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Ethics in Prevention Science Involving Genetic Testing

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Abstract The Human Genome Project and rapid technological advances in genomics have begun to enrich prevention science's contributions to understanding the role of genetic factors in the etiology, onset and escalation of mental disorders, allowing for more precise descriptions of the interplay between genetic and non-genetic influences. Understanding of ethical challenges associated with the integration of genetic data into prevention science has not kept pace with the rapid increase in the collection and storage of genetic data and dissemination of research results. This article discusses ethical issues associated with (1) decisions to withhold or disclose personal genetic information to participants; (2) implications of recruitment and data collection methods that may reveal genetic information of family members; and the (3) nature and timing of informed consent. These issues are presented within the contexts of adult and pediatric research, longitudinal studies, and use of biobanks for storage of genetic materials. Recommendations for research ethics decision-making are provided. The article concludes with a section on justice and research burdens and the unique ethical responsibilities of prevention scientists to ensure the new genomic science protects the informational rights of participants, their families and communities.

Keywords Ethics · Genetics · Prevention · Genetic testing · Disclosure · Confidentiality · Informed consent · Biobanks · Pediatric research · Longitudinal research · Justice

The Human Genome Project and rapid technological advances in genomics have begun to enrich prevention science's contributions to our understanding of the role of genetic factors in the etiology, onset and escalation of mental disorders, and allow for more precise descriptions of the interplay between genetic and non-genetic influences. The integration of genetic research methods into prevention science has illuminated the complex interactions between genetics and other psychosocial and environmental stressors in disorder etiology (e.g., Belsky and Pluess 2009; Kendler 2005; Rutter et al. 2006). To date, prevention research on the interplay of genetic and environmental factors in the development of mental health disorders have focused on parenting style, childhood maltreatment, and stressful life events as joint predictors of depression, aggression and future violence, antisocial behavior, ADHD and conduct problems (Dunn et al. 2011; Frazzetto et al. 2007; Kim-Cohen et al. 2006; Risch et al. 2009; Sonuga-Barke et al. 2009). Research has indicated that children with genetic susceptibility for substance use, sexual risk and externalizing behaviors not only have the poorest outcomes in uncontrolled environments, but also may respond most strongly to prevention programs (Brody et al. 2009). In light of such findings, the complex susceptibilities resulting from gene-environment interplay must be viewed not merely as vulnerabilities to disorder development but as potentially valuable sensitivities that may increase prevention success (Belsky and Pluess 2009).

The incorporation of genetic risk markers into prevention science has the power to enrich preventive interventions, such that researchers and practitioners can more efficiently and effectively target those at greatest risk for disorder development. Methodological advances for studying, storing and disseminating data derived from genetic risk markers also raises new ethical challenges for the field. Understanding of ethical challenges associated with the integration of genetic data into prevention science has not kept pace with the rapid increase in the collection and storage of genetic data and dissemination of research results. This article discusses ethical issues associated with (1) decisions to withhold or disclose personal genetic information to participants; (2) implications of recruitment or data collection methods that may reveal genetic information of family members; and the (3) nature

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and timing of informed consent. These issues are presented within the contexts of adult and pediatric research, longitudinal studies, and use of biobanks for storage of genetic materials. Following each section, recommendations for research ethics decision-making are provided. The article concludes with a section on justice and research burdens and the unique ethical responsibilities of prevention scientists to ensure the new genomic science protects the informational rights of participants, their families and communities.

Disclosure of Personal Genetic Information to Participants

A unique ethical concern for genetic research is the way in which personal genetic information influences our own identity and the identities we are assigned by others. While scientists recognize that single genetic variants have limited predictive power based on the complex, multifactorial etiology of mental, emotional and behavioral disorders, individuals often perceive genetic markers to be more deterministic than other risk factors in their potential to predict future disease (Kendler 2005). Thus decisions to share research-derived personal genetic information with participants requires a consideration of informational benefits and harms that may result (Beskow and Burke 2009). For example, in the early stages of exploring genetic correlates of mental health, data are not collected with the aim of generating personally useful health information, but with testing hypotheses about gene-environment-behavior relationships (Bioethics Advisory Committee 2005). Thus release of personal genetic information that does not have strong or reliable scientifically established links to mental health may be misleading in its practical implications, causing potential harm if it results in participants' over- or underestimation of personal risk.

