

Are videoconferenced consultations as effective as face-to-face consultations for hereditary breast and ovarian cancer genetic counseling?

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Purpose: Videoconferencing is increasingly used to deliver family cancer services for hereditary breast and ovarian cancer to outreach areas. This study compared the effectiveness and acceptability of genetic counseling for hereditary breast and ovarian cancer through videoconferencing (hereafter referred to as “telegenetics”). **Methods:** One hundred six women seen by telegenetics and 89 women seen face-to-face completed self-administered questionnaires before, and 1 month after, genetic counseling. Telegenetics consultations involved a genetic clinician via telegenetics in addition to a local genetic counselor present with the patient. **Results:** No significant differences were found between telegenetics and face-to-face genetic counseling in terms of knowledge gained ($P = 0.55$), satisfaction with the genetic counseling service ($P = 0.76$), cancer-specific anxiety ($P = 0.13$), generalized anxiety ($P = 0.42$), depression ($P = 0.96$), perceived empathy of the genetic clinician ($P = 0.13$), and perceived empathy of the genetic counselor ($P = 0.12$). Telegenetics performed significantly better than face-to-face counseling in meeting patients’ expectations ($P = 0.009$) and promoting perceived personal control ($P = 0.031$). **Conclusion:** Telegenetics seems to be an acceptable and effective method of delivering genetic counseling services for hereditary breast and ovarian cancer to underserved areas. *Genet Med* 2011;13(11):933–941.

Key Words: telehealth, videoconferencing, breast cancer, genetic counseling

Family cancer clinics (FCCs), offering genetic counseling for hereditary breast and ovarian cancer (HBOC), have experienced rapid service demand over the past 10 years,¹ highlighting the need for optimal use of scarce resources. Telemedicine, using videoconferencing in the genetic counseling setting (hereafter termed “telegenetics”), is a potentially viable alternative to

traditional face-to-face genetic counseling, possibly offering cost and time saving benefits to both patients and health practitioners.^{2–4} Several pilot studies have evaluated telegenetics^{5–11} and the use of videoconferencing in oncology consultations.^{12–15} The studies to date, however, have been restricted by small sample sizes¹⁶ and, thus, limited statistical power to detect clinically significant changes over time or differences between the telegenetics and or face-to-face groups.⁸

To assess whether telegenetics is in fact a viable alternative to traditional face-to-face genetic counseling, a comparative evaluation was undertaken as part of a larger study assessing telegenetics for HBOC.^{2,17} Traditional face-to-face genetic counseling has been shown to be effective at increasing genetic knowledge,¹⁸ accuracy of risk perception,¹⁹ patient satisfaction,²⁰ and decreasing anxiety and depression.²¹ It was hypothesized that telegenetics was at least as effective as face-to-face genetic counseling in improving patient outcomes.²²

METHODS

Participants and recruitment

Women with a moderate or potentially high-risk family history of HBOC,²³ seeking genetic counseling for the first time from one of three FCCs or one of four affiliated outreach genetic counseling services in New South Wales, an Australian State and the Australian Capital Territory, between December 2007 and December 2009 were invited to participate. Of those attending an outreach service with a genetic counselor, only women scheduled to see a genetic clinician (clinical geneticist and/or other medical specialist such as oncologist or surgeon with additional training in genetics) by telegenetics were eligible to participate in the telegenetics group. Participants attending a metropolitan FCC were recruited to the face-to-face control group. For both groups, women who were younger than 18 years or unable to give informed consent, or had low levels of English literacy (as data collection was based on self-administered questionnaire), were ineligible to be included in the study. The study was approved by the six institutional review boards responsible for the recruitment sites, and signed informed consent was obtained.

Eligible women were informed about the study by the local genetic counselor at their first preclinic contact. The research coordinator then contacted prospective participants by telephone. Those wishing to participate were subsequently mailed an information sheet, consent form, and the baseline questionnaire with a reply-paid envelope to be completed before attending their genetic counseling appointment. Follow-up questionnaires were mailed 1-month postconsultation. This time frame was chosen to facilitate comparisons with several other studies

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that assessed the efficacy of face-to-face cancer genetic counseling and used the same follow-up time frame.¹⁹

MEASURES

The following measures were administered to both groups at baseline only:

Demographic and consultation characteristics

Data on age, educational level, marital status, medical or allied health training, employment status, and number of biological children were assessed. Data relating to the family risk, and the number of occasions of service were recorded by the genetic counselors. No accurate data were available on the amount of time spent with each patient with the genetic counselor and/or the genetic clinician, and thus, “occasions of service” was used as a proxy measure of consultation time. Occasions of service refers to the number of consultations (including telephone consultations) a patient has with the genetic counselors or genetic clinicians. This variable was included in the study specifically because there was variability in practice across different clinics and most noticeably between outreach and metropolitan clinics.

