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Structuring Expanded Genetic Carrier Screening: A Longitudinal Analysis of Online News Coverage

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Abstract

Expanded carrier screening (ECS) is a genetic test that is designed to assess the risk of a healthy person passing down a genetic disorder, such as spinal muscular atrophy, to future children. ECS screens for up to several hundred disorders in one test, expanding on traditional carrier screening tests that target one or a few genetic disorders. However, little is known about how this health technology is being presented to the public in media coverage. Accordingly, this study is a qualitative content analysis of online news and information of ECS over a 6-year period, beginning in 2010 when the technology was publicly available. Results indicate that major coverage themes were consistent across the years included, although content within those themes changed over time. Using structuration theory to guide analysis, results reveal that online news and information from 2010 to 2015 structured ECS as a health technology innovation, an opportunity for business and investment, and a tool for family planning. Results are discussed in terms of implications for future research, for health journalism practice, and for clinical interactions.

People develop attitudes about health technologies over time through exposure to a variety of sources (Ancker, Silver, Miller, & Kaushal, 2013; McCaughey et al., 2016). Genetic technologies, such as carrier screening (CS) and expanded carrier screening (ECS), have received significant media attention in recent years. CS is genetic testing typically performed on an individual who does not have symptoms of a genetic disorder but who might have genetic variations that could be passed on to their offspring resulting in a genetic disorder, such as cystic fibrosis (American College of Obstetricians and Gynecologists [ACOG], 2017). With CS or ECS, individuals and couples are able to better understand their carrier status before pregnancy, and in the case of high risk couples, access other means of reproduction such as IVF or adoption (Wienke, Brown, Farmer, & Strange, 2014).

Little is known about how CS or ECS have been portrayed to the public by news media, specifically through online news and information. An examination of online news and information about ECS is warranted given that more than 3.2 billion people had Internet access as of 2015 (Davidson, 2015), and that health news and information remain among the most popular interests for online news consumers (Mitchell, Gottfried, Shearer, & Lu, 2017). Understanding online news and information representations of ECS can shed light on major

issues being presented to the public that might influence their attitudes about ECS and other emerging health technologies, allowing providers to better understand patient decisions about ECS.

CS and ECS

Genetic screening is expanding rapidly due to technology advances and an increased desire for knowledge about inherited traits and disease risks (Alswaidi et al., 2012; Bailey, Lewis, Roche, & Powell, 2014; Bajaj & Gross, 2014; McGowan, Cho, & Sharp, 2013; Schneider et al., 2016). CS has been extremely effective when used to target a specific disease and/or population, such as Tay–Sachs screening within the Ashkenazi Jewish population and broader cystic fibrosis screening (Bailey et al., 2014). Notably, contemporary society is much more ethnically diverse than in the past, which makes ethnicity-based screening less effective (Langlois, Benn, & Wilkins-Haug, 2015). ECS panels have been referred to as “pan-ethnic” or “universal” panels as they expand from targeted screening to screen for multiple disorders, sometimes several hundred disorders, and are not targeted based on ethnicity or family history.

Although ECS is increasing the amount of information people have when contemplating pregnancy, challenges accompany this increase (e.g., Benn et al., 2014; Beaudet, 2015; Cho, McGowan, Metcalfe, & Sharp, 2013; Munthe, 2014). For example, many providers hesitate to order full ECS panels due to anxiety producing results, such as a 20% rate of false-positive results (Munthe, 2015). Most ACOG Fellows recommend that ECS and other noninvasive prenatal testing devices (NIPTs) be regulated in some manner, and a majority believe ECS/NIPT testing could increase pregnancy terminations due to a confusion over the likelihood of full disease expression in offspring (Benn et al., 2014, p. 145). One reason for caution is limited knowledge about genetics and genetic screening among health-care providers while patients express desires for that information (Ormond et al., 2009; Ready, Haque, Srinivasan, & Marshall, 2012; Schneider et al., 2016). Given patients’ desire for ECS information, it is increasingly important to understand how information about ECS is presented to the public and how that information changes over time, particularly in easily accessible online formats. Because online news and information is presented within a broader social context, we used structuration theory to guide analysis.

