Guidance for patients considering direct-to-consumer genetic testing and health professionals involved in their care: development of a practical decision tool

Leigh Jackson, Lesley Goldsmith and Heather Skirton*

School of Nursing and Midwifery, Faculty of Health and Human Sciences, Plymouth University, Plymouth, UK.

*Correspondence to Heather Skirton, School of Nursing and Midwifery, Plymouth University, Drake Circus, Plymouth, PL4 8AA, UK; E-mail: heather.skirton@plymouth.ac.uk

Received June 27 2013; revised October 31 2013; Accepted December 23 2013.

Abstract

Background. Direct-to-consumer (DTC) genetic tests are available online, but there is little practical guidance for health professionals and consumers concerning their use. Work to produce such guidance was initially informed by three systematic reviews assessing the evidence on views and experiences of users and health professionals and policies of professional and bioethics organizations. The evidence suggested that consumers’ motivations include general curiosity, improving their general health, ascertaining the risk of a particular condition or planning for future children. However, health professionals and bioethics organizations expressed concerns about potential harms resulting from these tests. Using this evidence, we constructed a list of topics to be included in proposed guidelines.

Methods. Using an expert group technique, we aimed to develop guidance for (i) potential consumers and (ii) health professionals approached by patients considering or having undertaken such tests. We considered it important to involve a wide range of participants with relevant experience. Accordingly, researchers and clinicians based in four countries were invited to a 2-day workshop in August 2012. Following an iterative process, we decided to produce clinically relevant and pragmatic guidance in the form of a decision support tool for use in primary care.

Results. By utilizing both the relevant literature and the experience of the expert group, we identified seven key underlying reasons that might prompt individuals to consider DTC testing. We considered primary care physicians as the most likely health professionals from whom individuals would seek advice.

Conclusions. Based on the outcomes of the workshop, we developed a decision support tool encompassing varied clinical scenarios. Health professionals and patients are guided through a pathway that includes relevant actions and information on the appropriateness of the test. This tool will be freely accessible to health professionals and patients online.

Key words: Decision trees, direct-to-consumer, genetic testing, primary health care, personalized medicine.

Introduction

A range of genetic and genomic tests have been available direct to the consumer (DTC) via the Internet for at least a decade (1). Many companies, such as ‘23andMe’ (https://www.23andme.com/) and ‘Map My Gene’ (http://www.mapmygene.com/), offer tests including those assessing susceptibility to a range of common diseases. Alongside these, companies may offer other tests,
not directly related to health, such as ancestry testing, eye colour and hair curl (2) or ‘inborn talent genetic testing (3)’. Carrier testing for single gene disorders is also offered via the Internet by companies such as Counsyl (https://www.counsyl.com/), although increasing these (and other DTC) tests need to be ordered via a clinician (4). Finally, a consumer can access pharmacogenomic tests to assess ‘whether your medication is right for you’ without referral from a physician (5). In our definition of a DTC test used within this paper, we include all directly health-related genetic or genomic tests, including carrier testing for single gene disorders, susceptibility testing for common diseases or pharmacogenomic tests. Although nutrigenomic tests may have an effect on health, this is indirect and we have not included those tests in our definition.

It is difficult to assess the level of uptake of health-related DTC tests: they are accessed directly from private companies, via the Internet, thus making consumers of such tests difficult to identify. Indeed, it has been suggested that accessing personal genome testing directly, bypassing a health professional, may give the ‘consumer’ greater control over the privacy of their genetic data (6). However, in those studies reporting data from actual users, the major motivations to purchase DTC testing appear to be health related (7). Examples of this included the wish to identify the risk of developing a potentially heritable disease, or to use their genetic information to make lifestyle changes and thus improve their health (7). Early users express optimistic views about the future of personal genome screening (8). Results of other studies in which participants’ ‘intentions’ to use DTC testing have been explored have indicated that consumers would be interested in using DTC testing to support their own personal health management and also to aid their doctor to monitor their health more effectively (9,10). Use of the Internet for health purposes has become increasingly common in the USA: 80% of Internet users have searched for health information, with female users younger than 65, college graduates and those who can access broadband at home being the most likely to do so (11). Worldwide, there is an increasing number of people who use the Internet in this way (12). This may indicate potential for an increased interest in DTC testing and a need, therefore, for guidelines for potential consumers and for health professionals.