Sharing personal genetic information with participants may also inflict them with their own burdens of disclosure. For example, healthy adults informed of a genetic predisposition to a mental health disorder may struggle with whether this incurs an obligation to report these vulnerabilities to family members, future employers or health insurance agencies. Thus an additional disclosure consideration is whether the participant prefers not to know if he or she has a predisposition for developing a disorder (Murphy et al. 2008). Under current federal regulations and international guidelines, participants have a right to decide whether or not to be informed about the results of genetic testing, especially in cases in which early treatment is not available (DHHS 2009; UNESCO 1997).

Predictability, Clinical Utility, and Reliability

Several investigators have suggested that ethical decisions regarding whether to report personal genetic information to research participants must be based on the predictability, utility and reliability of the results (Grandjean and Sorsa 1996; Ravitsky and Wilfond 2006). For example, while advances in medical science have identified disease traits associated with highly penetrant gene variants (e.g., the *BRCA1* gene for breast cancer, mutations in the *HTT* gene for Huntington's disease), hundreds of genes may be responsible for the heritability of specific behavioral problems, different gene variants can influence similar psychologically relevant phenotypes, and genetic effects may account for only a small proportion of individual variance for complex psychological traits (Plomin and Davis 2009). Moreover, while gene-environment interactions can help to elucidate the factors placing certain individuals at increased risk for disorder development, many studies will lack clinical or personal relevance to individual study participants. Finally, the relatively small sample size of available study populations at risk for specific mental health disorders in particular contexts, and the variability of program components implemented in natural settings limit the efficiency, statistical power and thus the analytic validity of intervention evaluation studies; and even those results that yield significance are not often replicated (Henderson 2008). Recommendations for evaluating the ethical justification for withholding or disclosing personal genetic information to participants are provided in Table 1.

Disclosing Personal Genetic Information to Guardians and Minor Participants

The ethical issues introduced above are heightened when prevention science incorporating genetic factors involves children. First, in pediatric prevention science the interplay between genetic and environmental risk and protective factors for psychopathology and treatment responsivity may not emerge for several years following initial data collection or may emerge in different forms at various points of the lifespan. Second, in longitudinal studies genetic data may be stored and re-analyzed across many years and produce information not originally anticipated, raising issues of periodic re-consent especially as participants reach the age of legal majority. In addition, even when investigators can anticipate the range of findings, children do not have the legal right to consent to research participation, may not have the developmental cognitive skills to understand the potential informational risks of participation, may not have experience in exerting their rights to participate or withdraw data in the context of adult authority, and may have little control over parental access to their personal genetic information or the nature of results that investigators will share with them (Fisher 2006a).

Table 1 Recommendations for evaluating the ethical justification for withholding or disclosing personal genetic information to participants

Disclosure of personal genetic information to participants: general principles
Strength of empirical evidence. The weaker the scientific foundation for a hypothesized relationship between genetic factors and psychosocial or behavioral risk the weaker the ethical argument for disclosure (Fisher 2006a). Relevant ethical questions include: Is there sufficient quality and quantity of empirical evidence supporting an association between the genetic characteristic and manifestation of the mental health or behavioral risk (Ravitsky and Wilfond 2006)? What proportion of risk is attributed to heritability versus environmental factors? Is the magnitude of the gene-disorder association sufficiently large to justify informational risks associated with genetic screening (O'Connell et al. 2009)?
Severity of disorder. The more serious the disorder the stronger the ethical argument for disclosure. Relevant ethical questions include: Given the probabilistic nature and multiple pathways for genetic influences on mental health risk, what is the informational value of disclosure? Is the genetic risk related to minor behavioral problems or to serious mental health disorders that could benefit from early intervention (Ravitsky and Wilfond 2006)? Will disclosure avert or minimize harm to those participants?
Intervention effectiveness. The stronger the scientific evidence linking the genetic risk to intervention effectiveness the stronger the ethical argument for disclosure. Relevant questions include: What is the availability, safety and effectiveness of prevention intervention options related to the condition associated with genetic risk (Grandjean and Sorsa 1996)? If interventions are not available, will distress in response to disclosure be proportional to informational benefits? In such cases has the participant expressed a "right not to know" his or her genetic information?
Genetic counseling. If criteria for individual disclosure are met, investigators should examine whether there are sufficient procedures for communicating information in a clinically competent manner (Knoppers et al. 2006). This can include working with genetic counselors to assist in appropriate disclosure and referral procedures (World Health Organization 2003).