Theoretical Framework

Structuration theory (Giddens, 1984) is useful for understanding how social attitudes and practices develop over time, expanding analysis from a discrete collection of texts (i.e., online news and information) to how those texts are instantiations of broader social structures that pervade our social lives. According to structuration theory, people act and interact in social systems that include broad structures, which serve as rules and resources to both constrain and enable action within those systems. These structures include signification, involving meaning making; legitimation, involving normative behavior, legal, and procedural expectations; and domination, involving authoritative power over people and allocative power over material resources. Structures are produced, reproduced, and

sometimes transformed over time as people use them as both rules and resources for actions and interactions.

A central tenet of structuration theory is the duality of structure, which indicates that “all structural properties of social systems...are the medium and outcome of the contingently accomplished activities of situated actors” (Giddens, 1984, p. 191). For the purposes of this study, journalists, public relations professionals, and other people generating online content about ECS are situated actors, as are people who read and interpret online news and information about ECS. These actors draw on social structure in the context of generating, interpreting, and using online content about ECS. Their subsequent actions and interactions, then, also reproduce (and perhaps transform over time) social structure for future actions and interactions. Although the current analysis does not include behaviors that might be outcomes of online coverage of ECS, such as screening uptake, content appearing over time about ECS indicates behavioral choices on the part of both writers and readers.

Using structuration theory to analyze online media coverage of ECS screening identifies ways social structures constitute rules and resources for presenting the health technology to the public. Such structures not only constrain and enable the public discourse about ECS (signification structures) but also serve as rules and resources for who is seen as having authority to speak about ECS (domination structures) and how such screening technologies are folded into common health practices (legitimation structures).

Research Questions

RQ1: How has online news and information about ECS represented the technology over time?

RQ2: What structural rules and resources have been drawn on in online news and information about ECS to structurate ECS as a health-related option?

Method

This qualitative content analysis extends a previous quantitative content analysis that identified frames, tones, topics, and quoted sources of ECS articles (Holton, Canary, & Wong, 2017). While ECS became publicly available in 2009, online news and information including the term “expanded carrier screening” did not appear until 2010. Accordingly, this study used a Google News search of the term “expanded carrier screening” for the period of January 2010 to December 2015. Google News provides a robust collection of news and information and is not restricted solely to content from news organizations (i.e., blogs and related sources are typically included). To ensure articles collected were publicly available (i.e., not hidden behind paywalls; subscriptions were not required for viewing), articles from private, pay, and subscription sites were excluded. Further inclusion criteria were (1) the main issue covered in article was ECS or CS; (2) the article was a news-type article reporting on some issue relating to ECS rather than a policy document or position statement that was not disseminated with the intent to report information to the public; and (3) the article was not a book review or advertisement. Research assistants were trained in a series of collaborative and individual search sessions followed by further discussion-based training

sessions. This resulted in including 230 articles: 13 from 2010; 16 from 2011; 16 from 2012; 41 from 2013; 32 from 2014; and 112 from 2015. Articles were imported into NVivo, version 10, and separated by year.

Data Analysis

Using summative content analysis conventions, word frequency analyses were conducted for articles by year (Hsieh & Shannon, 2005). Search criteria were (a) words with a minimum of four letters and (b) top 25 most frequently appearing words. Search settings included similar words (i.e., the term “test” included “tests, testing, and tested”). Most frequent words were used to begin the coding process, which focused on the meaning conveyed by the text including key words. For example, the search term “test” identified the 2010 headline “Firm Brings Gene Test to the Masses,” which was coded “Widespread Use.” We used the sentence in which the term was used as the coding unit.

