

1 **Portuguese oncologists' practices regarding female fertility preservation:**

2 **Which barriers most relate with these practices?**

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Abstract

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This study aims to investigate the current practice patterns of Portuguese oncologists with different clinical specialties regarding female fertility preservation (FP) and to determine the relative endorsement of different barriers to these practices. A total of 111 doctors with different clinical specialties assisting female cancer patients of childbearing age at Portuguese clinical institutions completed a self-report questionnaire to assess their current practice patterns regarding female FP and their perceptions of the barriers to these practices. Although the majority of the oncologists reported discussing the reproductive future with their patients, 2,8% and 7,2% of these clinicians reported never informing about the risk of infertility and about FP, respectively, and 75,8% of the participants have referred fewer than ten patients to a reproductive medicine doctor. Time with patients was the strongest endorsed barrier to these practices. A stronger endorsement of the barriers “oncologists’ communication skills” and “patient-related factors” was related to a lower frequency of informing about both the risk of cancer-related infertility and about FP. It is important to overcome the intrinsic barriers that emerged as being the most relevant to oncologists’ FP practices and that can be modified, namely, the lack of communication skills and the oncologists’ perceptions of their patients’ characteristics.

Keywords: fertility preservation / oncologists practices / decision-making / childbearing age / oncology / communication in health

53 **Introduction**

54 Cancer survival rates have been increasing steadily over the past years all over the world (World Health
55 Organization, 2014). Portugal survival rates are high for several oncological diseases when compared with other
56 European countries (de Angelis et al., 2013). For breast cancer, one of the most frequently diagnosed
57 malignancy among young adult women (Assi et al., 2013), Portugal survival rates are greater than 80% (de
58 Angelis et al., 2013). The late side effects of the more successful but aggressive cancer treatment protocols has
59 been increasingly recognized, including the risk of future fertility impairment (Loren, Mangu, et al., 2013).
60 Sustained infertility develops in 50-90% of cancer survivors (Bahadur, 2000). Given the increasing incidence of
61 cancer at younger ages (Desandes & Stark, 2016) and the current social trend of delaying childbearing until
62 older ages (Schmidt et al., 2012), there is a growing number of young and childless cancer patients whose
63 reproductive future is at risk.

64 Fertility preservation (FP) methods are now offered to the young cancer patients facing cancer-related
65 infertility risk as an attempt to ensure their future biological parenthood. Female FP techniques have only
66 recently acquired criteria to be routinely offered to cancer patients (Practice Committees of American Society
67 for Reproductive Medicine & Society for Assisted Reproductive Technology, 2013). These techniques require
68 more invasive and complex procedures than the male FP option (Chang & Suh, 2008), which is a simple and
69 well-known technique all over the world (Loren, Mangu, et al., 2013). In Portugal, despite the availability of
70 male FP since the 1990s in several clinical institutions, female FP techniques are only offered since 2010; both
71 male and female FP options are funded by the Portuguese National Healthcare System.

72 Moreover, when compared to men, women have not only a higher rate of cancer diagnosis (Cancer Research
73 United Kingdom, 2013), but also a higher cancer survival rate (Siegel, Miller, & Jemal, 2016), and female
74 cancer survivors achieve lower reproductive rates than do male survivors (Stensheim, Cvancarova, Moller, &
75 Fossa, 2011). Cancer-related infertility has been shown to have a negative impact on the individual adaptation of
76 female cancer survivors (Carter et al., 2010; Loscalzo & Clark, 2007; Perz, Ussher, & Gilbert, 2014), so this
77 topic deserves further attention.

78 Female cancer patients seem to be interested in FP, wishing to receive information and to play an active role
79 in the decision-making process about FP as soon as possible after the diagnosis (Peate et al., 2011). Several
80 oncology societies worldwide (e.g., the American Society of Clinical Oncology, the European Society for
81 Medical Oncology) have recently published guidelines regarding the oncologists' role in discussing the
82 reproductive future with their patients of childbearing age. These guidelines recommend that, before the

83 infertility-inducing cancer treatment, all cancer patients of reproductive age should be fully informed about the
84 cancer-related infertility risk and of possible FP options, and that they should be referred to fertility specialists
85 to make a decision about FP (Loren, Mangu, et al., 2013; Peccatori et al., 2013). These are also the
86 recommendations of the Portuguese guidelines for oncologists about FP in adults with cancer (Almeida-Santos
87 et al., 2017). It is important to note that in Portugal, the fertility specialists that consult female cancer patients
88 regarding their fertility preservation are doctors with the clinical specialty in gynecology and a sub-
89 specialization in reproductive medicine.

90 Despite these strong recommendations, not all oncologists are discussing this topic with their patients.
91 Recent studies report that many cancer patients of childbearing age who received cancer treatment do not recall
92 infertility discussions with their oncologists and that those who were informed report a lack of or a delayed
93 referral to a fertility specialist consultation to make a decision about FP (Kim & Mersereau, 2015; Ruddy et al.,
94 2014). Female cancer patients seem to be at greater risk of not being informed about their fertility and FP than
95 male patients, as one study found that 50% of female cancer survivors reported having received information
96 about infertility risk (versus 80% of male participants), 14% reported having received information about FP
97 options (versus 68% of male participants), and only 2% underwent FP (versus 54% of male participants)
98 (Armuaud et al., 2012).

99 Furthermore, prior European and North American surveys have examined the practice patterns and
100 perceptions of oncologists regarding FP and have shown that, although oncologists recognize the importance of
101 discussing FP with young cancer patients, the rates of discussion about infertility risk and FP options and the
102 rates of referral to a fertility specialist are low (Adams, Hill, & Watson, 2013; Schover, Brey, Lichtin, Lipshultz,
103 & Jeha, 2002). In fact, 18-48% of these physicians report never referring patients to make a decision about FP
104 (Adams et al., 2013; Forman, Anders, & Behera, 2009). One study showed lower referral rates for female cancer
105 patients than for male patients, with 70% of doctors rarely ever referring a female patient to make a decision
106 about FP (Yee, Fuller-Thomson, Lau, & Greenblatt, 2012).

