Survey of Italian Pediatricians on awareness, experiences and beliefs regarding direct-to-consumer genetic testing in minors

Anna Baroncini (1), Francesca Torricelli (1), Guido Cocchi (2), Giovanni Corsello (3)

(1) GENISAP member (Italian Network of Public Health Genomics)
(2) Neonatology Unit, Paediatric Department, Alma Mater Studiorum Bologna University, Italy
(3) Operative Unit of Paediatrics and Neonatal Intensive Therapy, Mother and Child Department, University of Palermo, Italy

CORRESPONDING AUTHOR: Guido Cocchi, Neonatology Unit, Paediatric Department - Alma Mater Studiorum Bologna University, Phone: 00390512144654, email: guido.cocchi@unibo.it

ABSTRACT

Background: Our study wanted to assess Italian pediatricians’ awareness, experience and beliefs regarding direct-to-consumer (DTC) genetic tests (GT) in minors, with a focus on those for predisposition to complex disease, lifestyle, athletic ability and other inborn talents.

Methods: A 28-item questionnaire was administered through the SurveyMonkey® web platform to the 9,086 members of the Italian Society of Pediatrics for which a valid email address was available. The survey was opened from April through November 2017. Statistical analyses were performed using the Graphpad software package.

Results: 36.2% of the 442 respondents were aware of DTC-GT, but only 23.1% of them felt adequately prepared to meet families’ information needs. The first three sources of knowledge were the Internet (20.98%), magazines/newspapers (16.78%) and TV/Radio (14.33%), while companies’ direct marketing activity influenced knowledge only in 2.45% of the cases. Only 16.4% of the aware respondents had been already approached for advice. More than 95% of the pediatricians who were aware would not advise DTC-GT for lifestyle, athletic performance or other inborn talents. 69.2% was unfavourable to susceptibility tests for complex diseases. Most of them expressed an interest in learning more and indicated as preferred sources of information public policies issued by professional societies.

Conclusion: The low awareness and experience and the vendors’ tiny contribution to knowledge suggest a still limited penetration of DTC-GT companies in Italy. A great interest in learning more was found. Scientific societies are best positioned to support health professionals in this educational goal thanks to their role of trusted sources of information and guidance.

Key words: direct-to-consumer, genetic testing, susceptibility tests, lifestyle/behavioural tests, athletic testing
INTRODUCTION

Direct-to-consumer (DTC) genetic testing (GT) offered on a large scale, has grown in number of commercial companies, involves the marketing and selling of the tests directly to the public outside of the traditional healthcare system [1].

Marketed tests include a broad spectrum of applications. Some tests provide information about medically significant conditions, such as diagnostic and carrier testing for uncommon single-gene disorders (e.g. cystic fibrosis), drug susceptibility testing for common conditions (e.g. type 2 diabetes) or pharmacogenetic tests for drug therapy decisions. However, most of the tests are available for minor conditions, personal characteristics and non-medical purposes (e.g. eye color, ear size was, bitter taste perception, genetically tailored diet plan, propensity to addictions, talent identification, ancestry, paternity testing). Furthermore, several companies market neogeneration sequencing of multigene panels and some whole genome or exome scans, providing consumers with diseased-related and disease-unrelated information at the same time [2].

DTC-GT has sparked much controversy and can be especially problematic when it comes to minors. Children and adolescents are a vulnerable population as they lack decision-making legal capacity and may be especially susceptible to DTC-GT industry marketing influences [3,4].

DTC-GT has received a great amount of attention by print media and has been advertised or favorably featured in some radio and television programs. In addition, given the rapid growth of the Internet as a central source of health-related knowledge, advertisements and informative material provided by the vendors have become prominent sources of information regarding DTC-GT [5]. Unfortunately, misinformation is far from rare. In 2010 the U.S. Government Accountability Office found that 10 out of 15 investigated DTC-GT companies “were engaged in some form of fraudulent, deceptive, or otherwise questionable marketing practices” [6]. In 2012 the European Parliament published an internet survey on DTC-GT for health-related purposes, that showed that most companies’ websites failed to provide reliable scientific foundations for the offered tests, adequate protection against misleading interpretation of the need for and proper information on their consequences [7]. Current research is consistent with these concerns. It has been observed that those marketing claims, overstatements of benefits and understating limitations and harms [8,9]. In addition, they have been found poorly compliant with international guidelines on providing information on confidentiality, privacy and secondary use of genetic data [10].

