Accuracy of recall of information about a cancer predisposing *BRCA1/2* gene mutation amongst patients and relatives

Running title: Accuracy of information about a *BRCA1/2* mutation

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ABSTRACT

This observational study aimed to i) compare accuracy of information recalled by patients and relatives following genetic counselling about a newly identified *BRCA1/2* mutation; ii) identify differences in accuracy about genetics and hereditary cancer and iii) investigate whether accuracy amongst relatives improved when information was provided directly by genetics health professionals. Semi-structured interviews following results consultations with 10 breast/ ovarian cancer patients and 22 relatives were audio-recorded and transcribed. Information provided by the genetics health professional was tracked through the families and coded for accuracy. Accuracy was analysed using the Wilcoxon Signed Ranks test. Sources of information were tested using a Spearman's rank order correlation coefficient. 53% of the information recalled by patients was accurate. Accuracy of recall amongst relatives was significantly lower than amongst patients (p=0.017). Both groups recalled a lower proportion of information about hereditary cancer than genetics (p=0.005). Relatives who learnt the information from the patient alone recalled significantly less accurate information than those informed directly by genetics health professionals (p=0.001). Following genetic counselling about a *BRCA1/2* mutation, accuracy of recall was low amongst patients and relatives, particularly about hereditary cancer. Multiple sources of information, including direct contact with genetics health professionals, may improve accuracy of information amongst relatives.

Key words: accuracy, information, *BRCA1/2* mutation, communication, genetic counselling

INTRODUCTION

One of the goals of genetic counselling in the context of familial cancer risk is to provide relevant information in order to enable informed decision-making about genetic testing and risk management [1]. Until recently, genetic testing has generally been offered to women with breast or ovarian cancer after completing cancer treatment. However, *BRCA1/2* testing is increasingly offered to women with newly diagnosed breast cancer as part of their oncology management [2]. Thus the information that the patient understands and recalls about a cancer predisposing gene mutation may impact on treatment decisions as well on as the management of future cancer risks for herself and her relatives [3,4].

Responsibility for sharing information within families once a cancer predisposing gene mutation has been identified generally falls to the individual with cancer who receives the initial mutation result [5]. Families prefer information to be passed on by the patient [6] yet, although most families do appear to communicate genetic information [5], patients do not always share all information with all at risk relatives [7,8]. There are many barriers to family communication about hereditary cancer [9] including lack of close relationship [6], reluctance to upset relatives [10], youth or emotional readiness of relatives [11], family culture [8], perception of the risks and benefits of the information [12] and personal beliefs about the causes of genetic illness [13].

Information about a cancer predisposing gene mutation does not necessarily lead to changes in risk perception [1], although the way in which information is communicated within families may influence uptake of genetic counselling and screening [14] . However at risk individuals who are unaware of the implications of a mutation or the

available screening protocols may be unable to make informed decisions about whether or not to access genetic testing or screening. For example, in the UK untested women at 50% risk of a known *BRCA1/2* gene mutation are eligible for equivalent screening to women with a mutation [15]. Much is still unknown about the content of information that is shared within families or whether the accuracy of the information communicated and recalled impacts on decisions to seek genetic testing or risk management options.

Few studies have investigated the accuracy of the information recalled by cancer patients or their relatives following identification of a *BRCA1/2* gene mutation. A Belgian study of 107 first-degree relatives of 14 patients with a *BRCA1/2* mutation reported low levels of knowledge amongst patients and relatives about hereditary breast and ovarian cancer, dominant inheritance, the availability of predictive testing, cancer risks, risk reducing options and the possibility of prenatal diagnosis [16]. Levels of knowledge about hereditary cancer were found to be higher amongst patients than relatives. More recently a Dutch study found that patients' recall of information about *BRCA1/2* genetic test results was similar to the information provided during genetic counselling but there were few similarities between the information actually communicated to the patient and the information recalled by their relatives [17]. The authors concluded that the information was re-interpreted at each stage of the information transfer, highlighting problems with the accuracy of information communicated to relatives by patients.

Encouraging and facilitating family communication is a key element of genetic counselling [5,9]. However, an international review found that none of the guidelines

about family communication in genetics detailed how or what information should be communicated [18]. A worldwide survey of genetic counselling practice in facilitating family communication found that, although 90% of participants stated that they always identify at risk relatives and encourage family communication, 41% never write a letter specifically for at risk relatives [19].