107 Therefore, it is of major importance to better understand the factors that may contribute to the oncologists'
108 practices regarding FP. The physicians' age, gender and clinical specialty have already been reported as factors
109 that may influence these practices. Younger female oncologists with a clinical specialty who treat patients with
110 reproductive cancer (e.g., gynecology) are more likely to include FP information as part of their patient
111 treatment protocol and to refer patients to a fertility specialist than older male oncologists with other clinical
112 specialties (Forman, Anders, & Behera, 2010; Loren, Brazauskas, et al., 2013; Quinn, Vadaparampil, Bell-

113 Ellison, Gwede, & Albrecht, 2008; Quinn et al., 2007; Quinn et al., 2009; Schover et al., 2002; Shimizu et al.,
114 2013; Yee, Fuller-Thomson, et al., 2012).

115 Moreover, several barriers for the discussion of FP have also been identified in studies comprising
116 oncologists who work with pediatric and adult (both male and female) cancer patients. Despite the existence of
117 some heterogeneity in the literature regarding these barriers, some authors have proposed their organization into
118 five main themes: oncologists' knowledge of FP; oncologists' communication skills; patient-related issues;
119 time; and financially related barriers (e.g., Adams et al., 2013; Gilbert, Adams, Mehanna, Harrison, &
120 Hartshorne, 2011; Quinn et al., 2008). Many oncologists lack **knowledge** about potential cancer-related
121 infertility, FP options and their efficacy and about where to refer patients to perform these techniques (Overbeek
122 et al., 2014; Yee, Fuller-Thomson, et al., 2012), which can preclude them to initiate a discussion about FP with
123 a patient (Adams et al., 2013; Forman et al., 2010; King, Davies, Roche, Abraham, & Jones, 2012). Many
124 clinicians also reveal their lack of **communication skills**, referring feeling uncomfortable when discussing
125 fertility with their patients (Goossens et al., 2014), and frequently, the patient him/herself needs to raise the
126 topic (Yee, Abrol, McDonald, Tonelli, & Liu, 2012). **Patient-related issues** have also been documented as an
127 obstacle to oncologists' engagement in FP discussions. Clinicians' practices depend on patients' clinical
128 variables because they are less likely to discuss FP with patients with a poor prognosis, in emergent need to start
129 cancer therapy or with low cancer-related infertility risk (Adams et al., 2013; Loren, Brazauskas, et al., 2013;
130 Overbeek et al., 2014; Peddie et al., 2012). Oncologists also highlight that cancer patients who face a severe
131 illness are not interested in fertility and that this is a reason to not initiate a discussion about this topic (Shimizu
132 et al., 2013; Yee, Fuller-Thomson, et al., 2012). The same has been reported concerning certain socio-
133 demographic variables, with clinicians being less likely to discuss FP with female patients, those under the age
134 of majority, those who are single, homosexual or who already have children (Adams et al., 2013; Peddie et al.,
135 2012; Yee, Abrol, et al., 2012). In addition, many oncologists express being extremely pressured to consult a
136 great number of patients in a shorter amount of **time**, with topics beyond the cancer diagnosis and treatment
137 becoming a lower priority (Adams et al., 2013; Loren, Brazauskas, et al., 2013; Overbeek et al., 2014; Shimizu
138 et al., 2013). In fact, some prior studies found that time was the most commonly barrier to FP practices cited by
139 oncologists, after their lack of knowledge about the topic (Quinn et al., 2007). Finally, **financial** barriers have
140 also been presented as important by most prior surveys (Forman et al., 2010; Gilbert et al., 2011; Loren,
141 Brazauskas, et al., 2013). However, it is important to note that financial barriers were reported in studies
142 conducted in countries where the National Health System does not fund FP procedures.

143 Despite the significant findings to date, there are some gaps in the literature that must be addressed. First,
144 most of the existing studies rely on descriptive data about the oncologists' perceptions regarding the relevant
145 barriers to their FP practices but do not examine which of the different oncologists' perceived barriers to FP
146 discussion have a greater impact on the real FP practices documented by the physicians; thus, what are the most
147 influencing barriers of oncologists' FP practices remains unknown. Moreover, most of the existing studies are
148 performed in countries with a different context regarding female FP (e.g., Australia, Cancer Council Australia,
149 2010; United States of America, Lee et al., 2006; United Kingdom, Royal College of Physicians, The Royal
150 College of Radiologists, & Royal College of Obstetricians and Gynecologists, 2007), when compared with the
151 Portuguese context. First, in these countries, female FP is offered to patients for more than twenty years ago; in
152 Portugal, the female FP start being offered in 2010 in just one clinical institution (Melo, Canavarro, & Almeida-
153 Santos, 2017). Second, and in contrast with these countries, the first Portuguese clinical guidelines regarding the
154 FP practices were just developed and published in 2017 (Almeida-Santos et al., 2017). Third, in these countries,
155 FP costs are mostly covered by the patients or by insurance or there are restrictions on access to public
156 assistance coverage; in Portugal, the National Health System covers all the FP procedures for all cancer patients
157 with no exceptions (Assembleia da República Portuguesa, 2015). Thus, given these specificities it is important
158 to better understand the oncologists' FP practices in the Portuguese context, which may be similar to other
159 countries where FP techniques and guidelines for physicians are recently implemented and where the financial
160 costs for patients are not a possible barrier.