Two team members collaboratively coded articles for the earliest year (2010) using the constant comparative method and open coding principles (Tracy, 2013). Nonhierarchical, first-level codes were identified to start developing a sense of article content (Tracy, 2013). As coding continued, the team organized codes into larger categories of meaning that represented the articles for 2010. After collaboratively coding using the top five most frequent terms to identify text, two team members separately coded articles using the next five most frequent terms to guide coding. That coding phase was used to test inter-coder reliability, which was acceptable. One team member then coded remaining article text for 2010. This coding procedure was repeated for each year separately so that common codes as well as changes could be identified over the 6 years. For each year, Cohen’s kappa was excellent (2010 $k = .96$; 2011 $k = .96$; 2012 $k = .93$; 2013 $k = .97$; 2014 $k = .92$; 2015 $k = .98$).

Results

Media Representation of ECS

Research Question 1 asked, “How has online news and information about ECS represented the technology over time?” Most major themes persisted over the 6-year period, although content within those themes changed from year to year. Table 1 presents content themes with frequency counts and ratios (theme units/total units) for each theme by year.

General Information—Many articles included general information explaining genetics, CS, and ECS (e.g., “But reading genes isn’t exactly like testing for high blood pressure.”). Information about diseases identified by CS, such as cystic fibrosis and Tay–Sachs disease, was also a common feature of articles across years (e.g., “One in 50 Americans carries an SMA mutation.”). In 2014 and 2015, there was relatively less information conveyed about what ECS is compared to earlier years. However, all years include a significant amount of coverage that could be considered educational for lay readers to better understand genetics, CS, and ECS.

Specific Tests—All years included articles that discussed specific screening tests (e.g., “Good Start works closely with patients and their insurance providers to simplify the billing and payment process.”). The tests/laboratories changed over the years, with new test introductions to the market influencing the fluctuation of coverage over the years. For example, 2010 included references to three specific tests, eight tests were discussed in 2013, and by 2015, five tests were reported. Information about specific tests included general information about the tests as well as clearly promotional content and corporate promotional information. Some coverage of specific tests included research results released by companies to promote their tests, often with exact text appearing across multiple online sources, indicating a heavy reliance on company press releases.

Genetics Organizations—ECS articles included information about genetics organizations, notably more in 2014 and 2015 (Table 1). Organizations include for-profit companies marketing and testing new ECS products, nonprofit advocacy organizations, and university-based laboratories or centers. Over the years, the emphasis shifted from nonprofit and university organizations to for-profit organizations. By 2015, 74% of genetics organization references were about for-profit companies (e.g., “Recombine to Present Research on Expanded Carrier Screening Platform”) compared to no such references in 2010.

Technology Information—Articles provided information about technology, such as next-generation sequencing (NGS) and other screening technologies (e.g., “Within five years we will be able to download all our genetic information onto a memory stick, experts say.”). Although analysis indicates an increase of technology information from the first year to subsequent years, 2015 had a noticeable drop in technology information coverage, back to the 2% represented in 2010 (Table 1).

Business/Financial—Business and financial issues began to appear in articles in 2011. The first two years of coverage (2011 and 2012) primarily focused on start-up companies raising capital for getting their tests to market and investments obtained by those companies to finance their technologies and operations (e.g., “The company will use the money to support its commercial launch, initially with a single sperm bank.”). Later coverage included information about technology innovations, mergers/acquisitions, licenses, expanding markets, revenues, and university partnerships (e.g., “Hardison said that the company is also interested in entering the highly competitive NIPT market.”).

Research Information—Text that made specific reference to details of research studies were coded separately from other themes to analyze how much technical information was being conveyed in online articles (e.g., “Results of the research are reported in the current issue of Public Health Genomics.”). Data in this theme often elaborated on text coded in other themes, such as Specific Tests or Technology Information. As indicated in Table 1, little relative amount of coverage was devoted to research details during the period analyzed.

Benefits and Endorsements—Articles across years were noticeably positive about ECS and often connected positivity about expanded screening options to successes of targeted CS for specific populations (e.g., “On Tu B’Av, Remember The Importance Of Genetic

Testing”) or specific diseases (e.g., “The American College of Obstetricians and Gynecologists (ACOG) recommends cystic fibrosis carrier screening for all patients.”). Discussions of benefits of ECS dominated overall positive coverage of CS in 2010, 2011, and 2015, with fairly equal coverage given to benefits of ECS and targeted screening during 2012, 2013, and 2014. Articles across years also included personal stories of families who had benefited from ECS, providing anecdotal evidence of the benefits of ECS.

