and this
relatively low level of preparedness may have contributed to the infrequency at which
participants brought up these risks.

Participants reported that patients were more likely to ask about multiple
gestation, congenital structural abnormalities, chromosome abnormalities and risks to the
mother’s long-term health. While participants themselves were also more likely to bring
up multiple gestation, congenital structural abnormalities and chromosome abnormalities,
in all practice areas they were least likely to bring up risks to the mother’s long-term
health. Because no studies have identified an association between ART and risks to the
mother’s long-term health, participants may have been less inclined to initiate
conversations about this risk. Additionally, participants felt least prepared to discuss risks
to the mother’s long-term health, which may also help explain why they did not bring up this risk frequently. Finally, although an increased likelihood of imprinting disorders was one of the risks that participants were more likely to bring up, patients were reportedly least likely to ask about this risk suggesting that patients may not be as aware or concerned as genetic counselors about this risk.

**Variability in discussions about congenital structural abnormalities**

Participant responses indicated considerable variability regarding information provided to patients about the association between ART and congenital structural abnormalities. The majority (60.3%) reported that they did not provide specific risk numbers to patients, but rather used a blanket statement about a possible increased risk or about the precise risk being unknown due to conflicting studies in the medical literature. Participants who did discuss risks of congenital structural abnormalities reported a wide range of estimated risks, from 2.6% to 40% above the general population. The frequent use of blanket statements and variability in risk estimates provided to patient likely reflects the different and sometimes conflicting information in the medical literature. Furthermore, 5.2% of participants indicated that they informed patients that there is no association between ART and an increased risk of congenital structural abnormalities. This is somewhat surprising given that many studies have indicated an association specifically between IVF+ICSI and congenital structural abnormalities (Davies et al., 2012; Wen et al., 2012; Hansen et al., 2005; Klemetti et al., 2005) and may reflect a subset of the genetic counseling community that is not aware of this current literature.

Twenty participants reported that they discussed the risks of specific birth defects with patients and these included congenital heart defects, spina bifida, cleft lip and palate.
and urogenital abnormalities. Over half of these participants (60%), however, indicated that they only discussed risks of congenital heart defects. While an increased risk of cardiovascular abnormalities is one of a number of specific congenital structural abnormalities highlighted in the literature (Reefhuis et al., 2009; Davies et al., 2012), it is possible that participants brought up the risk of cardiac anomalies most often, because they perceived it as one of the more serious congenital defects associated with ART. Additionally, participants may have been inclined to discuss heart defects, because they felt more comfortable making a recommendation to monitor for this risk during pregnancy. Indeed, fourteen participants (45%) reported that they recommended a fetal echocardiogram for women pregnant as a result of ART. Although only twenty participants described recommendations they made to women in a pregnancy conceived through ART, their responses indicate that at least a subset of genetic counselors are using information about ART-related risks to make medical management recommendations.

**Comparisons between pre vs. post-conception counseling and different practice areas**

This study identified a number of similarities between how prenatal/ART genetic counselors discussed the risks of ART in pre-conception and post-conception sessions. When discussing ART with patients, prenatal/ART genetic counselors reported bringing up the vast majority of the risks to patients at similar frequencies in both pre-conception and post-conception sessions. Participants also did not report any differences between how often patients asked about individual risks in pre-conception and post-conception sessions. Furthermore, there was no difference between how prepared prenatal/ART genetic counselors felt to discuss the risks of ART in pre-conception and post-conception
The one significant difference that prenatal/ART participants reported between discussions in pre-conception and post-conception sessions was that they brought up risks of obstetrical and perinatal complications more often in pre-conception sessions. It is possible that participants discussed these risks less often in post-conception sessions as a way to prevent increased anxiety in women who are already pregnant. A comment from one participant about the challenges associated with discussing ART risks in post-conception sessions illustrates this:

“Essentially, the horse has already left the stable. It is a challenge to say, congratulations, you are finally pregnant, but did anyone tell you about these increased risks to your pregnancy – now you have something new to worry about.”