161 Therefore, the main purposes of this study are the following: (1) to assess the current practice patterns of a
162 sample of oncologists with different clinical specialties regarding the reproductive future of female cancer
163 patients of childbearing age (i.e., the frequency of informing about the risk of cancer-related infertility, the
164 frequency of informing about FP, the number of patients referred to a reproductive medicine doctor); (2) to
165 describe the strength of the endorsement of different barriers to oncologists' FP practices (i.e., the oncologists'
166 knowledge of FP, the oncologists' communication skills, patient-related factors and time with patients); (3) to
167 examine the role of the oncologists' individual characteristics (i.e., gender, age and clinical specialty) in their
168 female FP practices and in the strength of endorsement of the barriers to these practices; and (4) to determine
169 the relationship between the strength of endorsement of different barriers and FP practices.

170

171 **Methods**

172 *Procedures*

173 The present cross-sectional study was part of a larger research project that was approved by the Ethics
174 Committee of [Blind for Review], a large Portuguese university-based hospital, and followed the ethical
175 standards and procedures for research with human beings (e.g., Helsinki Declaration; American Psychological
176 Association, 2010; World Medical Organization, 2000).

177 The inclusion criteria were being a doctor who assists female cancer patients of childbearing age in a
178 Portuguese clinical institution and having knowledge and understanding of Portuguese to complete the survey.
179 A total of 111 male and female doctors who assist female cancer patients at clinical institutions in Portugal were
180 recruited face-to-face ($n = 37$; 78% response rate, based on the total number of surveys delivered) and online (n
181 = 74) between May 2013 and December 2015. Face-to-face recruitment was performed at clinical institutions
182 and scientific medical meetings. At clinical institutions, we have identified all the oncologists who assisted
183 female cancer patients in each of the clinical institutions participating in the study ([Blind for Review]), and all
184 of them were individually approached by a researcher to be invited to participate in the study; at scientific
185 meetings, the recruitment was conducted on the basis of random interception. In both cases, the participants
186 were given the survey in an envelope and instructed to complete it at that moment or later and to return it to the
187 researchers in a pre-addressed sealed envelope. Online recruitment was performed through a secure internet-
188 based survey (hosted by <http://www.limesurvey.com/>) whose web link was advertised on Facebook groups of
189 physicians and through pamphlets that were provided to the oncologists at clinical institutions and scientific
190 medical meetings. The web link to the online survey was also promoted by e-mail by the Portuguese Society of
191 Oncology to all of its members. Participation was voluntary, and no remuneration was provided.

192 All participants were given information concerning the research goals, the anonymity of the answers
193 provided, the participants' role and the researchers' obligations, and they expressed their consent in participating
194 in the study before completing the survey.

195

196 ***Measures***

197 The questionnaire was specifically developed for the present study by the research team, including two
198 psychologists and a reproductive medicine doctor with clinical experience in FP, based on prior studies. The
199 questionnaire was previously piloted with 10 oncologists with different clinical specialties (e.g., gynecology,
200 general oncology and hematology), so that the items could be examined and revised for clarity and
201 comprehensibility before the beginning of the study. The final self-report questionnaire took approximately 5
202 minutes to complete and included the following measures.

203

204 *Socio-demographic and clinical practice-related information*

205 Socio-demographic (gender, age) and clinical practice-related (clinical specialty, the number of female
206 cancer patients of childbearing age assisted per year) data were collected.

207

208 *Practices regarding female FP*

209 Practices regarding FP were assessed by two questions that were answered using a 5-point Likert scale
210 ranging from 0 (*Never*) to 4 (*Always*) and one open-ended question. These questions were developed based on
211 those previously used by other authors (Forman et al., 2010; Zapzalka, Redmon, & Pryor, 1999) and were the
212 following: 1) frequency of informing about the risk of cancer-related infertility – “How often do you inform
213 your female cancer patients of childbearing age about the potential impact of cancer treatment on their
214 fertility?”; 2) frequency of informing about FP – “How often do you inform your female cancer patients of
215 childbearing age who are at risk of cancer-related infertility about the possibility to preserve their fertility?”; and
216 3) number of patients referred to a reproductive medicine doctor (i.e., in Portugal, this is the fertility specialist to
217 whom patients need to be referred to discuss FP, make a decision about it, and implement their decision) –
218 “How many female cancer patients of childbearing age do you remember referring to a reproductive medicine
219 doctor to preserve their fertility in all your years of clinical practice?”.

220

221 *Barriers to practices regarding female FP*

222 Barriers to practices regarding female FP were assessed by the question “How much do you identify with the
223 following sentences?”, and clinicians were asked to evaluate their agreement with the items using a 5-point
224 Likert scale ranging from 0 (*Entirely disagree*) to 4 (*Entirely agree*). This measure consisted of 17 items that
225 were developed based on those used in prior studies (Adams et al., 2013; Gilbert et al., 2011; King et al., 2012;
226 Schover et al., 2002), and they were organized along four dimensions, with each referring to a different type of
227 barrier to oncologists’ practices regarding FP that has already been described in the existing literature: 1)
228 oncologists’ knowledge of FP (five items; e.g., “I do not know reproductive medicine doctors to whom to refer
229 patients for FP.”); 2) oncologists’ communication skills (two items; e.g., “I only inform the patient about the
230 risk of cancer-related infertility when she initiates the topic.”); 3) patient-related factors (nine items; e.g., “I do
231 not inform the patient about the risk of cancer-related infertility when she already has children.”); and 4) time
232 with patients (1 item; “I have little available time with the patients to discuss the risk of cancer-related

233 infertility.”). The total score of each dimension was the mean score of its items, with higher total scores
234 indicating a stronger endorsement of that barrier theme by the oncologists.

235

236 *Statistical analyses*

237 Analyses were conducted using IBM Statistical Package for the Social Sciences, version 23.0 (SPSS Inc.,
238 Chicago, IL, USA).

