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Knowledge, Attitudes, and Intentions Toward Fertility Awareness and Oocyte Cryopreservation Among Obstetrics and Gynecology Resident Physicians

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1 **Title:**

2 Knowledge, attitudes, and intentions toward fertility awareness and oocyte cryopreservation among
3 obstetrics and gynecology (OB/GYN) resident physicians
4

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6 Gynecologists views about age and oocyte storage
7
8

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34 **Abstract**

35 **Study question:** What knowledge, attitudes and intentions do US obstetrics and gynecology (OB/GYN)
36 residents have toward discussing age-related fertility decline and oocyte cryopreservation with their
37 patients?

38
39 **Summary answer:** Most OB/GYN residents believe that age-related fertility decline, but not oocyte
40 cryopreservation, should be discussed during well-woman annual exams; furthermore, nearly half of
41 residents overestimated the age at which female fertility markedly declines.

42
43 **What is known already:** Oocyte cryopreservation can be utilized to preserve fertility potential. Currently,
44 no studies of US OB/GYN residents exist that question their knowledge, attitudes, and intentions toward
45 discussing age-related fertility decline and oocyte cryopreservation with patients.

46
47 **Study design, size, duration:** A cross-sectional online survey was conducted during the fall of 2014 among
48 residents in American Council for Graduate (ACOG) Medical Education-approved OB/GYN residency
49 programs. Program directors were emailed via the ACOG Council on Resident Education in Obstetrics and
50 Gynecology server listing and asked to solicit resident participation.

51
52 **Participants/materials, setting, methods:** Participants included 238 residents evenly distributed between
53 post-graduate years 1-4 with varied post-residency plans; 90% of residents were women and 75% were 26-
54 30 years old. The survey was divided into three sections: demographics, fertility awareness, and attitudes
55 toward discussing fertility preservation options with patients. Descriptive and inferential statistics were
56 conducted.

57
58 **Main results and the role of chance:** A strong majority of residents (83%) believed an OB/GYN should
59 initiate discussions about age-related fertility decline with patients (mean patient age 31.8), and 73%
60 percent believed these discussions should be part of an annual exam. One third of residents overestimated
61 the age at which there is a slight decline in female fertility, while nearly half of residents overestimated the
62 age at which female fertility markedly declines. Over three-quarters of residents (78.4%) also
63 overestimated the likelihood of success using assisted reproductive treatments (ARTs). Residents were
64 likely to support oocyte cryopreservation in cancer patients irrespective of the woman's age, but much
65 less likely to support elective oocyte cryopreservation. For elective oocyte cryopreservation, 40% believed
66 OB/GYNs should initiate discussions with patients (mean age 31.1), while only 20% believed this topic
67 should be part of an annual exam.

68
69 **Limitations, reasons for caution:** Because the study invitation was sent through US OB/GYN residency
70 program directors rather than directly to residents, it is possible that some residents did not receive the
71 invitation to participate. This limits the generalizability of the findings.

72
73 **Wider implications of the findings:** Within the US, there appears to be a critical need for improved
74 education on fertility decline in OB/GYN residency programs. To promote informed reproductive decision-
75 making among patients, efforts should be made to help OB/GYNs provide comprehensive fertility
76 education to all women, while also respecting patient choices.

77
78 **Study funding/competing interest(s):** None

79
80 **Key words:** fertility awareness, fertility preservation, age-related fertility decline, elective oocyte
81 cryopreservation, medical oocyte cryopreservation, oocyte storage, ovarian aging, reproductive health
82 education, obstetrics and gynecology residents, physicians

83 Introduction

84 Studies assessing the relationship between female fertility and aging have utilized a variety of
85 approaches, including observational data on study populations, statistical modeling, and biochemical
86 assays (Howe et al., 1985; Menken and Larken, 1986; Dunson et al., 2002; Broekmans et al., 2006;
87 Eijkemans et al., 2014). Although the specified age of onset of fertility decline varies among studies, there
88 is widespread agreement that female fertility begins to decline by a woman's early 30s, and that the rate
89 of decline markedly increases at age 37 and thereafter (Howe et al., 1985; Dunson et al., 2002; Te Velde
90 and Pearson, 2002; ACOG, 2014; ASRM, 2013). However, a large number of international studies have
91 consistently found that people who are likely to delay childbearing underestimate the impact of age on
92 fertility as a potential risk factor for involuntary childlessness (Lampic et al., 2006; Tyden et al., 2006;
93 Bretherick et al., 2010; Hashiloni-Dolev et al., 2011; Virtala et al., 2011; Peterson et al., 2012; Wyndham et
94 al., 2012; Chan et al., 2015). These studies also found that participants overestimate the effectiveness of
95 assisted reproductive treatments (ARTs) to overcome age-related infertility (Center for Disease Control &
96 Prevention, 2014; Ferraretti et al., 2013; Leridon, 2004). It is therefore particularly important that women
97 of childbearing age have access to accurate information regarding the impact of age on fertility, as well as
98 the success rates of both ARTs and fertility preservation, so that they are empowered to make informed
99 reproductive decisions.

