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Genetic Testing for Susceptability to Disease from Exposure to Toxic Chemicals: Implications for Public and Worker Health Policies

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GENETIC TESTING FOR SUSCEPTIBILITY TO DISEASE FROM EXPOSURE TO TOXIC CHEMICALS: IMPLICATIONS FOR PUBLIC AND WORKER HEALTH POLICIES

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ABSTRACT: The Environmental Genome Program intends to identify "susceptibility genes" that would indicate if a person is more vulnerable to cancer or other disease as a result of exposure to certain chemicals in the workplace, the environment, foods, or other products. Research findings and the capability to test persons for such genes are likely to impugn and challenge health policies and regulatory programs that do not take genetic susceptibility into account when conferring health benefits and restricting chemical exposures. This article focuses on the Occupational Safety and Health Administration (OSHA) and discusses four options available to this agency for protecting genetically susceptible workers and the issues involved in designing and implementing each option. The options involve amending each workplace chemical standard to incorporate genetic testing in a medically supervised program akin to OSHA's Lead Standard, generic revision of all standards so they are sufficiently stringent to protect susceptible workers, requiring information dissemination to prompt management and workforce initiatives, and incorporating genetic susceptibility in holding employers accountable to OSHA's "general duty clause."

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I. PREDICTIVE GENETIC TESTING

The Human Genome Project and associated research activities are leading to the development of numerous tests for human "disease genes." These genetic tests analyze chromosomes, DNA, RNA, genes, and gene products to determine whether an alteration or other anomaly is causing or is likely to cause a specific disease or condition.[1]

Growing public demand and commercial interests have stimulated the rush to develop and use genetic tests for three main purposes: to diagnose persons who exhibit disease symptoms, to determine if persons who are currently asymptomatic carry disease genes that could be imparted to offspring, and to determine if asymptomatic persons are at increased risk of a hereditary disease. The public expects that medical interventions will quickly follow to mitigate, cure, or prevent many hereditary afflictions and illnesses caused by somatic mutations.

Despite the absence of regulatory safeguards for assuring that such tests have clinical validity and utility, and despite cautions from geneticists that extensive research is needed before the predictive value and reliability of many such tests are scientifically established, tests for over 300 genetic diseases are now available for clinical use.[2]

The Secretary's Advisory Committee on Genetic Testing (SACGT), created by the Department of Health and Human Services in 1998, serves as the principal advisory group to the federal government on technical and policy aspects of genetic testing. It has sought to balance its support for advances in genetic testing with various precautions. In its report on the *Adequacy of Oversight of Genetic Tests*, SACGT warns: "It is critical for the public to understand that while genetic tests can be extremely beneficial, they can also pose risks, including medical and psychological risks, risks to families, and social and economic risks that may affect entire groups as well as individuals . . . ."[3]

More specifically, SACGT warns of the "therapeutic gap" whereby "effective treatments are not available for many diseases now being diagnosed or predicted through genetic tests."[4] SACGT also warns of medical risks arising from actions taken in response to genetic tests, such as prophylactic surgery, psychological,

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1. SECRETARY'S ADVISORY COMMITTEE ON GENETIC TESTING, NAT'L INST. OF HEALTH, ADEQUACY OF OVERSIGHT OF GENETIC TESTS: PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS 1 (Apr. 12, 2000), http://www4.od.nih.gov/oba/gtdocuments.html.

2. *Id.* at 3, 9.

3. *Id.* at 4.

4. *Id.* at 5–7.

and emotional risks of despair following positive test results, and risks of social stigmatization, discrimination, and familial problems.[5]

Nevertheless, genetic testing is proliferating, utilizing findings about gene sequences of "high penetrance," *i.e.*, those sequences found to have "clear and direct phenotypic implications, in many different individuals and in a wide variety of environments," such as the sequences associated with Huntington's disease and Tay-Sachs disease.[6] Each of these sequences "has a very direct causal connection with a specific dysfunction" but is of low incidence in the population.[7]