239 Descriptive statistics were calculated to explore the sample characteristics (gender, age, clinical specialty)
240 and also to describe the oncologists’ practices regarding FP and the barriers to these practices. Taking into
241 account the heterogeneity of clinical specialties, the less frequent specialties (i.e., urology, general surgery,
242 medicine, dermatology, pneumology, nephrology, endocrinology) were recoded together in the category of
243 “Other”. Spearman bivariate correlation coefficients were computed to explore the associations among the
244 different oncologists’ practices regarding FP and to explore the associations among the oncologists’ strength of
245 endorsement of the different barriers to these practices. The strength levels of these associations were classified
246 as “small” for correlations lower than .30, as “moderate” for those higher than .30 and lower than .50, and as
247 “strong” for those at .50 or higher (Cohen, 1988).

248 A repeated-measures ANOVA (i.e., analysis of variance) was used to compare the oncologists’ relative
249 strength of endorsement of the different barriers to FP practices (barrier themes as the within-subjects factor).
250 Contrast analyses (Deviation method; the effect of each category, except the first, is compared to the overall
251 experimental effect; Field, 2013) were conducted to specify the nature of the differences.

252 To examine the role of the oncologists’ individual characteristics (gender, age and clinical specialty) in their
253 female FP practices and in the strength of their endorsement of these barriers to these practices, comparison tests
254 (*t* and Kruskal-Wallis tests) were used. Age was converted into a categorical variable (*0* = 40 years old or less
255 and *1* = more than 40 years old). Effect size measures were presented for the comparison analyses (small: $\eta^2 \geq$
256 .01, $d \geq .20$, $V = .01$; medium: $\eta^2 \geq .06$, $d \geq .50$, $V = .03$; large: $\eta^2 \geq .14$, $d \geq .80$, $V = .05$; Cohen, 1988).

257 Finally, two multiple linear regressions (Enter method) were performed to evaluate the relationships between
258 the oncologists’ strength of endorsement of each barrier theme and their practices regarding FP. These were
259 performed separately for each dependent variable (frequency of informing about the risk of cancer-related
260 infertility, frequency of informing about FP), but all of the predictors (oncologists’ knowledge of FP,
261 oncologists’ communication skills, patient-related factors, time with the patients) were included together in the

262 regression model. The effect sizes of the main effects were based on R^2 values, considering $R^2 \geq .02$ to be small,
263 $R^2 \geq .13$ to be medium and $R^2 \geq .26$ to be large effects (Cohen, 1992).

264 For all of the previously described analyses, the significance level was set at $p < .05$, and these results are
265 reported and discussed.

266

267 **Results**

268 ***Preliminary analyses***

269 The findings showed no significant differences between the participants recruited face-to-face and those
270 recruited online in terms of their socio-demographic characteristics [gender: $\chi^2(1) = 0.18, p = .673, V = .04$];
271 age: $t(109) = -0.10, p = .916, d = .02$], practices regarding female FP [frequency of informing about the risk of
272 infertility: $t(106) = -1.02, p = .309, d = .021$; frequency of informing about FP $t(69.19) = 1.68, p = .098, d = .34$;
273 number of patients referred to a reproductive medicine doctor: $t(101) = -1.09, p = .277, d = .26$], and barriers to
274 these practices [oncologists' knowledge of FP: $t(109) = 0.17, p = .868, d = .04$; oncologists' communication
275 skills: $t(109) = 0.64, p = .522, d = .13$; patient-related factors: $t(109) = 1.31, p = .194, d = .26$; time with
276 patients: $t(109) = 1.14, p = .259, d = .23$]. Taking into account the lack of significant differences between these
277 two samples, they can be analyzed together as a whole.

278

279 ***Participants***

280 The sample consisted of 111 doctors who assist female cancer patients at clinical institutions in Portugal.

281 Two thirds of the oncologists were women ($n = 72, 64.90\%$) and had a mean age of 42.97 years old ($SD =$
282 11.43). The most frequent clinical specialty was general oncology [$n = 47, 42.30\%$; with a mean number of
283 female cancer patients assisted per year of 55.74 ($SD = 56.93$, ranging from 3 to 250)], followed by gynecology
284 [$n = 30, 27.00\%$; with a mean number of female cancer patients assisted per year of 98.46 ($SD = 174.10$, ranging
285 from 3 to 880)] and hematology [$n = 15, 13.50\%$; with a mean number of female cancer patients assisted per
286 year of 24.67 ($SD = 14.33$, ranging from 4 to 50)]. The less frequent clinical specialists were grouped together in
287 the "Other" category [$n = 19, 17.10\%$; with a mean number of female cancer patients assisted per year of 75.89
288 ($SD = 120.21$, ranging from 0 to 400)].

289

290 ***Practices of oncologists regarding FP***

291 Two thirds of the oncologists revealed taking FP discussions into consideration in their clinical practice;
292 65,7% ($n = 71$) of these clinicians very often or always inform their female cancer patients about the risk of
293 cancer-related infertility, and 59,3% ($n = 64$) very often or always inform them about FP. However, 2,8% ($n =$
294 3) and 7,2% ($n = 8$) of the oncologists reported never informing their female cancer patients of childbearing age
295 about their risk of cancer-related infertility and about FP options, respectively.

296 Moreover, the oncologists reported that, in all their years of clinical practice, they have referred, on average,
297 7,38 ($SD = 13.22$, ranging from 0 to 100) female cancer patients to a reproductive medicine doctor to make a
298 decision about FP. A great proportion of clinicians (75.80%, $n = 78$) reported that they had referred fewer than
299 ten female cancer patients, and 18 (17.50%) oncologists indicated that they had never referred any female
300 cancer patient to a reproductive medicine doctor.

301 Significant and positive correlations between oncologists' practices about FP were found. Specifically, a
302 higher frequency of informing about the risk of cancer-related infertility was strongly associated with a higher
303 frequency of informing about FP ($r = .77, p < .001$) and moderately associated with a higher number of patients
304 referred to a reproductive medicine doctor ($r = .42, p < .001$). A higher frequency of informing about FP was
305 also moderately associated with a higher number of patients referred to a reproductive medicine doctor ($r = .34,$
306 $p < .05$).