Participant responses may also suggest that genetic counselors tend to defer to obstetricians to discuss these risks once a woman is already pregnant.

Data from this study illustrated that there were significant differences between what prenatal/ART participants and adult/pediatric/cancer/specialty clinic participants communicated to patients about the risks of ART. Overall, prenatal/ART participants initiated discussions about the risks of ART more often than adult/pediatric/cancer/specialty clinic participants. This is likely because in adult/pediatric/cancer/specialty clinic settings, patient visits have a different focus and genetic counselors often discuss ART in the context of PGD, which might be something that families could consider in the future. One respondent commented on this issue:

“I usually see patients in a cancer setting where ART is something down the line, not immediate...adding additional risks for them at the point that I see them does not typically seem necessary.”

Conversely, in ART/prenatal settings, patients are often considering using ART in the
near future or have already conceived using ART and there is likely more of an immediate need to discuss the risks of ART.

Participants reported that patients were more likely to ask about risks to the mother’s long-term health in adult/pediatric/cancer/specialty clinic settings and more likely to ask about congenital structural abnormalities and multiple gestation in prenatal/ART settings. This likely reflects different primary concerns of patients seen in each setting. In the prenatal/ART setting, patients are probably focused on a current pregnancy or hoping to become pregnant in the near future. However, in other clinical settings, especially in the cancer setting, a patient might be more concerned about a new diagnosis, treatment options, or the possibility that he or she might be at risk of developing a genetic condition. Consistent with this idea, patients were reportedly significantly more likely to ask about risks to their own long-term health in cancer genetic counseling sessions than in any other practice area.

Almost half of all participants (44.2%) reported feeling “a little bit prepared” or “not at all prepared” to discuss ART-related risks with patients. Prenatal/ART participants, however, felt more prepared than adult/pediatric/cancer participants to discuss each of the risks assessed in this study, even those which patients reportedly asked adult/pediatric/cancer participants about more often (i.e. risks to growth and development and risks to mother’s long-term health). This is likely because prenatal/ART genetic counselors discuss ART more often than genetic counselors in other specialties and are therefore more familiar with the technology and its associated risks. Prenatal/ART participants also reported using available resources more often than adult/pediatric/specialty clinic participants and the use of resources was positively
correlated with how prepared participants felt to discuss ART-related risks. As indicated by participants in this study, published guidelines designed specifically for genetic counselors may help further prepare them to discuss the risks of ART with patients.

**Study Limitations**

A major limitation of this study was that the number of survey respondents was relatively small (N=161), especially given that a proportion of participants (32.9%) did not answer every question in the survey. Therefore, it is not clear whether the respondents are reflective of the genetic counseling population as a whole. The sample size became even smaller when we divided participants by clinic type and this limited the potential for robust statistical comparisons between genetic counselors in different clinic groups. For example, because of the low number of IVF/PGD participants, we had to combine this group with the prenatal group in order to perform statistical analyses. Another limitation of this study was the possibility of selection bias. Because the survey was self-selected, genetic counselors who work frequently with ART patients or who have a personal experience with ART may have been more motivated to participate. All survey responses were also retrospective, which could have decreased the accuracy of the data based on participant recollection or may have biased participants to answer questions in a way that reflected favorably on their practice. Furthermore, participants provided their own perceptions on how often patients asked about each risk and these responses may not be truly indicative of what risks patients are inquiring about most often. Finally, because we did not include separate questions for IVF alone, for IVF-ICSI and for PGD, results of this study apply only to ART as a whole rather than to individual procedures.
CONCLUSION

This study represents the first look at what genetic counselors from a variety of practice areas are communicating to patients, and what concerns the patients themselves are raising, regarding both the well-established and uncertain risks of ART. The data provides valuable insight for genetic counselors in all clinical settings who are increasingly incorporating information about ART into their discussions with patients.