Following closely on the heels of the Human Genome Project is the federally sponsored Environmental Genome Project (EGP), which "aims to better understand the genetic basis of differential responses to environmental exposures" because "[t]he vast majority of diseases, many forms of cancer, for example, are the consequences of both environmental and genetic contributions" and "understanding the relationships between genetic variation and response to environmental exposure is important for understanding the causes of human disease and is crucial for the development of effective disease-prevention strategies."[8]

EGP research is focused on identifying common "low penetrance" gene sequences that are believed to "play some role in disease or disease susceptibility, but only in conjunction with other genetic components [or] environmental exposures."[9] Finding such relationships poses "much more uncertainty" than connections between high penetrance sequences and hereditary disease.[10] In addition to research-advancing objectives, the EGP intends to use its findings "to promote . . . efforts aimed at improving public health," including "earlier diagnosis of disease, and more effective disease-prevention strategies."[11]

II. PUBLIC HEALTH POLICY IMPLICATIONS OF EGP-DERIVED KNOWLEDGE

EGP research is being conducted to determine disease susceptibilities arising from the conjunction of low penetrance genes and exposure to particular environmental contaminants. For example, one project reports that "[a]t least three

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5. *Id.*

6. Richard R. Sharp & J. Carl Barrett, *The Environmental Genome Project and Bioethics*, 9 KENNEDY INST. ETHICS J. 175, 177 (1999).

7. *Id.*

8. *Id.* at 176.

9. *Id.* at 177.

10. *Id.*

11. *Id.* at 178. Discerning "the molecular basis for environmentally induced diseases" is a goal of the Strategic Plan 2000 of the National Institute of Environmental Health Sciences. NIEHS STRATEGIC PLAN 2000, 108 ENVTL. HEALTH PERSP. A306 (July 2000).

polymorphic genes have been identified that potentially can influence the bioaccumulation and toxicokinetics of lead in humans," and suggests that "genetically susceptible individuals may not be fully protected by current regulatory standards."[12] Consistent with EGP goals, the researchers posit that "[b]etter understanding of genetic factors could have significant ramifications for public health and intervention initiatives . . . and change public health policy."[13]

The ramifications for public health policy are significant. Each susceptibility gene that is found will, in theory, indicate the existence of an asymptomatic subset of the population that is especially vulnerable to exposure to chemical pollutants. This will impugn many federal standards intended to protect public and worker health from hazardous chemicals and will discredit agency regulatory programs. It also will create public anxieties because of uncertainty as to which persons are in vulnerable subgroups. If such persons are identified through large-scale testing programs, they will express more intense anxieties and outrage if government-funded therapeutic interventions are not available or government does not act to reduce exposure levels by setting and enforcing more stringent standards, shutting down the sources of the pollutants, or providing other safeguards. Public pressure, petitions, and litigation probably will ensue, forcing agencies to reconsider many regulations and facility permits. Agencies will need to somehow accommodate conflicting principles of equal protection and utility in their decisions for protecting genetically susceptible subgroups.[14]

Thus, governmental programs that are essential to public health policy will be challenged, particularly those that regulate the introduction of potentially hazardous products (such as pesticides, food additives, and pharmaceuticals) into commerce and those designed to confer public health benefits (such as Medicare, lead paint removal, and toxic waste cleanup). The relevance of susceptibility genes to these programs will be apparent and will require changes in decision criteria to adjust utilitarian considerations (*e.g.*, cost-benefit analysis) to meet demands by susceptible groups for equivalent protection or increased benefits based on equal protection and humanitarian considerations. For example, the Health Care Financing Administration (HCFA), struggling to contain the escalating costs of the Medicare program it administers, will need to consider whether the costs of testing the elderly for susceptibility genes and subsequent therapeutic interventions for reducing the likelihood of their future illness are to

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12. Ava O. Onalaja & Luz Claudio, *Genetic Susceptibility to Lead Poisoning*, 108 ENVTL. HEALTH PERSP. 23 (Supp. 1 Mar. 2000).