Legal Issues—Legal issues reflected involvement of the U.S. Federal Drug Administration (FDA) to approve and regulate ECS testing and marketing. Some legal issues concerned international regulations, particularly in the United Kingdom. The UK government published a major report in 2011 regarding CS for their national health system, which is reflected in 50 references to international legal issues that year. By 2015, FDA references dominated the legal discussion. The increase in coverage about the FDA is linked to a major decision made by the FDA in 2015 that eased restrictions on genetic tests marketed by for-profit laboratories to the public (e.g., “The FDA believes that in many circumstances it is not necessary for consumers to go through a licensed practitioner to have direct access to their personal genetic information.”).

Cautions or Negativity—Cautionary or negative information about ECS was not as dominant in articles as positive information. Early cautionary statements reflected concern about the new technology and uncertainty about implications of having so much genetic information, as in this author’s statement, “We should fully understand both the benefits and the consequences of sharing this kind of information before genetic testing is packaged and fed to the masses.” In sharp contrast to stories about the benefits of ECS, negative stories were rarely presented in articles over the 6-year period, with only 2 appearing in 2010 and three appearing in 2012. In 2015, a joint statement of five professional medical organizations was released to guide health-care providers in how to use ECS. Most of the cautionary coverage in that year concerned that published statement, such as, “Echoing some clear consumer concerns, the organization however said it does not support direct access genetic testing that is leveraged by businesses solely for advertising purposes.”

Ethical Implications—Ethical issues were raised in articles across years, although such issues are less predominant than other topics. The raw numbers of ethical references stayed similar across the years in spite of changes in the number of articles published each year, representing a reduction of coverage from 6% in 2010 to 1% in 2015. Ethical issues raised in articles changed over the years, from a focus on eugenics and human design concerns in the earlier years to a focus on informed decision making, privacy/confidentiality, and discrimination in the later years. For example, a 2015 article noted, “At some point we have to make sure that the way the company is presenting the information about the test, how it’s interpreted and so on, can be understood by the people who are expected to use it.” Other ethical issues presented over the years include minority health, abortion, and general references to the importance of ethical considerations in the genetic testing domain.

Cost/Insurance—Articles discussed costs of ECS, disease prevention costs, and insurance coverage of screening (e.g., “Much less than 1% of any population actually has access to

genetic tests, and we think a big reason for that is price.”). Disease prevention costs, which had a minor presence in 2010–2012, completely disappeared from articles in 2013–2015. When cost and insurance issues were raised, they were often paired with the topics of business partnerships and innovation, such as articles about a large insurance company covering a specific ECS test to the benefit of the insured.

Widespread Use—Articles across all years discussed the widespread use of CS, and sometimes the widespread use of ECS specifically. Widespread use often included discussions of the success of screening programs for Jewish populations and for cystic fibrosis. By 2015, this theme included more references to the increasing popularity of ECS rather than linking ECS to earlier targeted screening programs (e.g., “Carrier screening of prospective parents is becoming more widespread, the Wall Street Journal reports.”).

Popular Culture References—Popular culture references were rarely made. The most notable such references were to the movie “Gattaca” and to Angelina Jolie’s use of genetic testing to make health-care decisions.

Genetic Counseling—The publication of the joint statement in 2015 coincides with increased coverage about genetic counseling. Genetic counseling was not discussed at all in ECS articles until 2012 when there were four references. By 2015, there were 53 references to genetic counseling or counselors (e.g., “Our genetic counselors will call you regardless of where you are to explain what the results mean.”), representing 2% of coded content.

Structuration of ECS

Research Question 2 asked, “What structural rules and resources have been drawn on in online news and information about ECS to structurate ECS as a health-related option?” Our analysis identified broader social structures involving meaning (signification), norms or expectations (legitimation), and power (domination). Because structuration theory recognizes that social action, including communication, inherently includes all three dimensions of structure, we present the structuration of ECS involving four broad issues that emerged in theoretical analysis of code themes.