This observational study aimed to (i) compare the accuracy of information amongst patients and relatives following genetic counselling with index patients about a *BRCA1/2* mutation; (ii) compare the accuracy of information about general genetics and hereditary cancer and (iii) examine whether accuracy amongst relatives improved when information was provided directly by genetics health professionals. This was part of a larger study examining the experience and process of family communication using qualitative and quantitative methods. The qualitative analysis has been reported elsewhere [8,11,20].

MATERIALS AND METHODS

Participants: Eligible participants were women affected by breast or ovarian cancer who had been found to have a pathogenic *BRCA1/2* mutation following diagnostic genetic testing at one of two UK NHS Regional Genetics Centres (patients), and their 'at risk' biological relatives with whom they had shared the result (relatives). The study sample consisted of 10 patients with breast and/ or ovarian cancer and 22 of their relatives (at least two 'at risk' first, second or third-degree relatives of each patient).

Recruitment: All patients receiving diagnostic *BRCA1/2* genetic test results underwent pre-test genetic counselling and results were given during a subsequent consultation by a genetics health professional (genetic counsellor or clinical geneticist). Patients were recruited after blood was taken for genetic testing but prior to receiving their test result. The patients recruited their relatives after they had shared the result with them. These relatives may or may not have undergone predictive testing at the time of interview. All participants were over the age of 18 and spoke English. Only families where the patient and at least two relatives were interviewed were included.

Data were collected between 2006 and 2008. Health professionals consented to audio-recording of the consultations and analysis of clinic letters. Participants consented to audio-recording of consultations (for patients only) and research interviews. Ethics approval was obtained.

Procedure: Two researchers, who were employed consecutively on the project, carried out all of the semi-structured interviews. The patients were interviewed on one occasion approximately four weeks after receiving the genetic test result. The interview schedule addressed understanding of genetic risk and implications for themselves and family, whether or not they had informed relatives of the result, how and what information they had given to relatives and how this was received. Specific knowledge questions were not asked. One semi-structured interview was subsequently carried out with each relative, again using an interview schedule. Relatives were asked for details of what and how they were told about the mutation by the patient (i.e. what words were used, how they reacted to the information, how

they perceived their own risk, whether they intended to do anything as a result of the information and the sources of their information). Again specific knowledge questions were not asked.

The transcripts of the clinic consultations and the post-consultation summary letters were systematically searched for information that had been communicated by the health professional. This was grouped into 'general genetics information' (i.e. inheritance, the gene involved and genetic counselling/testing for relatives) and 'hereditary cancer information' (i.e. cancer risk for affected and unaffected individuals and risk management options). Interview transcripts were systematically searched for reference to the information that had been communicated by the genetics health professional. The research team agreed on the coding framework and definitions of accuracy. The transcripts of the patients and relatives were coded independently by two researchers for accuracy compared to the information provided by the health professional. Participants' statements that were correct compared to the information provided by the health professional were coded as accurate. Statements that were incorrect, unknown, not mentioned or incomplete were coded as inaccurate. Where a participant made more than one reference to information, these were grouped together and coded once. For example, if the participant had made two references to the same information, one accurate and one inaccurate, this was coded as inaccurate. Relatives' transcripts were also coded for the reported sources of information as follows: information provided by the patient only (coded as information level 1); information provided by the patient and the genetics consultation or a letter from the health professional (coded as information level 2): and information provided by the

patient and the genetics consultation and a letter from the health professional (coded as information level 3).

Analysis: Accurate and inaccurate statements were counted using Content Analysis [21] and analysed using SPSS. Because there were different numbers of relatives in each family (either two or three) the mean number of inaccuracies for the relatives in each family were calculated. Accuracy of recall of information for patients was operationalised as the number of accurate statements made during the interview divided by the total number of accurate and inaccurate statements so that if there were five accurate statements and five inaccurate statements, the accuracy score was 0.5 (5/10). Accuracy of recall of information for relatives involved calculating the accuracy score for each relative interviewed, and then calculating the mean score for the relatives as a whole. Thus if there were two relatives in the family and one had an accuracy score of 0.5 and the other had a score of 0.3, the score for the relatives would be 0.4. Accuracy of recall scores were calculated separately for genetics information and hereditary cancer information and for the two combined.
A priori hypotheses concerning differences in accuracy between patients and relatives and between genetics and hereditary cancer information were tested using the Wilcoxon Signed Ranks test. This evaluated differences between matched pairs of numbers with no assumption about the underlying distribution of those numbers. The alpha was set to 0.05, 2-tailed. Although the hypotheses were directional, it is rare to see the use of a 1-tailed test in this area and the sample size was small. Given this, a conservative approach was adopted and convention of a significance level set at $p<0.05$ was followed.