There was considerable variability in how often genetic counselors, even within the same practice area, discussed any of the risks of ART. Overall, prenatal/ART participants discussed ART-related risks significantly more often than those in adult/pediatric/cancer/specialty clinics. Participants in all practice areas were more likely to initiate discussions about risks of multiple gestation, congenital structural abnormalities and chromosome abnormalities, which is consistent with recommendations in the current literature. However, participants were also more likely to bring up risks of imprinting disorders, despite the lack of conclusive data regarding this risk. When asked specifically about information they provided patients regarding the risk of congenital structural abnormalities, participants reported a wide range of estimated risks, variation in the specific anomalies discussed and differing recommendations for monitoring the pregnancy.

There were both similarities and discrepancies between the ART risks that participants and their patients brought up in genetic counseling sessions and what concerns patients raised across different practice areas. Participants reported that patients
were more likely to ask about multiple gestation, congenital structural abnormalities, chromosome abnormalities and risks to the mother’s long-term health. There was no significant difference between the overall frequency that prenatal/ART patients and adult/cancer/pediatric patients asked about the risks of ART. However, patients reportedly asked about risks to the mother’s long-term health more often in adult/pediatric/cancer settings and about congenital structural abnormalities and multiple gestation more often in prenatal/ART settings. While a study specifically involving patients would be better able to identify their concerns, the results of this study still highlight the potential need for genetic counselors to tailor discussions about ART–related risks based on the specific inquiries of patients in different practice areas.

As a growing subset of patients continue to use and consider ART, it will be increasingly important that healthcare providers, including genetic counselors, consistently inform these patients of the associated risks. The results of this study demonstrate that there are inconsistencies in the information genetic counselors are providing to patients and suggest the need to better prepare genetic counselors to discuss ART-related risks particularly outside of the prenatal/ART practice areas. Additional resources published by the NSGC ART Special Interest Group and an increase in ART-related presentations at NSGC’s Annual Education Conference may help genetic counselors make sense of conflicting data in the literature regarding the risks of ART. Furthermore, future work aimed at developing consensus information on ART risks for genetic counselors and strategies for incorporating this information into their practice areas may better prepare genetic counselors to provide patients with consistent and up-to-date information regarding ART-related risks.
REFERENCES


CDC. (2010). National Center for Chronic Disease Prevention and Health Promotion, Division of Reproductive Health. 2010 assisted reproductive technology national summary report.


Place, I., & Englert, Y. A. (2003). A prospective longitudinal study of the physical, psychomotor, and intellectual development of singleton children up to 5 years who were conceived by intracytoplasmic sperm injection compared with children conceived spontaneously and by in vitro fertilization. *Fertility and Sterility 80*, 1388-1397.


APPENDICES

APPENDIX A: Online Survey

Logic flow is used in the survey and is summarized and highlighted in grey before each question that requires it.

INTRODUCTION:

Thank you for accepting the invitation to participate in this study.

This survey should take approximately 20-30 minutes to complete. In this survey you will be asked questions about the information you provide patients regarding the risks associated with assisted reproductive technology (ART). For the purpose of this study, the term ART will be used to refer to both preimplantation genetic diagnosis (PGD) with intracytoplasmic sperm injection (ICSI) as well as in vitro fertilization (IVF) with ICSI.

This research study has been approved by the Brandeis University Committee for Protection of Human Subjects (IRB). Your participation is completely anonymous and voluntary. By completing the survey, you are consenting to participate in this research study. Please note that you may exit the survey at any time.

Upon completion of the survey, you will have the option of being entered into a raffle to win one of two $50 amazon.com gift certificates.

Thank you very much for your consideration and time. If you have any questions about the study or survey, please do not hesitate to contact:

Kayla Flamenbaum
Brandeis University
Genetic Counseling Masters Program, Class of 2013
Email: kflam@brandeis.edu

Gretchen Schneider, MS, CGC
Principal Investigator
Email: Gretchen@brandeis.edu
Q1.1 How often do you discuss ART with patients? Please check the box that best applies.