The following outcome measures were administered to both groups at both baseline and the 1-month follow-up:

Knowledge about breast cancer genetics

Knowledge about breast cancer genetics was measured using a 12-item true/false scale, adapted from previous related research.^{24,25} One score was given for each correct answer (range: 0–12). The scale was found to have high internal consistency in this sample with Cronbach's α of 0.73.

Expectations met

At baseline, women were asked to indicate their response to six possible expectations, and their level of need for nine possible information topics they may want to have covered during their consultation, assessed using a 5-point scale.^{26,27} (0 = no need/not applicable; 4 = high need). At follow-up, women were asked to indicate whether each potential expectation or need had been met. Whether the expectation/need had been met was then recoded on a dichotomous scale (0 = not met/received but not expected, 1 = matching expectation and need met). Total scores ranged from 0 to 15. The reasons for attending genetic counseling scale and the information needs scale were found to have a Cronbach's α of 0.72 and 0.58, respectively.

Perceived personal control

This nine-item validated scale measures participants' subjective perception of their ability to control their situation.²⁸ Items are rated on a 3-point scale, with the total scores ranging from 0 to 18 and higher scores indicating greater perceived control.

Impact of Events Scale

Cancer-specific anxiety was measured using the Impact of Events Scale, a validated measure of the intrusion and avoidance responses toward a stressor, in this case “being at risk for breast/ovarian cancer.”^{29,30} Scores range from 0 to 75, with a score of 40 or more indicative of a significant stress response.³¹

Hospital and Anxiety Depression Scale

The Hospital and Anxiety Depression Scale is a 14-item measure of anxiety and depression.³² It has been used widely in evaluations of genetic counseling, particularly for HBOC.^{27,33,34}

The total range of scores is from 0 to 42, with higher values indicating more anxiety/depression. Scores of 10 or higher on either the anxiety or the depression subscales indicate a level of anxiety or depression warranting clinical intervention.

The following measures were administered at follow-up only:

Medical Interview Satisfaction Scale

General satisfaction with genetic counseling was measured using an 18-item short form of the Medical Interview Satisfaction Scale.^{35,36} It has been used previously in a cancer genetic counseling population.³⁶ Total scores ranged from 0 to 54, with higher scores indicating greater service satisfaction.

Consultation and relational empathy

Consultation and relational empathy is a 10-item scale that measures relational empathy within the consultation.³⁷ It has not previously been used in the cancer genetic counseling setting. Total scores ranged from 0 to 50, with higher scores indicating a higher level of perceived practitioner empathy.

Satisfaction with telegenetics

This was measured in the telegenetics group only using the Telemedicine Satisfaction Questionnaire.³⁸ Telegenetics participants were also asked what style of service delivery, face-to-face or telegenetics, they would prefer, should they require genetic counseling in the future.

Sample size

The study was powered with respect to testing the noninferiority of telegenetics to the control group, i.e., testing whether the telegenetics group is no worse than the control group, for cancer-specific anxiety. Cancer-specific anxiety, as measured by the Impact of Event Scale, was selected as the primary outcome variable as evidence is available that it is a highly sensitive measure of psychological adjustment in women at high risk for breast cancer, and it has been linked to important patient outcomes. For example, high levels of cancer-specific anxiety have been found to adversely impact on comprehension of risk information³⁹; and they are associated with intention to undergo, and actual uptake of, risk-reducing bilateral mastectomy⁴⁰ and with excessive performance of self-breast examination.⁴¹

The noninferiority margin for change in cancer-specific anxiety was set to be 5 units, i.e., the telegenetics group will be considered no worse (noninferior) than the control group if the true difference in mean change scores between the two groups is ≤ 5 units for this outcome.⁴² It was expected that the standard deviation would be 13–15 units.⁴³ For such standard deviations, the noninferiority margin equates to 0.33–0.38 of 1 standard deviation. This is more conservative compared with other noninferiority studies in telemedicine for mental health, which have used a noninferiority margin of 0.5 of 1 standard deviation.⁴⁴

The study aimed to obtain 125 participants in each group (250 in total). This would give 80% power to be able to claim that telegenetics is no worse than face-to-face genetic counseling (i.e., noninferior), with respect to cancer-specific anxiety, assuming the true mean difference between groups was 0 and a standard deviation of 14 units. The power calculation was based on a *t*-test for a noninferiority margin of 5 units. The sample was to be stratified by clinician, with equal numbers of women seen by each clinician within each of the two groups.