Research on genetic markers for mental health risk involving children thus presents challenges for determining when it is ethically appropriate to share the child's genetic information with guardians. Federal restrictions on a minor's legal status to consent to research within the context of children's still developing cognitive and emotional maturity often leads to situations in which the child does not play a role in decisions regarding whether investigators will share results of genetic testing with parents. Thus, when guardians are provided their child's research-derived personal genetic information they will be privy to one of the most private elements of individuality, one's genetic makeup, of which the child is unaware and may remain unaware as he or she gets older (Fisher 2006a).

U.S. federal regulations are unclear concerning the role of guardians in determining a child or adolescent's right to know or not know of a genetic risk revealed through research. In many cases guardians have the authority to decide whether they want to be informed about their child's genetic risk or want their child to be informed. Child participants may benefit when their guardians decide if disclosure of personal genetic information will be helpful or harmful to the child's development. Alternatively, guardian authority to control genetic risk information may deprive children of the "right not to know" afforded adult participants or deprive them the right to refuse invasive data collection procedures or withhold information from others that may be detrimental to their self-interests (Fisher 2006a; Grandjean and Sorsa 1996; Wilfond and Ross 2009). Informing parents about their child's genetic vulnerability to behavioral or mental health disorders discovered during research participation can be ethically appropriate when interventions exist that can reduce such vulnerability. However, the same decision may not be ethically justified when guardians are given information about their child's genetic risk for psychopathology that is only probabilistic and available treatments will not influence whether the child will develop the disease (Ross 2002).

Longitudinal Studies

Heritable changes in gene expression that influence and are influenced by social and environmental conditions early in human life can have effects throughout the life-course. Increasingly, pediatric research utilizes longitudinal designs to identify the developmental trajectories of mental health disorders and the joint effects of heredity and experience on mental health including substance abuse, aggressive behavior and attentional disorders (Frazzetto et al. 2007; Kim-Cohen et al. 2006). Longitudinal designs involve multiple periods of data collection, sometimes beginning prenatally or in early childhood, and progressing through adolescence or adulthood. Such research often involves asymptomatic children who will or will not develop the disorder under investigation.

Sharing with guardians genetic risk information obtained from asymptomatic children can threaten a healthy child's best interest. Parents may treat children differently based upon knowledge of their genetic predisposition to mental health disorders or a belief that without such an identified genetic trait the child will be free from risk (Wilfond and Ross 2009). Parents may also become overprotective or overly pessimistic about the child's future resulting in a restriction of activities and opportunities the child might have otherwise been afforded (Fisher 2006a).

Adult-Onset Disorders

In addition to these tensions, ethical issues arise when etiological or epidemiological research uncovers genetic information suggesting risk for adult-onset disorders. Because of the potential for such circumstances, the Canadian Paediatric Society has issued *Guidelines for Genetic Testing of Healthy Children* (CPS 2003), advising researchers against the genetic testing of healthy children for adult-onset disorders. According to these guidelines, genetic testing should be conducted only to evaluate risk for conditions that arise in childhood, and should be done strictly for therapeutic purposes. Additionally, the CPS asserts that, regardless of age, individuals have a right to medical privacy, and thus decisions regarding testing for adult-onset conditions and access to such information should ultimately be made at the discretion of the child, with attention given to their developing autonomy (CPS 2003).

Recommendations for evaluating the ethical justification for withholding or disclosing personal genetic information to guardians and child participants are provided in Table 2.

Disclosure of Genetic Information and Familial Risk

Since biological family members share gene characteristics, the genetic data on one family member allows for probabilistic inferences about the genetic traits of biological relatives that may: (a) identify them as potential carriers of a gene associated with a mental health disorder; (b) reveal misidentified paternity; or (c) identify familial behaviors as mediators or moderators of genetic risk (Fisher 2006b). The release of information regarding these genetic markers could impact medical service provision, limit insurability, or have other far-reaching implications for family members. In addition to genetic contributors to disorder development, knowledge gleaned from prevention research involving gene-environment interplay may result in the release of information regarding parenting style or behaviors suggesting maltreatment that could pose both legal and social risks for family members (Fisher 2006b). Prevention scientists incorporating genetic methods into their investigation of psychopathology must therefore consider ethical issues surrounding the informational rights of family members as participants or third parties.