ECS as a Health Technology Innovation—Articles analyzed clearly emphasized the technology of ECS and the innovation it represents for health care more broadly. This emphasis draws on the positive connotations of technology and innovation in our contemporary society (signification) while also reproducing those positive connotations through the predominant presentation of benefits and endorsements of ECS. Structuration of ECS in terms of technology and innovation is reflected in code themes of General Information, Specific Tests, Technology Information, Research Information, Benefits/Endorsements, Cost/Insurance, and Widespread Use. Credibility is afforded to new technologies and innovations reflecting the value and legitimacy of discovery as a broad social structure that both constrains and enables communication about ECS. Starting in 2013, information in the General Information code included information about NGS and what a breakthrough that technology provides for CS.

References to widespread use of CS and ECS also draw on the norm of “everyone is doing it,” reproducing ECS as a normative health choice tied to the legitimacy of technological advancements. In the earlier years, cystic fibrosis and Tay–Sachs were used as exemplar conditions to justify CS. References to CF decreased in the middle years and then came back up in later years, primarily due to new technologies for identifying additional mutations associated with CF.

Online articles also draw on authority that technologies and innovations have for determining our health decisions and behaviors. By focusing on technological features of ECS, other factors of consideration are minimized, such as considerations of privacy, discrimination, and the ability to understand the enormous amount of information produced by ECS (Ethical Implications). By drawing on technology as an authoritative structure, authors of ECS articles reproduce that authority for guiding health care decisions and behavior. One example is the connection of ECS to the Precision Medicine Initiative in 2015 articles (e.g., “Arguably the most tangible impact of precision medicine to date has been in the area of reproductive health, particularly carrier screening and non-invasive prenatal testing.”).

ECS as a Business Opportunity—ECS is a business and represents an opportunity for investment and financial gain. Online coverage of ECS draws on entrepreneurialism by posting articles about startups, investment opportunities, licenses, market development, revenues, and mergers and acquisitions. By drawing on such signification structures involving the business of ECS, these articles also reproduce the financial and business interpretations of ECS. The structuration of ECS as business opportunity is represented in several of the themes: General Information, Specific Tests, Genetics Organizations, Business/Financial, and Legal Issues. For instance, one 2015 article notes, “Vendors in the market are also taking advantage of opportunities such as strategic alliances and mergers and acquisitions, in order to increase their market share.”

Emphasizing the business and investment features of ECS draws on the legitimacy of capitalism as a system for organizing and driving health care. One 2013 article noted, “Medical genetic tests such as Gentle’s are not as tightly regulated in Belgium as in some other European countries, Schols said, and no legislation in Belgium ‘interferes with what we do.’” Using market share and other business-related issues as newsworthy topics draws on the normative structure of the “business” of health care while also reproducing it to constrain and enable future ECS decisions and behavior. Emphasizing the business aspect of ECS also minimizes attention to other issues such as costs to consumers, how results are stored and used, and how results are understood by the average consumer (Ethical Implications, Cost & Insurance).

ECS as Regulated Health Care—Throughout the data there is an underlying recognition that health-related inventions should be regulated to a certain degree, but that “over-regulation” hampers innovation and access. The structuration of health care as regulated is represented in the Legal Issues theme most prominently, but also is reflected in text coded in Cost and Insurance, Cautions and Negativity, and Ethical Implications. For example, the FDA was referenced in every year. Earlier years placed as much or more

emphasis on regulations of other countries. This theme draws on and reproduces the legitimization structure that health is a public good and should accordingly be regulated in the public sphere. This theme also structurates the authority of government agencies to regulate health-related businesses for the public good rather than relying on businesses to regulate themselves.