Existing policy guidelines on minors, mostly addressing the issue of direct-to-consumer genetic testing, highlight more potential risks than benefits, repeatedly warning away from utilizing such services [1,11]. The 2010 statement of the European Society of Human Genetics on direct-to-consumer genetic testing for health-related purposes declared that its context “does not allow for a proper development of the competence of a minor” and that it should not be offered before the age of legal majority. The rationale behind this position is that medical genetic testing, unless of high benefit, is inappropriate for minors [12]. In 2013 the American Academy of Pediatrics (AAP) and the American College of Medical Genetics (ACMG) released a joint statement strongly discouraging the use of DTC-GT of children “because of the lack of oversight on test content, accuracy, and interpretation” [13]. In addition, the AAP and the ACMG expressed concerns regarding privacy, self-determination and potential alteration of family dynamics and recommended the involvement of a professional healthcare provider in any type of genetic testing on minors [14]. Regrettably, a poor adherence of DTC-GT companies to recommendations and professional guidelines on predictive and presymptomatic genetic testing of children has been observed [15].

In the context of sport, the consensus statement of the International Federation of Sports Medicine (IFMS) denied scientific grounds for the current use of genetic testing in talent identification or training individualization to optimize performance. Accordingly, the shared view was that no child or young athlete should be exposed to DTC-GT to tailor training or select gifted children and adolescents [16]. Similar statements have been endorsed by the Human Genetics Society of Australia (HSAS) [17] and by the Australian Institute of Sport (AIS) [18]. Furthermore, (2017) AIS, IFMS and Athlome Consortium jointly called for international collaboration within a shared ethical framework for genomic research applied to sport and for “resistance against the agendas driven by direct-to-consumer genetic testing companies” [19].

A major argument against DTC-GT is the potential role of living, personal characteristics and inborn talents outside of sport has been given relatively little attention. Among the tests marketed directly for use in children and adolescents, information is afforded “about everything from cognitive abilities to kid’s physical attributes,” as put by a DTC firm’s website [20]. Actually, tests range from the ability to learn languages to exercise performance, family physicians, has been highlighted [22]. A number of empirical studies support this view, painting a consistent picture where consumers of health-related DTC-GT show a preference to access tests, interpret results, or making health-related decisions. Critiques on the availability and accessibility of a major role for medicine, leading to patient’s health deterioration. This new role represents a significant challenge for physians not specialized in genetics and the need to provide them with the knowledge and skills to properly advise patients has been underscored [24].

The worldwide proliferation of DTC-GT market and the public’s growing “genetic curiosity” suggest that, despite professional warnings, physicians will face an increasing pressure for advice from parents considering their use in children.

The aim of this study was to assess Italian pediatricians’ awareness, opinions, and beliefs about DTC-GT in minors, with a focus on tests for predisposition to common complex disease, lifestyle, athletic ability and other inborn talents.

METHODS

A 28-item questionnaire about knowledge, practice and attitudes of pediatricians toward the use of DTC-GT in minors was proposed to the active members of the Italian Pediatric Society, which is open on a voluntary basis to all specialists and registrars in pediatrics.

At the end of April 2017 the 9,086 affiliated physicians for which a valid e-mail address was available received an invitation to participate in the survey, including a short motivational introduction and the questionnaire URL. The survey was prepared using the web-based SurveyMonkey® platform. The invitation and link to join the survey were also enclosed in the April-May print issue of the journal. The survey was closed at the beginning of November 2017.

The survey, approved by the Steering Committee of the Italian Pediatric Society, was voluntary and confidential. Questionnaires were anonymously recorded.

The questionnaire was subdivided in five domains: 1) demographic and professional variables (5 questions) concerning sex, age range (20 and ≥ 20 years), professional profile (community based pediatrician, hospital pediatrician, private pediatrician, pediatric registrar, other) and main practice location (categorized into Northern, Central, Southern and Insular Italy), 2) knowledge about the use of an GT sold directly to consumers (3 questions, regarding knowledge, information’s sources and perceived adequacy to manage family’s and/or adolescent patient’s decision making process), 3) experiences with patients (7 questions, including whether or not they have been asked on DTC-GT in 2016 or in previous years by families/adolescent patients, questions typology, categories of tests, if any, eventually performed in 2016 by children/adolescents and age range of tested minors), 4) opinions and attitudes toward DTC-GT (9 questions with special focus on tests for multigene diseases, athletic abilities, other inborn talents and lifestyle), 5) educational needs about DTC-GT (4 questions concerning interest in learning more, reasons why the respondents did not eventually want to learn more, preferred topics and preferences for educational delivery methods). Apart from the five personal and professional queries, nine questions were dichotomous (yes/no, none/n”) and fourteen were multiple-choice with more than one possible answer. Multiple-choice questions included the choice “other”, with a “please specify” request allowing entry of free text.