Table 2 Recommendations for evaluating the ethical justification for withholding or disclosing personal genetic information to guardians and child participants

Disclosure of personal genetic information to guardians and children
Strength of evidence for heritability. The stronger the scientific validity and the larger the heritability factor in predicting the disorder, the stronger the ethical justification for disclosure of a child's personal genetic information. Questions to consider include: Is there sufficient scientific data to indicate a reliable genetic association with and high predictive validity for the mental health or behavioral disorder? Is the scientific design sufficient to identify the relative contribution of genes and environment if this information was to be shared with guardians or participants?
Clinical utility. The privacy rights of children may take precedence over the potential benefits of disclosure to guardians when the findings lack clinical utility, especially for adult onset disorders. Investigators should consider whether or not the disorder under study is a genetically related condition that can be ameliorated, prevented or treated before the child reaches the age of majority (Annas et al. 1995).
Stigmatization. In constructing policies on disclosure of personal genetic information to guardians or minor participants investigators need to weigh the informational benefits against the possibility of social or educational stigmatization and loss of future financial resources or health coverage. When disclosure presents such informational risk, ethical justification for sharing research derived genetic information depends upon whether appropriate genetic counseling and referral services are available to assist guardians and child participants understanding of and future decision-making regarding the child's genetic condition.
Asymptomatic children. Epidemiological and longitudinal research involving initially asymptomatic child participants raise ethical challenges in determining when guardians or children should be informed that data indicates the emergence of a disorder or a substantiated effect of environmental factors on genetic risk. Prior to study initiation, investigators should determine clinical thresholds triggering the obligation to alert guardians or older youth about the emergence of a disorder or environment-gene increase in behavioral risk. Development of appropriate data-monitoring plans for identifying potential iatrogenic effects of intervention procedures that might require withdrawal from the study should also be considered.
Maturation. Decisions to disclose personal genetic information to child and adolescent participants policies must draw on knowledge of the cognitive, experiential and emotional capacity of prospective participants to understand and respond adaptively to information regarding their individual genetic risk. Based on the points outlined above, investigators should consider the risks and benefits of a policy that provides minor participants with access to their personal genetic information when they reach the age of legal majority (Fisher et al. 1996).
Adult-onset disorders. The tension between respect for parental responsibility and children's maturing autonomy is heightened for pediatric genetic studies on adult onset disorders. Annas et al. (1995) recommend that parents should not have access to information derived from the analysis of their child's DNA unless it reveals a genetic condition that can be ameliorated, prevented or treated before the child reaches the age of majority. If investigators and their IRBs choose to set such limitations on access to DNA, information should be provided to the parents and child at the time of informed consent so that parents who do not agree with the restriction can refuse their child's participation (Fisher 2006a).

When Are Family Members Considered Research Participants?

According to federal regulations, an individual is considered to be a human subject in research either when there is direct interaction between the researcher and that individual, or when information about that individual may be identified or ascertained by the investigator (DHHS 2009, 45 CFR 46.102(f)). Using pedigree analysis, for example, investigators studying the natural course of risk factors for alcohol dependence have gained insights from genetic testing of affected and unaffected siblings, parents, and other family members (Hill et al. 2004; Kuo et al. 2007), and from observation of interpersonal family interactions and family history of alcohol abuse (Conner et al. 2010). The possibility of collecting identifiable familial information may be more limited in circumstances where data is collected from a large, anonymous sample at a single point in time. However, family privacy concerns may be raised when: (a) anonymous data are collected from a small sample of individuals with a rare mental health risk or identifiable small geographical area, specific health care facility or school setting; or (b) longitudinal investigations require that unique identifiers and contact information are linked to subject codes, and the primary subject shares the same address and surname as other family members (Fisher 2006b).

Private Information

The federal definition of "private information" also raise challenges in determining the extent to which family members are entitled to confidentiality and disclosure protections. The definition includes information: (a) about behavior that occurs in a context in which individuals can reasonably expect that no observation or recording is taking place; or (b) provided for specific purposes that individuals can reasonably expect will not be made public (DHHS 2009, 45 CFR 45.102(f)). The definition raises ethical challenges. For example, how should an IRB evaluate the privacy expectations of biological relatives who are not directly involved in the research but for whom probabilistic inferences about genetic traits can be made? How does one define "reasonable expectations" of healthy siblings who do not yet have the cognitive ability to understand the privacy implications of their assent to provide biological data for research purposes? Recommendations for evaluating whether human subjects protections apply to family members are provided in Table 3.