There is evidence of inconsistent levels of awareness and knowledge of DTC genetic testing amongst both the public and health professionals. In particular, Powell et al. (13) explored the educational needs of primary care physicians in the USA and found low levels of awareness, though the majority of respondents wanted to learn about DTC testing. Those authors concluded that health professionals should be given ‘the information and tools they need to help patients make informed decisions about DTC genetic testing (13)’ (p. 475). Resources suggested by health professionals include educational courses, meetings, medical journals and the Internet (13,14).

Decision tools are commonly used by health professionals, for example the decision tool used in the UK to guide the care of patients at risk of familial breast cancer (15). In view of the time constraints in primary care, however, we would suggest that any educational resource needs to be easily and quickly accessible as ‘just-in-time education’ has been shown to improve decision making in primary care (16).

This initiative to develop workable guidelines on DTC testing was undertaken as part of the EuroGentest2 project, which is a network of excellence, comprising a range of health professionals and scientists working in the field of genetics and genomics.

Evidence to inform discussion by the expert group

We prepared for this phase of the project by conducting three systematic reviews to obtain evidence on three perspectives relating to DTC genetic testing. The first was a review of position statements, policy documents, guidelines or recommendations published in relation to DTC testing since 2001 (17). The conclusion from that review was that public and professional bodies had concerns about potential harms to consumers from DTC genetic testing, and that these concerns appeared to outweigh any benefits. These concerns included risk of lack of confidentiality and privacy for the consumer, overstatement of predictive ability of some of the tests offered, and questions about the quality, clinical utility and validity of such tests. It was acknowledged that, due to freedom of access to the Internet and thus to DTC testing, it was essential both to protect consumers from harm and to provide health professionals with appropriate education on the potential advantages and risks of DTC genetic testing. The final conclusion of that review was that due to the range of differing opinions and health care contexts, producing a strict set of guidelines on DTC testing for health professionals would be challenging.

The second systematic review produced evidence from the perspective of the user (18). Levels of awareness were variable, as were the degree of knowledge and understanding. There was interest among potential users about information on their risks of developing common diseases, but concerns were expressed about privacy of genetic risk information and the reliability of genomic tests. It appeared that potential users would prefer to access genomic tests via a health professional, and also to discuss the results and obtain advice from a health professional. However, authors of only two papers recruited participants who had used DTC tests and samples from the large quantitative studies were not representative of the population. From this review, we concluded that there was public interest in DTC genomic tests, and that this was likely to result in an increased workload for a range of health professionals. We also considered that there were educational implications for both consumers and health professionals.
The third systematic review investigated evidence on DTC testing from the health professional perspective (19). Levels of awareness among health professionals were variable, and knowledge and understanding generally low. The findings of this review were limited by the fact that contact with patients who had actually undergone DTC testing was limited.

The evidence from these three reviews has, therefore, shown that it is necessary to support health professionals and patients considering the use of DTC genetic testing. Without clear guidance, patients could make uninformed decisions to test and/or experience problems due to misinterpretation of results.

Using this evidence from the literature, we finalized the aims of this study, which were to develop (i) guidelines for potential consumers who are considering using DTC genetic tests and (ii) guidance for health professionals who are approached by patients who are considering or have already undertaken such tests.

### Methods

We utilized the expert workshop methodology used in producing previous European guidelines (20). In common with other EuroGentest2 workshops, we considered it important to involve a wide range of participants with relevant experience to develop the guidelines for DTC testing. An expert group consisting of researchers and clinicians (see Table 1), from four countries, was invited to a 2-day workshop in August 2012, convened for the purpose of producing these guidelines. All had relevant professional backgrounds and a special interest in the issues arising from the recent developments in DTC genetic testing. One of