- Never
- Less than once a month
- Once a month
- 2-3 times a month
- Once a week
- 2-3 times a week
- Once a day
- Multiple times a day

*If Never is Selected, Then Skip to End of Survey*

Q1.2 Are you certified or eligible to be certified by *either* the American Board of Genetic Counseling (ABGC) or by the Canadian Association of Genetic Counsellors (CAGC)?

- Yes
- No

Q1.3 Which of the following levels of education have you completed? Please check all that apply.

- Master of Science (M.S.) in Genetic Counseling
- Masters Degree, Other, please specify ________________
- Doctoral Degree, please specify ________________
- Professional Degree (JD, MD), please specify ________________
- Other, please specify ________________

Q1.4 Please indicate which geographical region you currently practice in.

- Region 1 (CT, MA, ME, NH, RI, VT, CN Maritime Provinces)
- Region 2 (DC, DE, MD, NJ, NY, PA, VA, WV, PR, VI, Quebec)
- Region 3 (AL, FL, GA, KY, LA, MS, NC, SC, TN)
- Region 4 (AR, IA, IL, IN, KS, MI, MN, MO< ND, NE, OH, OK, SD, WI, Ontario)
- Region 5 (AZ, CO, MT, NM, TX, UT, WY, Alberta, Manitoba, Saskatchewan)
- Region 6 (AK, HI, ID, NV, OR, WA, British Columbia)
- Other, Please Specify _____________________
Q1.5 Please indicate your gender.

☐ Female
☐ Male
☐ Other

Q1.6 Please indicate how many years experience you have as a genetic counselor,

☐ Less than 2 years
☐ 2 – 5 years
☐ 6-10 years
☐ 11-15 years
☐ 16 – 20 years
☐ > 20 years

Q1.7 In which of the following institutions do you primarily discuss ART with patients? Please check the box that best applies.

☐ Community hospital
☐ University medical center
☐ Private clinic
☐ Military/veterans hospital
☐ Pharmaceutical/Biotech company
☐ Government organization or agency
☐ IVF/Infertility center
☐ PGD laboratory
☐ Other, please specify ________________________________

Q1.8 In which of the following clinical settings do you primarily discuss ART with patients? Please check the box that best applies.

☐ Prenatal
☐ PGD
☐ IVF
☐ IVF & PGD
☐ Adult
☐ Pediatric
☐ Cancer
☐ Other, Please Specify __________________________

Answer if Q1.8: Prenatal, PGD, IVF or IVG& PGD is Selected
Q1.9 Approximately what percentage of your ART discussions are with pre-conception versus post-conception patients? Please check the box that best applies.

- [ ] 100% pre-conception
- [ ] > 50% pre-conception, < 50% post-conception
- [ ] 50% pre-conception/ 50% post-conception
- [ ] > 50% post-conception, < 50% pre-conception
- [ ] 100% post-conception

**Answer if Q1.9: Pre-conception and Post-Conception is Selected**

Q2.1 Please check the box that best describes how important you feel the following risks are to discuss with patients for whom ART is a reproductive option (i.e. with pre-conception patients)

<table>
<thead>
<tr>
<th>Risk Description</th>
<th>Very Important</th>
<th>Important</th>
<th>Neutral</th>
<th>Somewhat Important</th>
<th>Not important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications in singleton pregnancies (ex gestational hypertension, placenta previa, placental abruption, induction of labor, caesarean delivery etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of <strong>imprinting disorders</strong> (ex. Beckwith-Wiedemann and Angelman syndrome)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes in singleton pregnancies (ex perinatal mortality, preterm delivery, low birth weight and NICU admission etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to <strong>childhood and long-term growth and development</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of <strong>structural congenital abnormalities</strong> (ex septal heart defects, cleft lip +/- cleft palate, hypospadias etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous <strong>chromosomal abnormalities</strong> (ex 47 XXX, autosomal structural anomalies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to <strong>mother’s long-term health</strong> (ex cancer, high blood pressure, diabetes etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple gestation</strong> and associated complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other, Please Specify</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q2.2 Please check the box that best describes how important you feel the following risks are to discuss with patients who have conceived using ART (i.e with post-conception patients)