Statistical analysis was conducted using the Graphpad software package (San Diego, CA, USA). The respondents’ personal characteristics and questionnaire responses were described using frequencies and percentages. Chi-square test was used to determine statistical significance. The significance level was considered as p<0.05.

RESULTS

A total of 442 physicians filled the questionnaire, resulting in a response rate of 4.86% of all active members of the Society (442/9,086). The proportion of missing answers to survey questions over all the items was less than 1%. No significant differences in survey response rates of the 6,000 female and 3,086 male society members were found ($\chi^2 = 0.017, df = 1$, n.s.).

The descriptive statistics for the demographic and professional variables of the respondents are summarized in Table 1.

Most of the participants (282/442, 63.8%) had no awareness of DTC-GT, while 160 (36.2%) were aware, although only 23.1% (37/160) of them felt adequately prepared to meet families’ information needs. A significantly larger percentage of male respondents than female respondents were aware of DTC-GT ($\chi^2 = 13.4$, df = 1, p < 0.001).
higher awareness (X² = 23.8, df = 4, p < .001) and in the two older age ranges no significant differences in female versus male awareness were observed (51-60 years X² = 1.649, df = 1; n.s.; >60 years X² = 0.029, df = 1, n.s.).

Table 2 shows the contribution of the various sources of knowledge on DTC-GT, based on 286 answers provided for this multiple-choice query by the physicians who were aware. The majority of them (88.1%, 141/160) marked at least two sources of information.

The majority of respondents who were aware of DTC-GT (83.6%, 133/159, one answer was left blank) had never discussed the topic with a patient’s family or an adolescent patient nor were asked to see their results. Only 16.4% (26/159) of them had already been approached by families asking questions before eventual testing or advice following its result. During 2016 a total of 60 clinical interactions were reported by 19 pediatricians (11.9%) and 11 of them (6/20) and 7-10 years in the remaining 20% (4/20).

The distribution of performed DTC tests according to their main categories (multichoice query with 27 answers) shows that the prevailing ones are carrier (9/27; 33.3%) and diagnostic testing (9/27; 33.3%), followed by presymptomatic and genetic relatedness tests (in both cases 3/27; 11.1%). In 2 cases (7.4%) and in 1 (3.7%) respectively, susceptibility and nutrigenetic testing had been performed.

A very large majority of the pediatricians who were aware would not advise DTC genetic testing for predicting sports performance and athletic talent (96.9%, 155/160) nor for lifestyle or inborn skills outside of athletics (96.3%, 154/160). Only five (3.1%) and six pediatricians (3.7%), respectively, support their use. The given reasons are summarized in Table 5.

69.2% (110/159, one answer was left blank) of the aware respondents had a negative view of DTC genetic tests for risk predictions of common complex diseases, many of which arise in adult life, while 49 (30.8%) have the opposite opinion. The reasons behind their judgements are outlined in Table 6.

76.9% (123/160) reported feeling unprepared to answer patient questions regarding DTC-GT and more than four-fifth of the aware physicians (133/160; 83.1%) reported wanting to learn more about DTC-GT.

The reasons why 27 respondents did not want to learn more were (out of 37 answers to this multichoice query): a) DTC genetic testing will not have a significant impact on the provision of health care in the next future or before my retirement (43.2%, 16/37); b) learning postponed until the issue will come up in the care context of specific patients (27%, 10/37); c) I will not face enquiries from the families about this topic (10.8%, 4/37); d) lack of...
TABLE 4. Categories of tests for which families sought information or advice in 2016