<table>
<thead>
<tr>
<th>Name</th>
<th>Professional background and qualifications</th>
<th>Relevant expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Pascal Borry</td>
<td>Professor of Bioethics and Law, PhD in social health sciences</td>
<td>The ethical, legal and social implications of genetic and genomics. Involved in Marie Curie project: ethical, legal and social aspects of DTC genetic testing.</td>
</tr>
<tr>
<td>Prof. Martina Cornel</td>
<td>Professor of Community Genetics and Public Health Genomics, community physician and epidemiologist, MD, PhD</td>
<td>Teaches medical students and health science students in the areas of health promotion and large-scale applications of genetics and genomics and is involved in postgraduate training in these areas. Heavily involved in developing training in genetics/genomics for primary care health workers. Chair of Professional and Public Policy Committee of the European Society of Human Genetics.</td>
</tr>
<tr>
<td>Dr Lesley Goldsmith</td>
<td>Research Fellow (Applied Health Genetics Research Group, Plymouth University) with previous managerial experience working in primary care in the UK, BSc (Hons), PhD</td>
<td>Experience in management of a primary care practice. Experienced social science researcher in health genetics, including use of DTC tests.</td>
</tr>
<tr>
<td>Dr Heidi Howard</td>
<td>Assistant Professor in Biomedical Ethics, BSc in biology and PhD in neurogenetics, Erasmus Mundus Master of Bioethics</td>
<td>Ethical, legal and social issues of genetics and genomics, in particular DTC genetic testing.</td>
</tr>
<tr>
<td>Leigh Jackson</td>
<td>Research Fellow (Applied Health Genetics Research Group, Plymouth University), BSc, PhD in stem cell genetics</td>
<td>Genetic scientist and researcher in health genetics, including use of DTC tests.</td>
</tr>
<tr>
<td>Prof. Cecile Janssens</td>
<td>Research Professor of Epidemiology, MSc epidemiology, PhD</td>
<td>Research concerns the translation of genomics research to applications in clinical and public health practice, with a focus on the predictive ability and utility of genomic risk prediction. Previous Chair of the Dutch Association of Community Genetics and Public Health Genomics.</td>
</tr>
<tr>
<td>Tessel Rigter</td>
<td>Researcher in Community Genetics, BSc in biomedical science, MSc in science communication (in health education)</td>
<td>Has contributed to projects in the realm of community genetics and public health genomics including development of ‘Best Practice Guidelines for Clinical Genetic Services’.</td>
</tr>
<tr>
<td>Prof. Heather Skirton</td>
<td>Professor of Applied Health Genetics, PhD in health psychology, MSc in health care (professional education), registered general nurse, qualified midwife, registered genetic counsellor (UK)</td>
<td>Over 30 years practice in clinical health care including 16 years as a genetic counsellor. Active in improving professional competence in genetic health care in Europe, including competence of primary care professionals.</td>
</tr>
</tbody>
</table>
the members had experience as a manager in primary care, one was a community physician and another an experienced genetic counsellor.

**Process**

In advance of the workshop, participants received communications detailing the focus of the planned work, together with a number of relevant publications (4,17,18,21–24), to enable them to prepare for the workshop.

There was detailed discussion on the best way to approach this task, and whether to produce separate documents for use by health professionals and consumers. The task was complicated by the fact that there are disparities in equity of access by patients to genetic services in Europe (25), and differences exist in legislation, culture and provision of health services in general. The consensus at the workshop was that a practical solution, likely to be of clinical use, would be to develop a decision tool for use by health professionals.

By utilizing the clinical experience within the participant group, we identified seven fundamental reasons why a person would present to their primary care physician to ask about DTC genetic testing (see Table 2). The health professionals in the expert group provided valuable input from their clinical experience, together with experts in bioethics and community genetics whose contributions related to issues such as patients receiving adequate information on the benefits and risks of DTC tests.

We considered the evidence from the literature, acknowledging the fact that this would not be a straightforward task in view of the disparities in equity of access in Europe. We also took into account that production of some form of guidance for both patients and health professionals was essentially a pre-emptive task, given the low levels of awareness and lack of evidence on ‘real’ usage of such tests. There was much discussion during this iterative process. We established that in most European countries patients will initially consult their primary care physician with regard to their health-related concerns. Having therefore decided to concentrate on the primary care consultation, we concluded that any decision support tool would only be of practical use to either the health professional or indirectly the patient, if the purpose of having a DTC test was first established.