100 Most women who want children report that their health care provider is the preferred and most
101 reliable source of information about reproductive health, rather than other sources such as the media,
102 peers, and the Internet (Peterson et al., 2012; Wyndham et al., 2012; Hodes-Wertz et al., 2013; Lundsberg
103 et al., 2014; Azhar et al., 2015). However, women typically wait to seek information from their health care
104 providers on fertility and conception until they are older, when their fertility may already be declining or
105 compromised (Lundsberg et al., 2014). Furthermore, not all health care providers are familiar with or

106 comfortable counseling their patients about age-related fertility decline. This combination of patient and
107 physician factors may lead to a relatively low percentage of patients who actually receive reproductive
108 health-related information directly from their health care providers (Lundsberg et al., 2014). Primary care
109 physicians, and to a greater extent obstetric and gynecology (OB/GYN) specialists in hospitals and general
110 practice, have an important role to play in educating patients about the relationship between age and
111 fertility. They are also in a position to discuss the implications of oocyte cryopreservation such as cost, risk,
112 and the estimated number of eggs needed to give women a reasonable chance of having a baby as a result
113 (Dondorp et al., 2012). For example, doctors can present the possibility of freezing one's eggs for future
114 use at a time of maximum reproductive potential. Although oocyte cryopreservation is clearly gaining
115 acceptance for use in patients diagnosed with cancer (Mertes and Pennings, 2011; Noyes et al., 2011),
116 considerable controversy exists regarding the use of oocyte cryopreservation for non-medical reasons
117 (Stoop et al., 2011; Stoop et al., 2014). In October 2012, the American Society for Reproductive Medicine
118 (ASRM) removed the experimental label from oocyte cryopreservation for medical reasons, given that it
119 has similar obstetric and perinatal outcomes compared to procedures using fresh oocytes (ASRM, 2013;
120 Oktay et al., 2006; Grifo and Noyes, 2010; Herrero et al., 2011; Rienzi et al., 2012; Levi Setti et al., 2013;
121 Cobo et al., 2014). However, because of the newness of the procedure, total success rates after long-term
122 freezing remain unclear making it is difficult to counsel women in either group on the minimum number of
123 oocytes required to have a reasonable chance of birth after oocyte cryopreservation.

124 To provide a more neutral and accurate description of this technology, we will refer to oocyte
125 cryopreservation for non-medical reasons as “elective oocyte cryopreservation” (EOC). Although EOC has
126 the potential to alter the landscape of female fertility decision-making, it is of paramount importance to
127 assess whether OB/GYNs—considered the first-line providers of comprehensive reproductive health

128 education—feel that they have a responsibility to educate patients about fertility decline and EOC, and
129 whether they have the necessary education to perform this function. As fertility preservation technologies
130 become more available in the US, OB/GYN awareness of these technologies may have a major impact on
131 whether fertility decline is discussed, and if EOC options are presented to women during their routine
132 gynecologic exams.

133 OB/GYN residents, currently in post-graduate training, may be the most likely physicians to
134 integrate new evidence-based medicine and technologies into their practice. Thus, this study was designed
135 to examine the knowledge, attitudes, and intentions of US OB/GYN residents in providing patients with
136 information on age-related fertility decline and oocyte cryopreservation. Our study aims to assess OB/GYN
137 residents' knowledge and beliefs regarding age-related fertility decline and the use and availability of
138 oocyte cryopreservation. It is based on three key research questions: 1) Do OB/GYN residents believe that
139 it is the role of OB/GYNs to initiate discussions about age-related fertility decline and oocyte
140 cryopreservation with their patients, and if so, at what ages and how frequently? 2) Do OB/GYN residents
141 possess accurate knowledge regarding the relationship between female fertility decline and age, as well as
142 the success rates of ARTs? And 3) Do OB/GYN residents differ in their attitudes toward oocyte
143 cryopreservation for patients diagnosed with cancer or other medical conditions versus EOC? To our
144 knowledge, this is the first study to examine these issues in a sample of US OB/GYN resident physicians.