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>Total answers = 47 * n° and %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrier testing</td>
<td>16 (34.3%)</td>
</tr>
<tr>
<td>Diagnostic tests</td>
<td>7 (14.9%)</td>
</tr>
<tr>
<td>Pre-symptomatic tests</td>
<td>6 (12.8%)</td>
</tr>
<tr>
<td>Genetic relatedness tests</td>
<td>6 (12.8%)</td>
</tr>
<tr>
<td>Susceptibility tests for common multifactorial conditions</td>
<td>5 (10.6%)</td>
</tr>
<tr>
<td>No specific category, generic questions</td>
<td>4 (8.5%)</td>
</tr>
<tr>
<td>Nutrigenetic tests</td>
<td>3 (6.4%)</td>
</tr>
<tr>
<td>Pharmacogenetic tests</td>
<td>0</td>
</tr>
<tr>
<td>Genetic ancestry testing</td>
<td>0</td>
</tr>
<tr>
<td>Sport tests</td>
<td>0</td>
</tr>
<tr>
<td>Lifestyle/behavioural tests</td>
<td>0</td>
</tr>
<tr>
<td>Phenotype tests</td>
<td>0</td>
</tr>
</tbody>
</table>

* Respondents could select more than one answer.

time to learn (8.1%, 3/37). In the “other” category two pediatricians (5.4%) stated that that primary responsibility for counselling would lie with other specialists, mainly clinical geneticists; another one felt already competent and the last one was predominantly interested in different areas of genetics.

When asked to indicate from a multichoice list which areas need particular strengthening in education programmes, the most common of the 573 provided answers were: a) evidence-based guidelines to adequately manage patients with increased genetic risks after testing (11.9%, 106/912); b) in-depth insight on the available types of DTC-GT (11.8%, 108/907); c) reliability of DTC-GT (17.6%, 101/573) and 7 % (29/415) of the preferences. Brochures, magazine and newspaper articles, TV/Radio programs and face-to-face encounters with representatives of DTC companies were the least chosen resources (respectively in 2.4%, 2.4%, 0.7 %, 0.5% of the cases).

DISCUSSION

We sought to assess Italian pediatricians’ awareness, experience and beliefs regarding DTC-GT in minors, with a focus on those for predisposition to complex disease, lifestyle, athletic ability and other inborn talents. Most of our respondents (63.8%) were unaware of DTC-GT. The awareness of DTC-GT among physicians varies considerably by specialization and across years and countries. To our knowledge, only one study has been published in Italy to date, disclosing a 31.6% awareness among family physicians in 2014 [25]. This value is not significantly different from the 36.2% actually found among

TABLE 5. Respondents’ opinions concerning DTC-GT for athletic abilities, lifestyle and inborn talents outside of athletics

<table>
<thead>
<tr>
<th>DTC GENETIC TESTING FOR ATHLETIC ABILITIES</th>
<th>Total answers = 400 n° and %</th>
<th>DTC GENETIC TESTING FOR LIFESTYLE AND INBORN TALENTS OUTSIDE OF ATHLETICS</th>
<th>Total answers = 409 n° and %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A– CONCERNS EXPRESSED BY AWARE RESPONDENTS WHO WOULD NOT ADVISE DTC-GT</td>
<td></td>
<td>B – REASONS ENDORSED BY AWARE RESPONDENTS WHO WOULD ADVISE DTC-GT</td>
<td></td>
</tr>
<tr>
<td>Doubts about test validity and utility, and results accuracy</td>
<td>93 (23.25%)</td>
<td>Tests are just indicative but they don’t harm</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>In minors genetic testing shouldn’t be done without the involvement of their doctors</td>
<td>86 (21.3%)</td>
<td>Tests can select what kind of sports minors are likely to be good at / to support family’s educational task</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>Potential alteration of family dynamic</td>
<td>83 (20.73%)</td>
<td>Tests can implement minors’ prospect of success (+/- in sport)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>Not evidence-based</td>
<td>68 (17.6%)</td>
<td>Tests are scientifically valid</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>Detrimental to minors’ autonomy</td>
<td>63 (15.75%)</td>
<td>To meet family’s needs and expectations</td>
<td>0</td>
</tr>
<tr>
<td>Privacy concern</td>
<td>7 (1.75%)</td>
<td>Test have a favorable cost/benefit ratio</td>
<td>0</td>
</tr>
</tbody>
</table>

* Respondents could select more than one answer

TABLE 6. Reasons endorsed by aware respondents who, respectively, would not advise or advise DTC-GT for common complex diseases