Data analysis

Descriptive statistics were used to describe the sample in terms of sociodemographic, clinical, and psychological characteristics. Change scores from baseline to the 1-month follow-up assessment were calculated for all outcome variables (knowledge of HBOC genetics, perceived personal control [PPC], cancer-specific anxiety, generalized anxiety, and depression). For the "Expectations met" variable, the follow-up scores were used for analysis. For several of the outcome variables (knowledge, PPC, cancer-specific anxiety, generalized anxiety, and depression), paired sample *t*-tests were performed to assess changes over time separately for the telegenetics and face-to-face groups.

Highly skewed change scores were recoded into binary variables (low/high). Multiple linear regression was used for normally distributed outcome variables and logistic regression for the recoded binary outcome variables. All regression models included the group variable, the baseline score of the outcome variable being tested, and the following potential confounding variables: age, level of education, cancer status, family risk status, the genetic clinician seen, whether a genetic counselor was present, and the total number of occasions of service. For linear regression models, residuals were checked for normality, and for logistic regression, Lemeshow and Homer's goodness of fit test was calculated.⁴⁵

Noninferiority with respect to change in cancer-specific anxiety will be claimed if the upper limit of the confidence interval for beta (i.e., the mean change score) is <5 , and superiority will be claimed if the upper limit is <0 . All *P* values presented in the article are with respect to testing the null hypothesis that there is no difference between groups (i.e., usual superiority testing).

RESULTS

From December 2007 to December 2009, 308 patients were invited to participate. Forty-seven were excluded for not meeting the inclusion criteria, formally declining, or not responding. One hundred thirty-seven participants were recruited to the telegenetics group, of which 106 (77%) completed both baseline and follow-up questionnaire. One hundred twenty-four participants were recruited to the face-to-face control group, of which 89 (72%) completed both questionnaires (Fig. 1). The target sample size could not be reached due to a slower than expected recruitment rate. This was due to the closure of two outreach

telegenetics clinics and clinical practices in the metropolitan clinics. In particular, at the time of the study, it was accepted practice that the genetic clinician in a metropolitan clinic see complex cases, and standard cases be seen by the genetic counselor alone, leaving fewer than expected potential participants for recruitment. Sociodemographics, family history, and medical characteristics are provided in Table 1. The telegenetics group included significantly more affected women (68%) than the face-to-face group (38%) ($\chi^2 = 15.5$, $P < 0.001$) and had received a greater number of occasions of service ($t_{195} = -4.3$, $P < 0.001$). At baseline, the telegenetics group had significantly higher levels of PPC ($t_{213} = 3.62$, $P < 0.001$) and lower levels of expectations ($t_{216} = -3.96$, $P < 0.001$). There were no other statistically significant differences in the tested variables between the two groups. Although for all telegenetics consultations, the local genetic counselor was present with the patient, and the genetic clinician was present via telegenetics, in face-to-face consultations, the genetic counselor was present in 51% of consultations.

Bivariate analyses to assess changes over time for telegenetics and face-to-face groups separately

Table 2 lists the mean baseline and follow-up outcome scores and change scores separately for the telegenetics and the face-to-face groups. Knowledge about HBOC was high at both baseline (Fig. 2) and follow-up (Fig. 3). At both time points, however, the number of participants reaching a clinically significant level of psychological distress was low (Table 3). Paired sample *t*-tests showed that HBOC knowledge increased significantly over time for both the telegenetics group ($t_{95} = -5.8$, $P < 0.001$) and the face-to-face controls ($t_{86} = -5.5$, $P < 0.001$). Significant decreases in PPC were also achieved for the telegenetics ($t_{86} = -9.4$, $P < 0.001$) and the face-to-face group ($t_{77} = -7.9$, $P < 0.001$). No significant changes were observed for cancer-specific anxiety, generalized anxiety, and depression for either group.

