

Health-Care Referrals from Direct-to-Consumer Genetic Testing

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Background: Direct-to-consumer genetic testing (DTC-GT) provides personalized genetic risk information directly to consumers. Little is known about how and why consumers then communicate the results of this testing to health-care professionals. **Aim:** To query specialists in clinical genetics about their experience with individuals who consulted them after DTC-GT. **Methods:** Invitations to participate in a questionnaire were sent to three different groups of genetic professionals, totaling 4047 invitations, asking questions about individuals who consulted them after DTC-GT. For each case reported, respondents were asked to describe how the case was referred to them, the patient's rationale for DTC-GT, and the type of DTC-GT performed. Respondents were also queried about the consequences of the consultations in terms of additional testing ordered. The costs associated with each consultation were estimated. A clinical case series was compiled based upon clinician responses. **Results:** The invitation resulted in 133 responses describing 22 cases of clinical interactions following DTC-GT. Most consultations (59.1%) were self-referred to genetics professionals, but 31.8% were physician referred. Among respondents, 52.3% deemed the DTC-GT to be "clinically useful." *BRCA1/2* testing was considered clinically useful in 85.7% of cases; 35.7% of other tests were considered clinically useful. Subsequent referrals from genetics professionals to specialists and/or additional diagnostic testing were common, generating individual downstream costs estimated to range from \$40 to \$20,600. **Conclusions:** This clinical case series suggests that approximately half of clinical geneticists who saw patients after DTC-GT judged that testing was clinically useful, especially the *BRCA1/2* testing. Further studies are needed in larger and more diverse populations to better understand the interactions between DTC-GT and the health-care system.

Introduction

DIRECT-TO-CONSUMER genetic testing (DTC-GT) is defined as DNA-based testing of single genes, panels of associated genes, or whole genome scans, ordered by the consumer outside of established health-care delivery systems by for-profit vendors. In recent years, numerous DTC-GT companies have emerged into this marketplace and considerable controversy has erupted over the accuracy and utility of such testing (Hunter *et al.*, 2008; Kraft and Hunter, 2009; McGuire and Burke, 2008; Evans and Green, 2009; Ng *et al.*, 2009). While it has been widely expected that some customers

receiving genetic information from DTC companies would seek further consultation from clinical providers within the conventional health-care system, there have been no prior reports describing this. In this report, we present a clinical case series consisting of reports submitted by genetic counselors and medical geneticists who responded to an inquiry requesting information about such consultations.

Materials and Methods

A questionnaire was constructed based upon interviews with genetic counselors and medical geneticists associated

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with the Brigham and Women's Hospital and Children's Hospital Boston. The questionnaire was piloted and subsequently refined, and then posted through an internet link on a commercial Web-based service (Zoomerang.com). An invitation to participate in the questionnaire, along with the link, was e-mailed to the list serve of the National Society of Genetic Counselors ($n = 2397$), the list serve of the Adult Genetics Special Interest Group ($n = 218$), and all members of the American College of Medical Genetics ($n = 1432$). The questionnaire was approved by the Partners Healthcare institutional review board and consent was implied by the return of the questionnaire. All e-mails containing the questionnaire link were sent between April 2, 2009, and May 1, 2009.

In the questionnaire, participants were asked to describe their own professional standing and whether or not they had encountered referrals due to DTC-GT. If they had encountered such referrals, they were asked to describe the patient characteristics, characteristics of the genetic testing involved, and patient interactions. They were also asked whether they deemed the test clinically useful for the patient, and to describe the consultations and diagnostic tests that followed from such testing, so that costs could be estimated.

Costs for subsequent referrals and diagnostic tests were estimated based on the cost of the DTC test as listed by the testing laboratory, which is available through the laboratory Web site. Health system costs reflect Medicare reimbursements (national averages), which are based on relative value units and current procedural terminology (CPT) codes.

As this was a preliminary inquiry, the questionnaire was only sent once, no incentives were offered for completion, and no data were collected on nonresponders.

TABLE 1. CLINICAL INFORMATION ABOUT 22 PATIENTS SEEN IN CONSULTATION AFTER DIRECT-TO-CONSUMER GENETIC TESTING

	n (%)
<i>Reasons for seeking DTC-GT^a</i>	
Concern about family history of disease	11 (50)
Concern about current or future risk of disease	9 (40.9)
Intellectual curiosity	6 (27.2)
DTC-GT recommended by physician	3 (13.6)
<i>Type of DTC testing purchased</i>	
Whole-genome SNP-based testing	9 (40.9)
Single-gene sequencing	7 (31.8)
Single-gene common variant panel	3 (13.6)
Other	3 (13.6)
<i>How referred to genetic counselor or medical geneticist</i>	
Self-referred	13 (59.1)
Physician referred	7 (31.8)
Referred by DTC company or DTC research project	2 (9.1)
<i>Reasons for consultation with genetic counselor or medical geneticist^a</i>	
Questions about personal disease risk	11 (50)
Questions about further management	12 (54.5)
Primary test interpretation	10 (45.4)
Test re-interpretation	8 (36.3)

^aResponses sum to >22 individual patients and >100% because multiple responses were permitted.

DTC-GT, direct-to-consumer genetic testing; SNP, single-nucleotide polymorphism.

