

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

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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 skills. 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 tests (GT), offered on a large scale since 2007 by a growing 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 have 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), susceptibility testing for common complex 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 wax type, bitter taste perception, genetically tailored diet plan, propensity to addictions, talent identification, ancestry, paternity testing). Furthermore, several companies market next-generation sequencing of multigene panels and some whole genome or exome scans, providing consumers with disease-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 favourably featured on 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 founts 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 foundation 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 DTC firms frequently make misleading claims, overstating tests' 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 DTC provision model in the context of disease-oriented 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 an adequate assessment 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 health benefits since childhood, should be deferred until the person is old enough to fully participate in the decision-making process [12]. In 2013 the American Academy of Pediatrics (AAP) and the American College of Medical Genetics and Genomics (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 2015 of the International Federation of Sports Medicine (FIMS) 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 Australasia [17] and by the Australian Institute of Sport (AIS) [18]. Furthermore, (2017) AIS, FIMS 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].

Commercial DNA testing for healthy 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 offered "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 music appreciation, aptitude for mathematics, sensitivity to second-hand smoke, optimism, faithfulness, shyness, emotional control, even propensity for teenage romance and so on. As the popularity of this typology of testing has increased, especially in East Asian countries where families are top spenders on private education, so have worries about their consequences. Aside from the lack of scientific evidence and some good examples of absurdity, critics have argued that marketing messages are rhetorical and misleading, conveying a striking picture of genetic determinism. As a consequence children may be

forced into a specific path or career without taking into account their wishes and preferences. With this concern in mind, in 2010 the Japan Society of Human Genetics warned against DNA testing for minors "related to ability, character and future career paths" [21].

Given all the questions surrounding DTC-GT, the central gatekeeper role of medical professionals, particularly of 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 healthcare decisions under the guidance of a physician [23]. This new role represents a significant challenge for most physicians 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, pediatricians too 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, experience, 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 Society's news magazine, which is sent to the postal address of all the active Society members. No solicitations were sent to non-responders. 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 (< 30, 31-40, 41-50, 51-60, >60 years), duration of practice (< 5, 5-10, 10-20 and ≥20 years), professional profile (community based pediatrician, hospital pediatrician of the NHS, University pediatrician, private pediatrician,

pediatric registrar, other) and main practice location (categorized into Northern, Central, Southern and Insular Italy),

2. knowledge and awareness on GT sold directly to consumers (3 questions, regarding knowledge, information's sources and perceived adequacy to manage family's and/or adolescent patient's questions and requests);
3. experiences with patients (7 questions, including whether or not they have been asked on DTC-GT in 2016 or in past years by families/adolescent patients, questions typology, categories of tests 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 multifactorial diseases, athletic abilities, other inborn talents and lifestyle);
5. educational needs about DTC-GT (4 questions concerning interest in learning more, the 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 dichotomic (yes/no; none/n°) and fourteen were multiple-choice with more than one possible answer. Six 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 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 ($\chi^2 = 13.4$, $df = 1$, $p < .001$).

Increasing age was significantly associated with

TABLE 1. Demographic and professional characteristics of the respondents (n=442)

SEX	N°	%
Female	292	66.07%
Male	147	33.25%
Not declared	3	0.68%
AGE RANGE		
< 30 y	10	2.26%
31-40 y	100	22.62%
41-50 y	74	16.74%
51-60 y	127	28.73%
>60 y	130	29.42%
Not declared	1	0.23%
PROFESSIONAL PROFILE		
Family pediatrician	156	35.29%
Hospital pediatrician (NHS)	190	42.99%
University pediatrician	23	5.20%
Pediatricians working in private health structures	22	4.98%
Registrar in Pediatrics	16	3.62%
Other	33	7.47%
Not declared	2	0.45%
YEARS OF PRACTICE		
<5 y	26	5.88%
5-10 y	68	15.39%
10-20 y	87	19.68%
>20 y	258	58.37%
Not declared	3	0.68%
REGION OF THE MAIN PROFESSIONAL PRACTICE		
Northern Italy	224	50.68%
Central Italy	112	25.34%
Southern Italy	76	17.19%
Insular Italy	30	6.79%

higher awareness ($X^2 = 23.8$, $df = 4$, $p < .001$) and in the two older age ranges no significant differences in female versus male awareness were observed (51-60 years $X^2 = 1.649$, $df = 1$; n.s.; >60 years $X^2 = 0.029$, $df = 1$, n.s.).

With regard to geographic area of main practice no significant trend north-south was observed.

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 (6.9%) had at least one family/patient bring in test results (in total 20 cases, range 1-3 cases for respondent). Categories of questions asked by families or adolescent patients are summarized in Table 3, while the types of tests for which information or advice was sought are reported in Table 4.