Informed Consent for Research Involving Genetic Testing

In addition to understanding basic information on the purpose and nature of research and participant rights and protections, informed consent procedures for prevention research involving analysis of genetic information must consider participants' genetic literacy. For prevention science we define "genetic literacy" as the degree to which prospective participants are familiar with and can apply information about the use of genetic data to make appropriate research participation decisions. The more complex and multifactorial the gene-risk association, the greater the ethical responsibility to provide genetic literacy education to participants during the consent process

Promoting Genetic Literacy

Attention to the participants' genetic literacy is of particular importance in prevention research incorporating genetic data because the new gene technologies, rapid scientific advances and evolving federal law can outpace the average person's knowledge, expectations, and ability to process informed consent information. First, the rapid rate at which new genetic technologies develop and the fact that many genes are related to more than one trait (pleiotropy) means that investigators may discover genetic risk that is unanticipated or incidental to the original aims of the research (Cooper et al. 2006). Second, prospective participants may not anticipate that genetic data collected to verify pedigree relationships may contradict assumed attributions of paternity or other biological bases of family relationships. Finally, the complex and probabilistic nature of data acquired through collection of genetic information for prevention studies can confuse participants attempting to understand the personal relevance of research results, leading to unrealistic expectations regarding the possibility of direct benefits (Henderson 2008).

To help ensure that prospective participants are making informed, rationale and voluntary participation decisions, development of informed consent procedures for prevention science research can draw on the growing body of knowledge on patient and participant understanding of genetic information (see Condit 2009) and include educative features that create a goodness-of-fit between participant consent capacities and the specific research context (e.g., Fisher 2003; Fisher and Ragsdale 2006; Masty and Fisher 2008).

Biobanks

Genetic literacy is particularly important as the storage of biological materials in biobanks becomes a standard requirement for federally funded research. The National Institutes of Health's [NIH] *Policy for Sharing of Data Obtained in NIH Supported or Conducted Genome-Wide Association Studies (GWAS)* is a federal effort to increase data available for genomic research in the use of databanks to store biospecimens for analysis by researchers in a central data

Table 3 Recommendations for protecting the privacy rights of biological relatives of research participants in genetic research

Determining informational risks and "human subject" status of family members
Links to family members. The first step in determining how to address familial information risk is to determine whether the research involves data that can explicitly or implicitly be linked to a family member's genetic profile, pedigree, or behavior. This may be of particular concern when research involves small communities (e.g., American Indian tribes) or unique conditions (rare genetically linked disorders).
Risks. Are there financial, economic, legal, or social risks to family members if genetic information is disclosed? Can the informational risks be adequately eliminated or minimized through de-identification of data, secure data storage, a Certificate of Confidentiality, or a policy of non-disclosure of genetic information to family members? If criteria for research inclusion is based on evidence of the genetic condition in relatives, whenever possible investigators need to consider how to inform prospective participants of their exclusion without revealing another family member's genetic information.
Regulatory criteria. If an individual's research participation can result in linkages of genetic information about family members and associated risks, then investigators and their IRBs need to determine whether collection of such information qualifies family members as "human subjects" under federal regulations. This determination includes the following questions: Is there direct interaction between the researcher and that individual, can individual information be identified or ascertained by the investigator, do family members presume their genetic information is private?
Additional protections. Whether or not family members fall under the category of "human subjects" investigators should develop procedures to ensure that when applicable family members are aware that genetic, genealogical and health data collected for an individual participant can provide probabilistic information about other family members, that during the course of the study it may be determined that some family members are not in fact genetic relatives, and the protections put in place to protect family privacy (Annas et al. 1995).

repository (NIH 2008a). GWAS requires investigators to de-identify data but to also include coding that other investigators can use to link phenotypic, genotypic, pedigree and exposure data. The use of biobanks and repositories raises issues of confidentiality because researchers must establish a means of identifying and linking specific participant data sets. In addition, the scope of potential information stored often will go beyond biological material to include information about behaviors and other genetically influenced traits to study a specific risk factor or for potentially unlimited investigation.

