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Ethics watch:

ETHICAL IMPLICATIONS OF EPIGENETICS RESEARCH

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New advances in epigenetics research are being reported at an accelerating rate. Intriguing research findings, primarily from animal studies, show that epigenetic changes tend to occur at a much higher frequency than mutations in DNA sequence, that the susceptibility to epigenetic changes is greater at earlier stages of development, and that epigenetic changes are often reversible[1,2]. Importantly, a growing body of data from animal and human studies suggests that alterations in gene expression that are due to epigenetic processes, such as DNA methylation, can be inherited and affect future generations[3,4].

Epigenetics research holds great promise for elucidating pathways that affect the progression from environmental exposure to phenotypic expression. It will have significant implications for the prevention, diagnosis and treatment of a wide range of disorders. Although a vast amount of literature has built up in the last two decades on the ethical implications of genomic research and applications, there is no comparable literature on the ethical implications of epigenetics research. Here we discuss four of these ethical issues.

First we consider environmental justice. Epigenetic effects have been associated with exposure to various toxic chemicals, airborne pollutants, pesticides and other harmful substances[1,2]. Many of these exposures are linked with poverty, discriminatory land use, and substandard living and working conditions[5]. At the same time, many individuals with these harmful exposures are considered medically vulnerable because of pre-existing health conditions that are frequently complicated by poor clinical management. Both the exposure to environmental hazards and the social, nutritional, medical and psychological stresses of low-income communities can separately and, perhaps even more importantly, cumulatively cause epigenetic changes that place exposed populations at increased risk. Epigenetics therefore provides a new window for understanding and possibly addressing the co-morbidities associated with disparate environmental exposures.

The second issue regards the intergenerational effects and equity of epigenetics research. A key implication of epigenetics research is that many environmental and hazardous exposures will affect not only the exposed individuals, but possibly their progeny and subsequent generations. This insight will create new challenges for environmental and health regulation, as well as for intergenerational equity. Intergenerational equity refers to the obligations of each generation to serve as a custodian or steward of the planet and its inhabitants for future generations. Thus, it could be asserted that each generation has an obligation to its descendants not to damage the genomes and epigenomes of future generations, such as

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FURTHER INFORMATION
US State Genetic Privacy Laws: http://www.ncsl.org/programs/health/genetics/prt.htm

through exposure to environmental hazards. It remains to be seen whether or how the possible transgenerational damage caused by environmentally induced epigenetic changes will affect environmental regulatory policies.

Epigenetics research also raises privacy and confidentiality issues, as it could provide a substantial amount of information about the likelihood that an individual will develop health problems, and even the probability that they will transmit the risk to his or her children[1,4]. The increased use of interoperable, longitudinal and comprehensive electronic health records and networks increases the risk of loss of privacy through unauthorized or compelled disclosures[6]. Several genetic privacy laws, particularly the State Genetic Privacy Laws enacted in the United States, contain definitions of 'genetic' that do not include privacy protection for epigenetic data. Therefore, new privacy legislation may be required to protect this sensitive information.

Finally, we must consider equitable access to health care. Greater understanding of the associations between environmental exposures and epigenetic effects will increase the importance of exposed individuals receiving health services for prevention, monitoring and treatment. In some countries, such as the United States, many of the individuals that are most likely to have hazardous exposures are among the least likely to have regular, timely and comprehensive access to health care. Even in countries with universal access to health care, it is not clear whether coverage will be provided for sophisticated (and probably expensive) new tests to detect the presence of, and eventually provide treatment to reverse, epigenetic alterations.

Some of the ethical concerns discussed above are similar to those already raised by genetics, but the role of environmental exposures in producing epigenetic effects adds new concerns. The use of epigenetics in environmental risk assessment will probably be among the first applications of the new research. Once epigenetic testing of individuals becomes available, concerns are likely to arise about possible privacy violations and epigenetic discrimination. The prospect of such non-genetic discrimination casts doubt on the wisdom and efficacy of current genetics-specific laws, and it suggests that broader laws are needed to prohibit adverse treatment on the basis of health status or biological markers.

Epigenetic research raises other profound issues, including individual and societal responsibilities to prevent hazardous exposures, monitor health status and provide treatment. Epigenetics also serves to highlight the effects of inequality in living and working conditions and adds a multigenerational dimension to environmentally caused adverse health effects.

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