We initially focussed on a scenario in which a patient was presenting to a primary health care professional for advice on whether to embark on DTC testing. In this situation, the important question to be answered before any advice or support can be given, is ‘Why do you wish to have this test?’ Once this first stage of the process had been confirmed, it was clear that the answer to that question would guide the way the health professional would handle the situation; this confirmed that some form of decision tool would be a useful clinical aid.

The findings, in the form of Tables 2 and 3, were circulated widely to experts in EuroGentest2 and placed on the project website with specific requests for comments and feedback. They were, therefore, made accessible to a wide range of health professionals including those working in primary care settings. Further modifications were not required.

**Results**

After asking the patient about their reason for considering a DTC test (Table 2) and having established the reason for attendance, the primary care professional would then need to investigate the background and intentions of the patient. In most cases, taking a family history (FH) may be required to clarify the level of risk for the individual patient. The next steps depend on the patient’s reason for attending, as illustrated in Table 2. Having taken a full medical and FH, it may be that there is no need for further action other than discussion with the patient to confirm that a DTC test is either not appropriate or may not be helpful. The health professional should explore the person’s intentions on receiving the test results. For example, if a patient was planning to establish his or her susceptibility to developing coronary heart disease, would he/she take any action if the result showed an increased risk? In some cases, for example, if the FH indicates the possibility of a monogenic disorder, the patient should be referred to the appropriate clinical genetics service, if unaffected, and/or to another specialist if already affected. If the family and medical histories indicate nothing of significance, physicians should follow the normal protocol for investigation and management of symptoms (if any), or offer the patient reassurance.

The health professional, having followed this decision pathway, will arrive at a Yes/No answer with regard to DTC testing based on the significance of the risk from FH. We have, thus, provided a set of general factors, which should be considered when supporting a potential user of DTC genetic testing to make a decision whether or not to proceed with it. We have also produced four context-specific boxes (A–D), to which the health professional can refer for information and supporting links (Table 3), to facilitate the patient in making a fully informed choice.

For example, we reasoned that if a patient had concerns (for self or future children) based on a FH of a genetic condition, this should be investigated using the usual routes, ascertaining and confirming the FH, followed by specialist referral to genetic services for appropriate further investigation and discussion of risks if indicated. Use of DTC tests would not be appropriate and may give a false sense of reassurance as a negative result may result due to failure to test for the mutation affecting the patient’s family. Where the patient has concerns due to current signs and/or symptoms, these should be investigated in the usual way for underlying disease.
**Table 2. Schematic illustration of the decision support tool**

<table>
<thead>
<tr>
<th>Stage 1: Reason for attending</th>
<th>Patient is aware of symptoms and has concerns for their own health.</th>
<th>Patient has concerns for their future health due to FH.</th>
<th>Patient has general health concerns.</th>
<th>Patient has concerns for future children because of FH.</th>
<th>Patient has concerns for future children due to other risk factor such as ethnicity or consanguinity.</th>
<th>Patient has general concerns about future children but is at population risk.</th>
<th>Patient is concerned about ensuring appropriate drug therapy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 2: Investigate background and intentions</td>
<td>Take medical history and follow normal protocol for investigation and management of symptoms.</td>
<td>Take FH and ask what they intend to do with results.</td>
<td>Explore concerns, take FH and ask what they intend to do with results.</td>
<td>Take FH and ask what they intend to do with the results.</td>
<td>Take FH, ask what they intend to do with results. Assess risk.</td>
<td>Explore concerns, take FH and discuss what they intend to do with the results.</td>
<td></td>
</tr>
<tr>
<td>Stage 3: Assess significance of risk</td>
<td>Is a monogenic disorder suspected?</td>
<td>After using algorithms, is risk sufficiently high to warrant referral to clinical genetics services or other specialist?</td>
<td>Is there a significant indication in FH?</td>
<td>Is there a significant indication in FH?</td>
<td>Is the risk significant?</td>
<td>Are the concerns related to a particular drug?</td>
<td></td>
</tr>
<tr>
<td>Stage 4: Decision regarding the advisability of DTC testing</td>
<td>If yes, refer to box A</td>
<td>If no, refer to boxes A and B</td>
<td>If yes, refer to box A and B</td>
<td>If no, refer to box A and B</td>
<td>If yes or no, refer to box C</td>
<td>If yes or no, refer to box D</td>
<td></td>
</tr>
</tbody>
</table>