145 **Methods**

146 The study used a cross-sectional design to examine the knowledge, attitudes, and intentions of US
147 OB/GYN residents. The study was reviewed and approved by the Yale University Human Investigation
148 Committee (HIC#1409014546). All 232 residency program directors listed on the website of the American
149 College of Obstetrician Gynecologists (ACOG) were sent a hyperlink to an online survey and asked to

150 forward this link to their residents. Resident participants had an opportunity to enter a raffle for one of six
151 \$50 incentives at the completion of the survey. Between September and October 2014, an initial invitation
152 email and two reminder emails were sent to each program director with a request to forward the
153 invitation to all residents.

154 *Instrument Design*

155 The survey was based on existing instruments measuring fertility awareness (Lampic et al., 2006),
156 and the clinical experiences of the study authors in the fields of obstetrics and gynecology, reproductive
157 endocrinology, psychology, and anthropology. The instrument was pre-tested on a small group of
158 graduate students for clarity and wording, and was refined through discussion with this focus group as
159 well as a literature review examining the published research on fertility awareness, preconception
160 counseling, and oocyte cryopreservation. The survey included demographic background questions and
161 questions about residents' attitudes towards discussing age-related fertility decline and oocyte
162 cryopreservation. Questions took the form of "yes/no" responses (e.g. "Should an OB/GYN initiate
163 discussions with patients regarding childbearing intentions?"), and open-ended numerical questions (e.g.
164 "If you answered YES to [the previous question], at what age would you initiate this discussion with
165 patients?"). Participants were also asked whether these conversations were appropriate for annual well-
166 woman exams, and data were collected regarding the reasons for or against discussing childbearing
167 intentions at well-woman exams. Options for open-ended qualitative responses using an 'other' category
168 were also given to more thoroughly assess residents' attitudes. As in previous studies of fertility
169 awareness, knowledge-based questions included age of 'slight' versus 'marked' decline in a woman's
170 ability to become pregnant, and the average success rate for couples undergoing a single round of in vitro
171 fertilization (IVF) (Lampic et al., 2006; Peterson et al., 2012; Chan et al., 2015). Participants were asked to

172 assess their own familiarity with oocyte cryopreservation, and whether oocyte cryopreservation was
173 offered at their training institution. They were also asked whether they would initiate discussions of
174 oocyte cryopreservation with their patients, at what ages they would initiate such discussions, and
175 whether such discussions should be part of a well-woman annual exam. Finally, residents were asked how
176 likely they would be to discuss oocyte cryopreservation and support insurance coverage for the technology
177 in different clinical situations (e.g., “A 25-year-old with cancer”) or for non-medical reasons (e.g., “A 25-
178 year-old who wants a career first”).

179 *Statistical analysis*

180 Data from the online survey were analyzed using SPSS (Version 21). Characteristics of study
181 participants were first analyzed with descriptive statistics. Next, descriptive analyses regarding issues
182 related to fertility awareness, pre-conception planning, and oocyte cryopreservation were conducted.
183 OB/GYN residents’ knowledge of fertility issues was then examined with analyses of variance (ANOVAs),
184 which tested whether knowledge differed based on participants’ year in residency. Gender differences
185 were not examined due to the small sample size of male residents.

186 **Results**

187 *Sample Characteristics*

188 Two hundred thirty nine residents participated in the online survey, or approximately 5% of all
189 OB/GYN residents in the United States (based on 5,021 total OB/GYN residents reported by the
190 Accreditation Council for Graduate Medical Education) (ACGME 2014). As shown in Table I, approximately
191 75% of residents were between the ages of 26 and 30. In addition, a significantly higher percentage of
192 respondents were women (90.3% versus 81%, $z = 3.72$, $p < .0001$) and white (71.7% versus 54%, $z = 5.46$,
193 $p < .0001$) when compared with the overall population of residents (ACGME, 2014). Respondents were

194 nearly equally split across year of residency and slightly more hailed from the northeastern and southern
195 regions of the US compared with the western and mid-western regions. Half of respondents (50.2%)
196 intended to pursue general practice in the future.

197 *Attitudes Toward Discussing Pre-Conception Planning and Fertility*

198 Findings regarding residents' tendencies to discuss pre-conception planning and fertility with
199 patients are shown in Table II. Nearly all respondents (91.7%) indicated that OB/GYNs should initiate
200 discussion with patients about childbearing intentions at a patient's mean age of 20.8 ($SD = 5.4$). A
201 majority of respondents also thought that OB/GYNs should initiate discussions about age-related fertility
202 decline (82.9%), although beginning at a patients' mean age of 31.8 ($SD = 3.5$). Furthermore, 72.4%
203 thought that discussing age-related fertility decline should be part of a well-woman annual exam with an
204 OB/GYN, as this would help to educate women about making informed reproductive decisions. Of the
205 27.6% of residents who did not think that discussing age-related fertility decline should be part of a well-
206 woman annual exam, 53% explained that an annual exam was too frequent, 53% did not want to be
207 perceived as pushing childbearing on their patients, and 40% reported that such discussions might lead to
208 emotional distress in patients.

