S 1322 IS

36 cosponsors in the House (Louise Slaughter's bill)

106th CONGRESS

1st Session

S. 1322

addtl cosponsors Tim Johnson Russ Feingold Chuck Schumer

To prohibit health insurance and employment discrimination against individuals and their family members on the basis of predictive genetic information or genetic services.

IN THE SENATE OF THE UNITED STATES

July 1, 1999

Mr. DASCHLE (for himself, Mr. HARKIN, Mr. DODD, and Mr. KENNEDY) introduced the following bill; which was read twice and referred to the Committee on Health, Education, Labor, and Pensions

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A BILL

To prohibit health insurance and employment discrimination against individuals and their family members on the basis of predictive genetic information or genetic services.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Genetic Nondiscrimination in Health Insurance and Employment Act of 1999'.

TITLE I--PROHIBITION OF HEALTH INSURANCE DISCRIMINATION ON THE BASIS OF PREDICTIVE GENETIC INFORMATION

SEC. 101. AMENDMENTS TO EMPLOYEE RETIREMENT INCOME SECURITY ACT OF 1974.

(a) PROHIBITION OF HEALTH INSURANCE DISCRIMINATION ON THE BASIS OF GENETIC SERVICES OR PREDICTIVE GENETIC INFORMATION-

(1) NO ENROLLMENT RESTRICTION FOR GENETIC SERVICES- Section 702(a)(1)(F) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1182(a)(1)(F)) is amended by inserting before the period `(or information about a request for or the receipt of genetic services by such individual or family member of such individual)'.

(2) NO DISCRIMINATION IN GROUP RATE BASED ON PREDICTIVE GENETIC INFORMATION-

(A) IN GENERAL- Subpart B of Part 7 of subtitle B of title I of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1185 et seq.) is amended by adding at the end the following:

`SEC. 714. PROHIBITING DISCRIMINATION AGAINST GROUPS ON THE BASIS OF PREDICTIVE GENETIC INFORMATION.

`A group health plan, and a health insurance issuer offering group health insurance coverage in connection with a group health plan, shall not deny eligibility to a group or adjust premium or contribution rates for a group on the basis of predictive genetic information concerning an individual in the group (or information about a request for or the receipt of genetic services by such individual or family member of such individual).'.

(B) CONFORMING AMENDMENTS-

(i) Section 702(b)(2)(A) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1182(b)) is amended to read as follows:

`(A) to restrict the amount that an employer may be charged for coverage under a group health plan, except as provided in section 714; or'.

(ii) Section 732(a) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1191a(a)) is amended by striking `section 711' and inserting `subsections (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request or receipt of genetic services by an individual or family member of such individual), (c), (d), (e), (f), or (g) of section 702, section 711 and section 714'.

(b) LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- Section 702 of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1182) is amended by adding at the end the following:

`(c) GENETIC TESTING-

`(1) LIMITATION ON REQUESTING OR REQUIRING GENETIC TESTING- A group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not request or require an individual or a family member of such individual to undergo a genetic test.

`(2) RULE OF CONSTRUCTION- Nothing in this title shall be construed to limit the authority of a health care professional, who is providing treatment with respect to an individual and who is employed by a group health plan or a health insurance issuer, to request that such individual or family member of such individual undergo a genetic test. Such a health care professional shall not require that such individual or family member undergo a genetic test.

`(d) COLLECTION OF PREDICTIVE GENETIC INFORMATION- Except as provided in subsections (f) and (g), a group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not request, require, collect, or purchase predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(e) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- A group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not disclose predictive genetic information about an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual) to--

`(1) any entity that is a member of the same controlled group as such issuer or plan sponsor of such group health plan;

`(2) any other group health plan or health insurance issuer or any insurance agent, third party administrator, or other person subject to regulation under State insurance laws;

`(3) the Medical Information Bureau or any other person that collects, compiles, publishes, or otherwise disseminates insurance information;

`(4) the individual's employer or any plan sponsor; or

`(5) any other person the Secretary may specify in regulations.

`(f) INFORMATION FOR PAYMENT FOR GENETIC SERVICES-

`(1) IN GENERAL- With respect to payment for genetic services conducted concerning an individual or the coordination of benefits, a group health plan, or a health insurance issuer offering group health insurance coverage in connection with a group health plan, may request that the individual provide the plan or issuer with evidence that such services were performed.

`(2) RULE OF CONSTRUCTION- Nothing in paragraph (1) shall be construed to--

`(A) permit a group health plan or health insurance issuer to request (or require) the results of the services referred to in such paragraph; or

`(B) require that a group health plan or health insurance issuer make payment for services described in such paragraph where the individual involved has refused to provide evidence of the performance of such services pursuant to a request by the plan or issuer in accordance with such paragraph.

`(g) INFORMATION FOR PAYMENT OF OTHER CLAIMS- With respect to the payment of claims for benefits other than genetic services, a group health plan, or a health insurance issuer offering group health insurance coverage in connection with a group health plan, may request that an individual provide predictive genetic information so long as such information--

`(1) is used solely for the payment of a claim;

`(2) is limited to information that is directly related to and necessary for the payment of such claim and the claim would otherwise be denied but for the predictive genetic information; and

`(3) is used only by an individual (or individuals) within such plan or issuer who needs access to such information for purposes of payment of a claim.

`(h) RULES OF CONSTRUCTION-

`(1) COLLECTION OR DISCLOSURE AUTHORIZED BY INDIVIDUAL- The provisions of subsections (d) (regarding collection) and (e) shall not apply to an individual if the individual (or legal representative of the individual) provides prior, knowing, voluntary, and written authorization for the collection or disclosure of predictive genetic information.

`(2) DISCLOSURE FOR HEALTH CARE TREATMENT- Nothing in this section shall be construed to limit or restrict the disclosure of predictive genetic information from a health care provider to another health care provider for the purpose of providing health care treatment to the individual involved.

`(i) DEFINITIONS- In this section:

`(1) CONTROLLED GROUP- The term `controlled group' means any group treated as a single employer under subsections (b), (c), (m), or (o)of section 414 of the Internal Revenue Code of 1986.

`(2) GROUP HEALTH PLAN, HEALTH INSURANCE ISSUER- The terms `group health plan' and `health insurance issuer' include a third party administrator or other person acting for or on behalf of such plan or issuer.'.

(c) ENFORCEMENT- Section 502 (29 U.S.C. 1132) is amended by adding at the end the following:

`(n) VIOLATION OF GENETIC DISCRIMINATION OR GENETIC DISCLOSURE PROVISIONS- In any action under this section against any administrator of a group health plan, or health insurance issuer offering group health insurance coverage in connection with a group health plan (including any third party administrator or other person acting for or on behalf of such plan or issuer) alleging a violation of subsection (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request or receipt of genetic services by an individual or family member of such individual), (c), (d), (e), (f), or (g) of section 702, or section 714, the court may award any appropriate legal or equitable relief. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of expert witnesses.

`(o) CIVIL PENALTY- The monetary provisions of section 308(b)(2)(C) of Public Law 101-336 (42 U.S.C. 12188(b)) shall apply for purposes of the Secretary enforcing the provisions referred to in subsection (n), except that any such relief awarded shall be paid only into the general fund of the Treasury.'.

(d) PREEMPTION- Section 731 of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1191) is amended--

(1) in subsection (a)(1), by inserting `or (e)' after `subsection (b)'; and

(2) by adding at the end the following:

`(e) SPECIAL RULE IN CASE OF GENETIC INFORMATION- With respect to group health insurance coverage offered by a health insurance issuer, the provisions of this part relating to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) shall not be construed to supersede any provision of State law which establishes, implements, or continues in effect a standard, requirement, or remedy that more completely--

`(1) protects the confidentiality of genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) or the privacy of an individual or a family member of the individual with respect to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) than does this part; or

`(2) prohibits discrimination on the basis of genetic information than does this part.'.

(e) DEFINITIONS- Section 733(d) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1191b(d)) is amended by adding at the end the following:

`(5) FAMILY MEMBER- The term `family member' means with respect to an individual--

`(A) the spouse of the individual;

`(B) a dependent child of the individual, including a child who is born to or placed for

adoption with the individual; and

`(C) all other individuals related by blood to the individual or the spouse or child described in subparagraph (A) or (B).

`(6) GENETIC INFORMATION- The term `genetic information' means information about genes, gene products, or inherited characteristics that may derive from an individual or a family member of such individual (including information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(7) GENETIC SERVICES- The term `genetic services' means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic and therapeutic purposes, and for genetic education and counseling.

`(8) GENETIC TEST- The term `genetic test' means the analysis of human DNA, RNA, chromosomes, proteins, and certain metabolites in order to detect genotypes, mutations, or chromosomal changes.

`(9) PREDICTIVE GENETIC INFORMATION-

`(A) IN GENERAL- The term `predictive genetic information' means--

`(i) information about an individual's genetic tests;

`(ii) information about genetic tests of family members of the individual; or

`(iii) information about the occurrence of a disease or disorder in family members.

`(B) LIMITATIONS- The term `predictive genetic information' shall not include--

`(i) information about the sex or age of the individual;

`(ii) information about chemical, blood, or urine analyses of the individual, unless these analyses are genetic tests; or

`(iii) information about physical exams of the individual, and other information relevant to determining the current health status of the individual.'.

(f) AMENDMENT CONCERNING SUPPLEMENTAL EXCEPTED BENEFITS- Section 732(c)(3) of the Employee Retirement Income Security Act of 1974 (29 U.S.C. 1191a(c)(3)) is amended by inserting `, other than the requirements of subsections (a)(1)(F), (b) (in cases relating to genetic information or information about a request for or the receipt of genetic services by an individual or a family member of such individual), (c), (d), (e), (f) and (g) of section 702 and section 714,' after `The requirements of this part'.

(g) EFFECTIVE DATE-

(1) IN GENERAL- Except as provided in this section, this section and the amendments made by this section shall apply with respect to group health plans for plan years beginning after October 1, 2000.

(2) SPECIAL RULE FOR COLLECTIVE BARGAINING AGREEMENTS- In the case of a group health plan maintained pursuant to one or more collective bargaining agreements between employee representatives and one or more employers ratified before the date of the enactment of this Act, this section and the amendments made by this section shall not apply to plan years beginning before the later of--

(A) the date on which the last of the collective bargaining agreements relating to the plan terminates (determined without regard to any extension thereof agreed to after the date of the enactment of this Act), or

(B) October 1, 2000.

For purposes of subparagraph (A), any plan amendment made pursuant to a collective bargaining agreement relating to the plan which amends the plan solely to conform to any requirement of the amendments made by this section shall not be treated as a termination of such collective bargaining agreement.

SEC. 102. AMENDMENTS TO THE PUBLIC HEALTH SERVICE ACT.

(a) AMENDMENTS RELATING TO THE GROUP MARKET-

(1) PROHIBITION OF HEALTH INSURANCE DISCRIMINATION ON THE BASIS OF PREDICTIVE GENETIC INFORMATION OR GENETIC SERVICES-

(A) NO ENROLLMENT RESTRICTION FOR GENETIC SERVICES- Section 2702(a)(1)(F) of the Public Health Service Act (42 U.S.C. 300gg-1(a)(1)(F)) is amended by inserting before the period the following: `(or information about a request for or the receipt of genetic services by an individual or a family member of such individual)'.

(B) NO DISCRIMINATION IN GROUP RATE BASED ON PREDICTIVE GENETIC INFORMATION-

(i) IN GENERAL- Subpart 2 of part A of title XXVII of the Public Health Service (42 U.S.C. 300gg-4 et seq.) is amended by adding at the end the following:

`SEC. 2707. PROHIBITING DISCRIMINATION AGAINST GROUPS ON THE BASIS OF PREDICTIVE GENETIC INFORMATION.

`A group health plan, and a health insurance issuer offering group health insurance coverage in connection with a group health plan, shall not deny eligibility to a group or adjust premium or contribution rates for a group on the basis of predictive genetic information concerning an individual in the group (or information about a request for or the receipt of genetic services by such individual or family member of such individual).'.

(ii) CONFORMING AMENDMENTS-

(I) Section 2702(b)(2)(A) of the Public Health Service Act (42 U.S.C. 300gg-1(b)(2)(A)) is amended to read as follows:

`(A) to restrict the amount that an employer may be charged for coverage under a group health plan, except as provided in section 2707; or'.

(II) Section 2721(a) of the Public Health Service Act (42 U.S.C. 300gg-21(a)) is amended by inserting `(other than subsections (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request or receipt of genetic services by an individual or family member of such individual), (c), (d), (e), (f), or (g) of section 2702 and section 2707)' after `subparts 1 and 3'.

(2) LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- Section 2702 of the Public Health Service Act (42 U.S.C. 300gg-1) is amended by adding at the end the following:

`(c) GENETIC TESTING-

`(1) LIMITATION ON REQUESTING OR REQUIRING GENETIC TESTING- A group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not request or require an individual or a family member of such individual to undergo a genetic test.

`(2) RULE OF CONSTRUCTION- Nothing in this title shall be construed to limit the authority of a health care professional, who is providing treatment with respect to an individual and who is employed by a group health plan or a health insurance issuer, to request that such individual or family member of such individual undergo a genetic test. Such a health care professional shall not require that such individual or family member undergo a genetic test.

`(d) COLLECTION OF PREDICTIVE GENETIC INFORMATION- Except as provided in subsections (f) and (g), a group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not request, require, collect, or purchase predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(e) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- A group health plan, or a health insurance issuer offering health insurance coverage in connection with a group health plan, shall not disclose predictive genetic information about an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual) to--

`(1) any entity that is a member of the same controlled group as such issuer or plan sponsor of such group health plan;

`(2) any other group health plan or health insurance issuer or any insurance agent, third party administrator, or other person subject to regulation under State insurance laws;

`(3) the Medical Information Bureau or any other person that collects, compiles, publishes, or otherwise disseminates insurance information;

`(4) the individual's employer or any plan sponsor; or

`(5) any other person the Secretary may specify in regulations.

`(f) INFORMATION FOR PAYMENT FOR GENETIC SERVICES-

`(1) IN GENERAL- With respect to payment for genetic services conducted concerning an individual or the coordination of benefits, a group health plan, or a health insurance issuer offering group health insurance coverage in connection with a group health plan, may request that the individual provide the plan or issuer with evidence that such services were performed.