Table 4 lists the results of all linear regressions, when controlling for the potential effects of confounders simultaneously. Telegenetics was found to be equivalent to face-to-face genetic counseling in terms of the primary outcome measure, cancer-specific anxiety ($\beta = -3.89$, 95% confidence interval [CI]: -8.94 to 1.16 , $P = 0.13$).

Because the upper limit of the CIs for the beta coefficient (mean change score) is <5 , we can claim noninferiority of the telegenetics group compared with the face-to-face group with respect to cancer-specific anxiety.

There was no difference between the telegenetics and face-to-face groups with respect to change scores for HBOC knowledge ($\beta = -0.22$, 95% CI: -0.94 to 0.50 , $P = 0.55$), generalized anxiety ($\beta = -0.53$, 95% CI: -1.81 , 0.75 , $P = 0.42$), and depression ($\beta = 0.03$, 95% CI: -1.04 to 1.10 , $P = 0.96$). However, the level of expectations met was higher in the telegenetics groups ($\beta = 1.30$, 95% CI: 0.32 to 2.27 , $P = 0.009$), and there was also a significantly greater increase in PPC in the telegenetics group ($\beta = 1.48$, 95% CI: 0.38 to 2.83 , $P = 0.031$).

Table 5 lists the results of the logistic regressions, which showed no differences between the two groups with respect to general service satisfaction (odds ratio [OR] = -0.14 , 95% CI: -1.06 to 0.77 , $P = 0.76$), perceived genetic clinician empathy (OR = 0.74 , 95% CI: -0.22 to 1.69 , $P = 0.13$), and perceived genetic counselor empathy (OR = -0.76 , 95% CI: -1.73 to 0.20 , $P = 0.12$).

When telegenetics participants were asked what style of service delivery they would prefer if they had to be seen again,

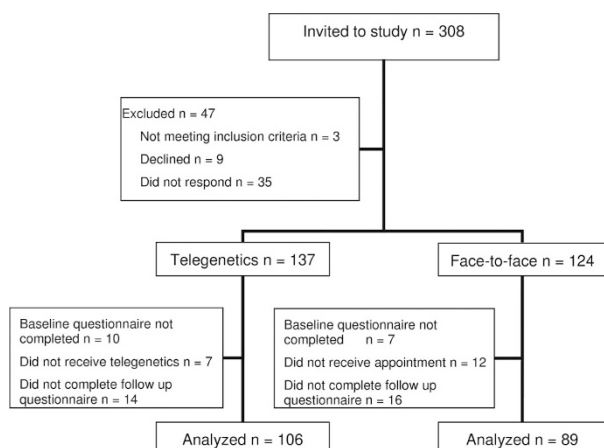


Fig. 1. Progress of participants through the study.

Table 1 Sociodemographics, family history, and medical characteristics of the telegenetics sample and the face-to-face controls

Variables	Level	Telegenetics, N (%)	Face-to-face, N (%)	P
Age ^a		48.8 (13.6)	47.0 (12.5)	0.31
Occasions of service ^a		3.6 (1.9)	2.6 (1.2)	0.001
Marital status	Single	10 (8)	13 (13)	0.10
	Defacto/committed relationship	7 (6)	7 (7)	
	Married	91 (76)	62 (60)	
	Separated/divorced/widowed	12 (10)	20 (19)	
No. biological children	Yes	100 (84)	86 (82)	0.81
	Mean no. girls ^a	1.2 (1.1)	1.0 (0.9)	
	Mean no. boys ^a	1.0 (1.0)	0.9 (0.9)	
Education	HSC or below	26 (22)	21 (20)	0.06
	Trade/certificate	62 (53)	42 (41)	
	Degree/postgraduate	28 (24)	40 (39)	
Employment status	Unemployed	3 (3)	1 (1)	0.65
	Retired/permanently unable to work	23 (19)	18 (17)	
	Home duties	19 (16)	14 (13)	
	Studying	3 (3)	4 (4)	
	Part-time employed	33 (28)	20 (19)	
	Full-time employed	32 (27)	38 (37)	
	Self-employed	6 (5)	9 (9)	
Allied health training	Yes	21 (18)	27 (26)	0.19
Cancer status	Affected	78 (68)	43 (41)	<0.001
	Unaffected	37 (32)	63 (59)	
Family risk status	Moderate	28 (24)	23 (23)	0.88
	High	87 (76)	79 (77)	
Clinician	Clinician 1	93 (78)	38 (36)	
	Clinician 2	25 (21)	14 (13)	
	Clinician 3	1 (1)	54 (51)	

^aMean (SD).