Sources of relatives' information: The *a priori* hypothesis, that accuracy of recall of information by relatives is positively associated with the number of sources of information, was tested using a Spearman's rank order correlation coefficient. The alpha was set to 0.05, 2-tailed.

RESULTS

Participants: Of the patients, six had a *BRCA1* mutation and four had a *BRCA2* mutation; five had breast cancer only, two had ovarian cancer only and three had breast and ovarian cancer. The mean age of the patients was 55.5 years (range 34 to 71). The mean age at diagnosis was 40.8 years for breast cancer (range 28 to 59) and 56.2 years for ovarian cancer (range 45 to 63). Amongst the relatives, 18 were unaffected with cancer, two had breast cancer (age 45 and 51 years), one had ovarian cancer (age 55) and one had oral cancer (age 63); there were six daughters, four sons, six sisters, two brothers, two nieces and two cousins; 12 were untested, three tested positive, four tested negative and three were awaiting results. The mean age of the relatives was 37.1 years (range 20 to 65) (These data are shown in the supplementary Table).

Volume of information communicated to patients: Overall, 209 information statements were communicated to the patients: 29% (61) relating to general genetics and 71% (148) relating to hereditary cancer. The mean number of information statements communicated to patients was 21 (range 16 to 26).

Accuracy of recall: The percentage agreement for independent coding of accuracy of participants' statements by two members of the research team (CJ and CD) was 94%

(627/667). All disagreements were readily resolved. Table 1 shows accuracy and inaccuracy across all families for all information (the relatives' score shown is the mean score for the relatives in each family).

[Insert Table 1]

Accuracy of recall of information overall (in relation to genetics and hereditary cancer combined) was low amongst the patients following genetic counselling (53%). Accuracy amongst the relatives was significantly lower (30%) than amongst the patients themselves (Wilcoxon Signed Ranks test z=2.40, p=0.017, 2-tailed). Overall accuracy of patients and relatives is shown in Table 2.

[Insert Table 2)

The accuracy of recall for patients and relatives combined was greater for general genetics information (60%) than for hereditary cancer information (36%) (z=2.80, p=0.005). There was a trend suggesting that this difference was greater for patients than for relatives (Wilcoxon Signed Ranks test, z=1.89, p=0.056). Table 3 shows accuracy and inaccuracy about general genetics and hereditary cancer information for patients and relatives.

[Insert Table 3]

Sources of information: There was a positive association between the accuracy of recall by relatives and the number of sources of information (Spearman's rank order correlation coefficient R=0.88, p=0.001) (Table 4). This was the case both for hereditary cancer (R=0.83, p=0.003) and general genetics information (R=0.72, p=0.02).

[Insert Table 4]

DISCUSSION

Only 53% of the information about general genetics and hereditary cancer recalled by patients was accurate. The reasons for the low levels of accuracy amongst patients were not investigated in this study. However, it is possible that the high volume of information communicated by health professionals (mean of 21 statements of information) may have contributed to the low recall amongst patients, as suggested by previous authors [22,23].

Accuracy of recall amongst relatives was significantly lower than accuracy amongst patients. The reduction in accuracy of recall as information was communicated to relatives is consistent with the findings of previous studies [16,24]. Patients and relatives differed in their experiences of cancer and their age at interview (patients' means age was 55.5 and relatives' means age was 37.1). These differences may have contributed to the lower level of accuracy amongst relatives. As previous research has suggested, there are a number of possible reasons why information may not be recalled following genetic counselling about a *BRCA1/2* mutation including lack of understanding [24], individual interpretation or perceived lack of relevance [8] and not valuing the information sufficiently to retain it [11].