The regulatory theme is juxtaposed with the business theme. Seeking new markets was frequently discussed in terms of the regulatory environment of a particular business or in terms of what was legally allowed. A major policy change occurred in 2015 with the FDA removing earlier restrictions on the marketing and distribution of some genetic screening tests, leading to a spike in coverage about the FDA and legal issues in that year, including such statements as, “In the same announcement, the FDA said it cleared the first carrier screening test from 23andMe, the Google-backed genetic testing firm that previously clashed with regulators.” Such statements represent the ever-present tension between control and autonomy in society, which exists in health care as well as other domains.

ECS as a (Heterosexual) Family Planning Tool—Using ECS for making reproductive decisions and family planning was conveyed as a heterosexual endeavor. The structuration of family planning as heteronormative is evident across coded content. Stories about ECS only represented different-sex parents in traditional family structures. This coverage draws on both symbolic and normative structures of heteronormativity in the domain of genetics and reproductive decision-making. In October 2016, the U.S. National Institutes of Health announced that sexual and gender minorities are recognized as a marginalized population in health contexts and now represent a funding priority. Articles included in this analysis were circulated before that announcement was made so they do not reflect that cultural shift in health care.

The emphasis throughout articles is that reproduction involves forethought and planning. This is evident across several themes, including General Information, Genetics Organizations, Benefits & Endorsements, Ethical Implications, and others. However, Langlois et al. (2015) note that almost one-third of first babies born in the United States are unplanned. Accordingly, the emphasis on ECS for family planning draws on a normative structure of family planning that might not be in sync with contemporary reproductive realities. Increased information provided by ECS, when not provided before conception, could be overwhelming or stress inducing rather than actually contributing to the value of “informed decision making” that emerged as an ethical issue addressed by ECS.

Discussion and Conclusions

This analysis elucidated what the average person might find when searching online for news and information about ECS. Results indicate that general themes were consistent over the 6-year period, although subtopics and emphases evolved over time. Several broad issues demonstrate the structuration of ECS through online news and information from 2010 to 2015.

Scholarly Implications

Articles included in this analysis are part of the social, legal, and economic context within which people make health-care decisions. As potential resources for deciding whether or not to seek ECS, online news and information clearly structure ECS as a positive innovation that harnesses the power of technological advancement to increase the amount of information people have about their genetic make-up and potential impacts on their offspring. The business and investment aspects represented over time also structure ECS as a resource that bridges health care, business, and family domains, primarily in positive ways. Online content demonstrates structuration of ECS as practiced within a regulatory context in tension with a market approach to health technologies.

There was a repeated practice of using professional conferences (i.e., academic, medical, or scientific) as venues for promoting lab-specific tests. This coincided with alliances being announced between businesses, nonprofit organizations, and academic institutions, such as the nonprofit organization JScreen that partnered with Emory University to provide screening to Jewish communities. The connection between businesses, nonprofit organizations, and academic research increases the credibility and authority of screening tests, another example of structuring ECS as a cross-domain technology.

Our findings extend prior research of the social and ethical implications of genetic tests. Williams-Jones and Graham (2003) noted in their analysis of a genetic test for breast cancer, “A genetic test will shape and be shaped by human behavior, relations, and society” (p. 284). Our findings support and expand on this assertion by providing a theoretically-grounded explanation of the structuration of ECS. Results can be further extended by examining other contexts to increase our understanding of the communicative constitution of health care, health technologies, and health decisions.

Practical Implications

Results also have implications for clinical and journalistic practice. Little relative space was given to ethical issues of privacy, informed decision-making, and other ethical implications of ECS. Prior research indicates patients generally rely on their providers to give them the information they need to understand ECS results, yet most providers know little more than the typical patient (Ready et al., 2012; Schneider et al., 2016). Reading articles about the technological aspects of ECS, without getting exposed to the important role of interpretation of results, might lead to misunderstandings about benefits and limitations of ECS and what results mean (Mitchell, 2010). This is where genetic counselors as resources within online news and information, as well as other resources, could play a significant role. As experts trained on the analysis and delivery of ECS results, they could help contextual coverage of ECS.