HSC, high school certificate.

7% indicated that they would prefer a face-to-face appointment, 33% preferred telegenetics again, and 59% did not have a preference.

DISCUSSION

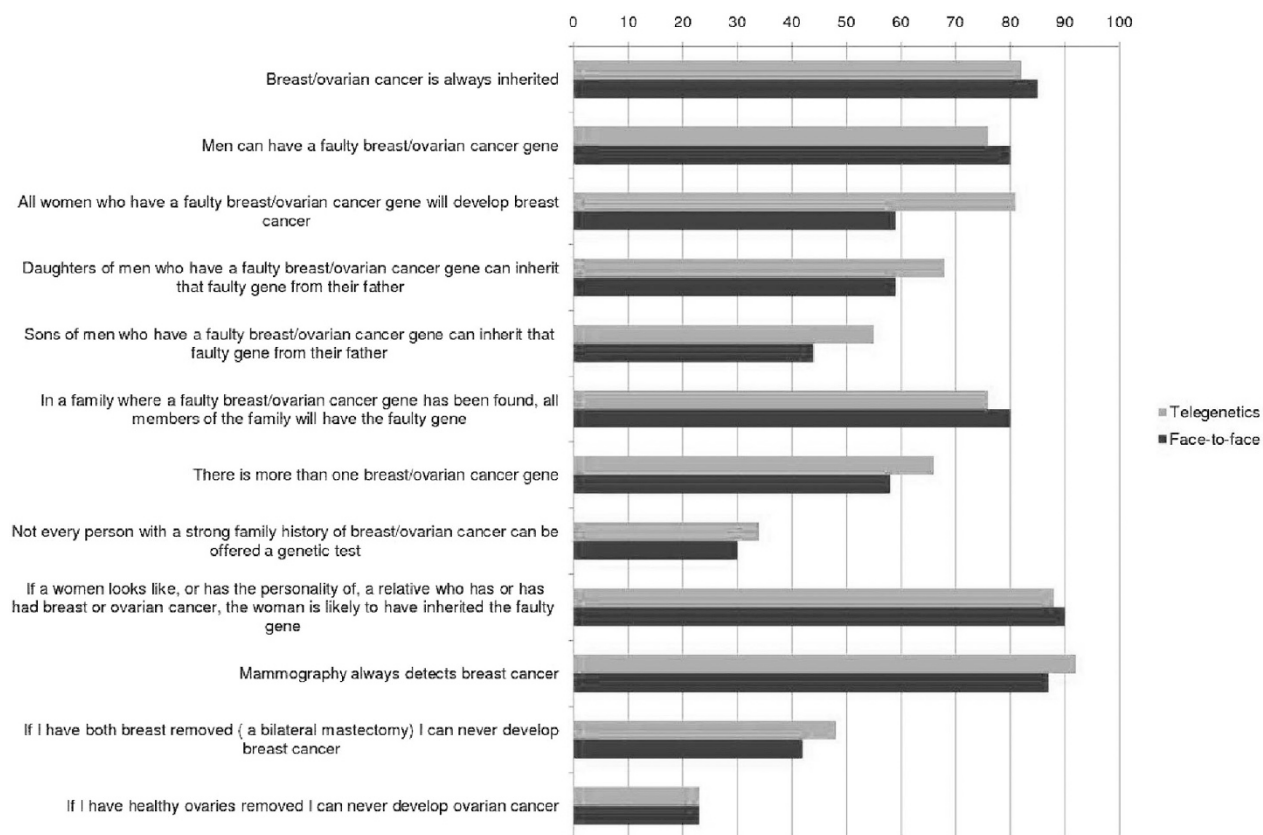
Prior evaluations of telegenetics indicate that it is effective in increasing genetic knowledge^{5,7} and that both patients and practitioners alike are highly satisfied^{8,9,11}; however, these studies have been limited by small sample sizes.^{14–16} Overall, with a larger sample and a comparison group, the results of this study concur with previous research and support the hypothesis that telegenetics was at least as effective as face-to-face genetic counseling across all outcomes measured.