13. *Id.*

14. *See* Carl Cranor, *Eggshell Skulls and Loss of Hair from Fright: Some Moral and Legal Principles that Protect Susceptible Subpopulations*, 4 ENVTL. TOXICOLOGY & PHARMACOLOGY 239 (1997). Agencies face similar challenges in protecting children and in protecting minorities from disproportionate environmental risks.

be covered. Thus far, HCFA criteria essentially limit Medicare coverage to diagnosis and treatment of actual illness.[15]

In addition, public health policy is shaped by state programs, private sector systems and arrangements, and litigation. These include state workers' compensation programs, litigation under state common law doctrines, corporate risk management, and private insurance for health care. Knowledge about susceptibility genes will be injected into these contexts as well.

Insurers can be expected to be eager to use estimates of the incidence of susceptibility genes in pricing workers' compensation, third party liability, and various health insurance coverages. Such knowledge would reduce uncertainty in estimating risk and claims and thereby enable insurers to do more accurate and profitable pricing of policies. Requiring that individual applicants for certain types of insurance undergo testing for such genes would further reduce uncertainty and enhance profits, although considerable public pressure against testing individuals may build and lead to statutory prohibitions.[16]

Knowledge about susceptibility genes is also likely to be used in various types of corporate risk management and loss control programs. Manufacturers of chemical products will use such knowledge for amplifying product warnings and educating customers to prevent harms and avoid products liability lawsuits.[17] Companies can be expected to want to conduct susceptibility gene tests on employees in chemical workplaces or at facilities in polluted regions to hire the most resistant workers and avoid workers' compensation claims. Although the Americans with Disabilities Act (ADA) prohibits pre-employment medical testing, it permits job function capability testing after a job offer is made to discern disability and determine whether "reasonable accommodation" should be provided by the employer.[18]

In toxic tort lawsuits, genetic susceptibility evidence will be introduced to establish or refute causation and fault. Likewise, in workers' compensation hearings it will be introduced to address causation and injury job-relatedness. Community residents will use the information in opposing facilities that would generate chemical pollutants, and they may regard promises of facility compliance with existing standards as inadequate.

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15. *See* Health Care Financing Administration, *Quality of Care Information; Coverage Policies; Clinical Diagnostic Laboratory Tests; Addendum A: Introduction to National Coverage Policies for Diagnostic Laboratory Tests* (June 2, 1999) (on file with author).

16. *See* Michael Baram, *The Laws of Genetics*, 105 ENVTL. HEALTH PERSP. 488, 488 (May 1997).

17. *See* CHEMICAL MANUFACTURERS ASS'N, RESPONSIBLE CARE: PRODUCT STEWARDSHIP CODE OF MANAGEMENT PRACTICES (1993), http://www.americanchemistry.com.

18. *See, e.g.*, 42 U.S.C. §§ 12111–12117 (1994); *see also* EEOC COMPLIANCE MANUAL § 902 (1995).

As these examples indicate, EGP findings will be injected into many of the disparate elements of public health policy. Knowledge of a particular susceptibility gene and an estimate of its incidence in the population served by a regulatory or benefits program will be sufficient, without testing the individual members of the population, for justifying reconsideration of regulations or benefits criteria. Similarly, revising workers' compensation and devising warnings for chemical products will be feasible without the need to test individuals. Thus, concerns about testing individuals, such as privacy, anxiety, medical risk, or stigma will not arise as direct consequences of such generic uses of genetic susceptibility knowledge. However, as noted earlier, reconsidering regulations or benefits criteria to assure equivalent health to susceptible subgroups will require artful adaptation of the utilitarian policies and analyses involved in agency decisionmaking processes. In addition, if the subgroup is composed largely of persons belonging to a racial or ethnic minority, agency failure to take action that would eliminate their disproportionate risk from chemical exposure could be construed as a violation of environmental justice[19] and Title VI of the Civil Rights Act.[20]

Other elements of public health policy involve decisionmaking about individuals, such as plaintiffs in toxic tort suits, claimants in workers' compensation hearings, applicants for health insurance, and insured persons seeking indemnification from Medicare or other insurers. In these contexts, genetic susceptibility may be considered essential information and necessitate individual testing. Testing for low penetrance susceptibility genes may result in medical and psychological risks, and dissemination of test results may bring about discrimination in employment and stigma for individuals found to be genetically susceptible to chemical risks. Whereas some of these problems may be effectively addressed by legal doctrines for protecting privacy and statutes and policies for assuring genetic privacy and preventing genetic discrimination,[21] there is no legal

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19. *See* Michael Baram, *Electromagnetic Fields: Health Risks and Environmental Justice*, 13 TOXICS LAW REP. (BNA) No. 19, at 623 (Oct. 7, 1998).