<table>
<thead>
<tr>
<th>Risk</th>
<th>Very Important</th>
<th>Important</th>
<th>Neutral</th>
<th>Somewhat Important</th>
<th>Not important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications in singleton pregnancies (ex gestational hypertension, placenta previa, placental abruption, induction of labor, caesarean delivery etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders (ex Beckwith-Wiedemann and Angelman syndrome)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes in singleton pregnancies (ex perinatal mortality, preterm delivery, low birth weight and NICU admission etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities (ex. septal heart defects, cleft lip +/- cleft palate, hypospadias etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities (ex 47 XXX, autosomal structural anomalies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health (ex cancer, high blood pressure, diabetes etc…)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q3.1 When discussing ART with **pre-conception** patients, in what percentage of cases do you provide information about any of the risks associated with the procedure?

__________

Q3.2 When discussing ART with **post-conception** patients, in what percentage of cases do you provide information about any of the risks associated with the procedure?

__________

If “0%” is Selected in Q3.1 & Q3.2: Proceed to Q9.
If > 0% is Selected in Q3.1: Proceed to Q4.1, Q4.2, and Q5.1.
If > 0% is Selected for Q3.2: Proceed to Q4.1, Q4.3 and Q6.1

Q4.1 When providing information about ART, which of the following risks do you **ONLY** discuss when patients themselves bring up or ask about the risk? Please check all that apply for both **pre-conception** and **post-conception** sessions.

<table>
<thead>
<tr>
<th>Pre-conception</th>
<th>Post-conception</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obstetrical complications (singleton pregnancies)</td>
</tr>
<tr>
<td>☐</td>
<td>Increased incidence of imprinting disorders</td>
</tr>
<tr>
<td>☐</td>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
</tr>
<tr>
<td>☐</td>
<td>Risks to childhood and long-term growth and development</td>
</tr>
<tr>
<td>☐</td>
<td>Risks to mother’s long-term health</td>
</tr>
<tr>
<td>☐</td>
<td>Multiple gestation</td>
</tr>
<tr>
<td>☐</td>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
</tr>
<tr>
<td>☐</td>
<td>Increased incidence of structural congenital abnormalities</td>
</tr>
<tr>
<td>☐</td>
<td>Other, Please Specify</td>
</tr>
</tbody>
</table>
Q4.2 How often do patients bring up or ask about the association between ART and the following risks in **pre-conception** sessions? Please check the box that best applies for each risk.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse perinatal and /or obstetrical outcomes in singleton pregnancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple gestation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to patient’s own health (ex. cancer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q4.3 How often do patients bring up or ask about the association between ART and the following risks in **post-conception** sessions? Please check the box that best applies for each risk.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse perinatal and /or obstetrical outcomes in singleton pregnancies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple gestation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to patient’s own health (ex. cancer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q5.1 When providing information about ART to **pre-conception** patients, how often do you initiate discussions about the following risks? Please check the box that best applies for each risk.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Always</th>
<th>Very Often</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Very Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple gestation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If Never is not Selected for “Congenital Structural Abnormalities” in Q5.1: Proceed to Q5.2, 5.3 and 5.
Q5.2 For the purpose of this study, I would like to further explore the discussions that genetic counselors are having with pre-conception patients about the risks of congenital structural abnormalities associated with ART.

In the space below, please briefly describe what you tell pre-conception patients about the association between ART and congenital structural abnormalities. If applicable, please include: i) any absolute risks, relative risks or other risk estimates that you provide, ii) any specific congenital structural abnormalities that you discuss and iii) anything you mention regarding the utility of current literature.

__________________________________________________________________

Q5.3 Please check the box that best describes how you discuss the risks of congenital structural abnormalities in pre-conception sessions with patients who are considering IVF alone versus with patients who are considering IVF with ICSI.