`(2) RULE OF CONSTRUCTION- Nothing in paragraph (1) shall be construed to--

`(A) permit a group health plan or health insurance issuer to request (or require) the results of the services referred to in such paragraph; or

`(B) require that a group health plan or health insurance issuer make payment for

services described in such paragraph where the individual involved has refused to provide evidence of the performance of such services pursuant to a request by the plan or issuer in accordance with such paragraph.

`(g) INFORMATION FOR PAYMENT OF OTHER CLAIMS- With respect to the payment of claims for benefits other than genetic services, a group health plan, or a health insurance issuer offering group health insurance coverage in connection with a group health plan, may request that an individual provide predictive genetic information so long as such information--

`(1) is used solely for the payment of a claim;

`(2) is limited to information that is directly related to and necessary for the payment of such claim and the claim would otherwise be denied but for the predictive genetic information; and

`(3) is used only by an individual (or individuals) within such plan or issuer who needs access to such information for purposes of payment of a claim.

`(h) RULES OF CONSTRUCTION-

`(1) COLLECTION OR DISCLOSURE AUTHORIZED BY INDIVIDUAL- The provisions of subsections (d) (regarding collection) and (e) shall not apply to an individual if the individual (or legal representative of the individual) provides prior, knowing, voluntary, and written authorization for the collection or disclosure of predictive genetic information.

`(2) DISCLOSURE FOR HEALTH CARE TREATMENT- Nothing in this section shall be construed to limit or restrict the disclosure of predictive genetic information from a health care provider to another health care provider for the purpose of providing health care treatment to the individual involved.

`(i) DEFINITIONS- In this section:

`(1) CONTROLLED GROUP- The term `controlled group' means any group treated as a single employer under subsections (b), (c), (m), or (o) of section 414 of the Internal Revenue Code of 1986.

`(2) GROUP HEALTH PLAN, HEALTH INSURANCE ISSUER- The terms `group health plan' and `health insurance issuer' include a third party administrator or other person acting for or on behalf of such plan or issuer.'.

(3) DEFINITIONS- Section 2791(d) of the Public Health Service Act (42 U.S.C. 300gg-91(d)) is amended by adding at the end the following new paragraphs:

`(15) FAMILY MEMBER- The term `family member' means with respect to an individual--

`(A) the spouse of the individual;

`(B) a dependent child of the individual, including a child who is born to or placed for adoption with the individual; and

`(C) all other individuals related by blood to the individual or the spouse or child described in subparagraph (A) or (B).

`(16) GENETIC INFORMATION- The term `genetic information' means information about genes, gene products, or inherited characteristics that may derive from an individual or a family member of such individual (including information about a request for or the receipt

of genetic services by such individual or family member of such individual).

`(17) GENETIC SERVICES- The term `genetic services' means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic and therapeutic purposes, and for genetic education and counselling.

`(18) GENETIC TEST- The term `genetic test' means the analysis of human DNA, RNA, chromosomes, proteins, and certain metabolites in order to detect genotypes, mutations, or chromosomal changes.

`(19) PREDICTIVE GENETIC INFORMATION-

`(A) IN GENERAL- The term `predictive genetic information' means--

`(i) information about an individual's genetic tests;

`(ii) information about genetic tests of family members of the individual; or

`(iii) information about the occurrence of a disease or disorder in family members.

`(B) LIMITATIONS- The term `predictive genetic information' shall not include--

`(i) information about the sex or age of the individual;

`(ii) information about chemical, blood, or urine analyses of the individual, unless these analyses are genetic tests; or

`(iii) information about physical exams of the individual, and other information relevant to determining the current health status of the individual.'.

(b) AMENDMENT RELATING TO THE INDIVIDUAL MARKET- The first subpart 3 of part B of title XXVII of the Public Health Service Act (42 U.S.C. 300gg-51 et seq.) is amended--

(1) by redesignating such subpart as subpart 2; and

(2) by adding at the end the following:

`SEC. 2753. PROHIBITION OF HEALTH INSURANCE DISCRIMINATION AGAINST INDIVIDUALS ON THE BASIS OF PREDICTIVE GENETIC INFORMATION.

`(a) IN ELIGIBILITY TO ENROLL- A health insurance issuer offering health insurance coverage in the individual market shall not establish rules for eligibility to enroll in individual health insurance coverage that are based on predictive genetic information concerning the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(b) IN PREMIUM RATES- A health insurance issuer offering health insurance coverage in the individual market shall not adjust premium rates on the basis of predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`SEC. 2754. LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION.

`(a) GENETIC TESTING-

`(1) LIMITATION ON REQUESTING OR REQUIRING GENETIC TESTING- A health insurance issuer offering health insurance coverage in the individual market shall not request or require an individual or a family member of such individual to undergo a genetic test.

`(2) RULE OF CONSTRUCTION- Nothing in this title shall be construed to limit the authority of a health care professional, who is providing treatment with respect to an individual and who is employed by a group health plan or a health insurance issuer, to request that such individual or family member of such individual undergo a genetic test. Such a health care professional shall not require that such individual or family member undergo a genetic test.

`(b) COLLECTION OF PREDICTIVE GENETIC INFORMATION- Except as provided in subsections (d) and (e), a health insurance issuer offering health insurance coverage in the individual market shall not request, require, collect, or purchase predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(c) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- A health insurance issuer offering health insurance coverage in the individual market shall not disclose predictive genetic information about an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual) to--

`(1) any entity that is a member of the same controlled group as such issuer or plan sponsor of such group health plan;

`(2) any other group health plan or health insurance issuer or any insurance agent, third party

administrator, or other person subject to regulation under State insurance laws;

`(3) the Medical Information Bureau or any other person that collects, compiles, publishes, or otherwise disseminates insurance information;

`(4) the individual's employer or any plan sponsor; or

`(5) any other person the Secretary may specify in regulations.

`(d) INFORMATION FOR PAYMENT FOR GENETIC SERVICES-

`(1) IN GENERAL- With respect to payment for genetic services conducted concerning an individual or the coordination of benefits, a health insurance issuer offering health insurance coverage in the individual market may request that the individual provide the plan or issuer with evidence that such services were performed.

`(2) RULE OF CONSTRUCTION- Nothing in paragraph (1) shall be construed to--

`(A) permit a health insurance issuer to request (or require) the results of the services referred to in such paragraph; or

`(B) require that a health insurance issuer make payment for services described in such paragraph where the individual involved has refused to provide evidence of the performance of such services pursuant to a request by the plan or issuer in accordance with such paragraph.

`(e) INFORMATION FOR PAYMENT OF OTHER CLAIMS- With respect to the payment of claims for benefits other than genetic services, a health insurance issuer offering health insurance coverage in the individual market may request that an individual provide predictive genetic information so long as such information--

`(1) is used solely for the payment of a claim;

`(2) is limited to information that is directly related to and necessary for the payment of such claim and the claim would otherwise be denied but for the predictive genetic information; and

`(3) is used only by an individual (or individuals) within such plan or issuer who needs access to such information for purposes of payment of a claim.

`(f) RULES OF CONSTRUCTION-

`(1) COLLECTION OR DISCLOSURE AUTHORIZED BY INDIVIDUAL- The provisions of subsections (c) (regarding collection) and (d) shall not apply to an individual if the individual (or legal representative of the individual) provides prior, knowing, voluntary, and written authorization for the collection or disclosure of predictive genetic information.

`(2) DISCLOSURE FOR HEALTH CARE TREATMENT- Nothing in this section shall be construed to limit or restrict the disclosure of predictive genetic information from a health care provider to another health care provider for the purpose of providing health care treatment to the individual involved.

`(g) DEFINITIONS- In this section:

`(1) CONTROLLED GROUP- The term `controlled group' means any group treated as a single employer under subsections (b), (c), (m), or (o) of section 414 of the Internal Revenue Code of 1986.

`(2) GROUP HEALTH PLAN, HEALTH INSURANCE ISSUER- The terms `group health plan' and `health insurance issuer' include a third party administrator or other person acting for or on behalf of such plan or issuer.'.

(c) ENFORCEMENT-

(1) GROUP PLANS- Section 2722 of the Public Health Service Act (42 U.S.C. 300gg-22) is amended by adding at the end the following:

`(c) VIOLATION OF GENETIC DISCRIMINATION OR GENETIC DISCLOSURE PROVISIONS- In any action under this section against any administrator of a group health plan, or health insurance issuer offering group health insurance coverage in connection with a group health plan (including any third party administrator or other person acting for or on behalf of such plan or issuer) alleging a violation of subsections (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request or receipt of genetic services by an individual or family member of such individual), (c), (d), (e), (f), or (g) of section 2702 and section 2707 the court may award any appropriate legal or equitable relief. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of expert witnesses.

`(d) CIVIL PENALTY- The monetary provisions of section 308(b)(2)(C) of Public Law 101-336 (42 U.S.C. 12188(b)) shall apply for purposes of the Secretary enforcing the provisions referred to in subsection (c), except that any such relief awarded shall be paid only into the general fund of the Treasury.'.

(2) INDIVIDUAL PLANS- Section 2761 of the Public Health Service Act (42 U.S.C. 300gg-45) is amended by adding at the end the following:

`(c) VIOLATION OF GENETIC DISCRIMINATION OR GENETIC DISCLOSURE PROVISIONS- In any action under this section against any health insurance issuer offering health insurance coverage in the individual market (including any other person acting for or on behalf of such issuer) alleging a violation of section 2753 and 2754 the court in which the action is commenced may award any appropriate legal or equitable relief. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of expert witnesses.

`(d) CIVIL PENALTY- The monetary provisions of section 308(b)(2)(C) of Public Law 101-336 (42 U.S.C. 12188(b)) shall apply for purposes of the Secretary enforcing the provisions referred to in subsection (c), except that any such relief awarded shall be paid only into the general fund of the Treasury.'.

(d) PREEMPTION-

(1) GROUP MARKET- Section 2723 of the Public Health Service Act (42 U.S.C. 300gg-23) is amended--

(A) in subsection (a)(1), by inserting `or (e)' after `subsection (b)'; and

(B) by adding at the end the following:

`(e) SPECIAL RULE IN CASE OF GENETIC INFORMATION- With respect to group health insurance coverage offered by a health insurance issuer, the provisions of this part relating to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) shall

not be construed to supersede any provision of State law which establishes, implements, or continues in effect a standard, requirement, or remedy that more completely--

`(1) protects the confidentiality of genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) or the privacy of an individual or a family member of the individual with respect to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual); or

`(2) prohibits discrimination on the basis of genetic information than does this part.'.

(2) INDIVIDUAL MARKET- Section 2762 of the Public Health Service Act (42 U.S.C. 300gg-46) is amended--

(A) in subsection (a), by inserting `and except as provided in subsection (c),' after `Subject to subsection (b),'; and

(B) by adding at the end the following:

`(c) SPECIAL RULE IN CASE OF GENETIC INFORMATION- With respect to individual health insurance coverage offered by a health insurance issuer, the provisions of this part (or part C insofar as it applies to this part) relating to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) shall not be construed to supersede any provision of State law (as defined in section 2723(d)) which establishes, implements, or continues in effect a standard, requirement, or remedy that more completely--

`(1) protects the confidentiality of genetic information (including information about a

request for or the receipt of genetic services of an individual or a family member of such individual) or the privacy of an individual or a family member of the individual with respect to genetic information (including information about a request for or the receipt of genetic services by an individual or a family member of such individual) than does this part (or part C insofar as it applies to this part); or

`(2) prohibits discrimination on the basis of genetic information than does this part (or part C insofar as it applies to this part).'.

(e) ELIMINATION OF OPTION OF NON-FEDERAL GOVERNMENTAL PLANS TO BE EXCEPTED FROM REQUIREMENTS CONCERNING GENETIC INFORMATION- Section 2721(b)(2) of the Public Health Service Act (42 U.S. C. 300gg-21(b)(2)) is amended--

(1) in subparagraph (A), by striking `If the plan sponsor' and inserting `Except as provided in subparagraph (D), if the plan sponsor'; and

(2) by adding at the end the following:

`(D) ELECTION NOT APPLICABLE TO REQUIREMENTS CONCERNING GENETIC INFORMATION- The election described in subparagraph (A) shall not be available with respect to the provisions of subsections (a)(1)(F), (c), (d), (e), (f), and (g) of section 2702 and section 2707, and the provisions of section 2702(b) to the extent that they apply to genetic information (or information about a request for or the receipt of genetic services by an individual or a family member of such individual).'.

(f) AMENDMENT CONCERNING SUPPLEMENTAL EXCEPTED BENEFITS-

(1) GROUP MARKET- Section 2721(d)(3) of the Public Health Service Act (42 U.S.C. 300gg-23(d)(3)) is amended by inserting `, other than the requirements of subsections (a)(1)(F), (b) (in cases relating to genetic information or information about a request for or the receipt of genetic services by an individual or a family member of such individual)), (c), (d), (e), (f) and (g) of section 2702 and section 2707,' after `The requirements of this part'.

(2) INDIVIDUAL MARKET- Section 2763(b) of the Public Health Service Act (42 U.S.C. 300gg-47(b)) is amended--

(A) by striking `The requirements of this part' and inserting the following:

`(1) IN GENERAL- Except as provided in paragraph (2), the requirements of this part'; and

(B) by adding at the end the following:

`(2) LIMITATION- The requirements of sections 2753 and 2754 shall apply to excepted benefits described in section 2791(c)(4).'.

(g) EFFECTIVE DATE-

(1) IN GENERAL- The amendments made by this section shall apply with respect to--

(A) group health plans, and health insurance coverage offered in connection with group health plans, for plan years beginning; and

(B) health insurance coverage offered, sold, issued, renewed, in effect, or operated in the individual market, after;

October 1, 2000.

(2) SPECIAL RULE FOR COLLECTIVE BARGAINING AGREEMENTS- In the case of a group health plan maintained pursuant to one or more collective bargaining agreements between employee representatives and one or more employers ratified before the date of the enactment of this Act, the amendments made by this section shall not apply to plan years beginning before the later of--

(A) the date on which the last of the collective bargaining agreements relating to the plan terminates (determined without regard to any extension thereof agreed to after the date of the enactment of this Act); or

(B) October 1, 2000.