A lower level of accuracy was seen about hereditary cancer than genetics amongst patients and relatives. This supports the findings of a previous study of accuracy of recall of patients with cancer and their relatives which found that information about cancer risk was the least accurately recalled [25]. However, in a study of first-degree relatives undergoing predictive testing for *BRCA1/2* mutations, higher levels of accuracy about hereditary cancer than inheritance were reported [16]. For the cancer patients in this study, general genetics information would have been addressed during

pre-test genetic counselling, whereas specific hereditary cancer information may not have been discussed in detail prior to learning the genetic test result. The patients may therefore have been less familiar with some or all of the hereditary cancer information than with the general genetics information. This may have contributed to the lower levels of accuracy about hereditary cancer amongst patients and relatives.

Giving information about the implications of genetic testing in order to enable informed decision-making is an integral component of genetic counselling [26,27]. Yet it is not known whether the accuracy of information recalled about an identified gene mutation impacts on the decisions that individuals make regarding genetic testing or risk management. A systematic review of the effect of communicating DNA based risk assessments on risk reducing behaviour found that there was insufficient evidence to draw conclusions for practice [28]. Ley's model of effective communication in medical practice stresses the importance of accurate recall, satisfaction and adherence for understanding [29]. However, Fuzzy Trace Theory suggests that individuals encode multiple representations of information with varying precision, enabling understanding of the 'gist' rather than the detail of information [30]. It is possible that understanding the gist of the information is sufficient for individuals to make decisions in this context. It is unclear whether there is a link between accurately recalling the information and the uptake of genetic testing and screening or the information individuals require about a *BRCA1/2* mutation in order to make these decisions.

Relatives who received information from several sources, including the genetics health professional, reported a higher level of accurate information recall than those

who received information from the patient alone. This suggests that multiple sources of information may improve the accuracy of information recalled by relatives. However, why this was the case or how accuracy was improved was not investigated by the study. Previous research has suggested that information provided to relatives by genetics health professionals may involve less interpretation and emotion than that provided by index patients [24]. This would also be in line with Family Systems Theory [31] in which illness, or in this case the genetic test result, influences and is influenced by the individuals within the family who interpret and manage interactions relating to the illness.

The patients in this study were tested after completing cancer treatment and were counselled by genetics health professionals with greater knowledge and expertise in genetics than cancer. The integration of genetics into mainstream medicine will inevitably shift the timing, location and focus of the delivery of information about genetic testing. These discussions are increasingly likely to take place prior to, or during, treatment and to be delivered by health professionals with greater knowledge and expertise in cancer than genetics. Although these findings are not directly transferable to that scenario, they may provide a basis for further research.

This study was limited to a self-selected sample and the participants were not assessed on recall of specific information. Accuracy of the information recalled compared with the information communicated by the health professional was drawn from qualitative data and involved judgements made by the research team but the use of an agreed definition of accuracy, the coding framework and high level of agreement by two researchers coding independently strengthened the study. Given changes in public

awareness of genetics and in the availability of verbal and written provision of information, there may have been changes in the understanding by relatives since the time of data collection in this study from 2006 to 2008. It follows that the findings may be different if the study were to be repeated now with a new sample. In order to asses the generalizability of the findings, they would need to be replicated on a larger scale and evaluated and in other settings, with other populations and with patients undergoing genetic testing close to diagnosis.

Further study is needed to examine the reasons for the low level of accuracy, the relevance of the information not accurately recalled, the impact of the inaccurate recall and factors that could influence recall, such as educational level, meaning, context, experience and emotion. Further research would be helpful to identify the information that individuals require in order to make risk management decisions and the extent to which accurate recall of information about a *BRCA1/2* mutation is necessary for such decision-making.

CONCLUSION

These findings suggest that following identification of a *BRCA1/2* mutation in the clinical genetics setting, accuracy of recall of information amongst patients and relatives is low; particularly about cancer risks and risk management options. The findings highlight the importance of communicating clear and accurate information about general genetics and hereditary cancer to patients and relatives once a gene mutation is identified and suggest that accuracy of recall amongst relatives may be improved when the information is communicated via multiple sources of information, including direct contact with genetics health professionals. These findings provide

evidence supporting the concern that at-risk relatives may understand little about their cancer risks and risk management options which could be important for clinical practice.

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DISCLAIMER

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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