209 *Awareness of Fertility Issues*

210 Residents' knowledge about the ages when female fertility declines and their estimate of chance of
211 success with IVF are shown in Table III. One third overestimated the age when fertility starts to decline
212 and almost half of residents (46.5%) overestimated when fertility declines markedly. Estimates of slight
213 and marked decline in fertility did not differ based on year in residency.

214 Residents also overestimated the overall chance of success in having a child after undergoing one
215 IVF treatment cycle, as more than three-quarters of residents (78.4%) believed that the success rate was

216 30% or higher. The respondents' mean estimate of overall success was 42.3% ($SD = 18.4\%$; minimum = 5%;
217 maximum = 80%). Estimates for success after IVF did not differ by residency year.

218 *Familiarity with Oocyte Cryopreservation and Attitudes Toward Use*

219 Residents' attitudes towards the use of oocyte cryopreservation are presented in Table IV. Only
220 one in four residents (25.1%) indicated that they were either "familiar" or "very familiar" with oocyte
221 cryopreservation. However, six in ten residents (62.6%) worked at a training institution that offered oocyte
222 cryopreservation to patients, suggesting a lack of education within US institutions' OB/GYN residency
223 programs about these new technologies.

224 Sixty percent of respondents did not think that OB/GYNs should initiate discussion of oocyte
225 cryopreservation with their female patients. Of the 40% of respondents who did think that OB/GYNs
226 should initiate discussion, the mean patient age at which such discussions would occur was 31.1 ($SD = 4.2$).
227 Even fewer respondents (20.4%) thought that discussion of oocyte cryopreservation should be part of an
228 annual well-woman exam. Reasons given for discussing oocyte cryopreservation during an annual exam
229 included educating women to make informed reproductive choices and helping them understand the
230 implications of oocyte cryopreservation. Reasons against discussing this issue during an annual exam
231 included wanting to be respectful of patient choices and not wanting to be perceived as pushing
232 childbearing.

233 *Likelihood of Discussing or Supporting Oocyte Cryopreservation for Different Patient Situations*

234 When presented with different patient scenarios, residents showed varying levels of support for
235 discussing oocyte cryopreservation. As shown in Figure 1, residents were very likely to discuss oocyte
236 cryopreservation with patients who had received a cancer diagnosis, regardless of whether that patient
237 was 25 or 35 years of age. In contrast, residents were either somewhat or very unlikely to discuss EOC with

238 patients who wanted to pursue a career before starting a family, especially for younger patients. Similar
239 patterns were evident for residents' support of insurance coverage of oocyte cryopreservation, with many
240 more residents likely to support insurance coverage for patients who had received a cancer diagnosis
241 versus those who wished to pursue a career prior to starting a family (data not shown).

242 **Discussion**

243 To our knowledge, this is the first study to examine the attitudes, knowledge, and intentions
244 regarding fertility awareness and oocyte cryopreservation among US OB/GYN residents. Nearly all
245 residents (92%) who completed the survey believed that an OB/GYN should initiate discussions regarding
246 their patients' childbearing intentions. Furthermore, 83% of residents said that they believed an OB/GYN
247 should initiate discussions about age-related fertility decline with female patients, and 72% said that these
248 discussions should be a part of an annual well-woman exam. These findings are encouraging, as numerous
249 international studies have shown that women who are likely to delay childbearing also lack awareness of
250 age-related fertility decline. A recent study sampling fertility patients from 79 countries found that
251 accurate fertility knowledge was reported by only 56.9% of patients, supporting the need for more
252 education (Bunting et al., 2013). Although physicians and other health care providers should be the first-
253 line reproductive health educators for women (Peterson et al., 2012; Wyndham et al., 2012; Hodes-Wertz
254 et al., 2013), studies show that many women report never having discussed the effect of age on their
255 ability to conceive, even though they identify their health care providers as their top source of information
256 on fertility and reproductive health (Lundsberg et al., 2014).