20 families brought the results of DTC-GT to the consultation. The age range of tested children was up to 2 years in 50% of the cases (10/20), 2-6 years in 30%

TABLE 2. Information sources about dtc genetic testing

SOURCE	Total answers = 286 ^ n° and (%)
Internet	60 (20.98%)
Magazines and newspapers	48 (16.78%)
Tv/Radio	41 (14.33%)
Medical Journals	38 (13.29%)
Patients' Families/Patients	30 (10.49%)
Scientific Meetings	23 (8.04%)
Physicians and other healthcare providers	21 (7.34%)
Professional Societies	14 (4.90%)
Selling Companies	7 (2.45%)
Other *	4 (1.40%)

^ Respondents could choose multiple answers

* Including advertising in pharmacy, personal acquaintance with a seller or with consumers of DTC-GT

TABLE 3. Categories of questions asked by families/patients about DTC genetic testing

QUESTION CATEGORY	Total answers = 78 * n° and (%)
If you would advise testing	21 (26.92%)
Information about specific tests	13 (16.67%)
Whether clinical test results may change patient's health care	12 (15.38%)
Information about testing benefits	12 (15.38%)
Whether test results may help improving lifestyle and/or obtaining better performances	11 (14.10%)
Information about selling companies	3 (3.85%)
What you would do in my position	3 (3.85%)
Cost/benefit appropriateness	3 (3.85%)

* Respondents could select more than one answer

(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

CATEGORY	Total answers = 47 *	
	n° and (%)	
Carrier testing	16 (34%)	
Diagnostic tests	7 (14.9%)	
Pre-symptomatic tests	6 (12.8%)	
Genetic relatedness tests	6 (12.8%)	
Susceptibility tests to common multifactorial conditions	5 (10.6%)	
No specific category, generic questions	4 (8.5%)	
Nutrigenetic tests	3 (6.4%)	
Pharmacogenetic tests	0	
Genetic ancestry testing	0	
Sport tests	0	
Lifestyle/behavioural tests	0	
Phenotype tests	0	

* 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 (19%, 109/573); b) in-depth insight on the available types of DTC-GT (18.8%, 108/573); c) reliability of DTC-GT (17.6%, 101/573); d) how to interpret test results (16.1%, 92/573); e) associated ethical issues (14%, 80/573). The least chosen options were: a) informative resources dedicated to physicians (7.2%; 41/573), b) informative resources dedicated to patients (4.5%; 26/573), c) characteristics of DTC companies and of their services (2.8%, 16/573).

Four sources were the most highly endorsed for future learning, cumulatively accounting for almost four fifth of the 415 answers to this multi-choice query: public policies (e.g. position statements and guidelines) issued by scientific societies (24.6%, 102/415), journal articles (22.6%,

94/415), professional medical meetings (e.g. seminars, congressional sections, residential courses; 16.9%, 70/415) and meetings with medical genetics specialists (14.5%, 60/415). Multimedia learning platforms and trusted internet websites accounted respectively for 8.4% (35/415) 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

A- CONCERNS EXPRESSED BY AWARE RESPONDENTS WHO WOULD NOT ADVISE DTC-GT	DTC GENETIC TESTING FOR ATHLETIC ABILITIES	DTC GENETIC TESTING FOR LIFESTYLE AND INBORN TALENTS OUTSIDE OF ATHLETICS
	Total answers = 400 n° and % *	Total answers = 409 n° and % *
Doubts about test validity and utility and results accuracy	93 (23.25%)	101 (24.7%)
In minors genetic testing shouldn't be done without the involvement of their doctors	86 (21.5%)	80 (19.6%)
Potential alteration of family dynamic	83 (20.75%)	87 (21.3%)
Not evidence-based	68 (17%)	64 (15.6%)
Detrimental to minors’ autonomy	63 (15.75%)	66 (16.1%)
Privacy concern	7 (1.75%)	11 (2.7%)
B – REASONS ENDORSED BY AWARE RESPONDENTS WHO WOULD ADVISE DTC-GT	Total answers = 5 n° and %	Total answers = 11 n° and %
Tests are just indicative but they don't harm	2 (40%)	3 (27.27%)
Tests can select what kind of sports minors are likely to be good at /To support family's educational task	1 (20%)	2 (18.19 %)
Tests can implement minors’ prospect of success (+/- in sport)	1 (20%)	1 (9.09%)
Tests are scientifically valid	1 (20%)	1 (9.09%)
To meet family's needs and expectations	0	3 (27.27%)
Test have a favourable cost-benefit ratio	0	1 (9.09%)

* 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

“would not advise”	Total answers = 251*	“would advise”	Total answers = 103*
Reason	n° and %	Reason	n° and %
In minors genetic testing shouldn't be done without the involvement of their doctors	63 (25.1%)	Promotion of lifestyle changes	36 (35%)
Difficult interpretation of the results	61 (24.3%)	Promotion of screening test	31 (30.1%)
Doubts about test validity and utility and results accuracy	54 (21.52%)	To get a diagnosis potentially useful also for other family members	28 (27.2%)
No guidelines to reduce risk since childhood	44 (17.53%)	Modification of the plan of scheduled visits for minors with increased risk of disease	7 (6.8%)
Concern about privacy and minors’ autonomy	24 (9.56%)	More respectful of privacy	1 (0.9%)
Other^	5 (1.99%)	Other	0

* 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.