307

308 ***Barriers to oncologists' practices regarding FP***

309 **Table 1** presents information about the explored barriers to the oncologists' practices regarding FP.

310 [Insert_table_1_about_here]

311 A significant multivariate effect was found for these barriers [Pillai's Trace = 0.54, $F(3, 108) = 41.87, p <$
312 $.001, \eta^2 = .54$], suggesting that there were differences concerning the oncologists' relative strength of
313 endorsement of such barriers. Specifically, compared to the other barriers, time with patients was significantly
314 strongly endorsed ($p < .050, \eta^2 = .43$), and oncologists' knowledge about FP was significantly poorly endorsed
315 ($p < .001, \eta^2 = .43$) by the oncologists.

316 Additionally, the strength of endorsement of the barrier themes proved to be weakly to strongly positively
317 associated with each other.

318

319 ***The role of the oncologists' individual characteristics in their practices regarding FP and in the strength***
320 ***of endorsement of the barriers to these practices***

321 **Table 2** presents information about the role of the oncologists' individual characteristics (i.e., gender, age,
322 clinical specialty) in their practices regarding FP (i.e., frequency of informing about the risk of cancer-related
323 infertility, frequency of informing about FP) and in the strength of endorsement of the barriers to these
324 practices.

325 [Insert_table_2_about_here]

326 Significant age differences concerning the frequency of informing female cancer patients about FP were
327 found. Older oncologists reported informing about FP more frequently than younger oncologists. Moreover, age
328 differences concerning the barrier theme of "oncologists' communication skills" were also found, with younger
329 clinicians strongly endorsing this barrier to their practices regarding FP compared to older clinicians. No
330 significant differences were found concerning the remaining individual characteristics.

331 Moreover, significant and positive correlations between oncologists' practices regarding FP were found for
332 all the clinical specialties. The association between the frequency of informing about the risk of cancer-related
333 infertility and the frequency of informing about FP ranged from .66 ("Oncology", $p < .001$) and .85 ("Other", p
334 $< .001$). The association between the frequency of informing about the risk of cancer-related infertility and the
335 number of patients referred to a reproductive medicine doctor ranged between .47 ("Oncology", $p < .01$) and .65
336 ("Other", $p < .01$). Finally, the association between the frequency of informing about FP and the number of
337 patients referred to a reproductive medicine doctor ranged between .34 ("Oncology", $p < .05$) and .55 ("Other",
338 $p < .05$).

339 The association between the mean number of female cancer patients in childbearing age assisted per year
340 and the oncologists' practices regarding FP was only significant for the "other" specialty category of
341 oncologists. For this category, a higher number of patients assisted per year was strongly associated with a
342 higher frequency of informing about the risk of cancer-related infertility ($r = .56, p < .05$).

343

344 ***The relationship between the strength of endorsement of different barrier themes and oncologists'***
345 ***practices regarding the frequency of informing about the risk of cancer-related infertility and FP***

346 **Table 3** presents the regression models predicting the oncologists' practices regarding the frequency of
347 informing about the risk of cancer-related infertility and FP. The overall models were significant and explained
348 between 8% and 31% of the variance.

349 A stronger endorsement of oncologists' communication skills as a barrier to the practices regarding FP
350 predicted a lower frequency of both informing female cancer patients about the risk of cancer-related infertility

351 and informing about FP. A stronger endorsement of the “patient-related factors” barrier theme also predicted a
352 lower frequency of informing about cancer-related infertility risk.

353 [Insert_table_3_about_here]

354

355 **Discussion**

356 The main findings of this study are: (1) although the majority of the Portuguese oncologists reported very
357 often or always informing their female cancer patients of childbearing age about their risk of cancer-related
358 infertility and FP, there were still some practitioners who do not take a discussion of FP into consideration in
359 their clinical practice; (2) in all their years of clinical practice, most of these clinicians have referred fewer than
360 ten female cancer patients to a reproductive medicine doctor to make a decision about FP; (3) although lack of
361 time with patients was the strongest endorsed barrier to oncologists’ FP practices of discussion, the lack of
362 oncologists’ communication skills and patient-related factors seem to be the barriers that were more associated
363 with their practices regarding FP; and (4) older oncologists reported informing about FP more frequently, and
364 they weakly endorsed “oncologists’ communication skills” as a barrier to practices regarding FP compared to
365 younger clinicians.

366

367 ***Practices of oncologists regarding FP***

368 Our results showed a discrepancy between the oncologists’ perceptions of discussing FP with their patients
369 and the practice of referring the patient to a fertility specialist. These results are in line with existing research
370 (e.g., Adams et al., 2013) conducted in countries in which the FP is a well-established practice, suggesting that
371 such discrepancy seems to be independent of the contextual specificities. One possible explanation for this
372 discrepancy may be the oncologists social desirability bias, that is, the overestimation of the self-reported
373 oncologists’ practices regarding the frequency of discussing FP with the patients. However, the referral of
374 female cancer patients by the oncologists to make a decision regarding FP with a reproductive medicine doctor
375 may still not be a well-established practice in Portugal, considering that female FP practices are recent in the
376 country and the clinical guidelines for practitioners have been just recently developed and published.

377 Taking into account the existence of female FP options that can be offered to these patients and the existing
378 research that emphasizes the importance of this discussion with them (e.g., Peate et al., 2011; Perz et al., 2014),
379 these results highlight the need to implement strategies that help to generalize the FP discussion and referral
380 practices. Considering the positive associations between the different practices found in the present study, it is

381 expected that increasing the frequency of informing patients about cancer-related infertility will also contribute
382 to increase the frequency of informing about FP and will increase the number of patients referred to a
383 reproductive medicine doctor. Therefore, there is a need to attempt to improve these practices in general.