For purposes of subparagraph (A), any plan amendment made pursuant to a collective bargaining agreement relating to the plan which amends the plan solely to conform to any requirement of the amendments made by this section shall not be treated as a termination of such collective bargaining agreement.

SEC. 103. AMENDMENTS TO INTERNAL REVENUE CODE OF 1986.

(a) PROHIBITION OF HEALTH INSURANCE DISCRIMINATION ON THE BASIS OF GENETIC SERVICES OR PREDICTIVE GENETIC INFORMATION-

(1) NO ENROLLMENT RESTRICTION FOR GENETIC SERVICES- Section 9802(a)(1)(F) of the Internal Revenue Code of 1986 is amended by inserting before the period `(or information about a request for or the receipt of genetic services by such individual or family member of such individual)'.

(2) NO DISCRIMINATION IN GROUP RATE BASED ON PREDICTIVE GENETIC INFORMATION-

(A) IN GENERAL- Subchapter B of chapter 100 of the Internal Revenue Code of 1986 is amended by adding at the end the following:

`SEC. 9813. PROHIBITING DISCRIMINATION AGAINST GROUPS ON THE BASIS OF PREDICTIVE GENETIC INFORMATION.

`A group health plan shall not deny eligibility to a group or adjust premium or contribution rates for a group on the basis of predictive genetic information concerning an individual in the group (or information about a request for or the receipt of genetic services by such individual or family member of such individual).'.

(B) CONFORMING AMENDMENTS-

(i) Section 9802(b)(2)(A) of the Internal Revenue Code of 1986 is amended to read as follows:

`(A) to restrict the amount that an employer may be charged for coverage under a group health plan, except as provided in section 9813; or'.

(ii) Section 9831(a) of the Internal Revenue Code of 1986 is amended by inserting `(other than subsections (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request for or receipt of genetic services by an individual or family member of such individual), (d) (e), (f), (g) or (h) of section 9802 or section 9813) after `chapter'.

(b) LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF

PREDICTIVE GENETIC INFORMATION- Section 9802 of the Internal Revenue Code of 1986 is amended by adding at the end the following:

`(d) GENETIC TESTING-

`(1) LIMITATION ON REQUESTING OR REQUIRING GENETIC TESTING- A group health plan shall not request or require an individual or a family member of such individual to undergo a genetic test.

`(2) RULE OF CONSTRUCTION- Nothing in this title shall be construed to limit the authority of a health care professional, who is providing treatment with respect to an individual and who is employed by a group health plan, to request that such individual or family member of such individual undergo a genetic test. Such a health care professional shall not require that such individual or family member undergo a genetic test.

`(e) COLLECTION OF PREDICTIVE GENETIC INFORMATION- Except as provided in subsections (g) and (h), a group health plan shall not request, require, collect, or purchase predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(f) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- A group health plan shall not disclose predictive genetic information about an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual) to--

`(1) any entity that is a member of the same controlled group as such issuer or plan sponsor of such group health plan;

`(2) any other group health plan or health insurance issuer or any insurance agent, third party administrator, or other person subject to regulation under State insurance laws;

`(3) the Medical Information Bureau or any other person that collects, compiles, publishes, or otherwise disseminates insurance information;

`(4) the individual's employer or any plan sponsor; or

`(5) any other person the Secretary may specify in regulations.

`(g) INFORMATION FOR PAYMENT FOR GENETIC SERVICES-

`(1) IN GENERAL- With respect to payment for genetic services conducted concerning an individual or the coordination of benefits, a group health plan may request that the individual provide the plan with evidence that such services were performed.

`(2) RULE OF CONSTRUCTION- Nothing in paragraph (1) shall be construed to--

`(A) permit a group health plan to request (or require) the results of the services referred to in such paragraph; or

`(B) require that a group health plan make payment for services described in such paragraph where the individual involved has refused to provide evidence of the performance of such services pursuant to a request by the plan in accordance with such paragraph.

`(h) INFORMATION FOR PAYMENT OF OTHER CLAIMS- With respect to the payment of claims for benefits other than genetic services, a group health plan may request that an individual provide predictive genetic information so long as such information--

`(1) is used solely for the payment of a claim;

`(2) is limited to information that is directly related to and necessary for the payment of such claim and the claim would otherwise be denied but for the predictive genetic information; and

`(3) is used only by an individual (or individuals) within such plan or issuer who needs access to such information for purposes of payment of a claim.

`(i) RULES OF CONSTRUCTION-

`(1) COLLECTION OR DISCLOSURE AUTHORIZED BY INDIVIDUAL- The provisions of subsections (e) (regarding collection) and (f) shall not apply to an individual if the individual (or legal representative of the individual) provides prior, knowing, voluntary, and written authorization for the collection or disclosure of predictive genetic information.

`(2) DISCLOSURE FOR HEALTH CARE TREATMENT- Nothing in this section shall be construed to limit or restrict the disclosure of predictive genetic information from a health care provider to another health care provider for the purpose of providing health care treatment to the individual involved.

`(j) DEFINITIONS- In this section:

`(1) CONTROLLED GROUP- The term `controlled group' means any group treated as a single employer under subsections (b), (c), (m), or (o) of section 414.

`(2) GROUP HEALTH PLAN, HEALTH INSURANCE ISSUER- The terms `group health plan' and `health insurance issuer' include a third party administrator or other person acting for or on behalf of such plan or issuer.

`(k) VIOLATION OF GENETIC DISCRIMINATION OR GENETIC DISCLOSURE PROVISIONS- In any action under this section against any administrator of a group health plan (including any third party administrator or other person acting for or on behalf of such plan) alleging a violation of subsection (a)(1)(F), (b) (with respect to cases relating to genetic information or information about a request or receipt of genetic services by an individual or family member of such individual), (d), (e), (f), (g) or (h) of this section or section 9813, the court may award any appropriate legal or equitable relief. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of expert witnesses.

`(l) CIVIL PENALTY- The monetary provisions of section 308(b)(2)(C) of Public Law 101-336 (42 U.S.C. 12188(b)) shall apply for purposes of the Secretary enforcing the provisions referred to in subsection (k), except that any such relief awarded shall be paid only into the general fund of the Treasury.'.

(c) DEFINITIONS- Section 9832(d) of the Internal Revenue Code of 1986 is amended by adding at the end the following:

`(6) FAMILY MEMBER- The term `family member' means with respect to an individual--

`(A) the spouse of the individual;

`(B) a dependent child of the individual, including a child who is born to or placed for adoption with the individual; and

`(C) all other individuals related by blood to the individual or the spouse or child described in subparagraph (A) or (B).

`(7) GENETIC INFORMATION- The term `genetic information' means information about genes, gene products, or inherited characteristics that may derive from an individual or a family member of such individual (including information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(8) GENETIC SERVICES- The term `genetic services' means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic and therapeutic purposes, and for genetic education and counseling.

`(9) GENETIC TEST- The term `genetic test' means the analysis of human DNA, RNA, chromosomes, proteins, and certain metabolites in order to detect genotypes, mutations, or chromosomal changes.

`(10) PREDICTIVE GENETIC INFORMATION-

`(A) IN GENERAL- The term `predictive genetic information' means--

`(i) information about an individual's genetic tests;

`(ii) information about genetic tests of family members of the individual; or

`(iii) information about the occurrence of a disease or disorder in family members.

`(B) LIMITATIONS- The term `predictive genetic information' shall not include--

`(i) information about the sex or age of the individual;

`(ii) information about chemical, blood, or urine analyses of the individual, unless these analyses are genetic tests; or

`(iii) information about physical exams of the individual, and other information relevant to determining the current health status of the individual.'.

(d) EFFECTIVE DATE-

(1) IN GENERAL- Except as provided in this section, this section and the amendments made by this section shall apply with respect to group health plans for plan years beginning after October 1, 2000.

(2) SPECIAL RULE FOR COLLECTIVE BARGAINING AGREEMENTS- In the case of a group health plan maintained pursuant to one or more collective bargaining agreements between employee representatives and one or more employers ratified before the date of the enactment of this Act, this section and the amendments made by this section shall not apply to plan years beginning before the later of--

(A) the date on which the last of the collective bargaining agreements relating to the plan terminates (determined without regard to any extension thereof agreed to after the date of the enactment of this Act), or

(B) October 1, 2000.

For purposes of subparagraph (A), any plan amendment made pursuant to a collective bargaining agreement relating to the plan which amends the plan solely to conform to any requirement of the amendments made by this section shall not be treated as a termination of such collective bargaining agreement.

SEC. 104. AMENDMENTS TO TITLE XVIII OF THE SOCIAL SECURITY ACT RELATING TO MEDIGAP.

(a) NONDISCRIMINATION-

(1) IN GENERAL- Section 1882(s)(2) of the Social Security Act (42 U.S.C. 1395ss(s)(2)) is amended by adding at the end the following:

`(E)(i) An issuer of a medicare supplemental policy shall not deny or condition the issuance or effectiveness of the policy, and shall not discriminate in the pricing of the policy (including the adjustment of premium rates) of an eligible individual on the basis of predictive genetic information concerning the individual (or information about a request for, or the receipt of, genetic services by such individual or family member of such individual).

`(ii) For purposes of clause (i), the terms `family member', `genetic services', and `predictive genetic information' shall have the meanings given such terms in subsection (v).'.

(2) EFFECTIVE DATE- The amendment made by paragraph (1) shall apply with respect to a policy for policy years beginning after October 1, 2000.

(b) LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION-

(1) IN GENERAL- Section 1882 of the Social Security Act (42 U.S.C. 1395ss) is amended by adding at the end the following:

`(v) LIMITATIONS ON GENETIC TESTING AND ON COLLECTION AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION-

`(1) GENETIC TESTING-

`(A) LIMITATION ON REQUESTING OR REQUIRING GENETIC TESTING- An issuer of a medicare supplemental policy shall not request or require an individual or a family member of such individual to undergo a genetic test.

`(B) RULE OF CONSTRUCTION- Nothing in this title shall be construed to limit the authority of a health care professional, who is providing treatment with respect to an individual and who is employed by an issuer of a medicare supplemental policy, to request that such individual or family member of such individual undergo a genetic test. Such a health care professional shall not require that such individual or family member undergo a genetic test.

`(2) COLLECTION OF PREDICTIVE GENETIC INFORMATION- Except as provided in paragraphs (4) and (5), an issuer of a medicare supplemental policy shall not request, require, collect, or purchase predictive genetic information concerning an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual).

`(3) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- An issuer of a medicare supplemental policy shall not disclose predictive genetic information about an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual) to--

`(A) any entity that is a member of the same controlled group as such issuer;

`(B) any issuer of a medicare supplemental policy, group health plan or health insurance issuer, or any insurance agent, third party administrator, or other person subject to regulation under State insurance laws;

`(C) the Medical Information Bureau or any other person that collects, compiles, publishes, or otherwise disseminates insurance information;

`(D) the individual's employer or any plan sponsor; or

`(E) any other person the Secretary may specify in regulations.

`(4) INFORMATION FOR PAYMENT FOR GENETIC SERVICES-

`(A) IN GENERAL- With respect to payment for genetic services conducted concerning an individual or the coordination of benefits, an issuer of a medicare supplemental policy may request that the individual provide the issuer with evidence that such services were performed.

`(B) RULE OF CONSTRUCTION- Nothing in subparagraph (A) shall be construed to--

`(i) permit an issuer to request (or require) the results of the services referred to in such subparagraph; or

`(ii) require that an issuer make payment for services described in such subparagraph where the individual involved has refused to provide evidence of the performance of such services pursuant to a request by the issuer in accordance with such subparagraph.

`(5) INFORMATION FOR PAYMENT OF OTHER CLAIMS- With respect to the payment of claims for benefits other than genetic services, an issuer of a medicare supplemental policy may request that an individual provide predictive genetic information so long as such information--

`(A) is used solely for the payment of a claim;

`(B) is limited to information that is directly related to and necessary for the payment of such claim and the claim would otherwise be

denied but for the predictive genetic information; and

`(C) is used only by an individual (or individuals) within such issuer who needs access to such information for purposes of payment of a claim.

`(6) RULES OF CONSTRUCTION-

`(A) COLLECTION OR DISCLOSURE AUTHORIZED BY INDIVIDUAL- The provisions of paragraphs (2) (regarding collection) and (3) shall not apply to an individual if the individual (or legal representative of the individual) provides prior, knowing, voluntary, and written authorization for the collection or disclosure of predictive genetic information.

`(B) DISCLOSURE FOR HEALTH CARE TREATMENT- Nothing in this section shall be construed to limit or restrict the disclosure of predictive genetic information from a health care provider to another health care provider for the purpose of providing health care treatment to the individual involved.

`(7) VIOLATION OF GENETIC DISCRIMINATION OR GENETIC DISCLOSURE PROVISIONS- In any action under this subsection against any administrator of a medicare supplemental policy (including any third party administrator or other person acting for or on behalf of such policy) alleging a violation of this subsection, the court may award any appropriate legal or equitable relief. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of expert witnesses.

`(8) CIVIL PENALTY- The monetary provisions of section 308(b)(2)(C) of Public Law 101-336 (42 U.S.C. 12188(b)) shall apply for purposes of the Secretary enforcing the provisions of this subsection, except that any such relief awarded shall be paid only into the general fund of the Treasury.

`(9) SPECIAL RULE IN CASE OF GENETIC INFORMATION- This subsection (relating to genetic information or information about a request for, or the receipt of, genetic services by an individual or a family member of such individual) shall not be construed to supersede any provision of State law which establishes, implements, or continues in effect a standard, requirement, or remedy that more completely--

> `(A) protects the confidentiality of genetic information (including information about a request for, or the receipt of, genetic services by an individual or a family member of such individual) or the privacy of an individual or a family member of the individual with respect to genetic information (including information about a request for, or the receipt of, genetic services by an individual or a family member of such individual) than does this subsection; or
>
> `(B) prohibits discrimination on the basis of genetic information than does this subsection.