Results

Of 4047 invitations sent, 133 providers (3.3%) completed the questionnaire; of these, 121 (91.0%) were genetic counselors, 6 (4.5%) were medical geneticists, and the remaining 6 (4.5%) were other health-care providers. Of the 133 providers who responded, 22 (16.5%) (90.9% were genetic counselors and 9% physician-providers) reported providing consultations to patients who were referred in response to DTC-GT. These providers supplied some information about those patients.

According to questionnaire responses, of the 22 patients referred for DTC-GT, 13 (59.1%) were self-referred, 6 (27.2%) were referred by their primary care provider, and 1 each was referred by an oncologist, an insurance company, and the DTC company. The age of the patients ranged from 21 to 75 years. The ethnicity of the patients was reported for 20 patients to be Caucasian, 1 Hispanic, and 1 Asian American. Clinical information reported about the 22 patients referred for DTC-GT is shown in Table 1.

Testing was reported to have been performed by several different companies, including well-known DTC-GT companies such as 23andMe (22.7%), Navigenics (9.1%), and DNADirect (9.1%). However, some of the patients reportedly had their testing done at Genelex (9.1%) and Myriad (18.1%), two companies that only provide testing in response to requests from a health-care provider, suggesting that these tests had been initiated by the patient, perhaps in response to DTC advertising, even if they had been ordered by their health-care provider.

When asked about the clinical utility of the DTC genetic test performed, 52.4% of providers described the test as useful (see Table 2). When considering the type of testing, it is noteworthy

TABLE 2. UTILITY OF THE GENETIC TESTING, REFERRALS, AND ESTIMATED COSTS

	n (%)
<i>Was the initial testing clinically useful? (21 responses)</i>	
Yes	11 (52.4)
No	10 (47.6)
<i>How many referrals to other providers were made based on this testing? (15 responses)</i>	
One	11 (73.3)
Two	2 (13.3)
Three or more	2 (13.3)
<i>To what specialists were referrals made? (11 persons responded with 17 specialists)</i>	
Breast care specialist or surgeon	4 (23.5)
Geneticist or genetic counselor	6 (35.3)
Radiologist	2 (11.7)
Other	4 (23.5)
<i>What, if any, tests were ordered based on the genetic testing? (17 respondents selected all that applied)</i>	
Further genetic testing	2
Mammography	3
CA-125	2
CT or MRI of chest or abdomen	2
PSA	1

CT, computed tomography; MRI, magnetic resonance imaging; PSA, prostate-specific antigen.

thy that *BRCA1/2* testing was considered clinically useful in 85.7% of cases. Of the remaining tests performed, 64.3% were considered not clinically useful.

The costs of initial genetic testing were estimated to be between \$0 (two patients received the testing for free) and \$3120 per patient. The cost of subsequent follow-up care (including visit to genetic counselor, referrals to specialists, and referrals for additional diagnostic testing) was estimated to range from \$40 for the lowest cost case to \$20,604 for the highest cost case.

Discussion

This pilot study provides clinical scenarios where 22 genetics professionals responded to a questionnaire about patients who were referred to discuss the results of their genetic testing. While the questionnaire explicitly asked about DTC-GT, responses included six referrals from testing by companies such as Genelex and Myriad that do not offer DTC services and several responses that suggested the referral was related to genealogy and paternity testing. Nonetheless, it is notable that 52% of the responding genetics professionals felt that the initial genetic testing was "clinically useful," since recent publications on the utility of DTC-GT have largely been pessimistic about its clinical utility (Hunter *et al.*, 2008; Kraft and Hunter, 2009). Further study is required to understand why *BRCA1/2* testing was disproportionately (i.e., in six of seven cases) associated with an impression of clinical utility on the part of the genetics professional.

The referral patterns documented in this study are also of interest. While the large proportion of self-referred individuals is perhaps to be expected, the eight physician referrals speak to the likelihood that when faced with DTC-GT results, physicians will ask for support from genetics professionals. The referrals from the genetic counselors are also of interest. Referral to physician specialists, or to another type of genetic counselor, was common. Moreover, estimated costs associated with these referrals and the downstream diagnostic testing that occurred ranged from very little to a high of \$20,604. The potential for high downstream costs as a result of DTC-GT appears to justify the concerns expressed by some that this phenomenon will "raid the medical commons," generating high costs in response to testing of questionable clinical validity and utility (McGuire and Burke, 2008).

This pilot study has several limitations. The questionnaire was distributed to a large number of geneticists and genetic counselors through an e-mail list serve, and was worded in such a way as to request a response only from those who had

seen a patient with DTC testing. It is not possible from this study to ascertain how many potential recipients did not open the e-mail or how many may have seen DTC-GT patients and failed to respond. Moreover, no attempts were made to incentivize responses or follow-up with additional queries to nonresponders; thus, the overall response rate is very low. While these results cannot be construed to be in any way representative, they, nonetheless, offer a window into the potential referral patterns to genetic professionals and from them into the mainstream medical care system. Future, more systematic studies of DTC-GT will be needed to ascertain the clinical utility, referral patterns, and downstream costs associated with this new phenomenon.

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Disclosure Statement

The authors have no conflicts of interest to disclose.

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