384

385 ***Barriers to oncologists' practices regarding FP***

386 This is the first study comparing the oncologists' relative strength of endorsement of the different barriers to
387 the FP practices, taking into account that the existing studies only rely on the descriptive oncologists'
388 perceptions regarding the barriers to their FP practices and do not examine which barriers have a greater impact
389 on the FP practices. Our results showed that time with patients was the strongest endorsed barrier and
390 oncologists' knowledge was the weakest endorsed one. In prior qualitative studies with oncologists, the lack of
391 time with patients has also been referred by these practitioners as one of the most important barrier to their FP
392 discussion practices (e.g., Quinn et al., 2007). It is important to note that the Portuguese public health
393 institutions are overwhelmed with a large number of patients and poor human resources to meet their needs, in
394 the context of the National Health System. These oncologists are forced to make a high number of consultations
395 in a short period of time and thus need to decrease the time they spend with each patient. Considering that this
396 can clearly compromise the implementation of the clinical guidelines regarding the treatment of cancer patients
397 and specifically concerning FP, health policies decision makers should reflect about these institutional factors
398 that need to be optimized. The oncologists' lower endorsement of the knowledge regarding FP as a barrier to
399 their practices is an unexpected result, taking into account the previous studies (e.g., King et al., 2012). We can
400 hypothesize that this is already a result of the efforts of Portuguese clinical societies (e.g., the Portuguese
401 Society for Reproductive Medicine, the Portuguese League Against Cancer) in developing several information
402 tools for oncologists in recent years regarding the reproductive future of cancer patients (e.g., pamphlets,
403 websites) (Portuguese Centre for Fertility Preservation, 2015; Silva, Almeida-Santos, Melo, & Rama, 2017), but
404 this can also be a result of the oncologists' inaccurate perception of their own FP knowledge. Future studies are
405 needed to objectively assess the Portuguese oncologists' knowledge about this topic.

406 Moreover, considering that the strength of the endorsement of oncologists' intrinsic barriers (i.e., their
407 knowledge, communication skills, and their subjective perception of discussing fertility with patients with
408 different clinical and socio-demographic characteristics) (Panagiotopoulou, Ghuman, Sandher, Herbert, &
409 Stewart, 2015) proved to be more strongly associated with each other than with extrinsic barriers (lack of time
410 with patients) and that these intrinsic barriers are more related with the oncologists' personal characteristics and

411 can be more easily changed, it becomes clear the importance of developing and implementing effective
412 strategies to overcome these intrinsic barriers together, considering a holistic approach to this matter.

413

414 ***The role of the oncologists' individual characteristics in their practices regarding FP and in the strength***
415 ***of endorsement of the barriers to these practices***

416 Unexpectedly, the present study only found age differences regarding the oncologists' practices, with older
417 oncologists informing their female cancer patients about FP more frequently than younger oncologists. This
418 result is not consistent with previous studies, which have found that younger oncologists inform more frequently
419 about FP than older oncologists (e.g., Yee, Fuller-Thomson, et al., 2012). Two reasons may explain our results.
420 First, older oncologists have more clinical experience, which may be translated in more communication skills in
421 health settings than younger clinicians. In fact, these results are congruent with another novel result of the
422 present study, that younger oncologists more strongly endorse "oncologists' communication skills" as a barrier
423 to the practices regarding FP than older oncologists. Second, in Portuguese health institutions, the first
424 consultations with patients (in which the diagnosis is disclosed, and information concerning treatment side
425 effects and FP is discussed) are commonly performed by more experienced and older oncologists; thus, younger
426 oncologists may not face the opportunity to discuss fertility with their patients as frequently.

427 Considering the positive associations found between the different FP discussion practices for all clinical
428 specialties, it is important to develop strategies for the optimization of these practices for all the doctors that
429 assist female cancer patients. Moreover, only in the less representative clinical specialties (grouped in the
430 "other" category), an association between the mean number of female cancer patients assisted per year and the
431 practices of the oncologists was found. One possible explanation for this result is that, given the wide variation
432 in clinical specialties and in the number of female patients assisted per year, it is possible that the oncologists
433 that assist more female patients were more frequently confronted with the need to inform and discuss about FP
434 topics.

435

436 ***The relationship between the strength of endorsement of different barrier themes and oncologists'***
437 ***practices regarding the frequency of informing about the risk of cancer-related infertility and FP***

438 To the best of our knowledge, this study is the first to examine the relationship between the strength of
439 endorsement of the different barriers by oncologists and their real FP discussion practices. Oncologists' lack of

440 communication skills and patient-related factors proved to predict poorer oncologists' practices of discussion
441 with patients about infertility risk and FP.

442 The moment when a cancer diagnosis is received may be so emotionally overwhelming that the patient's
443 ability to receive and process information is typically impaired. Thus, it is predicted that communication at these
444 moments will be more successful if it is presented by a communicator who is perceived by the patient as
445 appealing (Cacioppo, Cacioppo, & Petty, 2017; Petty & Cacioppo, 1986). Taking into account that the
446 discussion about the reproductive future of the patient occurs near the cancer diagnosis and together with the
447 explanation of the treatment plan and its side effects, it can be assumed that the communication skills of the
448 communicator of this information are essential features. Oncologists need to be direct and appealing, drawing
449 the patient's attention to her own infertility risk and guiding her about FP.

450 Moreover, the discussion of the reproductive future with patients with certain characteristics can be a
451 challenging task for oncologists, taking into account that some of the characteristics raise ethical, moral and
452 legal issues (e.g., the discussion of future infertility with patients with a poor prognosis can be challenging
453 because it raises questions about hope for survival and other emotionally overwhelming issues). Communication
454 skills are even more important in such cases, which is consistent with our previously described finding
455 regarding the strong association between the "patient-related factors" and "oncologists' communication skills"
456 barriers. For these two reasons (i.e., the ethical, moral and legal issues that these discussions can raise and the
457 lack of communication skills), oncologists' practices regarding fertility can be negatively affected. However,
458 oncologists' decisions to discuss fertility with some patients and not to do so with others are subjective, which
459 can lead to a marginalization of some patients' worries about their reproductive future.