`(10) DEFINITIONS- In this subsection:

> `(A) CONTROLLED GROUP- The term `controlled group' means any group treated as a single employer under subsection (b), (c), (m), or (o) of section 414 of the Internal Revenue Code of 1986.
>
> `(B) FAMILY MEMBER- The term `family member' means with respect to an individual--
>
> > `(i) the spouse of the individual;
> >
> > `(ii) a dependent child of the individual, including a child who is born to or placed for adoption with the individual; and
> >
> > `(iii) all other individuals related by blood to the individual or the spouse or child described in clause (i) or (ii).
>
> `(C) GENETIC INFORMATION- The term `genetic information' means information about genes, gene products, or inherited characteristics that may derive from an individual or a family member of such individual (including information about a request for, or the receipt of, genetic services by such individual or family member of such individual).
>
> `(D) GENETIC SERVICES- The term `genetic services' means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic and therapeutic purposes, and for genetic education and counseling.
>
> `(E) GENETIC TEST- The term `genetic test' means the analysis of human DNA,

RNA, chromosomes, proteins, and certain metabolites in order to detect genotypes, mutations, or chromosomal changes.

`(F) ISSUER OF A MEDICARE SUPPLEMENTAL POLICY- The term `issuer of a medicare supplemental policy' includes a third-party

administrator or other person acting for or on behalf of such issuer.

`(G) PREDICTIVE GENETIC INFORMATION-

`(i) IN GENERAL- The term `predictive genetic information' means--

`(I) information about an individual's genetic tests;

`(II) information about genetic tests of family members of the individual; or

`(III) information about the occurrence of a disease or disorder in family members.

`(ii) LIMITATIONS- The term `predictive genetic information' shall not include--

`(I) information about the sex or age of the individual;

`(II) information about chemical, blood, or urine analyses of the individual, unless these analyses are genetic tests; or

`(III) information about physical exams of the individual, and other information relevant to determining the current health status of the individual.'.

(2) CONFORMING AMENDMENT- Section 1882(o) of the Social Security Act (42 U.S.C. 1395ss(o)) is amended by adding at the end the following:

`(4) The issuer of the medicare supplemental policy complies with subsection (s)(2)(E) and subsection (v).'.

(3) EFFECTIVE DATE- The amendments made by this subsection shall apply with respect to an issuer of a medicare supplemental policy for policy years beginning after October 1, 2000.

(c) TRANSITION PROVISIONS-

(1) IN GENERAL- If the Secretary of Health and Human Services identifies a State as requiring a change to its statutes or regulations to conform its regulatory program to the changes made by this section, the State regulatory program shall not be considered to be out of compliance with the requirements of section 1882 of the Social Security Act due solely to failure to make such change until the date specified in paragraph (4).

(2) NAIC STANDARDS- If, not later than June 30, 2000, the National Association of Insurance Commissioners (in this subsection referred to as the `NAIC') modifies its NAIC Model Regulation relating to section 1882 of the Social Security Act (referred to in such section as the 1991 NAIC Model Regulation, as subsequently modified) to conform to the amendments made by this section, such revised regulation incorporating the modifications shall be considered to be the applicable NAIC model regulation (including the revised NAIC model regulation and the 1991 NAIC Model Regulation) for the purposes of such

section.

(3) SECRETARY STANDARDS- If the NAIC does not make the modifications described in paragraph (2) within the period specified in such paragraph, the Secretary of Health and Human Services shall, not later than October 1, 2000, make the modifications described in such paragraph and such revised regulation incorporating the modifications shall be considered to be the appropriate regulation for the purposes of such section.

(4) DATE SPECIFIED-

(A) IN GENERAL- Subject to subparagraph (B), the date specified in this paragraph for a State is the earlier of--

(i) the date the State changes its statutes or regulations to conform its regulatory program to the changes made by this section, or

(ii) October 1, 2000.

(B) ADDITIONAL LEGISLATIVE ACTION REQUIRED- In the case of a State which the Secretary identifies as--

(i) requiring State legislation (other than legislation appropriating funds) to conform its regulatory program to the changes made in this section, but

(ii) having a legislature which is not scheduled to meet in 2000 in a legislative session in which such legislation may be considered,

the date specified in this paragraph is the first day of the first calendar quarter beginning after the close of the first legislative session of the State legislature that begins on or after July 1, 2000. For purposes of the previous sentence, in the case of a State that has a 2-year legislative session, each year of such session shall be deemed to be a separate regular session of the State legislature.

TITLE II--PROHIBITION OF EMPLOYMENT DISCRIMINATION ON THE BASIS OF PREDICTIVE GENETIC INFORMATION

SEC. 201. DEFINITIONS.

In this title:

(1) EMPLOYEE; EMPLOYER; EMPLOYMENT AGENCY; LABOR ORGANIZATION; MEMBER- The terms `employee', `employer', `employment agency', and `labor organization' have the meanings given such terms in section 701 of the Civil Rights Act of 1964 (42 U.S.C. 2000e), except that the terms `employee' and `employer' shall also include the meanings given such terms in section 717 of the Civil Rights Act of 1964 (42 U.S.C. 2000e-16). The terms `employee' and `member' include an applicant for employment and an applicant for membership in a labor organization, respectively.

(2) FAMILY MEMBER- The term `family member' means with respect to an individual--

(A) the spouse of the individual;

(B) a dependent child of the individual, including a child who is born to or placed for adoption with the individual; and

(C) all other individuals related by blood to the individual or the spouse or child described in subparagraph (A) or (B).

(3) GENETIC MONITORING- The term `genetic monitoring' means the periodic examination of employees to evaluate acquired modifications to their genetic material, such as chromosomal damage or evidence of increased occurrence of mutations, that may have developed in the course of employment due to exposure to toxic substances in the workplace, in order to identify, evaluate, and respond to the effects of or control adverse environmental exposures in the workplace.

(4) GENETIC SERVICES- The term `genetic services' means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic and therapeutic purposes, and for genetic education and counseling.

(5) GENETIC TEST- The term `genetic test' means the analysis of human DNA, RNA, chromosomes, proteins, and certain metabolites in order to detect genotypes, mutations, or chromosomal changes.

(6) PREDICTIVE GENETIC INFORMATION-

(A) IN GENERAL- The term `predictive genetic information' means--

(i) information about an individual's genetic tests;

(ii) information about genetic tests of family members of the individual; or

(iii) information about the occurrence of a disease or disorder in family members.

(B) LIMITATIONS- The term `predictive genetic information' shall not include--

(i) information about the sex or age of the individual;

(ii) information about chemical, blood, or urine analyses of the individual, unless these analyses are genetic tests; or

(iii) information about physical exams of the individual, and other information relevant to determining the current health status of the individual.

SEC. 202. EMPLOYER PRACTICES.

(a) IN GENERAL- It shall be an unlawful employment practice for an employer--

(1) to fail or refuse to hire or to discharge any individual, or otherwise to discriminate against any individual with respect to the compensation, terms, conditions, or privileges of employment of the individual, because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual;

(2) to limit, segregate, or classify the employees of the employer in any way that would deprive or tend to deprive any individual of employment opportunities or otherwise adversely affect the status of the individual as an employee, because of predictive genetic information with respect to the individual, or information about a request for or the receipt of genetic services by such individual or family member of such individual; or

(3) to request, require, collect or purchase predictive genetic information with respect to an individual or a family member of the individual except--

(A) where used for genetic monitoring of biological effects of toxic substances in the

workplace, but only if--

(i) the employee has provided prior, knowing, voluntary, and written authorization;

(ii) the employee is informed of individual monitoring results;

(iii) the monitoring conforms to any genetic monitoring regulations that may be promulgated by the Secretary of Labor pursuant to the Occupational Safety and Health Act of 1970 (29 U.S.C. 651 et seq.) or the Federal Mine Safety and Health Act of 1977 (30 U.S.C. 801 et seq.); and

(iv) the employer, excluding any licensed health care professional that is involved in the genetic monitoring program, receives the results of the monitoring only in aggregate terms that do not disclose the identity of specific employees; or

(B) where genetic services are offered by the employer and the employee provides prior, knowing, voluntary, and written authorization, and only the employee or family member of such employee receives the results of such services.

(b) LIMITATION- In the case of predictive genetic information to which subparagraph (A) or (B) of subsection (a)(3) applies, such information may not be used in violation of paragraph (1) or (2) of subsection (a).

SEC. 203. EMPLOYMENT AGENCY PRACTICES.

It shall be an unlawful employment practice for an employment agency--

(1) to fail or refuse to refer for employment, or otherwise to discriminate against, any individual because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual);

(2) to limit, segregate, or classify individuals or fail or refuse to refer for employment any individual in any way that would deprive or tend to deprive any individual of employment opportunities or would limit the employment opportunities or otherwise adversely affect the status of the individual as an employee, because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual);

(3) to request, require, collect or purchase predictive genetic information with respect to an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual); or

(4) to cause or attempt to cause an employer to discriminate against an individual in violation of this title.

SEC. 204. LABOR ORGANIZATION PRACTICES.

It shall be an unlawful employment practice for a labor organization--

(1) to exclude or to expel from the membership of the organization, or otherwise to discriminate against, any individual because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual);

(2) to limit, segregate, or classify the members of the organization, or fail or refuse to refer for employment any individual, in any way that would deprive or tend to deprive any individual of employment opportunities, or would limit the employment opportunities or otherwise adversely affect the status of the individual as an employee, because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual);

(3) to request, require, collect or purchase predictive genetic information with respect to an individual (or information about a request for or the receipt of genetic services by such individual or family member of such individual); or

(4) to cause or attempt to cause an employer to discriminate against an individual in violation of this title.

SEC. 205. TRAINING PROGRAMS.

It shall be an unlawful employment practice for any employer, labor organization, or joint labor-management committee controlling apprenticeship or other training or retraining, including on-the-job training programs--

(1) to discriminate against any individual because of predictive genetic information with respect to the individual (or information about a request for or the receipt of genetic services by such individual), in admission to, or employment in, any program established to provide apprenticeship or other training or retraining;

(2) to limit, segregate, or classify the members of the organization, or fail or refuse to refer for employment any individual, in any way that would deprive or tend to deprive any individual of employment opportunities, or would limit the employment opportunities or otherwise adversely affect the status of the individual as an employee, because of predictive genetic information with respect to the individual (or information about a request for or receipt of genetic services by such individual or family member of such individual);

(3) to request, require, collect or purchase predictive genetic information with respect to an individual (or information about a request for or receipt of genetic services by such individual or family member of such individual); or

(4) to cause or attempt to cause an employer to discriminate against an individual in violation of this title.

SEC. 206. MAINTENANCE AND DISCLOSURE OF PREDICTIVE GENETIC INFORMATION.

(a) MAINTENANCE OF PREDICTIVE GENETIC INFORMATION- If an employer possesses predictive genetic information about an employee (or information about a request for or receipt of genetic services by such employee

or family member of such employee), such information shall be treated or maintained as part of the employee's confidential medical records.

(b) DISCLOSURE OF PREDICTIVE GENETIC INFORMATION- An employer shall not disclose predictive genetic information (or information about a request for or receipt of genetic services by such employee or family member of such employee) except--

(1) to the employee who is the subject of the information at the request of the employee;

(2) to an occupational or other health researcher if the research is conducted in compliance with the regulations and protections provided for under part 46 of title 45, Code of Federal Regulations;

(3) under legal compulsion of a Federal court order, except that if the court order was secured without the knowledge of the individual to whom the information refers, the employer shall provide the individual with adequate notice to challenge the court order unless the court order also imposes confidentiality requirements; and

(4) to government officials who are investigating compliance with this Act if the information is relevant to the investigation.

SEC. 207. CIVIL ACTION.

(a) IN GENERAL- One or more employees, members of a labor organization, or participants in training programs may bring an action in a Federal or State court of competent jurisdiction against an employer, employment agency, labor organization, or joint labor-management committee or training program who commits a violation of this title.

(b) ENFORCEMENT BY THE EQUAL EMPLOYMENT OPPORTUNITY COMMISSION-

(1) IN GENERAL- The powers, remedies, and procedures set forth in sections 705, 706, 707, 709, 710, and 717 of the Civil Rights Act of 1964 (42 U.S.C. 2000e-4, 2000e-5, 2000e-6, 2000e-8, 2000e-9, and 2000e-16) shall be the powers, remedies, and procedures provided to the Equal Employment Opportunity Commission to enforce this title. The Commission may promulgate regulations to implement these powers, remedies, and procedures.

(2) EXHAUSTION OF REMEDIES- Nothing in this subsection shall be construed to require that an individual exhaust the administrative remedies available through the Equal Employment Opportunity Commission prior to commencing a civil action under this section, except that if an individual files a charge of discrimination with the Commission that alleges a violation of this title, the individual shall exhaust the administrative remedies available through the Commission prior to commencing a civil action under this section.

(c) REMEDY- A Federal or State court may award any appropriate legal or equitable relief under this section. Such relief may include a requirement for the payment of attorney's fees and costs, including the costs of experts.

SEC. 208. CONSTRUCTION.

Nothing in this title shall be construed to--

(1) limit the rights or protections of an individual under the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.), including coverage afforded to individuals under section 102 of such Act;

(2) limit the rights or protections of an individual under the Rehabilitation Act of 1973 (29 U.S.C. 701 et seq.);

(3) limit the rights or protections of an individual under any other Federal or State statute that provides equal or greater protection to an individual than the rights accorded under this Act;

(4) apply to the Armed Forces Repository of Specimen Samples for the Identification of Remains; or

(5) limit the statutory or regulatory authority of the Occupational Safety and Health Administration or the Mine Safety and Health Administration to promulgate or enforce workplace safety and health laws and regulations.

SEC. 209. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as may be necessary to carry out this title.

SEC. 210. EFFECTIVE DATE.

This title shall become effective on October 1, 2000.

END

Alliance of Genetic Support Groups
4301 Connecticut Avenue, NW, Suite 404
Washington DC 20008-2304
202-966-5557 x207 phone
202-966-8553 fax
mdavidson@geneticalliance.org
http://www.geneticalliance.org

ALLIANCE OF GENETIC SUPPORT GROUPS

FAX

To: Devora From: Mary Davidson

Fax: 202-456-5557 Tel:

Urgent **For Review** **Please Comment** **Please Reply** **Please Recycle**

Here are the case examples that I mentioned. In every case either a trained masters level social worker or genetic counselor has spoken with the person to confirm the details. Please call me if you have any questions.