## Table 3. Information boxes regarding DTC testing

<table>
<thead>
<tr>
<th>Box A: DTC testing for monogenic disorders</th>
<th>Box B: DTC testing for complex disorders</th>
<th>Box C: DTC carrier testing</th>
<th>Box D: DTC pharmacogenomic testing</th>
<th>General considerations for DTC testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>There may be a lack of availability of pre- and post-test counselling (especially family relevance and disclosure)</td>
<td>The ability of the tests to predict actual disease is weak</td>
<td>If the patient is seeking carrier testing, this should be discussed in the context of reproductive options available in the country (e.g. prenatal diagnosis, termination of pregnancy, pre-implantation genetic diagnosis)</td>
<td>This would usually be carried out by the health care services before prescription if necessary</td>
<td>The patient’s privacy could be compromised</td>
</tr>
<tr>
<td>Non-genetic risk factors are generally not taken into account</td>
<td>Conditions and mutations tested for may not include those most relevant to the patient’s specific population</td>
<td>There is only limited proven value at the current time in the majority of situations</td>
<td>Transparency—what is included in test?</td>
<td>Quality of genetic tests and services, including:</td>
</tr>
<tr>
<td>There may be specific concerns regarding assessment of the test</td>
<td>There is a lack of consistency regarding the way in which risks are calculated; this results in significantly variable risk estimates for the same patient from different companies</td>
<td>Results may lead to false reassurance or unwarranted anxiety</td>
<td>Is the laboratory properly accredited?</td>
<td></td>
</tr>
<tr>
<td>The quality of the test is important if used for treatment decision</td>
<td>The test should be specific to the disease being investigated (DTC may not cover all relevant genes and mutations)</td>
<td>The package of tests offered may include not only tests for severe childhood disorders but also adult onset conditions, resulting in unanticipated results for the patient themselves</td>
<td>Are the personnel suitably qualified?</td>
<td></td>
</tr>
<tr>
<td>Lifestyle measures will still be important, regardless of result</td>
<td>What is the cost to the patient? (Will they be reimbursed?)</td>
<td>Discuss examples of value in very specific circumstances of utility</td>
<td>Does the test have any clinical validity?</td>
<td>Are there quality assurance procedures to ensure analytical validity?</td>
</tr>
<tr>
<td>Treatment options are unlikely to be affected by results</td>
<td>The result should be focussed on the relevant condition</td>
<td>The result should be focussed on the relevant condition</td>
<td>Are there provisions for ensuring informed consent?</td>
<td>Is there potential for unwanted or unrequested results?</td>
</tr>
<tr>
<td>There may be specific concerns regarding assessment of the test</td>
<td>The quality of the test is important if used for treatment decision</td>
<td>The test should be specific to the disease being investigated (DTC may not cover all relevant genes and mutations)</td>
<td>What utility do the results have for the patient?</td>
<td>Is there potential for advertising claims that may be misunderstood by or misrepresented to patients</td>
</tr>
<tr>
<td>Is the laboratory properly accredited?</td>
<td>Are the personnel suitably qualified?</td>
<td>Does the test have any clinical validity?</td>
<td>Are there quality assurance procedures to ensure analytical validity?</td>
<td>Is there potential for unwanted or unrequested results?</td>
</tr>
<tr>
<td>Quality of genetic tests and services, including:</td>
<td>Transparency—what is included in test?</td>
<td>Is the laboratory properly accredited?</td>
<td>Are there provisions for ensuring informed consent?</td>
<td>Is there potential for advertising claims that may be misunderstood by or misrepresented to patients</td>
</tr>
<tr>
<td>Is there potential for advertising claims that may be misunderstood by or misrepresented to patients</td>
<td>Are there quality assurance procedures to ensure analytical validity?</td>
<td>Is there potential for unwanted or unrequested results?</td>
<td>Is there provision of pre- and post-test counselling?</td>
<td>There are legal restrictions on DTC testing in some countries</td>
</tr>
</tbody>
</table>
The situation regarding those with general health concerns may be less straightforward, but even then the use of DTC tests is unlikely to be more helpful than discussion of lifestyle choices. The main finding following the discussions in the workshop and production of Table 2 was that in only one of the scenarios would DTC testing be considered (preconception carrier testing), and even this would only be in certain circumstances, such as for couples concerned to reduce risk of recessive conditions in their future children. In many cases, the first time a family becomes aware of the risk of a recessive condition is after the birth of an affected child; however, use of DTC testing may enable carriers to be identified before pregnancy, thus giving couples the opportunity to consider their reproductive options, including prenatal testing.