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]. Some empirical studies have looked at the awareness of other medical specialists regarding DTC-GT. 68.4% and 86% of the Japanese and European clinical geneticists, surveyed respectively in 2007 and 2010, were aware of DTC-GT [27,28]. The level of awareness was 38% 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 article by Ram et al. indicates that the proportion of New Zealanders general practitioners who had heard about DTC genetic testing was 47.8% [30].

According to our respondents the primary information source about DTC-GT is the Internet, similarly to the previous Italian study, confirming the web's growing role as a medium for knowledge transfer. Non-traditional players in medical education (TV, radio, magazines and newspapers) jointly account for more than 30% of information sources. By contrast, medical journals, scientific meetings and professional societies, taken together, constitute around 26% of the learning sources. Direct marketing activities of the companies influenced the knowledge in 2.45% of the cases. This percentage is slightly higher than that observed in the 2014 Italian survey (1.3%), but much lower of the 13.5% indicated by the primary care providers investigated in US by Powell et al. [29] and of the 11.7% disclosed by Japanese general practitioners surveyed by Ohata et al. [27], suggesting a still low market penetration of DTC companies in Italy.

Given the promotional nature of the informative material of for-profit companies and the reductionist approach to genome often conveyed by popular media, these data highlight the importance that institutional bodies monitor and anticipate upcoming health market trends so to provide professionals with timely and unbiased information, as exemplified by the Australian model [31] and envisaged by the Italian plan for the innovation of Health System based on Omic Sciences [32].

Direct experience with DTC-GT is obviously lower than awareness. In the year prior to survey (2016) 11.9% of the aware respondents had at least one family/patient asking questions before or after testing, and 6.9% had at least one family/patient bring in test results. Interestingly, most testing were done to look for mutations in single genes related to monogenic disorders or to detect genetic relatedness (e.g. paternity test), while tests related to conditions where there are both genetic and environmental influences were very infrequently seen and limited to susceptibility testing to common complex diseases and to nutrigenomic. No tests for athletic abilities, lifestyle and inborn talents outside of athletics were declared.

With regard to DTC provision model of genetic testing to minors, the large majority of respondents who were

aware expresses views in agreement with guidelines and statements of scientific societies [12,13,14,16,17,18]. Only less than 4% would advise testing for athletic abilities, lifestyle and other inborn talents. The position on DTC susceptibility testing is more nuanced and slightly more than 30% would advise them.

A considerable 83.1% of the respondents who were aware expressed the desire of learning more about DTC-GT. Providers holding the opposite view mostly endorsed the reason of the unlikely impact of DTC-GT on their care practice. However, caution should be expressed on this point. Proliferation of DTC-GT, marketing efforts and growing public awareness could rapidly increase demand for these tests. In addition, empirical research shows that public's attitude toward pediatric testing can be unaligned with experts' views. McGuire et al. found that 52% of social networkers having used or being interested in personal genome testing for themselves would consider using for their children and that 63% agreed that parents should be able to have their children tested [33]. Tercyak 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 BRCA1/2 testing [35]. Testing of minors for carrier status to assess future reproductive risks and for adult-onset conditions for which no prevention/treatment is available during childhood is supported, respectively, by 60% and 47% of British adults surveyed by Shkedi-Rafid et al. [36] 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 desiring to learn more trust the scientific societies and the traditional medical education channels, that account for almost 80% of the preferred sources for future learning. Interestingly, despite the growing number of online resources available to assist integrating genomics into 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 somewhat surprising since Italian 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, counselling behaviour 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-pediatrician alliance let us predict that pediatric professionals will increasingly be engaged in discussion involving this complex matter. In addition, a direct-to-physician advertising of commercial genetic tests, especially in the pharmacogenomics field, is foreseeable in the next future [40].

Our data indicate also that pediatricians are interested in learning more about DTC-GT. Scientific societies are best positioned to support health professionals in this communication challenge thanks to their role of trusted sources of information and guidance within the physician community. They can develop statements and guidelines shaping care practice, disseminate information through specialistic journals and organise continuing medical education courses, taking into account pediatricians' preferences for areas such as interpretation of results and management of patients with increased genetic risks after testing, clinical validity and clinical utility of the tests and ethical issues associated with DTC-GT. In our opinion, a special effort should be dedicated to facilitate physicians' access to online information sources that must be user-friendly, reliable, unbiased and regularly updated

Competing Interests

The authors declare no conflicts or competing of interest.

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