The informational risks and benefits of biobanking go far into the future and cannot be as readily identified in terms of informed consent. This potential risk may be minimized once data collection has been completed, as the use of de-identifying procedures can effectively disassociate participants with identifiable personal information; however, de-identification alone cannot fully eliminate privacy concerns, as results regarding unique mental health conditions within specific demographic or geographic populations may increase the likelihood of individual or group identification (Fisher 2006a). As noted by the Secretary's Advisory Committee on Human Research Protections (SACHRP 2010), there is a tension between the investigator's responsibility to be as specific as possible when informing participants of potential future use of their genetic data and the reality that specifics of future research are, by definition, not known at the time of consent.

Longitudinal Research

Longitudinal research necessarily requires multiple data collection periods and the tracking of individual participant progression over the course of months or years. Over time data collection methods and specific analyses may change. For example, in pediatric genetic risk studies data collection may shift from the use of umbilical cord blood testing at birth to analysis of saliva or blood samples as the child develops, to risks behaviors in adolescence. In addition to tests of genetic risk, information on interpersonal interactions and environmental contexts may at different points in time include both self-reports and interviews with other persons (e.g., family members, teachers). Given the lapses between data collection periods and the changing nature of data collection, re-consent at various time points is often required to ensure the continued informed, rationale and voluntary requirements of research participation. Approaches to enhancing genetic literacy for longitudinal studies may thus emphasize different aspects of the research at relevant points in data collection. In longitudinal pediatric research children's developing consent capacities, autonomy and privacy rights are best protected by viewing parental permission and child assent as ongoing educational processes that are monitored and repeated at appropriate periods (Fisher 2006a).

The Right to Withdraw Among the unique ethical challenges raised by prevention science research involving children is the storage of genetic materials in data repositories. This feature of much genetic prevention research further complicates consent processes, as little consensus exists either publically or scientifically regarding the right of individuals to withdraw previously collected biological samples if, upon re-consent, they choose to un-enroll from the research. Precedents for resolution of this controversy may be found in the Health Insurance Portability and Accountability

Act (HIPAA 1996). According to HIPAA regulations, research participants have a right to revoke authorization of protected health information (PHI) in future research. However, when PHI has been already obtained for initially consented purposes, researchers may continue to use these data in analysis. This underscores the importance of re-consenting procedures, as participant authorization may be the best determinant of whether stored data collected at different points in the study may be withdrawn (Fisher 2006a; 45 CFR 164.508[b][3][i]). Recommendations for informed consent procedures for research involving genetic testing are provided in Table 4.

Social Justice and Prevention Science Involving Genetic Risk

The current expansion of genetics as a major explanatory framework for mental health disorders and intervention responsivity has the potential to perpetrate social inequities by ignoring more powerful and enduring structural injustices embedded in social and political systems (Fisher et al. 2012). The emerging gene-environment paradigm also influences societal definitions of normal and abnormal and health and disease. When a genetic influence on risk is reported, a new "genetized" disease may be created (Lippman 1991) irrespective of the likelihood of developing a disorder. Similarly, when prevention efforts fail, scientists disseminating their findings should be alert to the public tendency toward genetic essentialism and the potential for genetic stereotyping (Collins et al. 2003; Henderson 2008).

Public responses to population-based genetics research can also stigmatize historically oppressed groups as being predisposed to specific diseases, simultaneously affecting members' public and personal identities (Ossorio and Duster 2005). For example, in 2004 members of the Havasupai tribe sued the University of Arizona for stigmatizing their tribe by using blood samples originally collected

Table 4 Recommendations for informed consent procedures for research involving genetic testing