257 Although it is encouraging that the majority of OB/GYN residents believe that physicians should
258 initiate discussions about fertility decline with their patients, a surprisingly large percentage of the
259 residents surveyed were misinformed about fertility decline themselves. For example, 33% of residents

260 believed female fertility slightly declines at age 35 or after, and nearly half (46.5%) of residents indicated
261 that fertility declines markedly at age 40 or after—when, in fact, the marked decline occurs on average
262 around the age of 37 (Dunson et al., 2002; ASRM, 2013). Given that OB/GYNs are the gatekeepers of the
263 dissemination of correct reproductive knowledge, it is concerning that nearly half of the residents in this
264 study were so uninformed about these basic reproductive facts. Furthermore, given that prior studies
265 suggest that provision of fertility information impacts patient knowledge and intentions toward delaying
266 childbearing (Williamson et al., 2014), these findings highlight a critical need for improved education and
267 curricular offerings on age-related fertility decline in OB/GYN residency programs in the US.

268 In addition to misconceptions about age-related infertility, residents in this study were also
269 misinformed about the success rates of ARTs. Over three-quarters of residents (78.4%) overestimated the
270 likely success of IVF in treating infertility. OB/GYN residents seem to share the common misconceptions—
271 perpetuated by inaccurate media reports, especially of “celebrity moms”—that women can delay having
272 children until after 40, and that any difficulties can be overcome through IVF (Wyndham et al., 2012). It is
273 important to educate practitioners that ARTs such as IVF can only make up for half of the births lost by
274 postponing a first attempt to conceive from age 30 to 35, so that they may correct any misperceptions
275 that patients may have (Leridon, 2004; Wyndham et al., 2012; ASRM, 2013). ART success rates are directly
276 related to the age of the patient. For example, women under 35 in the United States have a 41.5% chance
277 for a live birth using IVF. However, for older women - who may have intentionally postponed childbearing
278 under the false impression that ARTs could correct any difficulties with fertility - only 11.7% of women
279 aged 41-42, and only 4.5% of women ages 43-44 had a live birth (CDC, 2014). In other words, women who
280 use ART in their 40s are much less likely than younger women to have a live birth as a result.

281 When OB/GYN residents in this study were asked whether they should initiate discussions

282 regarding oocyte cryopreservation with patients, less than half (40%) believed that OB/GYNs should, and
283 only one-fifth (20%) reported that it should be a part of an annual well-woman exam. In a 2013 study of
284 183 women who had undergone at least one oocyte cryopreservation cycle, the mean age of patients who
285 cryopreserved their oocytes was 38, an age at which oocytes already have reduced quality and
286 reproductive potential (Hodes-Wertz et al., 2013). Furthermore, 79% of the women wished they had
287 undergone EOC at an earlier age, and only one-third had discussed EOC with their gynecologist prior to the
288 procedure. In the current study, residents believed OB/GYNs should initiate discussions about EOC with
289 patients starting at age 31, an age when a woman's reproductive potential is greater than the current
290 norm among actual EOC users, who are on average freezing their oocytes in their late 30s. Recent data
291 from decision-analysis models propose that the highest probability of achieving a live birth may be when
292 women undertake EOC at <34 years of age (Mesen et al., 2015). Also, cost-effectiveness studies show that
293 freezing oocytes by age 35 in women who plan to delay childbearing until age 40 effectively reduces the
294 cost per live birth (Devine et al. 2015).

295 In considering the role of physicians in discussing these issues with patients, it is important to note
296 that childbearing decisions are also influenced by relational circumstances or other factors that are
297 beyond a patient's immediate control. For example, in a study of women who underwent EOC to preserve
298 their fertility, 161 (88%) had delayed childbearing because they lacked a partner (Hodes-Wertz et al.,
299 2013). OB/GYNs should be sensitive to these possibilities while delivering information about fertility
300 decline and EOC. However, EOC may offer some women relief from the pressure of entering into an
301 unwanted relationship "for the sake of children," or to have children before they are ready. Counseling
302 women about their fertility and the possibility of EOC requires both maximal sensitivity and respect for
303 patients' reproductive autonomy. Yet, ideally, OB/GYNs should be initiating such discussions with their

304 patients at an age when patients' reproductive potential can be maximized (the late 20s to early 30s) and
305 when women may have the greatest flexibility in reproductive decision making.

306 We acknowledge an absence of studies that examine how women may respond to such
307 discussions. However, we support the conclusions of other studies that call for research to investigate if
308 patients want physicians to initiate these types of discussions, and under what circumstances they would
309 like them to take place (Buske et al., 2015). The results of such research would be useful for OB/GYN
310 training programs around the world, in order to teach residents how to deliver information about age-
311 related fertility decline and oocyte cryopreservation in a way that respects patient circumstances, while
312 providing education required for informed decision-making.