This is the first study known to the authors to measure perceived practitioner empathy as an outcome of genetic counseling. Perceived empathy of both the genetic clinician and the genetic counselor was equivalent in telegenetics when compared with face-to-face counseling. This is reassuring, as the limited ability to build rapport was a concern expressed by genetic clinicians during a study of their experience of delivering telegenetics.¹⁷ We found that telegenetics did not, in fact, interfere with the level of empathy conveyed, confirming the findings of an earlier study, where women who underwent telegenetics reported a high level of rapport with their genetic clinician.⁴⁶

Telegenetics performed better in increasing PPC, which is considered a key psychological outcome of genetic counsel-

Table 2 Mean baseline and follow-up outcome scores for the telegenetics and face-to-face control group

Outcome measure	Telegenetics					Face to face				
	Baseline		Follow-up		Change score mean (SD)	Baseline		Follow-up		Change score mean (SD)
	N	Mean (SD)	N	Mean (SD)		N	Mean (SD)	N	Mean (SD)	
Cancer-specific anxiety	117	20.8 (1.7)	97	17.5 (1.5)	−2.3 (12.9)	104	20.7 (1.5)	88	20.5 (1.7)	−0.2 (14.0)
Knowledge	119	7.7 (2.7)	96	8.7 (2.5)	1.0 (1.8)	106	7.4 (2.9)	89	8.9 (2.4)	1.4 (2.4)
PPC	113	8.0 (3.6)	92	11.5 (3.0)	3.4 (3.3)	102	6.2 (3.6)	82	9.8 (4.0)	3.6 (4.0)
Generalized anxiety	119	6.3 (4.1)	95	5.4 (3.8)	−0.5 (3.1)	104	6.7 (4.6)	86	6.5 (4.2)	−0.5 (3.4)
Depression	119	3.1 (3.3)	95	2.9 (3.3)	0.1 (2.5)	104	3.5 (3.8)	88	3.2 (3.8)	−0.4 (2.7)
Expectations prior and met	—	—	89	11.2 (2.6)	—	—	—	81	10.6 (2.4)	—
Generalized satisfaction with genetic counseling	—	—	87	45.6 (8.4)	—	—	—	84	40.8 (9.9)	—
Telegenetics satisfaction	—	—	97	32.0 (5.4)	—	—	—	—	—	—
Empathy—genetic clinician	—	—	97	41.1 (9.1)	—	—	—	81	41.1 (10.2)	—
Empathy—genetic counselor	—	—	97	45.5 (7.0)	—	—	—	55	43.0 (8.9)	—

**Fig. 2.** Percentage of accurate knowledge at baseline by grouping.

ing.^{47,48} One factor that may account for this findings is the amount of time women in the telegenetics group received with the genetic counselor. Although the number of occasions of service (as a proxy measure of time spent with patient) was controlled for, it was not possible to include the total amount of

time spent with the patient in our analyses as a potential confounder. It is possible that genetic counselors may spend more time providing psychosocial support or may be more skilled as a result of their more intensive training in providing such support,⁴⁹ than genetic clinicians, whose training typically em-