Informed consent for collection and storage of genetic information
General requirements. Informed consent for prevention studies incorporating genetic data should include explanations of: (a) how and for how long genetic material will be stored; (b) if, when, and how materials will be destroyed; (c) confidentiality protections including de-identification and risks of identity linkage when appropriate; (d) how use of data in the future might differ from the study's original focus; (e) the nature of personal genetic information that will or will not be disclosed to participants and the rationale for disclosure decisions; (f) opportunities for and limitations on the right to withdraw data; and (g) when relevant permission to contact participants in the future and share de-identified genetic information with other researchers (see Wolf et al. 2010).
Data storage. When genetic information will be stored for possible future use, federal guidelines permit inclusion of broad language in the consent form "sufficient to give subjects a reasonable idea of the types of research that might be conducted in the future (e.g. links between genes and environmental factors) and the associated privacy protections and risks (e.g. data will be de-identified, linkages with demographic data may for small or unique populations have higher risk of identification), but without placing unreasonable restrictions on what the research might be" or promising that "specimens will *only* be used for research on XYZ" (SACHRP, 2010, p. 7).
Pediatric research. When identifiable genetic material will be stored in databases or used in longitudinal studies, parental permission and child assent procedures when feasible and relevant to the research context should explain whether or not their are plans at the time child participants become legal adults to: (a) provide them information on where biological materials are stored; (b) disclose personal genetic information relevant to their current or future mental health; and (c) their right to re-consent or withdraw permission for further use of data at that time.
Risks and legal requirements. When relevant to the data collection and storage procedures, prospective participants should be told about potential informational risks including genetic discrimination (Wolf et al. 2010) and legal requirements to provide access to genetic or biological information to federal funding agencies as well as federal genetic privacy protections (e.g., Genetic Information Nondiscrimination Act [GINA], Office of Human Research Protections 2009; see also Hansson and Maschke 2009).
Secondary analysis. According to NIH (2008b) investigators wishing to conduct secondary analysis of data stored in biobanks or repositories should work with oversight boards to determine if the original consent form specifically prohibited the proposed research activity, and if not determine whether: (a) the nature of the proposed secondary research can reasonably be understood to fall within the scope of research that was described in the original consent form (b) the new research use imposes new or significantly greater informational or privacy risks than described in the initial consent form and (c) investigators are aware of study population concerns about the proposed new use?
Re-consent. In longitudinal studies when relevant investigators should provide participants opportunities to re-familiarize themselves with the nature, risks and benefits and their rights to consent or dissent to additional participation. This is particularly important in pediatric longitudinal studies in which children's and guardian's assessment of the implications of participation may change with the child's increasing maturity. At all phases of informed consent participants should be informed about the implications of their withdrawal for continued use of their data. In most cases, if previously collected data can be de-identified at the time of withdrawal then it should be able to continue to be used for future analyses. Similarly when data have been already obtained for initially consented purposes, in most cases researchers may continue to use these data in analysis.
Waiver of family member consent. If determined to be research participants, family members of primary participants would be provided with the protection of informed consent under federal regulations. However, federal regulations permit the waiver of informed consent for family members if the research is identified as presenting no more than minimal risk to these third party individuals (DHHS 2009, 45 CFR 46.102(i)).

for a study on diabetes to study genetic markers for schizophrenia (Mello and Wolf 2010). Although evolutionary and social pressures may have influenced the frequency of a small percentage of gene variants across populations, socially constructed conceptions of race do not correspond to genetic ancestry nor are there reliable measures of genetically discrete or scientifically meaningful gene-based racial distinctions (Beskow and Burke 2009). The scientific value and validity of genetic research findings aimed at examining and preventing risk across various racial/ethnic/cultural groups is thus threatened by the absence of clear definitions of what these terms mean, the continuous shaping of these terms by social and political forces, and disregard for the historical coupling of these terms with political beliefs regarding the inherent superiority of a particular group (Duster 2005; Fisher et al. 2002, 1997). During study design prevention scientists should carefully evaluate the theoretical, empirical, and social frameworks driving the definitions of race, ethnicity, or culture used to select participant populations and include environmental factors that reflect the reality and impact of historical and contemporary forms of prejudice and discrimination as implicating factors in the development of mental health disorders (Fisher et al. 2012).

Conclusion

This is an exciting time for prevention science. Research is moving rapidly toward identifying gene variants associated with mental health disorders, molecular pathways that underlie the effects of known risk factors, potent environmental influences on the emergence of gene-environment produced pathologies, and potential biological targets for prevention intervention (O'Connell et al. 2009). These advances lead to uncharted ethical territory involving not only informational risks associated with economic, employment and health resources, but also the ways in which individuals understand themselves (Svendsen and Koch 2006). Protecting and enhancing the rights and welfare of individuals participating in prevention research involving genetic testing does not occur in a vacuum. The rights of "genetic citizenship" (Svendsen and Koch 2006) and federal funding for genomic research are often driven by economic and political concerns (e.g., urban crime, school misconduct) that may have little to do with the concerns and social circumstances of participant groups (Fisher 1999; Fisher and Wallace 2000). Prevention scientists' ethical awareness of the potential informational goods and harms of genomic research and heightened sensitivity to the real world contexts in which participants live will yield a prevention science that minimizes informational risk, optimizes participants' informed choice, and promotes public health.

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