313 Examining the attitudes and knowledge of physicians regarding fertility preservation is critical, and
314 this need has been highlighted in several international studies. For example, in Germany, a survey of 120
315 oncologists found that while nearly all of the physicians felt fertility preservation was an important issue,
316 only half reported having a thorough understanding of it, and only 40% reported discussing it with patients
317 routinely (Buske et al., 2015). A recent study of breast cancer specialists in Japan found that physicians
318 who had more positive attitudes toward fertility preservation were more likely to discuss this with
319 patients, and calls were made to improve interdisciplinary communication between physicians and
320 infertility specialists to improve patient care (Shimizu et al., 2011). Countries around the world are also
321 beginning to incorporate EOC into standard fertility care, with some nations considering oocyte
322 cryopreservation to be cost effective and thus potentially covered by insurance or national health plans
323 (Shkedi-Rafid et al., 2011; Van Loendersloot et al., 2011). In the current study, residents suggested that
324 they would be more likely to support insurance coverage for oocyte cryopreservation in cancer patients
325 than for age-matched patients seeking EOC. Thus, future studies must examine how financial coverage of

326 these technologies might impact attitudes toward and uses of both medical oocyte cryopreservation and
327 EOC in countries throughout the world.

328 Finally, it is important to note that women do not typically make their reproductive decisions
329 alone, and often include male partners. Men have also been found to significantly overestimate the ages
330 at which female fertility declines (Peterson et al., 2012). Furthermore, some data have shown that
331 women's desire for childbearing may be related in part to whether a male partner desires children
332 (Holton, et al., 2011). Given that reproductive health and the impact of fertility treatments have
333 increasingly been conceptualized as a couple's issue (Peterson et al., 2009; Peterson et al., 2011), it is
334 important that providers of men's health care also be encouraged to seek appropriate education regarding
335 age-related fertility decline. As noted in a recent review, men are often the 'forgotten partner' when
336 couples are diagnosed with infertility – even in cases of male-factor infertility (Petok, 2015). Once a couple
337 is diagnosed with infertility, both partners participate in the help seeking process (Johnson & Johnson,
338 2009). Thus, leaving men out of reproductive counseling overlooks the significant contribution that men
339 make to reproduction (Inhorn et al., 2009). Discussions of fertility decline and oocyte cryopreservation can
340 include men as well as women, so that both individuals and couples are better informed about their full
341 range of reproductive options (Azhar et al., 2015).

342 **Limitations**

343 The findings of this study must also be interpreted in light of the study's limitations. First, due to
344 our sampling methods, we were unable to calculate the exact number of residents who actually received a
345 recruitment email. Because residents completed the survey in an online, anonymous questionnaire
346 format, we must take into account the possibility for bias in the study findings. Inherent to email-based
347 sampling is self-selection bias; we were unable to evaluate characteristics of non-respondents and thus

348 cannot be sure that our findings may therefore not be generalizable to all residents. In addition, female
349 residents were slightly over-represented in our sample when compared to the proportion of female
350 OB/GYN residents in the US (AAMC, 2014; ACGME, 2014). The study also did not address residents'
351 attitudes and intentions regarding the education of men about fertility decline and oocyte
352 cryopreservation. Finally, due to the small number of male respondents, analyses lacked sufficient power
353 to explore gender differences among the study responses.

354 **Conclusion**

355 This study is the first of its kind to examine the knowledge, attitudes, and intentions of US OB/GYN
356 residents in providing patients with information on age-related fertility decline and oocyte
357 cryopreservation. The findings highlight a critical need for improved education among US OB/GYN
358 residents about issues related to age-related fertility decline and the use of oocyte cryopreservation for
359 both medical and elective reasons. Although our study focused on OB/GYN residents in the US, topics of
360 reproductive health and fertility are universal; thus, further research is needed to explore the role of
361 education across cultures and in countries where OB/GYN training programs may differ in duration and
362 method. If OB/GYNs are taught to present fertility decline and oocyte cryopreservation to patients in a
363 way that is both respectful of individual patient autonomy and informative about new reproductive
364 technologies, then they will maximize their patients' ability to make the most informed reproductive
365 decisions possible.

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370 **Authors' roles:**

371 P. Patrizio proposed the study, design and reviewed and analyzed data; L. Yu and B. Peterson designed the
372 study instrument, implemented the study, analyzed data, and prepared the initial manuscript; J. Boehm
373 conducted data analysis and statistics and assisted with manuscript preparation; M. Inhorn edited the
374 manuscript and further enhanced data analysis.