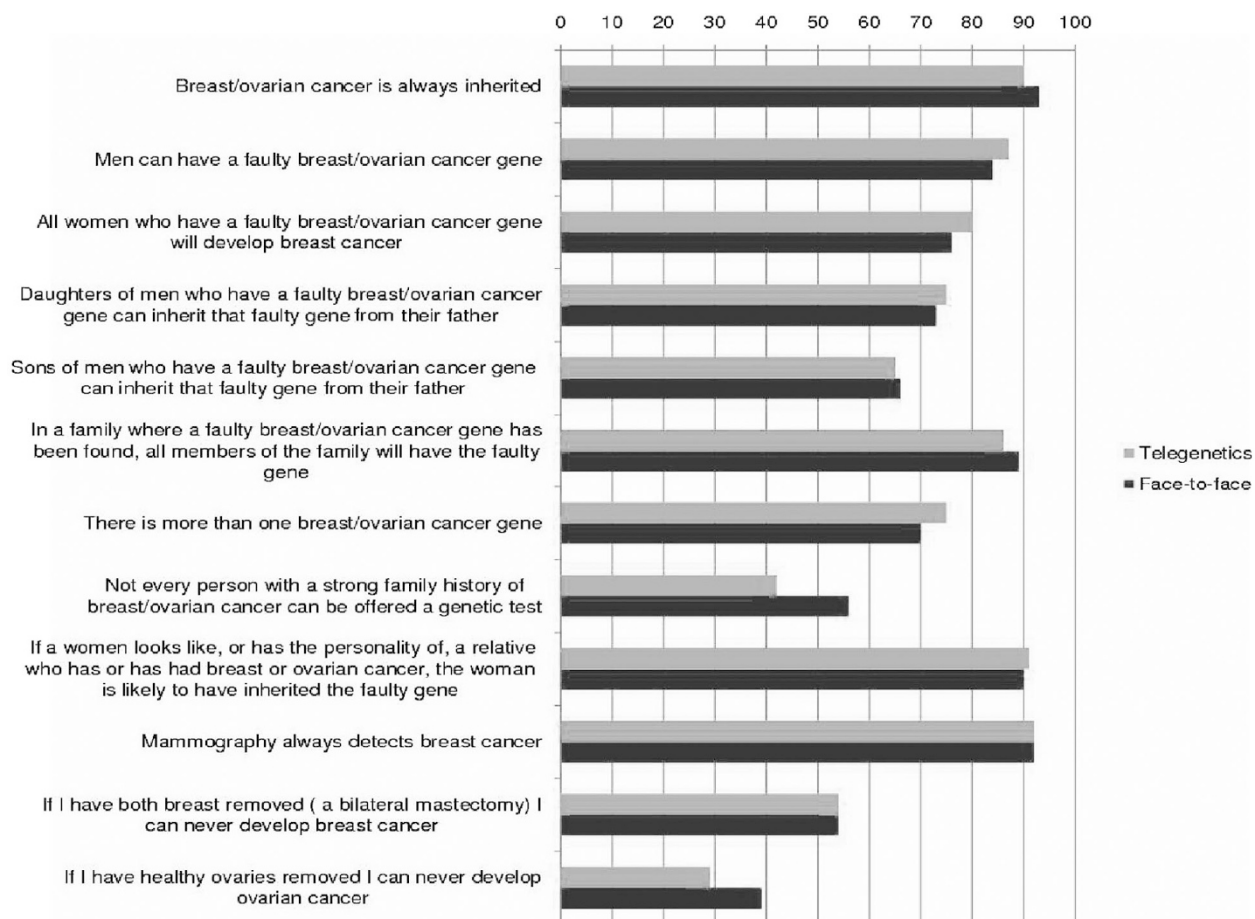


Fig. 3. Percentage of accurate HBOC knowledge by grouping at 1-month follow-up.

Table 3 Number of participants with levels of psychological distress that indicate a need for clinical intervention

Outcome measure	Telegenetics		Face-to-face	
	Baseline, N (%)	Follow-up, N (%)	Baseline, N (%)	Follow-up, N (%)
Total IES (≥ 40)	16 (14)	11 (11)	12 (12)	12 (14)
HADS-A (≥ 11)	14 (12)	7 (8)	18 (17)	10 (11)
HADS-D (≥ 11)	3 (3)	4 (4)	4 (4)	3 (4)

IES, Impact of Events Scale; HADS, Hospital Anxiety and Depression Scale.

phasizes factual knowledge about medical genetics. This in turn may have led to increased PPC in the telegenetics group. What are needed now are studies comparing the counseling process⁵⁰ of telegenetics and face-to-face genetic counseling with document what communication behaviors may account for the differential effects observed in this study.

Overall, telegenetics for HBOC performed as well as, and for several outcomes better than, face-to-face genetic counseling for all outcomes measured. Given its advantages in terms of convenience, clinical effectiveness, and potential cost savings, we can conclude that telegenetics offers a viable alternative

service delivery method to rural and outreach areas. However, our study assessed mean changes in patient outcomes over time, and thus, the findings do not rule out the possibility that telegenetics may be less suitable for certain subgroups of women, such as those with low levels of literacy or those with a recent diagnosis of cancer. Indeed, our qualitative report of women's experiences of telegenetics indicates that telegenetics may be less appropriate when cancer treatment decisions may need to be made rapidly based on a genetic testing result, possibly in the context of increased patient anxiety.⁴⁶

Limitations

This study has several limitations. First, it was designed as a prospective cohort study to describe the current practice in telegenetics in New South Wales and the Australian Capital Territory, Australia; it was not a randomized controlled trial as it would not have been feasible to randomize patients in metropolitan and rural regions to either face-to-face or telegenetics counseling. The telegenetics group included a larger proportion of affected women, compared with the face-to-face group; although disease status was statistically controlled for, it is possible that practitioners varied their counseling style with affected women, as has been previously reported.⁵¹ We did not collect data on who had genetic testing and if and when genetic testing results were received during the follow-up period. It is possible that the test result itself may be a significant confounder of the efficacy of telegenetics. Although patients of