20. 42 U.S.C. § 2000(e) (1994).

21. *See, e.g.*, Exec. Order No. 13,145, 65 Fed. Reg. 6877 (Feb. 8, 2000). Attempts by state legislatures to address issues of genetic privacy have been limited in scope and lack comparative consistency. *See* Natalie A. Stepanuk, *Genetic Information and Third Party Access to Information: New Jersey's Pioneering Legislation as a Model for Federal Privacy Protection of Genetic Information*, 47 CATH. U. L. REV. 1105, 1115–16 (1998); David M. Studdert, *Direct Contracts, Data Sharing and Employee Risk Selection: New Stakes for Patient Privacy in Tomorrow's Health Insurance Markets*, 25 AM. J. L. & MED. 233, 256 (1999). Although many states have enacted or plan to enact genetic discrimination statutes, most of these statutes address only the use of genetic information by insurers, while only a small minority of states have adopted legislation prohibiting genetic discrimination by employers. *See* Tara L. Rachinsky, *Genetic Testing: Toward a Comprehensive Policy to Prevent Genetic Discrimination in the Workplace*, 2 U. PA. J. LAB. & EMP. L. 575, 587 (2000). States with existing statutes prohibiting genetic discrimination by employers include New Jersey, N.J. REV. STAT. § 10:5-12 (N.J. 1997); Hawaii, H.R. 1372, 20th Leg. (Haw. 1999); Kansas, S. 22, 78th

safeguard against emotional risk and stigma. Thus, individuals seeking monetary benefits and remedies in these contexts will assume certain risks for which there is no effective legal recourse when they voluntarily undergo testing.

III. GENETIC SUSCEPTIBILITY AND OSHA REGULATION

Genetic susceptibility knowledge will have major implications for regulatory programs which aim to protect human health from chemical exposures. The Environmental Protection Agency (EPA) regulates the emission of hazardous air pollutants,[22] drinking water quality,[23] pesticides,[24] and other toxic substances,[25] based, in part, on analyses of human exposure and response to the chemicals involved. Similarly, the Food and Drug Administration (FDA) regulates food additives[26] and pharmaceuticals,[27] and the Occupational Safety and Health Administration (OSHA) regulates toxic substances in the workplace[28] and enforces the duty of employers to furnish to employees "employment and a place of employment which are free from recognized hazards."[29] Although the statutes mandating these programs provide differing criteria for determining safety, each statute requires consideration of relevant facts regarding human exposure and response to chemical pollutants or products. Therefore, these agencies must consider knowledge of genetic susceptibility in setting standards.

Thus far, EPA and FDA have not enacted general policies for addressing genetic susceptibility, nor have they enacted standards that rely on human testing for implementation. OSHA also lacks a general policy, but for almost two decades it has required biological monitoring of workers to implement its standards for several workplace toxins. Biological monitoring usually involves testing a person's urine, blood, or other bodily fluids to determine that person's uptake and concentration of a specific toxin.

For example, OSHA's lead standard[30] "requires employers to measure workers' blood lead levels regularly. If the measured concentration of lead in the blood exceeds certain limits, the worker must be removed from further exposure

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Leg. (Kan. 1999); Nevada, S. 16, 70th Reg. Sess. (Nev. 1999); and Texas S. 538, 76th Leg. (Tex. 1999).

22. 42 U.S.C. § 7412 (1994)

23. 42 U.S.C. § 300f (2000).

24. 7 U.S.C. §§ 136 1361, 1360 (1994).

25. Toxic Substances Control Act, Pub. L. No. 94-469, 90 Stat. 2003 (1976) (codified as amended in scattered sections of 15 U.S.C.)

26. 21 U.S.C. § 348 (1994).