Discussion

The availability of genetic and genomic testing DTC via the Internet has resulted in much discussion concerning the ethical, legal and social issues involved, over the last decade (22). Reviews of the literature have indicated concerns amongst both users, potential users (18) and health professionals (19), although potential benefits such as increased opportunity for screening (26) and enabling consumers to manage their own health (9) have been expressed. While discussing the fundamental reasons that might influence an individual to embark on DTC testing, we were also able to explore the limited body of evidence that has identified risks, concerns and possible benefits of DTC testing, and the ethical issues arising. Although there is evidence that consumers or potential consumers have an interest in finding out their risk of developing common diseases such as heart disease (18), levels of knowledge and understanding were inconsistent, with one study in the USA (27) reporting that less than half of their participants were confident in understanding the risks and benefits of personal genome testing or had sufficient knowledge to understand the results. In some cases, there was a preference to access genomic tests via a trusted health professional (28), or to discuss the results and obtain further guidance from a health professional subsequent to a DTC test (27). In view of these latter findings, we considered it essential to provide educational material based on the evidence identified in our three reviews. These information boxes (Table 3) form an integral part of the decision support tool.

Implications for clinical practice

Although we initially set out to produce guidelines on DTC genetic testing, the consensus was that a practical tool was needed to help primary care physicians and potential users, and that this tool should be easily accessible and contain information links for those who wished to learn more. The decision support tool has been produced in an online format to facilitate access by both health professionals and users. We consider that the tool could be used by any health professional or patient and is not restricted to primary care settings. We have placed the DTC decision support tool on the EuroGentest website (http://www.eurongentest.org/index.php?id=939) and plan to place links on other relevant websites (such as patient support groups) to ensure that it is freely available. In addition to this, it would be useful to place a link on such public health information sites as National Health Service Choices (in the UK) and the US National Library of Medicine. As part of the tool, links are provided to relevant evidence and policy documents; in addition, we provide material on such topics as inheritance patterns and pedigrees, which we hope will contribute to the known educational needs of primary care physicians and help to inform potential users. In particular, we anticipate that the use of this tool will enable health professionals to discuss DTC genetic testing appropriately with patients. This in turn will equip them to help patients to generate realistic expectations of these tests and avoid creating a sense of false reassurance. In addition, a knowledge of the uses of DTC genetic tests that have clinical utility, such as preconception carrier testing, will enable physicians to use the results to inform patients of the options available to them, refer to relevant services and facilitate better management of health.

Future research

In order to test the accessibility and utility of this tool in clinical practice, further research is required. This would include investigation of the responses of both health professionals and patients to the tool and the impact of the tool on testing decisions.

Acknowledgements

This study was undertaken as part of the work of Unit 2, Work Package 7 of the EuroGentest2 Coordination Action 2011 project. We wish to thank Prof. H Kaariainen and Prof. J Sequiros for their helpful comments on the text, and in particular, Prof. P Borry for his valuable contribution to the draft.

Declaration

Funding: EuroGentest2 (HEALTH-F4-2010–261469).

The workshop participants who contributed to these guidelines were P Borry, M Cornel, L Goldsmith, H Howard, L Jackson, C Janssens, T Rigter and H Skirton.

Ethical approval: none.

Conflict of interest: none.

References