460 In addition, it is important to note that lack of time with patients was not found to be a predictor of
461 oncologists' practices regarding FP, despite being the strongest endorsed barrier by these clinicians. This is a
462 particularly innovative and important finding of our study that draws our attention to the fact that oncologists
463 may be less conscious about the intrinsic factors that can undermine their clinical practices. They may be more
464 aware of the impact of institutional factors on their professional performance because, feeling pressured by the
465 health institution, they address it in their everyday professional lives. Despite previous studies found lack of
466 time with patients to be one of the most important barrier for the oncologists (e.g., Quinn et al., 2007), we have
467 to bear in mind that these studies only described these barriers according to the perceptions of the physicians,
468 not examining their association with the real oncologists' practices regarding FP.

469

470 ***Limitations***

471 Despite the important and innovative findings of the present study, which may be generalizable to other
472 countries with a similar context to Portugal regarding the novelty of female FP and procedures costs-free for
473 patients, there are some limitations that must be considered. First, it is important to note certain factors that may
474 undermine the representativeness of the sample, such as the sample size (e.g., some clinical specialties are
475 under-represented), the diversity of recruitment methods and the fact that it was a self-selected sample (i.e.,
476 oncologists with an interest in the topic may be more likely to participate in the study). Second, considering that
477 it was a self-administered questionnaire and that it may occur a social desirability bias leading to an
478 overestimation of the real practices regarding FP, our results must be regarded as an indication of oncologists'
479 perceptions about their practices and their endorsed barriers. Finally, this was a cross-sectional study, and its
480 results do not demonstrate causality and must be interpreted with caution.

481 Future research that uses a larger sample of oncologists with different clinical specialties is a next logical
482 step. To replicate this study in other countries with oncologists from the National Health System and with those
483 from the private practice would also be helpful to examine the differences in terms of the most important
484 barriers to the FP practices, in order to better optimize them in the distinctive institutional contexts. It would
485 also be important to cross these results with data from female cancer patients regarding their experience
486 regarding the information about their reproductive future and FP that they received. Finally, it would be relevant
487 to assess the practices of other health professionals (e.g., nurses, psychologists) that also contact with cancer
488 patients and that can help to promote a better decision-making process regarding FP.

489

490 ***Implications for practice***

491 This study highlighted and extended existing findings regarding the extreme importance of promoting better
492 FP discussion and referral practices among oncologists, in order to promote a shared decision-making process
493 regarding FP and, consequently, a better quality of life of the patients in survivorship (Letourneau et al., 2012).
494 Moreover, this study adds novel results to the literature which can give us more clues about how to promote
495 better physicians' practices in Portugal, and in other countries with National Health System and where female
496 FP techniques are just recently being offered to patients.

497 Oncologists' communication skills and patients-related factors proved to be the barriers mostly associated
498 with FP practices, but lack of time is perceived by these clinicians as the most important one. Despite
499 strengthening the importance of implementing changes in health policies in order to overcome institutional gaps

500 that are limiting the implementation of the clinical guidelines regarding FP, this data mostly draw our attention
501 to the importance of supporting oncologists in their adaptation to this new field of intervention, namely of
502 helping them to be more conscientious about the role of their own intrinsic barriers on their FP discussion and
503 referral practices. Furthermore, the development of active education networks for oncologists is crucial, namely,
504 to increase their knowledge about FP (e.g., development/adaptation of easy to use software for the calculation of
505 patient infertility risk and of methods of contact with a fertility specialist to clinical cases discussion), to
506 improve their communication skills and to adjust their perceptions of the patient-related factors that do not allow
507 them to discuss this topic (e.g., development/implementation of training sessions for oncologists in health
508 institutions). Specifically, younger oncologists need to be more involved in the FP discussion, considering their
509 strongest endorsement of the lack communication skills as a barrier to their practices. Within this context, the
510 cooperation of other disciplines, such as Psychology, may be important in contributing to the education of the
511 oncologists regarding the impact that their intrinsic barriers can have in their clinical practice, in promoting
512 oncologists' self-knowledge, and in the training of oncologists' communication skills, that should start in their
513 early years of medical training.

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657 **List of tables**

658 **Table 1.** Barriers to oncologists' practices regarding FP.

659 **Table 2.** The role of oncologists' individual characteristics in their practices regarding FP and in the strength
660 of endorsement of the barriers to these practices.

661 **Table 3.** Predictors of oncologists' practices regarding FP.

662

Table 1. Barriers to oncologists' practices regarding FP (n = 111).