27. 21 U.S.C. § 351 (1994).

28. 29 U.S.C. § 651 (1994).

29. 29 U.S.C. § 654 (1999) (general duty clause).

30. *See* 29 C.F.R. § 1910.1025 (1999) (general industry); 29 C.F.R. § 1926.62 (1999) (construction industry).

to lead until the level drops to an acceptable value. For up to 18 months, the employer must maintain the worker's wages and seniority status even if the person cannot perform his or her regular job."[31]

Implementation of the standard in Massachusetts, for example, involves a medical surveillance program under which the employer pays for the medical and testing services involved, notifies employees of test results, and retains medical and exposure records. In addition, the "medical supervisor" of the program provides the employer with test results, a brief medical report indicating whether tested employees are at increased risk, and recommendations for limiting further lead exposure as appropriate. However, the program precludes employer use of prophylactic chelation as a means of preventing lead concentrations in workers, because this would shift the burden of health protection from employers to employees.[32] Thus, an elaborate legal framework governs use of biological monitoring under the OSHA lead standard. This framework is designed to ensure that testing is medically supervised, that management and workers are informed of test results, that workers at risk are medically removed or given other protections and retain job status and pay, and that management retains the burden of assuring worker health.

Such programs provide OSHA with relevant experience for requiring genetic testing in protecting workers from chemical risks. As OSHA's Director of Health Standards has observed, "[g]enetic monitoring can be viewed as an extension of other types of biological monitoring . . . to detect biological changes or assess individual exposures that could be associated with increased risk of occupational disease."[33]

Periodic genetic monitoring would not be required to determine which workers are genetically susceptible to a particular chemical, but a single test would need to be performed on each employee.[34] Thereafter, biological or ambient

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31. OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, PREVENTING ILLNESS AND INJURY IN THE WORKPLACE 92 (1985).

32. *See* OCCUPATIONAL HEALTH SURVEILLANCE PROGRAM, MASSACHUSETTS DEPT. PUB. HEALTH, MEDICAL GUIDELINES & MODEL CONTRACT FOR A LEAD MEDICAL PROGRAM (June 1997).

33. Anita Shill, Genetic Information in the Workplace: Applications and Prohibitions 4 (Apr. 7) (unpublished manuscript on file with author); OFFICE OF COMPLIANCE PROGRAMMING, OSHA, INSTRUCTION STD 1-23.4, OSHA MEDICAL SURVEILLANCE REGULATIONS–GENETIC TESTING (1980), available at http://www.osha-slc.gov/OshDoc/Directive_data/STD_1-23_4.html (indicates that compilation of an employee's medical history may include genetic and environmental facts, but does not prescribe genetic testing).

34. To avoid charges of genetic discrimination and violation of the ADA, which precludes pre-employment testing of job applicants, the testing would have to take place after hiring. *See* Pat Phibbs, *Toxicogenetic Testing More Practical with Finding on Number of Genes in Genome*, 31 O.S.H. REP. (BNA) No. 8, at 153 (Feb. 22, 2001) (discussing EEOC v. Burlington Northern Santa Fe Railroad Co., No. 01-4013 (N.D. Iowa filed Feb. 9, 2001)

monitoring for chemical exposure would have to be conducted periodically to determine when the identified susceptible workers reach unacceptable risk thresholds. For such monitoring of chemical exposure, the lead-standard framework then could be applied to assure that management and workers are fully informed, that records are retained, and that medically informed protective measures are carried out.[35]

In lieu of incorporating genetic susceptibility testing and associated monitoring into each of its workplace standards for toxic chemicals, OSHA could use knowledge of genetic susceptibility to make each standard so stringent that it protects even the subsets of genetically susceptible workers. Although this would obviate the need for genetically testing individual workers, OSHA standards must be technically and economically feasible.[36] Extremely stringent standards to protect the genetically susceptible are not likely to meet these criteria. In addition, such a standard set for safeguarding a very small subgroup of susceptible workers would be vulnerable if challenged as an impermissible deviation from the Supreme Court's rough "instruction" that OSHA regulation be confined to risks that are "significant," *i.e.*, a lifetime risk of one in a thousand or greater, but not one in a million.[37]