375

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378 **Conflict of interest:**

379 None

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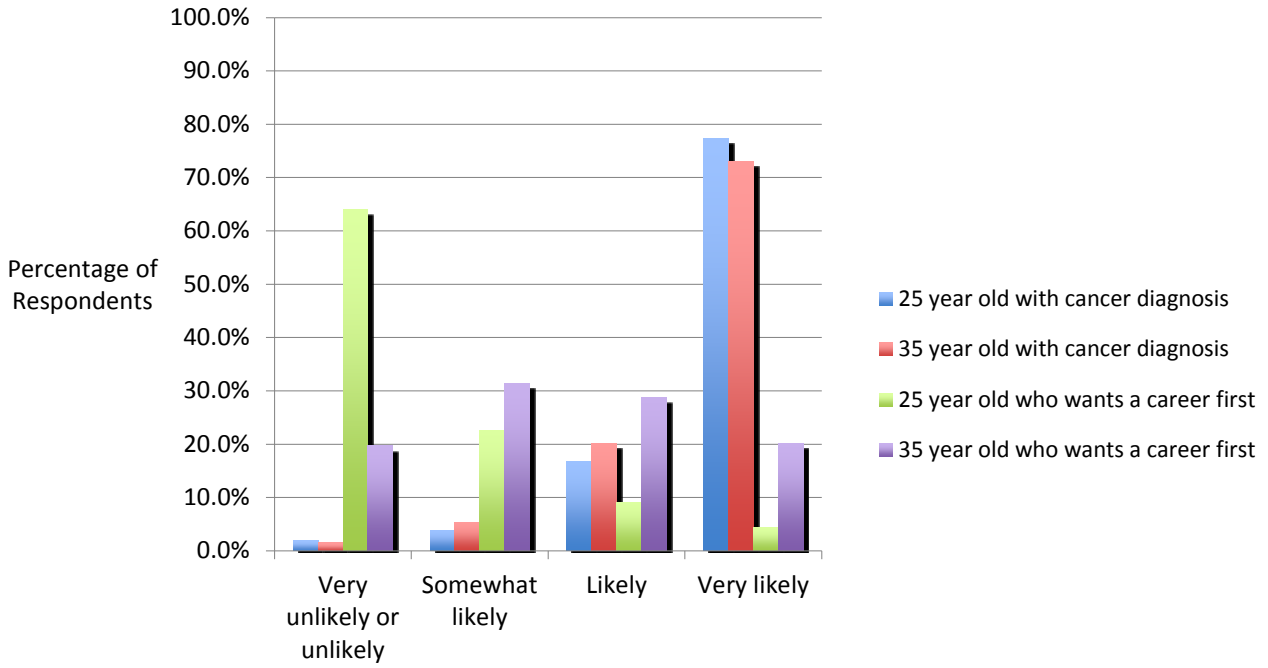


Figure 1: Likelihood of discussing medically indicated and elective oocyte cryopreservation by age

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Table 1. Characteristics of the Sample

Characteristic	<i>N</i>	%
Age		
18-25	7	2.9
26-30	179	74.9
31-35	51	21.3
36-40	2	0.8
41-45	0	0
Gender		
Female	214	90.3
Male	23	9.7
Other	0	0
Racial/Ethnic Background		
White/Caucasian	170	71.7
Black/African American	16	6.8
Asian and Pacific Islander	27	11.4
Hispanic/Latino	12	5.1
Middle Eastern	3	1.3
Multiracial	6	2.5
Other	3	1.3
Current Relationship Status		
Single/Never Married	83	34.7
Committed Relationship	52	21.8
Married	101	42.3

Separated	3	1.3
Other	0	0
<hr/>		
Currently Have Children		
Yes	33	13.9
No	205	86.1
<hr/>		
Religious Affiliation		
Christianity	110	46.6
Judaism	16	6.8
Islam	5	2.1
Hinduism	9	3.8
Buddhism	1	0.4
Other	7	3
None	88	37.3
<hr/>		
Post-Graduate Year		
1	62	25.9
2	66	27.6
3	53	22.2
4	57	23.8
Other	1	0.4
<hr/>		
Geographic Location		
West	35	14.8
Midwest	45	19
Northeast	90	38
South	59	24.9
Other	8	3.4
<hr/>		

Professional Plans

Maternal Fetal Medicine	18	7.5
Reproductive Endocrinology and Infertility	18	7.5
Urogynecology	17	7.1
Gynecologic Oncology	26	10.9
Family Planning	12	5
Other Fellowship	10	4.2
General Practice	120	50.2
Other	18	7.5