66644489

776-9580

Discrimination Contacts
Alliance e-mail Request sent 9/99

1. Neurofibromatosis

Medical discharge from Air Force because of NF diagnosis during second week of training. No health problems now or then, purely cosmetic expression, confirmed by MRI. Grandfather, uncle and brother also have NF, but their only symptoms are café au lait spots. Disqualification in code book. Discharged in 28 days due to risks that might occur with NF. Comfortable talking on camera.

2. Polycystic Kidney Disease

Person with life insurance problems. Father and younger sister died of PKD. Currently normal kidney functioning with some evidence of decline. Wanted to apply for life insurance beyond the bare minimum required by state employment. Concerns about privacy echoed by on-line support group. Went to a company anonymously to obtain life insurance, told them about situation and asked about cost. Two days later told that they would deny him coverage.

3. Neurofibromatosis

Refused employment on basis of appearance. Working thru temp agency at office for 9 months. During that time became aware that position was about to become permanent . They were satisfied with her work so she went to personnel and filled out an application to be interviewed by the current manager. When interviewed, she was told "off the record," I can't hire you because that would disrupt my office and there would be drop of production level due to co-workers begin uncomfortable and/or distracted by my face.

4. Hereditary Hemorrhagic Telangiactasia (HHT)

Problems with insurance because HHT was on her medical record. Her father had HHT. Bleeding disorder. She has never been diagnosed. She would like to discuss her permanent insurance exclusion with newsmedia.

5. Glutaric Acidemia

Prudential declined life insurance application for her child, age 3, due to diagnosis at birth. Excellent prognosis and no problems at this point.

6. Huntington's Disease

Asked for assurance that participant's privacy and anonymity would be protected. He mentioned that he heard a man speak about how he was denied health insurance because there was a notation in his medical history that he asked if there were a test for HD. Never took the test but has been denied insurance. Understandable privacy concerns. Must guarantee anonymity.

7. Neurofibromatosis

Interested woman who will call Alliance. She filed discrimination report against employer and was laid off six weeks later.

Worked for company for 5 years. Co-worker there made comments to her all the time. Her supervisor was told numerous times and did nothing to stop it. There was a change in management and still no changes were made. She went above her supervisor to the head of the company. She filed a complaint about her supervisor and 4 weeks later she was laid off. She has had many interviews since then but due to her different physical appearance, she feels that as soon as she meets the prospective employers, they do not hire her based on appearances and ignore her credentials. Very credible.

8. Ehlers Danlos

Wants interview concerning growing up with Ehlers Danlos and discrimination issues.

9. Homocystinuria

Gerber company denied infant son life insurance. Told to try again when he is two years old.

prospective employers, they do not hire her based on appearances and ignore her credentials. Very credible.

Contact dates:
Staff: Lois

8. Ehlers Danlos – Oklahoma

Wants interview concerning growing up with Ehlers Danlos and discrimination issues. Member of Alliance listserv.

Contact dates: 9/21/99 – 10/25/99
Staff: Lois

9. Neurofibromatosis -

Got our number from NF Assoc. Message on Alliance voicemail.

Contact info: Anastasia Gitz
310-937-0802

10. Diagnosis? – Wisconsin

Works for W2 program in Wisconsin. Left message 10/25/99.

Contact dates:
Staff:

11. Homocystinuria -
Gerber company denied infant son Colin health insurance. Will try again when he is two years old.

12. NF Association – New York City

Re: Dismissal from airforce for medical reasons. Good story.

Discrimination Contacts

Alliance e-mail Request sent 9/99

1. Neurofibromatosis – South Carolina

Medical discharge from Air Force because of NF diagnosis during second week of training. No health problems now or then, purely cosmetic expression, confirmed by MRI. Grandmother , mother and sister also have NF but only café au lait spots. Disqualification in code book. Discharged in 28 days due to risks that might occur with NF. Comfortable talking on camera.

Contact dates: 9/99
Staff: Lois

2. Polycystic Kidney Disease - Massachusetts.

Member of Polysystic Kidney Research Foundation with life insurance problems. Mother and older brother died of PKD. Currently normal kidney functioning with some evidence of decline. Getting married in 5 weeks. Wanted to apply for life insurance beyond the bare minimum required by state employment. Concerns about privacy echoed by on-line support group. Went to a company anonymously to obtain life insurance , told them about situation and asked about cost. Two days later told that they would deny him coverage. Active in lobbying efforts with Kennedy's office and Shriver Center (Phil Reilly).

Contact dates: dates: 9/23/99; 10/25/99
Staff: Mary, Elizabeth

3. Neurofibromatosis – New Jersey

Refused employment on basis of appearance. Working thru Kelly Temps Office Services at office in Livingston, NJ for 9 months. During that time became aware that position was about to become permanent . They were satisfied with her work so she went to personnel and filled out an application to be interviewed by the current manager. When interviewed, she was told "off the record", I can't hire you because that would disrupt my office and there would be drop of production level due to co-workers begin uncomfortable and/or distracted by my face.

Contact dates:
Staff: Lois

4. Hereditary Hemorrhagic Telangiactasia (HHT) - Indiana

Problems with insurance because HHT was on her medical record. Her mother had HHT. Bleeding disorder. She has never been diagnosed. She would like to discuss her permanent insurance exclusion with newsmedia. Referred by Meg Johnson of HHT Foundation.

Contact dates: 9/23/99
Staff: Mary, Lois

5. Glutaric Acidemia – Pennsylvania

Prudential declined life insurance application for daughter, age 3, due to diagnosis t birth. Excellent prognosis and no problems at this point.

Contact dates: 9/99
Staff: Mary

6. Hereditary Disease Foundation – Los Angeles ?

Contacted Tracy on 9/23/99 and asked for assurance that participant's privacy and anonymity would be protected. He mentioned that at a recent HDF workshop on HD and Ataxia, that a man spoke who was denied health insurance because there was a notation in his medical history that he asked if there were a test for HD. Never took the test but has been denied insurance. Understandable privacy concerns. Must guarantee anonymity.

Contact dates:
Staff: Tracy

work-related

7. Neurofibromatosis - California

National NF Association in NY called re CNN interview request. Has interested woman who will call Alliance. She filed discrimination report against employer and was laid off six weeks later.

Worked for company for 5 years. Girl there made comments to her all the time. Her supervisor was told numerous times and did nothing to stop it. There was a change in management and stil no changes were made. She went above her supervisor to the head of the company. She filed a complaint about her supervisor and 4 weeks later she was laid off. She has had many interview since then but doe to her different physical appearance, she feels that as soon as she meets the

Every American -- regardless of genetic inheritance -- deserves the protection federal legislation alone can provide. We appreciate all the wisdom and leadership you bring to resolution of these problems.

February 7, 2000

Genetic Discrimination Ban Sought

A.P. INDEXES: TOP STORIES | NEWS | SPORTS | BUSINESS | TECHNOLOGY | ENTERTAINMENT

Filed at 7:53 p.m. EST

By The Associated Press

WASHINGTON (AP) -- President Clinton plans to sign an executive order barring federal agencies from discriminating against workers on the basis of genetic tests, a step prompted by fears about rapid advances in scientific research.

The order, which congressional aides said Clinton would sign Tuesday, echoes a bill sponsored by Sens. Tom Daschle, D-S.D., and Edward M. Kennedy, D-Mass., barring employers from refusing to hire people at risk for health problems and insurers from refusing to sell them coverage.

Congressional officials, speaking on condition of anonymity, said Monday that Clinton would announce his decision during a speech at the National Academy of Sciences. White House aides declined comment.

Advances in genetic testing will soon allow doctors to predict the medical futures of their patients. That has raised concerns that such information could be against those who are likely to suffer from cancer, diabetes, heart disease or other ailments.

Clinton has been speaking out on the issue for years. In his 1998 State of the Union speech, he declared that ``we must see that science serves humanity, not the other way around."

``We must prevent the misuse of genetic tests to discriminate against any American," he said.

Ranit Schmelzer, Daschle's spokeswoman, said the Senate minority leader has long argued that ``as more information about people's future health becomes available it becomes important to protect that information."

``People shouldn't be discriminated against in employment or in

other areas because of some genetic information that may be available on them," she said.

The order Clinton was signing would restrict federal agencies' abilities to collect or use genetic information, the sources said, including family medical histories. The order was limited to civilian employees of the federal government.

Exceptions to such data collection would be allowed in cases where workers give written consent as part of a health care program monitoring their medical conditions. Another exception would be granted for gathering information to study workplace safety.

In addition to the order, Clinton was expected to voice his support for the Daschle-Kennedy legislation, which would extend assurances against abuse of genetic information to the general public -- a step that would require congressional action.

Mary Davidson
9665557

hit ∅

National Survey of Public and Stakeholders' Attitudes and Awareness of Genetic Issues

Conducted for the

National Center for Genome Resources

Between August 1996 and December 1996

Project Director: John M. Boyle, Ph.D.

Analysts: Patricia Vanderwolf
Stephen Dienstfrey

Schulman, Ronca, and Bucuvalas, Inc.

NATIONAL SURVEY OF PUBLIC AND STAKEHOLDERS ATTITUDES AND AWARENESS OF GENETIC ISSUES

EXECUTIVE SUMMARY

Table of Contents Introduction

The National Center for Genome Resources (NCGR) commissioned a national survey of public and leadership opinion (designed with counsel from the New York Academy of Sciences (NYAS)) related to issues of genetic testing and treatment. The purpose of the survey was to identify current concerns among various stakeholder groups about the use of the emergent biotechnologies. This information would be used to plan a National Leadership Conference on issues of genetic testing.

The survey was conducted by the national survey research firm of Schulman, Ronca and Bucuvalas, Inc. (SRBI), under the direction of Dr. John Boyle. Dr. Boyle directed the 1986 Survey of Public Attitudes toward Science, Biotechnology and Genetic Engineering for the Office of Technology Assessment of the U.S. Congress. Among other things, the current survey offered an opportunity to examine continuity and change in public attitudes toward genetic testing and treatment over the past decade.

The project involved three separate, but related, surveys. First, a national survey of the **adult population** of the United States was conducted between August 23 and September 30, 1996. The survey was conducted by telephone among a national sample of households selected by random digit dialing. A total of 1,039 randomly selected adults were interviewed. The average interview length of the public survey was 24.5 minutes.

Second, a national survey of **primary care physicians** in the United States was conducted between September 6 and December 10, 1996. The physician sample was restricted to physicians in the specialties of general practice, family practice, internal medicine, obstetrics/gynecology and pediatrics, who were currently involved in direct patient care. The sample was drawn from the current physician lists compiled by the American Medical Association and the American Osteopathic Association. The randomly sampled physicians were sent an eight page self-administered questionnaire. Three mailings and telephone follow-ups were conducted by SRBI. A total of 521 completed questionnaires (out of 2950 mailed questionnaires) were returned. The response rate was 18%. A substantial self-selection bias may be present in the data. Consequently we are not comfortable making statistical interpretations or conclusions derived from them. The results may be useful for other purposes.

Third, a national telephone survey was conducted with seven **leadership** groups between October 1 and December 18, 1996. A total of 100 interviews were conducted with the leaders of national **patient**-based health organizations. A total of 102 interviews were conducted with the research and development directors from a national sample of pharmaceutical and biotechnology **industry**. A total of 76 interviews were conducted with a random sample of **scientists** who were members of the American Society of Human Genetics. A total of 50 interviews were conducted with medical science and health editors, columnists and writers from the **media**. A total of 50 interviews were conducted with a national sample of **religious** leaders drawn from Who's Who in Religion. A total of 70 interviews were conducted with the medical directors of a national sample of health and life **insurers**. Finally, a total of 79 interviews were conducted with **policy-makers** at the federal and state level. The leadership interviews averaged 30 minutes in length.

The public survey found that about half of adult population could be classified as "science attentives" -- i.e., very interested in scientific and medical issues, very concerned about government policy related to science and medicine or who feel their basic understanding of scientific and medical issues is very good. The proportion of science attentives among the public has hardly changed between 1986 (49%) and 1996 (51%). However, there has been a measurable increase in public confidence in their understanding of biotechnology concepts. The proportion who believe that they understand the meaning of "gene" has increased from 85% to 91% in the past decade, while the proportion who feel they understand the meaning of "human gene therapy" has increased from 39% in 1986 to 49% in 1996.

Today, two thirds of the public (68%) report they are aware that scientists are trying to identify and map every gene in the human organisms. About seven in ten of the public approve the idea of mapping the human genetic structure, either strongly (25%) or somewhat (44%). Public approval of gene mapping increases when placed in the context of the goals of this research. More than nine out of ten Americans (93%) approve using genetic information for early diagnosis of disease -- with 60% approving strongly. Only slightly fewer (86%) approve of the use of genetic tests that could identify persons who would eventually develop the disease even if this would be years or decades in the future. Nearly nine out of ten Americans (88%) approve the use of genetic tests that could identify whether an individual is a carrier of a disease gene. Finally, a similar proportion of the public (87%) approve correcting genes that cause serious disease.

Public approval for the uses of genetic treatment were quite high in 1986. However, in most areas that proportion of the public approving the use of genetic treatment has continued to increase -- substantially in at least one of these. Slight increases are seen in the proportion of Americans approving the changing of the makeup of human cells to cure a usually fatal genetic disease, from 83% to 85%, and to prevent children from inheriting a usually fatal genetic disease, from 84% to 86%. Those approving genetic changes to reduce the risk of developing a fatal disease later in life jumped from 77% to 84%. Public approval for the use of genetic treatments has declined somewhat only in the areas of preventing children from inheriting a usually non-fatal genetic disease or birth defect, from 77% to 72%; and improving the physical characteristics children would inherit, from 44% to 35%.

One important change in public attitudes about genetic issues over the past decade is the moral dimension. In 1986, a very substantial minority of the public (42%) felt it was morally wrong to change the genetic makeup of human cells. Ten years later, only 22% of the public say they consider changing the genetic makeup of human cells is morally wrong, regardless of the purpose. Like the public, a minority in most leadership groups, including 8% of physicians and 9% of policy-makers, believe changing genetic makeup in morally wrong. However, even among religious leaders, only 10% believe genetic treatment is morally wrong.