In addition, OSHA could rely on informational regulation for bringing genetic susceptibility knowledge to the attention of management and workers. This could be accomplished by amending its Hazard Communication Standard (HCS).[38] HCS requires chemical manufacturers to identify hazardous chemicals they sell to industrial customers, to label containers of such chemicals with appropriate warnings, and to prepare a Material Safety Data Sheet (MSDS) for each such chemical, which includes a description of its hazardous attributes, such as toxicity and carcinogenicity, and instructions for protecting worker health when using the chemical. It must then be provided to all downstream employers who purchase the chemicals. Thereafter, the HCS requires such employers and manufacturers to notify their own employees of MSDS availability, make the MSDSs readily accessible to them, and provide training about the hazards and safe use of the chemicals, including appropriate measures for self-protection.

The substantive content of the informational requirements is left to each manufacturer.[39]Assurance that MSDSs will be sufficiently informative is provided

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(regarding genetic testing of Burlington employees for genetic susceptibility to carpal tunnel syndrome)).

35. This scenario assumes the accuracy and validity of testing for susceptibility genes and of biological and ambient monitoring for chemical exposures.

36. American Textile Mfrs. Inst. v. Donovan, 452 U.S. 490, 542 (1981).

37. Industrial Union Dept., AFL-CIO v. American Petroleum Inst., 448 U.S. 607, 641 (1980).

38. 29 C.F.R. §1910.1200 (1999).

39. *See* Michael Baram, *Generic Strategies for Protecting Worker Health and Safety, in* LAW AND THE WORKPLACE (J. Snyder & J. Klees eds., 1996).

to some extent by manufacturers' concerns that inadequacies could lead to downstream worker illnesses and trigger product liability suits against them. Assurance that employers will have sufficiently instructive MSDSs and training materials is similarly provided by competition among manufacturers for customers. The more a manufacturer can do to help a customer company efficiently comply with the HCS, the more likely it is that customer loyalty to the manufacturer will accrue. As a result, many manufacturers voluntarily amplify MSDSs with additional helpful information and provide training materials and other guidance for customer use. Thus, liability doctrines and market forces combine to promote compliance with the HCS.[40]

Another significant feature of the HCS is the absence of any OSHA exemptions for hazardous chemicals that pose a *de minimis* risk to worker health. OSHA's rationale for not affording such exemptions is that manufacturers have no way of knowing how downstream customers use the chemicals and cannot determine if downstream use will pose only a *de minimis* risk. Thus, they should not be led by OSHA to rely on *de minimis* risk because this could lead to preventable harms and manufacturer liability.[41] Courts have upheld OSHA's position.

OSHA amendment of the HCS, or new guidance for its implementation, could bring about incorporation of genetic susceptibility knowledge in MSDSs and training programs. This option would shift the burden of using such knowledge onto industry and is likely to encounter less resistance because it is not as prescriptive as revised standards and lead-like medical programs would be. Implementation would be driven by OSHA enforcement of the HCS, manufacturer concerns about potential products liability suits, and manufacturer competition for customers. Discriminatory implications could be contained by other legislation, such as the ADA. However, it could lead to further burden-shifting, as employers would likely seek to have their susceptible workers take new self-protective measures that are disproportionately burdensome or disadvantageous (such as wearing "moon suits" and other cumbersome personal protective gear), unless OSHA or collective bargaining intervenes.

Finally, OSHA could forgo any standard-revising or HCS-amending and rely instead on the general duty clause (GDC) of the Occupational Safety and Health Act, which provides that each employer "shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious harm to his employees."[42] This brief statement has been construed by OSHA, its review commission, and the courts as a duty imposed by Congress on private sector employers, enforceable by OSHA without any need for further rulemaking. OSHA is

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40. *Id.* at 74–75.

41. *Id.* at 74 (citing General Carbon v. OSHA, 1988 WL 17401 (D.C. Cir. 1988)).