<table>
<thead>
<tr>
<th>Reason</th>
<th>Total answers = 251 * n° and %</th>
<th>“would not advise”</th>
<th>Total answers = 103* n° and %</th>
</tr>
</thead>
<tbody>
<tr>
<td>In minors genetic testing shouldn’t be done without the involvement of their doctors</td>
<td>63 (25.1%)</td>
<td>Promotion of lifestyle changes</td>
<td>36 (35%)</td>
</tr>
<tr>
<td>Difficult interpretation of the results</td>
<td>61 (24.3%)</td>
<td>Promotion of screening test</td>
<td>31 (30.1%)</td>
</tr>
<tr>
<td>Doubts about test validity and utility, and results accuracy</td>
<td>54 (21.52%)</td>
<td>To get a diagnosis potentially useful also for other family members</td>
<td>28 (27.2%)</td>
</tr>
<tr>
<td>No guidelines to reduce risk since childhood</td>
<td>44 (17.53%)</td>
<td>Modification of the plan of scheduled visits for minors with increased risk of disease</td>
<td>7 (6.8%)</td>
</tr>
<tr>
<td>Concern about privacy and minors’ autonomy</td>
<td>24 (9.5%)</td>
<td>More respectful of privacy</td>
<td>1 (0.9%)</td>
</tr>
<tr>
<td>Other*</td>
<td>5 (1.9%)</td>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

* Respondents could choose more than one answer

* Other responses, submitted as free text, can be categorized as follows: a) correct lifestyle should be pursued independently from genetic test b) familial history is useful to detect risks; c) DTC-GT results may be misinterpreted by the family.

"would not advise" Total answers = 251* "would advise" Total answers = 103*
investigated pediatricians. By contrast, in a 2008 US survey
pediatricians were among the most aware physicians (50%)
of personal genomics offered directly to consumers [26].
With regard to DTC provision model of genetic testing
in minors, 86% of the Japanese and European clinical geneticists,
participated in this survey. According to our respondents,
the awareness among general practitioners and 38.7% among
primary care physicians investigated several years ago respectively
in Japan and in North Carolina [US] [27,29]. The 2012
results of a National Family Health System based on Omic Sciences
[32] and envisaged by the Italian plan for the innovation of
healthcare services in Italy [33], clearly demonstrate the web’s growing role as a
medium for knowledge transfer. Non-traditional players in
education, as exemplified by the Australian model [31]
jointly account for more than 30% of information sources.
In the year prior to survey (2016) 11.9% of the learning sources. Direct marketing activities of
material of for-profit companies and the reductionist
interest. In the 2014 Italian survey (1.3%), but much lower of the
patients, was a 26% of the general practitioners investigated in US by Powell et al [29] and of the 11.7
parents should be able to have their children tested [33]. Tencay et al. reported that parents enrolled in an
observational study on genetic test for common adult-onset diseases are inclined to have their children tested too [34]. A similar view is held by mothers participating in
BRCAl/2 testing [35]. Testing of minors for carrier status to assess future reproductive risks and for adult-onset conditions, of which the prevention/treatment is available
donors during childhood is supported, respectively, by 60% and 47% of British adults surveyed by Shkedi et al. [35] and
healthcare professionals regularly face requests from parents for these tests [37].
However, in agreement with several other studies [38], most pediatricians, though aware, felt unprepared to appropriately counsel on DTC-GT and expressed the desire to learn more. The large majority of those desirous to learn more trust the scientific societies and the traditional medical education
care channels, that account for almost 80% of the preferred sources for future learning. Interestingly, despite the growing number of online and e-learning resources on genetics to medical care, multimedia learning platforms and websites are perceived less useful than traditional channels, together accounting for about 15% of the preferences. The finding is somehow not surprising since pediatricians frequently use the Internet during their practice [39].

We acknowledge that this study has several limitations. First, the overall response rate is very low as no attempts were made to incentivize responses. Second, the respondent group may be more highly motivated than providers nationally. Although this is not a representative sample, the results offer a window into the awareness, experiences and beliefs of pediatric professionals regarding DTC-GT, still largely lacking. We hope that in the future more systematic studies of DTC-GT will ascertain diffusion, counseling behaviors and ethical aspects associated with this new phenomenon.

CONCLUSION
Though our survey show low awareness and limited experiences of Italian pediatricians with DTC-GT, the continuing expansion of this market and the strong parent/physician alliance let us predict that pediatric professionals will increasingly be engaged in discussion involving this complex matter. In addition, DTC-genotyping advertising of commercial genetic tests, especially in the pharmacogenomics field, is foreseeable in the near future [40].

We hope that in the future more systematic studies of DTC-GT will ascertain diffusion, counseling behaviors and ethical aspects associated with this new phenomenon.

Competing Interests
The authors declare no conflicts or competing of interest.

Acknowledgements
We are grateful to all pediatricians who kindly participated in this survey.
We would also like to thank the Italian Society of Pediatrics that supported the study.

References