Attitudes about the morality of genetic manipulation is one factor in public and leadership disapproval of genetic testing and treatment. Another factor is the desirability of knowing about likely negative health outcomes that may occur in the future. Nearly three-quarters of the public (73%) feel it is a good thing, not a bad thing, for a healthy person to be able to find out how likely they are to get a serious health condition in the future. Leadership groups generally agree with the public that it is better to know, with agreement ranging from 62% among religious leaders to 81% among the industry representatives.

The leading reason the public says it would be good thing to know about future health conditions is the possibility of prevention (57%). However, the current treatment status of a condition appears to

have relatively little impact on public approval for genetic testing. Ninety four percent of the public think patients should be advised by their doctors to be tested for a genetic likelihood to develop a treatable cancer, but a substantial majority (76%) also feel they should be advised to be tested for an untreatable cancer. There is relatively close agreement between the public and physicians that patients should be advised of genetic testing for those with family histories of both treatable cancers (94%-91%) and untreatable cancers (76%-69%). Similarly, the current treatment status of the disease has less impact than might be expected on the public's desire to be genetically tested if they had a family history of treatable cancer (84%) or an untreatable cancer (69%).

Nearly nine out of ten Americans (87%) approve of making genetic tests of whether they or their children would be likely to develop a serious genetic disease available through a physician. Nearly two thirds (65%) say they would personally take a test to determine their personal likelihood of developing a fatal disease later in life, if it were available. Three quarters (76%) say they would take a test that would indicate whether children would be likely to inherit a fatal genetic disease, before having children, if it were available.

Given this level of public interest in genetic testing, it is not surprising that a majority of all leadership groups (except religious) expect considerable growth in the number of genetic tests available in the next ten years. Indeed, a majority of the leadership sample expects primary care physicians (70%), prepaid health groups (56%), and health department screening programs (53%) to be conducting genetic tests for diseases and predispositions in the next ten years. Nearly half expect health insurers (49%) and the military (46%) to be conducting these tests in the next ten years. Aside from technological limitations, however, the surveys identify two problem areas that may affect the rate of this development.

First, confidentiality of testing and test results is a major concern for the public. A majority of all stakeholder groups except for doctors (43%) and insurers (41%) believe information about a person's genetic tests should be treated as more confidential than other information in the health record. A majority of the public believe that a spouse (75%) or adult children (59%) have a right to information about an individual's genetic conditions, risks and predispositions. However, a majority also believes other relatives (65%), employers (85%), health insurers (69%), and life insurers (69%) should be prohibited from this information. If health insurers or employers could get access to the results of genetic tests, the majority of the public say they probably (36%) or definitely (27%) would not take such tests. Doctors (45% and 40% respectively) and other stakeholders (ranging from a high of 56% and 36% respectively among industry leaders to a low of 37% and 37% from insurers) agree even more strongly that patients would avoid testing unless confidentiality could be maintained.

Second, since the physician will be the gatekeeper to genetic testing, the ability and willingness of physicians to advise patients on these tests will be a major factor in patient demand. Currently, most primary care physicians are asked by patients about genetic testing, screening and counseling only once or twice a year (44%) or never (34%). Similarly, most refer patients or their family members for genetic testing or screening only once or twice a year (40%) or never (44%). Consequently, the only aspect of patient counseling related to genetic testing that a majority of primary care physicians feel very confident is their ability is to refer to an appropriate specialist.

This is not surprising, since the majority of primary care physicians report genetics was covered inadequately (36%) or hardly at all (19%) in the other courses required for their degree. A majority also reports that ethics was covered inadequately (30%) or hardly at all (27%) in the other courses required for their degree. Hence, a majority of primary care physicians report their formal training in genetic testing, screening and counseling was inadequate (48%) or very inadequate (15%) for the

current needs of their practice. This inadequacy needs to be addressed if physicians are to be able to handle patient needs associated with increased genetic testing.

Most stakeholders believe current efforts to identify genetic markers of disease and disease predisposition will have at least a moderate amount of effect on society. About two thirds of representatives of patient organizations (66%), industry (65%) and the scientific community (67%) believe that society will get a lot of benefit from advances in medical application of biotechnology in the next twenty years. Four out of five from all of the stakeholder groups believe society will get at least some benefit from this technology. Less than one in five from any of these groups except for policy-makers (25%) believe advances in medical applications of biotechnology will pose a lot of risk in the next twenty years. Nonetheless, a majority from all of these groups except for scientists (48%) feel the technology will pose at least some risk. On the whole, however, the vast majority of representatives of patient organizations (90%), scientists (97%), industry (95%), science media (78%), religious leaders (74%), insurers (79%), and policy-makers (73%) believe the benefits will outweigh the risks of continued research in medical applications of biotechnology.

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Questions? Comments? Feel free to e-mail us at gpi@ncgr.org

CHAPTER 4

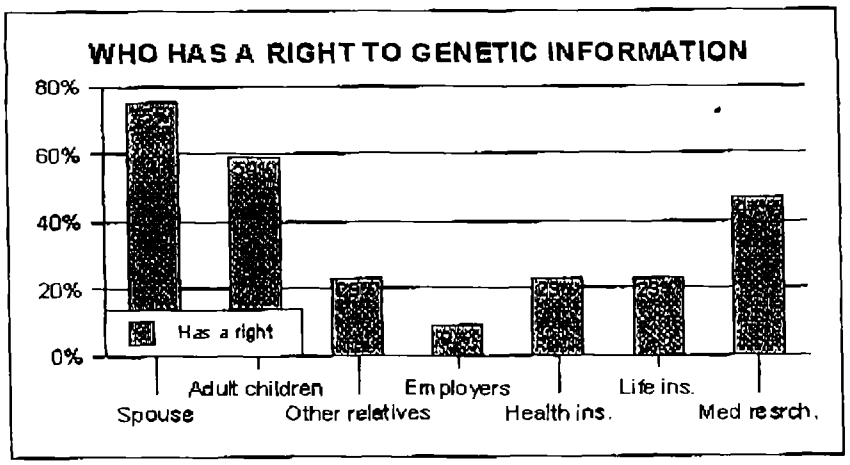
PUBLIC PERSPECTIVE OF CONFIDENTIALITY AND GENETIC TESTING

Chapter 3 Table of Contents Chapter 5

Questions 1-10

1. Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?
2. Who do you think should be prohibited from obtaining that information from your records?
3. Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?
4. Who do you think should be prohibited from obtaining that information from your records?
5. Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?
6. Who do you think should be prohibited from obtaining that information from your records?
7. In your opinion, how likely are health insurers in the future to ask applicants to take genetic tests for at least some conditions?
8. In your opinion, how likely are employers in the future to ask job applicants to take genetic tests for at least some conditions?
9. How likely would you be to take genetic tests for diseases, if health insurers or employers could get access to the results?
10. Have you ever. . .
    - Been denied health insurance because of a medical condition
    - Had existing health insurance canceled because of a medical condition
    - Had a treatment of a pre-existing condition excluded from coverage
    - Been turned down for a job because of health insurance cost
    - Lost an existing job because of health insurance cost
    - Had any of these

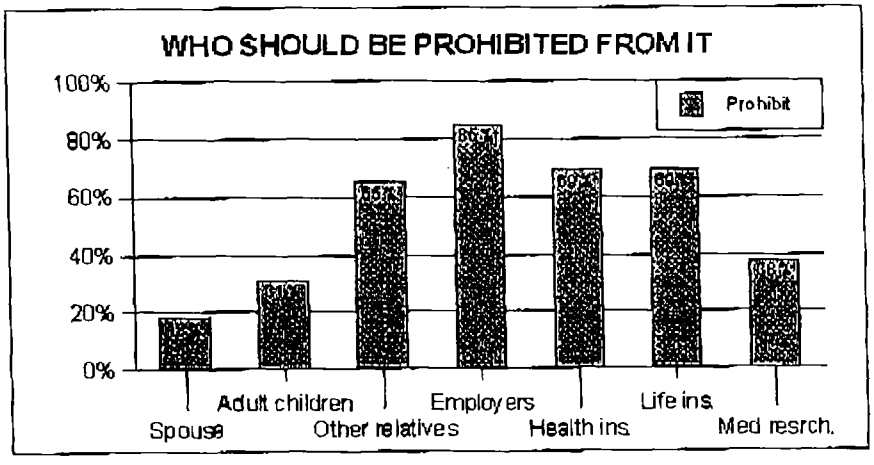
Q1 Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?



The survey indicates that the American public tends to approve genetic testing for a broad range of applications, including early detection of treatable conditions, pre-symptomatic screening carrier for genetic predisposition, and carrier detection. A majority of the public believes such tests should be made available through physicians; physicians should advise patients at risk to these conditions to take these tests; and they would take such tests, themselves, if they were available. However, after these tests are conducted, who does the public believe should have access to the information?

Three quarters of the public believes that spouses have a right to information about an individual's genetic conditions, risks and predispositions. A majority of the public (59%) believe that adult children have a right to information about their parent's genetic conditions, risks and predispositions. However, these are the only two groups that a majority of the public agree have a right to an individual's genetic information. Slightly less than half of the public (47%) feel has a right to genetic information is medical researchers. No other group is felt to have a right to genetic information by more that a quarter of the American public.

Q2 Who do you think should be prohibited from obtaining that information from your records?

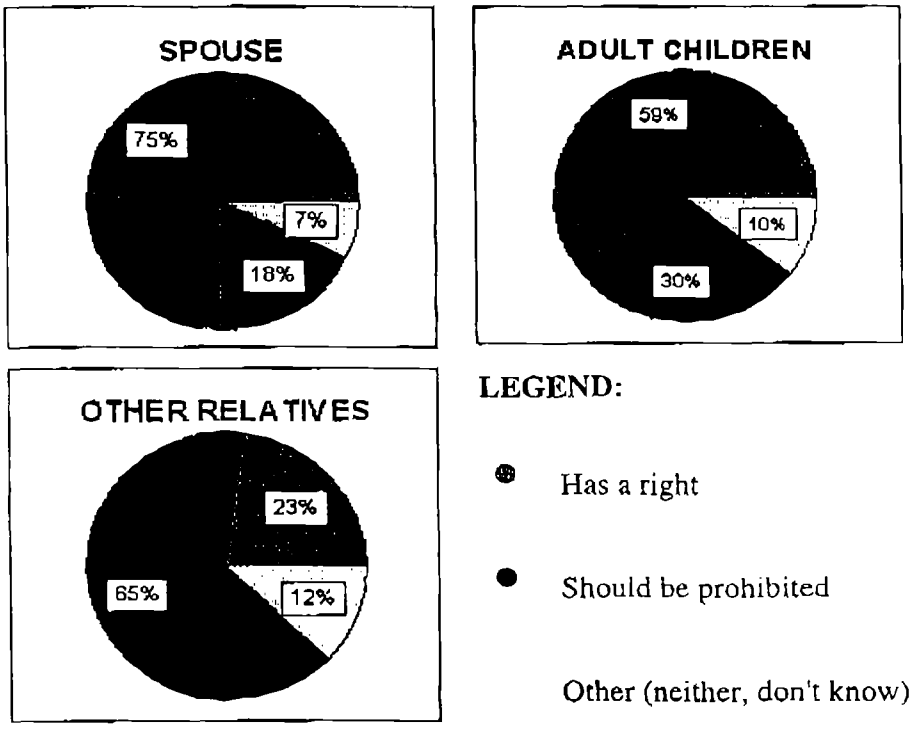


With the exception of spouses, adult children and, to a lesser extent, medical researchers, the public thinks that other parties should be prohibited from obtaining information about an individual's genetic conditions, risks and predispositions from their records. Six out of seven adult Americans

(85%) say that employers should be prohibited from obtaining genetic information from an individual's records. About seven in ten (69%) say that health insurers and life insurers should be prohibited from obtaining genetic information from a person's records. And, nearly two thirds (65%) say that relatives other than a spouse or adult children should be prohibited from obtaining genetic information from an individual's records.

Q3. Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?

Q4. Who do you think should be prohibited from obtaining that information from your records?

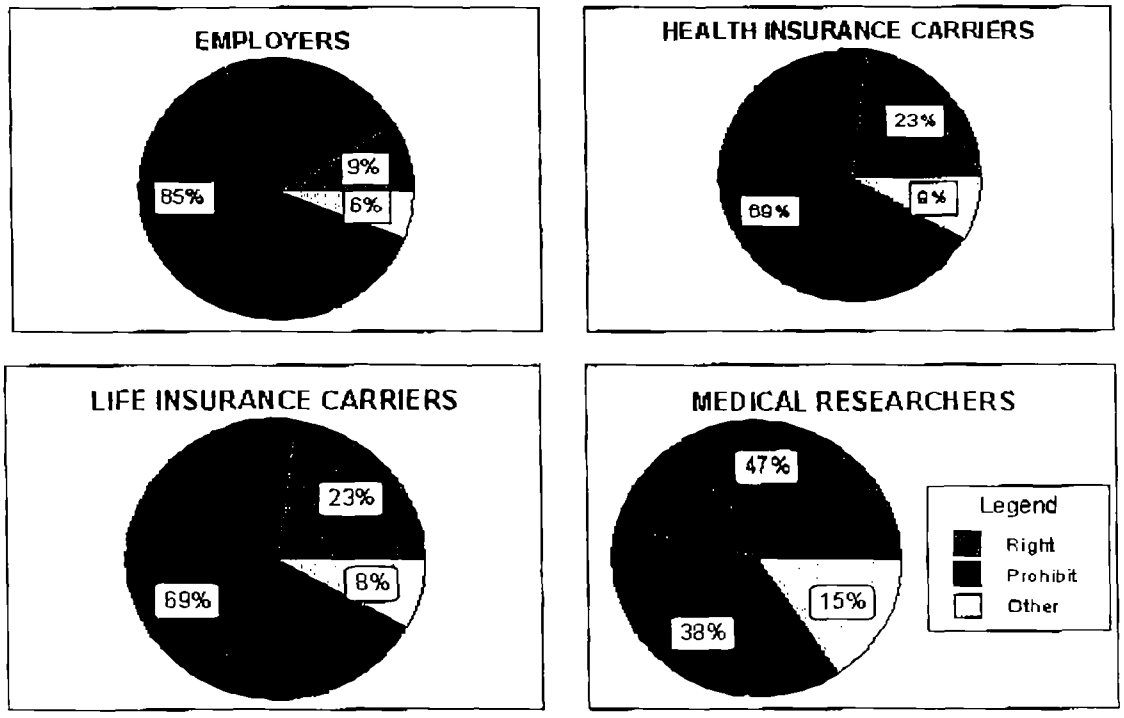


The public appears to make a clear distinction between the right of spouses and adult children, on the one hand, and other relatives to have access to an individual's genetic information. This is an important distinction because the findings of genetic testing could have a direct bearing on the risk of siblings and their children -- included in the other relative category rather than considered separately -- for heritable conditions. Nonetheless, the public feels that other relatives not only do not have a right to this information, a majority feels that they should be prohibited from obtaining the information.