42. 29 U.S.C. § 654 (1994).

authorized to inspect private workplaces, question employees, issue citations, and impose penalties if it finds violations. Because the GDC is ambiguous, however, OSHA enforcement has sparked controversy and many appeals over several decades. Courts have held that the GDC establishes fault-based liability, not strict liability, for employers who fail to eliminate a workplace hazard that is "recognized," "serious," and "abatable by feasible means."[43]

OSHA defines a "hazard" as "a danger which threatens physical harm to employees." A hazard is "serious" when its "likely" consequences include "death or serious physical harm" such as chronic illnesses "which require the passage of a substantial time period to occur."[44] The hazard is "recognized" if it is known to the employer or its employees, or persons who are knowledgeable about or belong to the same industrial sector. Thus, an employer can be found in violation of the GDC on the basis of actual or imputed knowledge.[45] OSHA must also prove "there was feasible means by which the employer could have eliminated or materially reduced the hazard,"[46] which remains a matter of considerable ambiguity.[47]

Finally, the courts have held that Congress intended the GDC to be a "gap-filler," an obligation to be imposed on an employer only when an OSHA standard is not available to abate the hazard at issue. Thus, employers cited for GDC violations frequently argue that an existing OSHA standard preempts GDC applicability, even when the standard inadequately addresses the hazard in question. This has led to judicial modification of this preemption doctrine in such cases. In *International Union v. General Dynamics Land Systems Division*,[48] the D.C. Circuit Court of Appeals held that:

> If . . . an employer knows a particular safety standard is inadequate to protect his workers against the specific hazard it is intended to address, or that the conditions in his place of employment are such that the safety standard will not adequately deal with the hazards to which his employees are exposed, he has duty under [the GDC] to take whatever measures may be required by the Act, over and above those mandated by the safety standard, to safeguard his workers . . . . Scienter is the key.

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43. *See* Baram, *supra* note 39, at 69–73.

44. *See* OSHA, U.S. DEP'T LABOR, DIRECTIVE, CPL 2.45B, CH-3 (1992), *available at* http://www.osha-slc.gov/OshDoc/Directive_data/CPL_2_45B_CH-4.html.

45. Imputed knowledge can come from MSDSs and other warnings provided by chemical or equipment suppliers, consultant and expert studies, other experience in the same industrial sector, industry voluntary standards, and studies or reports by unions, workers and insurers. *Id. See also* National Realty & Constr. Co. v. OSHRC, 489 F.2d 1257, 1267 (D.C. Cir 1973).

46. Duricon Co. v. OSHRC, 750 F.2d 28 (6th Cir. 1984). Congress has referred to this decision as the most appropriate judicial interpretation of its general duty mandate. *See* S. Rep. 228, 101st Cong., 1st Sess. 208, 209 (1989).

47. *See* Baram, *supra* note 39, at 71–72.

48. 815 F.2d 1570, 1577 (D.C. Cir 1987), *cert. denied*, 484 U.S. 976 (1987).

Thus, OSHA can carry out a GDC-based strategy for putting genetic susceptibility knowledge to use. This would call for the agency to broadly publicize genetic susceptibility knowledge and its relevance to preventing workplace health hazards, identify and notify the types of firms and industrial sectors where such hazards are likely because of the chemicals being used, devise and implement an inspection program, and take appropriate enforcement actions for GDC violations arising from an employer's failure to act on genetic knowledge to prevent harm to its susceptible workers. Seemingly simplistic and more attractive than incurring the burdens of revising specific chemical standards, this approach would fail unless OSHA is able to produce evidence that susceptible workers were indeed present, chemically exposed, and not sufficiently protected in the cited employers' workplaces. Thus, the GDC strategy would ultimately depend on finding susceptible workers, which necessitates testing the exposed workforce for susceptibility genes.

In sum, OSHA has several options for putting genetic susceptibility knowledge to use in protecting worker health, but each option poses difficult issues for the agency. Similar difficulties exist for EPA and FDA. Nevertheless, given the proven ability of agencies to absorb and accommodate new scientific findings and the inevitability that genetic susceptibility knowledge will become more reliable, agencies need to begin to develop strategies for incorporating such knowledge and to seek participation from all stakeholders in this important undertaking.