	<u>Entirely disagree</u>	<u>Slightly agree</u>	<u>Somewhat agree</u>	<u>Mostly agree</u>	<u>Entirely agree</u>	<u>Dimension</u>
	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>	<i>M (SD) Min-M</i>
Oncologists' knowledge of FP						0.38 (0.45) 0-1
1. <i>The success rates of the FP techniques are so low, that it is not important to refer patients to a reproductive medicine doctor.</i>	77 (69.40)	27 (24.30)	5 (4.50)	0	2 (1.80)	
2. <i>I do not discuss fertility with my cancer patients, taking into account the risk of a cancer recurrence and/or of offspring malformations.</i>	74 (67.30)	27 (23.70)	7 (6.10)	1 (0.90)	1 (0.90)	
3. <i>Most of the FP techniques are still experimental, so I should not refer cancer patients to a reproductive medicine doctor.</i>	78 (70.30)	28 (25.20)	5 (4.50)	0	0	
4. <i>I do not discuss the risk of cancer-related infertility with my patients, because I do not know where to refer them.</i>	80 (73.40)	19 (17.40)	8 (7.30)	2 (1.80)	0	
5. <i>I do not know reproductive medicine doctors where to refer patients to FP.</i>	86 (77.50)	15 (13.50)	8 (7.20)	0	2 (1.80)	
Oncologists' communication skills						0.79 (0.78) 0-3
6. <i>I only inform the patient about the risk of cancer-related infertility when she initiates the topic.</i>	68 (61.80)	29 (26.40)	10 (9.10)	3 (2.70)	0	
7. <i>I feel comfortable discussing the risk of cancer-related infertility with my cancer patients.^a</i>	39 (35.10)	41 (36.90)	20 (18.00)	8 (7.20)	3 (2.70)	
Patient-related factors						0.85 (0.50) 0-2
8. <i>Cancer patients are not interested in the fertility topic, because they are facing a severe illness. So I do not talk about it.</i>	75 (67.60)	22 (19.80)	8 (7.20)	5 (4.50)	1 (0.90)	
9. <i>I only inform patients about the risk of cancer-related infertility when they are married.</i>	86 (78.90)	21 (19.30)	2 (1.80)	0	0	
10. <i>I discuss the risk of cancer-related infertility with all my cancer patients.^a</i>	27 (24.80)	37 (33.90)	30 (27.50)	10 (9.20)	5 (4.60)	
11. <i>I do not discuss the risk of cancer-related infertility with patients with a bad prognosis.</i>	21 (19.10)	28 (25.50)	31 (28.20)	22 (20.00)	8 (7.30)	
12. <i>I do not discuss the risk of cancer-related infertility with patients under de age of majority.</i>	80 (75.50)	15 (14.20)	6 (5.70)	1 (0.90)	4 (3.80)	
13. <i>I do not discuss the risk of cancer-related infertility with patients in emergent need to start cancer therapy.</i>	55 (50.00)	24 (21.80)	22 (20.00)	5 (4.50)	4 (3.60)	
14. <i>I do not inform the patient about the risk of cancer-related infertility when she already has children.</i>	71 (64.50)	23 (20.90)	11 (10.00)	5 (4.50)	0	
15. <i>I do not inform the patient about the risk of cancer-related infertility when she is homosexual.</i>	72 (66.10)	26 (23.90)	7 (6.40)	1 (0.90)	3 (2.80)	
16. <i>I always discuss the risk of cancer-related infertility, even when the patient has a high probability of being fertile after cancer treatment.^a</i>	27 (24.50)	30 (27.30)	26 (23.60)	17 (15.50)	10 (9.10)	
Time with patients						0.91 (1.12) 0-4
17. <i>I have little time available with the patients to discuss the risk of cancer-related infertility.</i>	58 (52.30)	20 (18.00)	20 (18.00)	11 (9.60)	2 (1.80)	

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1. Oncologists' knowledge of FP

2. Oncologists' communication skills	.52*		
3. Patient-related factors	.55*	.61*	
4. Time with patients	.25*	.28*	.39*

^a Reversed items.

* $p < .010$

Table 2. The role of oncologists' individual characteristics in their practices regarding FP and in the strength of endorsement of the barriers to these practices.

	Practices regarding FP		Barriers to the practices regarding FP			
	Frequency of informing about risk of cancer-related infertility	Frequency of informing about FP	Oncologists' knowledge of FP	Oncologists' communication skills	Patient-related factors	Time with patients
Individual characteristics						
Gender, <i>M (SD)</i>						
<i>Male</i>	2.74 (1.19)	2.59 (1.41)	0.39 (0.48)	0.82 (0.88)	0.89 (0.48)	1.18 (1.23)
<i>Female</i>	2.84 (1.07)	2.54 (1.16)	0.38 (0.44)	0.78 (0.73)	0.84 (0.52)	0.76 (1.04)
<i>t</i>	-0.44	0.21	0.11	0.23	0.52	1.88
<i>p</i>	.664	.832	.916	.819	.604	.063
<i>d</i>	.09	.04	.02	.05	.10	.37
Age, <i>M (SD)</i>						
≤40	2.73 (1.13)	2.33 (1.18)	0.45 (0.46)	0.97 (0.83)	0.91 (0.47)	1.00 (1.13)
>41	2.88 (1.09)	2.75 (1.29)	0.32 (0.44)	0.63 (0.70)	0.81 (0.54)	0.82 (1.12)
<i>t</i>	-0.71	-1.77	1.62	2.34	1.01	0.82
<i>p</i>	.479	.080	.107	.021	.313	.414
<i>d</i>	.14	.34	.29	.44	.20	.16
Clinical specialty, <i>M (SD)</i>						
General Oncology	0.62 (0.49)	0.49 (0.50)	0.36 (0.42)	0.77 (0.74)	0.93 (0.50)	1.17 (1.22)
Gynaecology	0.73 (0.45)	0.67 (0.48)	0.30 (0.37)	0.68 (0.62)	0.75 (0.42)	0.57 (0.90)
Haematology	0.67 (0.49)	0.75 (0.45)	0.54 (0.49)	0.80 (0.77)	0.88 (0.61)	0.93 (1.03)
Other	0.63 (0.50)	0.63 (0.50)	0.45 (0.61)	1.05 (1.06)	0.84 (0.54)	0.79 (1.18)
χ^2	1.16	4.07	2.84	0.940	2.82	5.55
<i>p</i>	.763	.254	.417	.816	.421	.135

Table 3. Predictors of oncologists' practices regarding FP.

	Frequency of informing about the risk of cancer-related infertility	Frequency of informing about FP
	$R^2 = .31$	$R^2 = .26$
	$F(4, 103) = 13.08^*$	$F(4, 103) = 10.41^*$
	$\beta / B (SE)$	$\beta / B (SE)$
Oncologists' knowledge of FP	-0.03 / -0.08 (0.25)	-0.08 / -0.23 (0.29)
Oncologists' communication skills	-0.32 / -0.47 (0.15)**	-0.40 / -0.66 (0.18)*
Patient-related factors	-0.33 / -0.73 (0.24)**	-0.15 / -0.38 (0.28)
Time with the patients	0.07 / 0.07 (0.08)	0.12 / 0.14 (0.10)

* $p < .001$, ** $p < .005$, *** $p < .05$