Results of our study also have implications for health journalists. A large number of articles relied exclusively, or almost exclusively, on press releases distributed by for-profit laboratory companies that market ECS tests. Health journalists have a responsibility to provide clear information in forms that are both understandable and accurate. Results of this study underscore the importance of good journalistic practices that include obtaining multiple

sources for information, perhaps turning to genetic counselors more frequently, and presenting issues clearly and accurately. The number of company-generated press releases reiterated across multiple sources may also explain the repeated emphasis on technology, innovation, business, and investments across the years. When it comes to ECS and other emergent health technologies, news media may be creating an echo chamber of sorts wherein the volume of coverage may increase over time while the messages largely remain the same.

Limitations and Future Directions

We recognize that this study has several limitations. First, as a qualitative content analysis focused solely on topic rather than other potentially relevant variables, our findings are limited to content of articles. This study does not address sources, tones, audiences, or other factors related to the communicative constitution of health technologies. Findings are also limited by the inclusion of only publicly available online news articles rather than including all sources of news and information about ECS, such as social media, podcasts, print media, and broadcast media. These sources represent opportunities for future research, particularly from a perspective of the structuration of ECS in more interactive media. Future research could also refine findings of this study by comparing themes across article sources, such as broad news media versus medical news media, international versus U.S. coverage, and articles generated by advocacy and nonprofit groups.

Results of this study could also be extended by focusing on how news media representations of ECS influence patient–provider interactions about family planning and screening options. Health innovations are a pervasive element of contemporary living. How individuals make sense of these innovations for health-related decisions is a communicative accomplishment representing multiple levels of meaning, norms, and power. Future research can build on the results of this study to increase understanding about those communicative processes and outcomes for the benefit of current and future generations.

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Table 1.

Content themes, 2010–2015

Themes	Number of References in Theme					
	2010	2011	2012	2013	2014	2015
	<i>n</i> = 13 (Ratio)	<i>n</i> = 16 (Ratio)	<i>n</i> = 16 (Ratio)	<i>n</i> = 41 (Ratio)	<i>n</i> = 32 (Ratio)	<i>n</i> = 112 (Ratio)
General Information	144 (.26)	172 (.24)	106 (.23)	216 (.20)	92 (.14)	474 (.17)
Specific Tests	82 (.15)	178 (.24)	56 (.12)	288 (.27)	120 (.19)	366 (.13)
Genetics Organizations	16 (.03)	20 (.03)	65 (.14)	84 (.08)	139 (.22)	494 (.17)
Technology Information	12 (.02)	34 (.05)	30 (.14)	82 (.08)	51 (.08)	61 (.02)
Business, Financial	0 (.00)	7 (.01)	14 (.03)	38 (.04)	74 (.11)	57 (.02)
Research Information	16 (.03)	30 (.04)	12 (.06)	34 (.03)	34 (.05)	123 (.04)
Benefits & Endorsements	131 (.24)	91 (.13)	62 (.13)	178 (.17)	58 (.09)	258 (.09)
Legal Issues	15 (.03)	81 (.11)	16 (.03)	50 (.05)	22 (.03)	667 (.23)
Cautions & Negativity	20 (.04)	58 (.08)	10 (.02)	3 (.00)	1 (.00)	148 (.05)
Ethical Implications	35 (.06)	35 (.05)	35 (.07)	40 (.04)	10 (.02)	42 (.01)
Cost & Insurance	25 (.05)	13 (.02)	41 (.09)	21 (.02)	18 (.03)	72 (.03)
Widespread Use	42 (.08)	4 (.01)	19 (.04)	35 (.03)	18 (.03)	23 (.01)
Popular Culture	7 (.01)	4 (.01)	0 (.00)	0 (.00)	4 (.01)	7 (.00)
Genetic Counseling	0 (.00)	0 (.00)	4 (.01)	8 (.01)	4 (.01)	53 (.02)
<i>Total Refs</i>	<i>545</i>	<i>727</i>	<i>470</i>	<i>1077</i>	<i>645</i>	<i>2845</i>

n refers to the number of articles included in analysis for each year.

Themes represented by 10% or more of coverage in a year are in **bold** font.