Even for those groups that a majority of the public belief have a right to information about an individual's conditions, risks and predispositions, a not- insignificant minority feels that spouses and adult children should be barred from this information. Nearly one in five (18%) believe that spouses should be prohibited from an individual's genetic information. Three out of ten (31%) say that adult children should be prohibited from obtaining this information.

Q5. Who do you feel has a right to information about an individual's genetic conditions, risks, and predispositions?

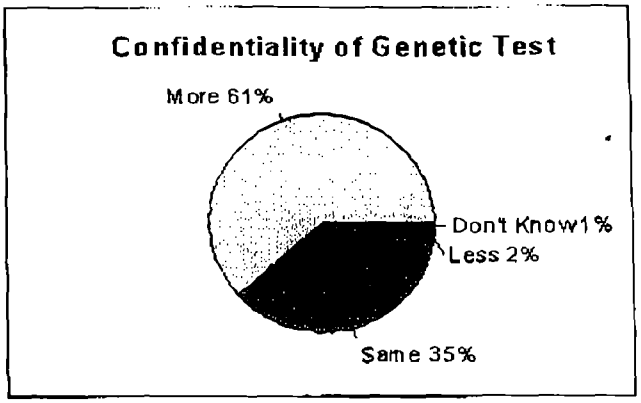
Q6. Who do you think should be prohibited from obtaining that information from your records?



There is little doubt how the public feels about employers access to information about an individual's genetic conditions, risks and predispositions. Only 9% believe that employers have a right to this information, while 85% feel that they should be prohibited from obtaining it. In the case of insurers, however, while two thirds feel that they should be prohibited from information about an individual's genetic conditions, risks and predispositions, nearly a quarter (23%) think that they have a right to it.

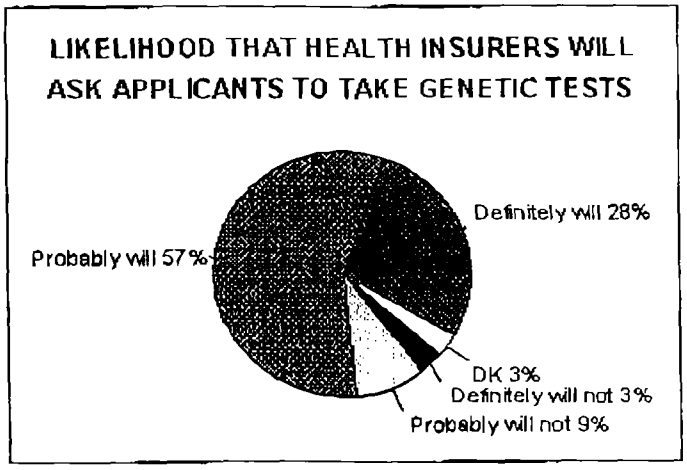
The public is most divided over medical researchers' access to genetic information. Nearly half of the public (48%) feel that researchers have a right to this type of information. However, only a somewhat smaller proportion (38%) feel that researchers should be prohibited from this information.

Q6. Do you believe that information about a patient's genetic tests should be treated as more confidential, the same, or less confidential than other medical information in his/her health record?



The survey documents the public sentiment that genetic information is different than other forms of medical information. More than six out of ten Americans (61%) feel that information about a patient's genetic tests should be treated as more confidential than other medical information in his or her health record. By contrast, only 2% of the public feels that information on genetic tests is less confidential than other medical information. About a third (35%) feel that genetic information should be treated the same as other information in a patient's medical record.

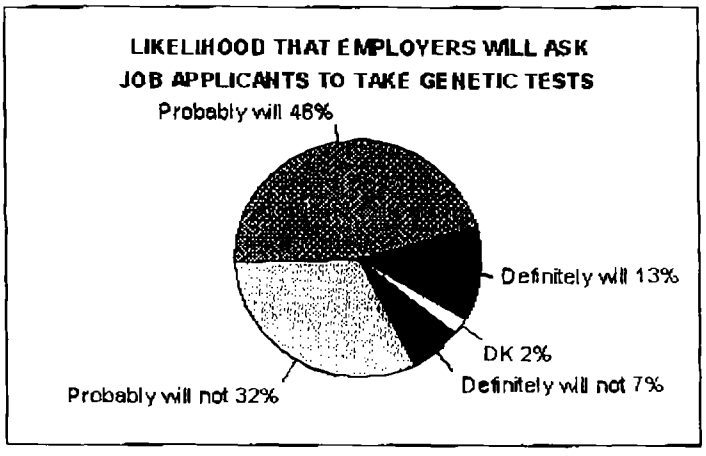
Q7. In your opinion, how likely are health insurers in the future to ask applicants to take genetic tests for at least some conditions?



One source of public concern about the confidentiality of genetic information is the fear that health insurers are likely to seek this information in the future. Nearly three out of ten Americans (28%) say health insurers definitely will ask applicants to take genetic tests for at least some conditions in the future. And, six out of seven (85%) think health insurers definitely or probably will ask applicants in the future to take genetic tests for some conditions.

The expectation that health insurers will definitely seek genetic information on applicants in the future increases with educational attainment. Only 18% of those without a high school degree think that health insurers will definitely ask applicants for genetic tests in the future. By contrast, 32% of college graduates believe that health insurers will definitely seek genetic testing in the future. Almost half (49%) of those who are carriers of inherited conditions believe that health insurers will definitely require genetic tests for at least some conditions in the future.

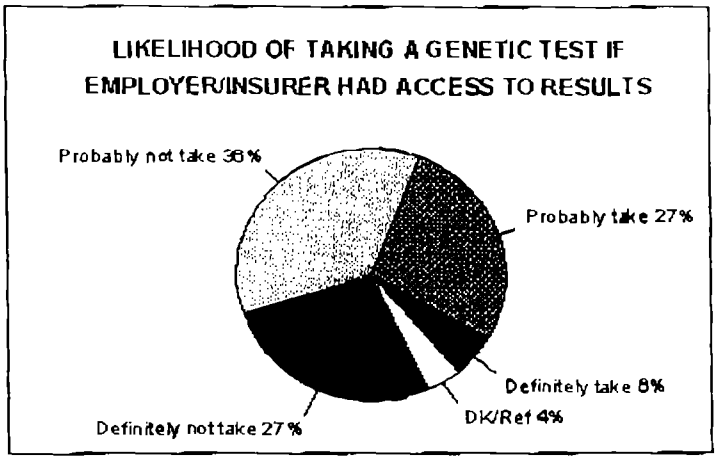
Q8. In your opinion, how likely are employers in the future to ask job applicants to take genetic tests for at least some conditions?



The majority of Americans also believe that employers definitely or probably will ask job applicants to take genetic tests for at least some conditions in the future. Only 13% believe that employers will definitely seek such tests from job applicants in the future. But, nearly half (46%) think employers probably will ask for such tests in the future.

Men are somewhat more likely (65%) than women (54%) to expect genetic testing by employers in the future. There is relatively little difference by education in the expectation of future genetic testing by employers. However, the belief that employers definitely or probably will ask for genetic tests from job applicants increases with age from 52% of 18-34 year olds to 69% of those 65 and older. Three quarters (75%) of carriers of inherited health conditions expect employers to ask for genetic tests of job applicants in the future.

Q9. How likely would you be to take genetic tests for diseases, if health insurers or employers could get access to the results?



A third of the public (33%) says they definitely (6%) or probably (27%) would take genetic tests for

diseases even if health insurers or employers could get access to the results. However, the survey suggests that employer or insurer access to genetic test results would have a chilling effect on genetic testing for most Americans. More than six out of ten say they definitely would not (27%) or probably would not (36%) take genetic tests for diseases if health insurers or employers could get access to the results.

The impact of employer/insurer access to test results on willingness to be tested increases with education. Among those with less than high school degrees, only a minority (40%) say they would probably or definitely avoid testing if results were not confidential. The proportion who would avoid testing increases to 59% of those with high school degrees, 63% of those with some college, and nearly three quarters (74%) of college graduates.

Q10. Have you ever. . .
Been denied health insurance because of a medical condition 3%
Had existing health insurance canceled because of a medical condition 1%
Had a treatment of a pre-existing condition excluded from coverage 7%
Been turned down for a job because of health insurance cost 1%
Lost an existing job because of health insurance cost 1%
Had any of these 9%

Concerns about employer and insurer access to genetic information are undoubtedly driven by fears of employment or insurance discrimination. About one in ten adult Americans report that have had serious health insurance or employment problems as a result of a medical condition. These individuals, however, are not the ones most concerned about future genetic testing because their disabilities are already part of their medical record. Those with personal or family histories of genetic disorders are no more likely to avoid future testing (64%) than those without such histories (63%).

The greatest anxiety about future testing should lie with those who are currently not identified as at risk to future health problems who fear that testing might label them as unemployable or uninsurable.

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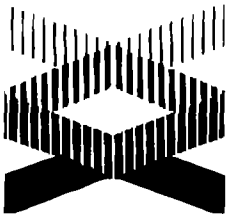
Questions? Comments? Feel free to e-mail us at gpi@ncgr.org

FAX TRANSMITTAL SHEET

NATIONAL HUMAN GENOME RESEARCH INSTITUTE



National Institutes of Health
Building 31, Room 4B09
Bethesda, MD 20892-2152

TO: Devorah Adler

FAX: 202-456-5557

FROM: Barbara Fuller, J.D.

DATE: 2-7-2000

# of pages including cover sheet:

Return FAX number: (301) 402-0837

If there are problems send a return FAX or call (301) 402-0955

Comments: Devorah: Please give me a call if any questions about the results of this survey - or if you need any other information. My direct line is 301-594-0631.

Summary of the 1999 Workplace Testing Survey by the American Management Association

Employers surveyed: 1054

Date of survey: March 22, 1999

Range of employees per employer:

16% - fewer than 99
23% - between 100 and 249
21% - between 250 and 499
20% - between 500 and 999
20% - more than 1000

Medical exams:

- 51% perform medical exams of all newly hired personnel or job applicants.
- 8% perform scheduled or periodic medical exams of current employees.
- 33% perform scheduled or periodic medical exams of employees in selected categories.
- 55% perform medical exams on a non-scheduled basis on either randomly selected employees or when job performance suggests a cause.
- Of those who perform medical testing on *applicants:*
  - 12% do not perform the same tests on all applicants
  - 5% do not notify the applicant of the test being done
  - 15% do not notify the applicant of the test results
  - **28% obtain family histories**
- Of those who perform medical testing on *employees*:
  - 26% do not perform the same tests on all employees
  - 11% do not notify the employee of the test results
  - 6.5% do not notify the employee of the test results
  - **17% obtain family histories**

Genetic tests:

- Of the 1054 employers surveyed, only 3 *answered* the question "Does your company perform any type of genetic testing." Of the 3 employers that answered the question:
  - 3 employers said they did perform genetic testing on job applicants
  - 2 employers said they perform genetic testing on employees

Note: The question specific to genetic testing was physically separate from all other questions on the questionnaire and may not have been noticed by those completing the questionnaire.

Family Histories:

- 219 employers who perform medical testing on *applicants* obtain family histories
- 130 employers who perform medical testing on *employees* obtain family histories
- Of those surveyed:
  - 5% use family history information in hiring decisions
  - 2% use family history information in assigning or reassigning current employees
  - .2% use family history information in retaining or dismissing current employees

Breast or Colon Cancer:

- 1% test *applicants* and 4% test *employees* for breast or colon cancer.*
- Of those who perform tests for breast or colon cancer:
  - 11% use the results in hiring decisions
  - 9% use the results in assigning or reassigning current employees
  - No employer said they use the results to retain or dismiss current employees

Huntington's Disease:

- 0% said they test applicants or employees for Huntington's Disease

Workplace Hazards:

- 13% test *applicants* and 12% test *employees* for susceptibility to workplace hazards.*
- Of those who perform tests for susceptibility to workplace hazards:
  - 40% use the results in hiring decisions
  - 44% use the results in assigning or reassigning current employees
  - 10% use the results to retain or dismiss current employees

Sickle Cell:

- .5% (5 employers) test *applicants* and .7% (7 employers) test *employees* for "sickle cell disease or anemia."

- Of those who perform tests for sickle cell disease or anemia:
  - 2 use the results in hiring decisions
  - 1 uses the results in assigning or reassigning current employees
  - 1 uses the results in retaining or dismissing current employees

Sexually Transmitted Diseases:

- 3% test *applicants* and 1% test *employees* for sexually transmitted diseases*
- Of those who perform tests for sexually transmitted diseases:
  - 15 use the results in hiring decisions
  - 3 use the results in assigning or reassigning current employees
  - 1 uses the results in retaining or dismissing current employees

HIV:

- 2% test *applicants* and 1% test *employees* for HIV*
- Of those who perform tests for HIV:
  - 12 use the results in hiring decisions
  - 9 use the results in assigning or reassigning current employees
  - 4 use the results in retaining or dismissing current employees

Pregnancy:

- .5% test *applicants* and .2% test *employees* for pregnancy*
- Of those who perform tests for pregnancy:
  - 1 uses the results in hiring decisions
  - 1 uses the results in assigning or reassigning current employees
  - 0 use the results in retaining or dismissing current employees

* Approximately one third of those surveyed did not answer this question.