Table 2. OB/GYN Residents' Attitudes Toward Discussing Pre-Conception Planning and Fertility

Item	N	%	
Should an OB/GYN initiate discussions with patients about their potential childbearing intentions?			
Yes	198	91.7	
No	18	8.3	
Should an OB/GYN initiate discussions about age-related fertility decline with patients?			
Yes	180	82.9	
No	37	17.1	
Should discussing the natural decline in fertility with age be part of a well-woman annual exam with a gynecologist?			
Yes	157	72.4	
No	60	27.6	
Reasons for Yes	Educating women about this helps women make informed reproductive decisions	141	89.8
	I want to provide comprehensive health education to my patients	127	80.9
	Women should be aware of the correct relationship between fertility and age	112	71.3
	I can help dispel many of the myths in society/media regarding fertility and age	85	54.1
	Other	0	0
Reasons for No	Bringing this issue up annually is too frequent, but I am not opposed to discussing this issue with patients every three to four years	32	53.3
	I don't want to be perceived as pushing childbearing on patients	32	53.3
	Bringing up this issue annually may lead to emotional distress in my patients	24	40
	I want to be able to fully respect patient choices	23	38.3
	I don't have enough time	7	11.7
	Other	7	11.7
	It is not my primary responsibility	2	3.3

Table III Obstetrics and gynecology (OB/GYN) Residents' Awareness of Fertility Issues

Fertility Issue	All Residents (N = 217)	1st Year Residents (N = 55)	2nd Year Residents (N = 58)	3rd Year Residents (N = 51)	4th Year Residents (N = 53)	p
At what age is there a <i>slight</i> decrease in women's ability to become pregnant?	31.67 (3.10)	31.55 (3.47)	31.43 (2.74)	31.37 (2.95)	32.36 (3.21)	0.32
15-24	0.9%	1.8%	0%	0%	1.9%	
25-29*	9.7%	9.1%	10.3%	15.7%	3.8%	
30-34*	53.0%	50.9%	60.3%	54.9%	45.3%	
35-59	33.1%	38.2%	29.3%	29.4%	49.1%	
At what age is there a <i>marked</i> decrease in women's ability to become pregnant?	37.58 (2.53)	37.95 (2.54)	37.17 (2.62)	37.20 (2.51)	38.00 (2.39)	0.15
25-34	0%	0%	0%	0%	0%	
35-39*	52.5%	47.3%	60.3%	58.8%	43.4%	
40-44	46.5%	50.9%	37.9%	41.2%	56.6%	
45-59	0.9%	1.8%	1.7%	0%	0%	
What is the overall chance, on average, that a couple who undergoes treatment with in vitro fertilization will have a child after one treatment?	42.30 (18.37)	41.20 (19.52)	45.02 (18.75)	42.02 (18.61)	40.75 (16.62)	0.61
0-19%	5.1%	7.3%	1.7%	5.9%	5.7%	
20-29%*	16.6%	16.4%	17.2%	13.7%	18.9%	
30-39%	24.0%	29.1%	19.0%	29.4%	18.9%	
40-100%	54.4%	47.3%	62.1%	51.0%	56.6%	

*Asterisk indicates the correct category based on published literature. For the slight decline in fertility, literature suggests this decline can begin in the late 20s to early 30s. *Note.* Means and standard deviations are presented in the first row for each fertility issue; percentages are presented in subsequent rows. Significance values come from one-way analyses of variance testing for differences based on year in residency.

Table 4. OB/GYN Residents' Attitudes Toward Use of Oocyte Cryopreservation

Item	N	%	
Should an OB/GYN initiate discussions regarding oocyte cryopreservation with female patients?			
Yes	83	39.9	
No	125	60.1	
Should discussing oocyte cryopreservation be part of a well-woman annual exam with a gynecologist?			
Yes	42	20.4	
No	164	79.6	
Reasons for Yes	Educating women about this issue helps women make more informed reproductive decisions	33	78.6
	Understanding the implications of oocyte cryopreservation increases women's childbearing choices	31	73.8
	I want to provide comprehensive health education to all my patients	28	66.7
	Other	1	2.4
Reasons for No	Bringing this issue up annually is too frequent, but I am not opposed to discussing this issue with patients every three to four years	79	48.2
	I don't want to be perceived as pushing childbearing on patients	49	29.9
	Other	45	27.4
	Bringing up this issue annually may lead to emotional distress in my patients	44	26.8
	I want to be able to fully respect patient choices	40	24.4
	It is not my primary responsibility	28	17.1
	I don't have enough time	25	15.2