Table 4 Final models of linear regressions

Outcome	B	SE	95% CI	P
Cancer-specific anxiety ^a				
Group status				
Telegenetics	−3.89	2.58	−8.94 to 1.16	0.13
Face-to-face (reference group)				
Disease status				
Unaffected	−6.65	2.35	2.05 to 11.26	0.005
Affected (reference group)				
Baseline cancer-specific anxiety	−0.38	0.07	−0.51 to −0.24	<0.001
Change in hereditary breast/ovarian cancer knowledge ^a				
Group status				
Telegenetics	−0.22	0.37	−0.94 to 0.50	0.55
Face-to-face (reference group)				
Age	−0.03	0.01	−0.05 to 0.00	0.023
Baseline knowledge score	−0.51	0.06	−0.61 to −0.40	<0.001
Meeting expectations ^a				
Group status				
Telegenetics	1.30	0.50	0.32 to 2.27	0.009
Face-to-face (reference group)				
Age	0.04	0.02	0.00 to 0.07	0.049
Baseline expectations	0.40	0.07	0.26 to 0.55	<0.001
Change in perceived personal control ^a				
Group status				
Telegenetics	1.48	0.69	0.13 to 2.83	0.031
Face-to-face (reference group)				
Level of education				0.007
High school or below	−2.38	0.76	−3.87 to −0.89	0.002
College/certificate	−0.91	0.60	−2.08 to 0.27	0.13
Graduate/postgraduate (reference group)				
Disease status				
Unaffected	1.21	0.59	0.06 to 2.36	0.04
Affected (reference group)				
Baseline perceived personal control	−0.55	0.07	−0.69 to −0.40	<0.001
Change in generalized anxiety ^a				
Group status				
Telegenetics	−0.53	0.65	−1.81 to 0.75	0.42
Face-to-face (reference group)				
Baseline generalized anxiety	−0.35	0.06	−0.46 to −0.24	<0.001
Change in depression ^a				
Group status				
Telegenetics	0.03	0.54	−1.04 to 1.10	0.96
Face-to-face (reference group)				
Baseline depression	−0.25	0.06	−0.36 to −0.13	<0.001

^aOnly statistically significant confounder variables are shown for each outcome variable.

Table 5 Final models of logistic regressions

Outcome	OR	95% CI	P
Satisfaction with genetic counseling service			
Group status			
Telegenetics	−0.14	−1.06 to 0.77	0.76
Face-to-face (reference group)			
Number of occasions of service	−0.29	−0.56 to −0.03	0.029
Perceived empathy of genetic clinician			
Group status			
Telegenetics	0.74	−0.22 to 1.69	0.13
Face-to-face (reference group)			
Age	−0.03	−0.06 to −0.00	0.049
Perceived empathy of genetic counselor			
Group status	−0.76	−1.73 to 0.20	0.12
Telegenetics			
Face-to-face (reference group)			
Number of occasions of service	−0.43	−0.74 to −0.13	0.006

^aOnly statistically significant confounder variables are shown for each outcome variable.

OR, odds ratio.

three genetic clinicians were assessed, the majority of the consultations were conducted by only one of these clinicians, which limits the generalizability of the findings. All practitioners delivering telegenetics in this study adopted a model using local genetic counselors onsite with the patient during the consultation. The study does not evaluate alternative models, such as having an alternative health professional present with the patient, and thus, caution must be used when interpreting these results in any other service delivery model. It does, however, reflect standard practice in Australia at the time of the study. The face-to-face group was seen with a genetic counselor present only 50% of the time, and this variation (although statistically controlled for) may have diminished the comparability of the two groups. Furthermore, women were seen by different genetic counselors, and this may have impacted on patient outcomes. The originally planned sample size was not achieved due to slower than expected recruitment rate. Thus, the study was underpowered in terms of the effect size we were planning on detecting. However, effect sizes of 0.5 have been used in similar noninferiority studies in telemedicine⁴⁴ and thus, by comparison, our study had greater power to detect noninferiority. If we had used a noninferiority margin of 0.5 rather than 0.35 of an effect size, we would have had more than 80% power to detect noninferiority. Indeed our study was sufficiently powered to detect significant differences between the telegenetics and face-to-face groups on two of the secondary outcome variables.

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