☐ I discuss the risks similarly in both patient populations
☐ I provide patients considering “IVF alone” with higher risk estimates
☐ I provide patients considering “IVF with ICSI” with higher risk estimates
☐ Other, Please Specify _______________________________________

Q5.4 Please check the box that best describes how you discuss the risks of congenital structural abnormalities in pre-conception sessions with patients considering IVF for the purpose of PGD versus with patients considering IVF because of infertility.

☐ I discuss the risks similarly in both patient populations
☐ I provide infertility patients with higher risk estimates
☐ I provide infertility patients with higher risk estimates only if IVF will be done with ICSI
☐ I provide PGD patients with higher risk estimates
☐ Other, Please Specify _______________________________________
Q6.1 When providing information about ART to post-conception patients, how often do you initiate discussions about the following risks? Please check the box that best applies for each risk.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Always</th>
<th>Very Often</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Very Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If Never is not Selected for “Congenital Structural Abnormalities” in Q6.1: Proceed to answer Q6.2, 6.3 and 6.4

Q6.2 For the purpose of this study, I would like to further explore the discussions that genetic counselors are having with post-conception patients about the risks of congenital structural abnormalities associated with ART.

In the space below, please briefly describe what you tell post-conception patients about the association between ART and congenital structural abnormalities. If applicable, please include: i) any absolute risks, relative risks or other risk estimates that you provide, ii) any specific congenital structural abnormalities that you discuss and iii) anything you mention regarding the utility of current literature.
Q6.3 Please check the box that best describes how you discuss the risks of **congenital structural abnormalities** in **post-conception** sessions with patients who have conceived using **IVF alone** versus with patients who having conceived using **ICSI in conjunction with IVF**.

- [ ] I discuss the risks similarly in both patient populations
- [ ] I provide patients considering “IVF alone” with higher risk estimates
- [ ] I provide patients considering “IVF with ICSI” with higher risk estimates
- [ ] Other, Please Specify ____________________________

Q6.4 Please check the box that best describes how you discuss the risks of **congenital structural abnormalities** in **post-conception** sessions with patients who used **IVF for the purpose of PGD** versus with patients who used **IVF because of infertility**.

- [ ] I discuss the risks similarly in both patient populations
- [ ] I provide infertility patients with higher risk estimates
- [ ] I provide infertility patients with higher risk estimates only if IVF will be done with ICSI
- [ ] I provide PGD patients with higher risk estimates
- [ ] Other, Please Specify ____________________________
Q7.1 Please check the box that best describes how prepared you feel to discuss each of the following risks with patients for whom ART is a reproductive option (i.e with pre-conception patients).

<table>
<thead>
<tr>
<th>Risk</th>
<th>Very prepared</th>
<th>Prepared</th>
<th>Somewhat prepared</th>
<th>A little bit prepared</th>
<th>Not prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple gestation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Q7.2 Please check the box that best describes how prepared you feel to discuss each of the following risks with patients who have conceived using ART (i.e. with post-conception patients).

<table>
<thead>
<tr>
<th>Risk</th>
<th>Very prepared</th>
<th>Prepared</th>
<th>Somewhat prepared</th>
<th>A little bit prepared</th>
<th>Not at all prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

__________
Q8.1 Please check the box that best describes how challenging it is to discuss each of the following risks with patients for whom ART is a reproductive option (i.e. with *pre-conception* patients).

<table>
<thead>
<tr>
<th>Risk</th>
<th>Very challenging</th>
<th>Challenging</th>
<th>Somewhat challenging</th>
<th>A little bit challenging</th>
<th>Not at all challenging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased incidence of imprinting disorders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse perinatal outcomes (singleton pregnancies)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to childhood and long-term growth and development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risks to mother’s long-term health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of spontaneous chromosomal abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased incidence of structural congenital abnormalities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Please Specify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Answer if Challenging is selected any of the above Risks

Q8.2 Please briefly list one or two of the challenges you have encountered while discussing the risks of ART with *pre-conception* patients.

_________________________________________________________________
Q9. Were any of the following incorporated into your graduate school training? Please check all that apply.

- Lectures/presentations related to ART, including its associated risks
- Exposure to ART during clinical rotations/observations
- Exposure to ART during laboratory or research-based rotations/observations
- None

Q10.1 What sources of information have you used to obtain up-to-date information regarding the risks associated with ART? Please check all that apply.

- Relevant medical journals (ex. Fertility and Sterility, Journal of Assisted Reproduction and Genetics etc…)
- American Society for Reproductive Medicine, “Risks of In Vitro Fertilization; Fact Sheet”
- American Congress of Obstetrics and Gynecologists (ACOG) committee opinion, “Perinatal Risks Associated with Assisted Reproductive Technology”
- Society of Obstetricians and Gynaecologists of Canada (SOGC) – Canadian Fertility and Andrology Society Guideline “Pregnancy Outcomes after Assisted Reproductive Technology”
- Consulting with genetic counselor colleagues
- Consulting with reproductive endocrinologists
- Consulting with clinical geneticists
- ART NSGC SIG (resources and listserv)
- General NSGC listserv
- Relevant conferences or meetings (ex. ASRM, ACOG, SOGC)
- None
- Other, Please Specify ______________________

Q10.2 What resources do you feel would help provide additional guidance on how to discuss the risks of ART with patients in different genetic counseling settings. Please check all that apply.

- More focus on ART and its associated risks during graduate training
- Presentations/talks at relevant meetings and conferences
- Information and resources provided by NSGC ART SIG group
- Online courses on ART and its associated risks
- Published guidelines focused on discussing the risks of ART with patients in genetic counseling sessions
- Patient education materials
- None
- Other, Please Specify________________________
Q11.1 If you wish, please provide any additional thoughts or comments you have regarding ART risk counseling that were not covered in this survey.

Thank you for your participation.

If you would like to enter a drawing to win one of two $50 Amazon.com gift cards, please email kflam@brandeis.edu stating your interest in the draw. Your email address / name will in no way be connected to your responses in this survey.
APPENDIX B

Recruitment E-mail Subject: Student Research Project – Discussing Risks of Assisted Reproductive Technology in the Genetic Counseling Setting

Invitation to Participate: Discussing Risks of Assisted Reproductive Technology: Current Practices in the Genetic Counseling Setting

Dear NSGC/CAGC members,

I would like to invite you to participate in a survey investigating the risks associated with assisted reproductive technology (ART) that are being discussed in different genetic counseling settings. The purpose of this study is to identify the risks of ART that genetic counselors are discussing most often with both pre-conception and post-conception patients and to explore the need for additional resources focused on counseling patients about the potential risks associated with ART.

Any genetic counselor who discusses ART with either patients considering ART or with patients who have conceived using ART is eligible to participate. For the purpose of this study, ART includes both in vitro fertilization as well as pre-implantation genetic diagnosis.

The survey should take approximately 20-30 minutes to complete and your responses will be anonymous. Participation in this study is voluntary and you may choose to stop the survey at any time.

Two participants who enter the raffle at the end of the survey will be randomly selected to receive a $50 amazon.com gift certificate.

Please follow the link below to access the survey,

If you have any questions, comments or concerns, please do not hesitate to contact myself by email at kflam@brandeis.edu, or the primary advisor, Gretchen Schneider at gretchen@brandeis.edu Thank you in advance for your time and consideration. It is greatly appreciated.

Kayla Flam, B.S.H. CGC
Master of Science Candidate 2013
Brandeis University
Genetic Counseling Program
kflam@brandeis.edu

Gretchen H. Schneider, M.S., CGC
Licensed Genetic Counselor
Professor of the Practice
Co-director of Clinical Training
Brandeis University Genetic Counseling Program
Gretchen@brandeis.edu