[redacted]

Executive Order

TO PROHIBIT DISCRIMINATION IN FEDERAL EMPLOYMENT
BASED ON GENETIC INFORMATION

By the authority vested in me as President of the United States by the Constitution and the laws of the United States of America, it is ordered as follows:

Section 1. Nondiscrimination in Federal Employment on the Basis of Protected Genetic Information.

1-101. It is the policy of the Government of the United States to provide equal employment opportunity in Federal employment for all qualified persons and to prohibit discrimination against employees based on protected genetic information, or information about a request for or the receipt of genetic services. This policy of equal opportunity applies to every aspect of Federal employment.

1-102. The head of each Executive department and agency shall extend the policy set forth in section 1-101 to all its employees covered by section 717 of Title VII of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000e-16).

1-103. Executive departments and agencies shall carry out the provisions of this order to the extent permitted by law and consistent with their statutory and regulatory authorities, and their enforcement mechanisms. The Equal Employment Opportunity Commission shall be responsible for coordinating the policy of the Government of the United States to prohibit discrimination against employees in Federal employment based on protected genetic information, or information about a request for or the receipt of genetic services.

Sec. 2. Requirements Applicable to Employing Departments and Agencies.

1-201. Definitions.

(a) The term "employee" shall include an employee, applicant for employment, or former employee covered by section 717 of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000e-16).

(b) Genetic monitoring means the periodic examination of employees to evaluate acquired modifications to their genetic material, such as chromosomal damage or evidence of increased occurrence of mutations, that may have developed in the course of employment due to exposure to toxic substances in the workplace, in order

to identify, evaluate, respond to the effects of, or control adverse environmental exposures in the workplace.

(c) Genetic services means health services, including genetic tests, provided to obtain, assess, or interpret genetic information for diagnostic or therapeutic purposes, or for genetic education or counseling.

(d) Genetic test means the analysis of human DNA, RNA, chromosomes, proteins, or certain metabolites in order to detect disease-related genotypes or mutations. Tests for metabolites fall within the definition of "genetic tests" when an excess or deficiency of the metabolites indicates the presence of a mutation or mutations. The conducting of metabolic tests by a department or agency that are not intended to reveal the presence of a mutation shall not be considered a violation of this order, regardless of the results of the tests. Test results revealing a mutation shall, however, be subject to the provisions of this order.

(e) Protected genetic information.

(1) In general, protected genetic information means:

(A) information about an individual's genetic tests;

(B) information about the genetic tests of an individual's family members; or

(C) information about the occurrence of a disease, or medical condition or disorder in family members of the individual.

(2) Information about an individual's current health status (including information about sex, age, physical exams, and chemical, blood, or urine analyses) is not protected genetic information unless it is described in subparagraph (1).

1-202. In discharging their responsibilities under this order, departments and agencies shall implement the following nondiscrimination requirements.

(a) The employing department or agency shall not discharge, fail or refuse to hire, or otherwise discriminate against any employee with respect to the compensation, terms, conditions, or privileges of employment of that employee, because of protected genetic information with respect to the employee, or because of information about a request for or the receipt of genetic services by such employee.

(b) The employing department or agency shall not limit, segregate, or classify employees in any way that would deprive or tend to deprive any employee of employment opportunities or otherwise adversely affect that employee's status, because of protected genetic information with respect to the employee or because of information about a request for or the receipt of genetic services by such employee.

(c) The employing department or agency shall not request, require, collect, or purchase protected genetic information with respect to an employee, or information about a request for or the receipt of genetic services by such employee.

(d) The employing department or agency shall not disclose protected genetic information with respect to an employee, or information about a request for or the receipt of genetic services by an employee except:

(1) to the employee who is the subject of the information, at his or her request;

(2) to an occupational or other health researcher, if the research conducted complies with the regulations and protections provided for under part 46 of title 45, of the Code of Federal Regulations;

(3) if required by a Federal statute, congressional subpoena, or an order issued by a court of competent jurisdiction, except that if the subpoena or court order was secured without the knowledge of the individual to whom the information refers, the employer shall provide the individual with adequate notice to challenge the subpoena or court order, unless the subpoena or court order also imposes confidentiality requirements; or

(4) to executive branch officials investigating compliance with this order, if the information is relevant to the investigation.

(e) The employing department or agency shall not maintain protected genetic information or information about a request for or the receipt of genetic services in general personnel files; such information shall be treated as confidential medical records and kept separate from personnel files.

Sec. 3. Exceptions.

1-301. The following exceptions shall apply to the nondiscrimination requirements set forth in section 1-202.

(a) The employing department or agency may request or require information defined in section 1-201(e)(1)(C) with respect to an applicant who has been given a conditional offer of employment or to an employee if:

(1) the request or requirement is consistent with the Rehabilitation Act and other applicable law;

(2) the information obtained is to be used exclusively to assess whether further medical evaluation is needed to diagnose a current disease, or medical condition or disorder, or under the terms of section 1-301(b) of this order;

(3) such current disease, or medical condition or disorder could prevent the applicant or employee from performing the essential functions of the position held or desired; and

(4) the information defined in section 1-201(e)(1)(C) of this order will not be disclosed to persons other than medical personnel involved in or responsible for assessing whether further medical evaluation is needed to diagnose a current disease, or medical condition or disorder, or under the terms of section 1-301(b) of this order.

(b) (b) The employing department or agency may request, collect, or purchase protected genetic information with respect to an employee, or any information about a request for or receipt of genetic services by such employee if:

(1) the employee uses genetic or health care services provided by the employer (other than use pursuant to section 1-301(a) of this order);

(2) the employee who uses the genetic or health care services has provided prior knowing, voluntary, and written authorization to the employer to collect protected genetic information;

(3) the person who performs the genetic or health care services does not disclose protected genetic information to anyone except to the employee who uses the

services for treatment of the individual; pursuant to section 1-202(d) of this order; for program evaluation or assessment; for compiling and analyzing information in anticipation of or for use in a civil or criminal legal proceeding; or, for payment or accounting purposes, to verify that the service was performed (but in such cases the genetic information itself cannot be disclosed);

(4) such information is not used in violation of sections 1-202(a) or 1-202(b) of this order.

(c) The employing department or agency may collect protected genetic information with respect to an employee if the requirements of part 46 of title 45 of the Code of Federal Regulations are met.

(d) Genetic monitoring of biological effects of toxic substances in the workplace shall be permitted if all of the following conditions are met:

(1) the employee has provided prior, knowing, voluntary, and written authorization;

(2) the employee is notified when the results of the monitoring are available and, at that time, the employer makes any protected genetic information that may have been acquired during the monitoring available to the employee and informs the employee how to obtain such information;

(3) the monitoring conforms to any genetic monitoring regulations that may be promulgated by the Secretary of Labor; and

(4) the employer, excluding any licensed health care professionals that are involved in the genetic monitoring program, receives results of the monitoring only in aggregate terms that do not disclose the identity of specific employees.

(e) This order does not limit the statutory authority of a Federal department or agency to:

(1) promulgate or enforce workplace safety and health laws and regulations;

(2) conduct or sponsor occupational or other health research that is conducted in compliance with regulations at part 46 of title 45, of the Code of Federal Regulations; or

(3) collect protected genetic information as a part of a lawful program, the primary purpose of which is to carry out identification purposes.

Sec. 4. Miscellaneous.

1-401. The head of each department and agency shall take appropriate action to disseminate this policy and, to this end, shall designate a high level official responsible for carrying out its responsibilities under this order.

1-402. Nothing in this order shall be construed to:

(a) limit the rights or protections of an individual under the Rehabilitation Act of 1973 (29 U.S.C. 701, et seq.), the Privacy Act of 1974 (5 U.S.C. 552a), or other applicable law; or

(b) require specific benefits for an employee or dependent under the Federal Employees Health Benefits Program or similar program.

1-403. This order clarifies and makes uniform Administration policy and does not create any right or benefit, substantive or procedural, enforceable at law by a party against the United States, its officers or employees, or any other person.

THE WHITE HOUSE,

Should insurance companies have access to your genetic record or DNA without permission?

Yes 6% No 94%

Should a person whose genetic profile shows potential problems pay higher health insurance rates than someone whose profile does not?

Yes 8% No 88%

Should employers be able to obtain access to employees' genetic records or DNA without permission?

Yes 5% No 95%

Time Magazine, January 1999

The Genome Program's Conscience

A research program on the ethical, legal, and social implications of genome studies, launched as an "afterthought," is now the world's biggest bioethics program

In October 1988, James D. Watson, the Nobel Prize–winning geneticist, stood before a packed press conference to announce that he had been appointed to head biology's biggest and most ambitious single endeavor: the Human Genome Project at the National Institutes of Health (NIH). When asked about the social implications of this massive effort to decipher the human genetic blueprint, Watson announced—off the cuff, according to a former aide—that a fixed portion of the project's budget would be set aside for studies of how genetics research would impact society. Thus was created what Francis Collins, Watson's successor, calls "the largest investment in bioethics in the history of the world."

Over the past 6 years, Watson's spur-of-the-moment decision has steered $40 million of genome project funds into studies of the "ethical, legal, and social implications" (ELSI) of genetics research, creating in the process a unique amalgam of social, legal, and hard science studies—a model that is being copied in Europe and Japan. The ELSI program now gets a 5% slice of the budget of the National Center for Human Genome Research (NCHGR) at NIH, and 3% of the Office of Health and Environmental Research in the Department of Energy (DOE), NIH's partner in the Human Genome Project. Next year alone, the two agencies will spend $11 million on ELSI studies.

This huge investment should now be paying off, as the genome program spawns new findings and technologies that are challenging society's capacity to deal with them: Genetic tests for diseases such as cystic fibrosis, breast cancer, colon cancer, and sickle cell anemia are being developed or are already in use, at least in research clinics. Some people who test positive for disease genes are already finding it hard to get insurance, even jobs (see p. 621). And research into the genetic basis of behavior is provoking heated controversy. To learn whether the ELSI program is helping society cope with this genetics revolution, *Science* asked leading geneticists, ethicists, and genome program officials for their assessment of the effort so far.

"A mixed bag" is how Stanford University geneticist Paul Billings puts it, and that verdict is widely echoed. Billings adds that the program is making important contributions to ethics research, a point that the first chief of NCHGR's ELSI program, Eric Juengst—now director of the bioethics program at Case Western Reserve University in Cleveland—and other ESLI advocates underscore. They point to some practical accomplishments as well, such as a widely accepted set of principles to guard against genetic discrimination, echoed in a bill protecting workers against loss of insurance that passed Congress in August. But others say its biggest accomplishment has been to fill the library shelves with bioethics texts.

One reason for the varied assessments is the changing nature of the ELSI program itself. ELSI spent much of its money in the early days on conferences and analytical studies featuring many prominent bioethicists—efforts that swelled the bioethics journals with academic papers on genetics and society. In recent years, however, ELSI has been moving away from philosophy to concentrate more on technical problems, such as the genetic discrimination issue, ensuring quality in DNA testing labs, educating doctors in the use of genetic data, and guiding researchers on obtaining informed consent—"really critical issues that would not otherwise have found a home," says oncologist Kenneth Beutow of the Memorial Sloan-Kettering Cancer Center.

PAULINE LUBENS

Vexing Issues. Francis Collins supports ELSI but clashed with members of an advisory group.

But spending money on these issues doesn't necessarily mean ELSI or its grantees will reach a consensus on what should be done about them. Indeed, when the debate strikes close to home—as it did recently in a review of the ethics of using stored human tissues in research—the experts may agree to disagree. Another barrier to consensus is the incendiary nature of the issues with which it deals. Last year, for example, an ELSI-funded conference on genes and crime drew the wrath of activist groups (*Science*, 29 September 1995, p. 1808). And earlier this year, Collins clashed with members of the ELSI Working Group—a panel of outside advisers who help guide the program and have issued ethics policy statements—over the group's proposed research plans, which included exploring the volatile topic of genes and behavior. Collins vetoed their agenda, saying the agency couldn't afford it. Some members of the Working Group felt that their independence had been curbed. Two, including the chair, resigned.

Since then, Collins has commissioned an independent review, due in December, of the working group's structure and purpose presumably to help determine its fate. At the same time, the new chair of the ELSI Working Group, sociologist Troy Duster of the University of California, Berkeley, says that the Working Group should be moved out from under NCHGR's control. In a 15 August letter to the review panel, Duster argued that the Working Group, because its concerns are "much broader than the technical and laboratory aspects" of NCHGR, should report directly to a Cabinet-level office or to Congress. Duster also has said he would favor a general review extending beyond the Working Group to all of ELSI.

A blurry mandate

Assessing ELSI would be difficult, though, because it was created, Duster claims, as an "afterthought" to the genome program and for that reason has a blurry mandate. Its official task is not just to analyze ethical issues, but to "define ... and develop initial policy options to address them." But ELSI does not have a public process for ranking issues that need attention.

In the early days, many looked askance at the entire ELSI undertaking, a curious science-ethics hybrid. When NIH leaders were briefed on ELSI, Juengst wrote in the Summer 1996 issue of *Social Philosophy and Policy*, "a senior NIH official" grumbled: "I still don't understand why you want to spend all this money subsidizing the vacuous pronunciamentos of self-styled 'ethicists.' " Collins acknowledges that "there has always been a two-culture problem between the ELSI types and the science types." Some of the science

ELSI's Cystic Fibrosis Experiment

In 1989, a group of biologists that included Francis Collins, then a professor at the University of Michigan, identified a genetic defect that causes cystic fibrosis (CF). Almost immediately, geneticists began to worry how it might impact society. Several journals, *Science* among them, warned of a tidal wave of genetic testing as companies rushed to market diagnostic kits. One paper envisioned a "billion-dollar industry" operating in a realm where there was "little formal guidance or regulation," with patients learning about their status as carriers of the primary mutation, delta F508, from doctors too ill-informed or hurried to provide good counseling.

The tidal wave never struck, and a set of studies funded by the program in Ethical, Legal, and Social Implications (ELSI) at the National Center for Human Genome Research (NCHGR) suggests it's not about to. The consortium—ELSI's first clinical look at the difficult social issues that come with a new genetic test—hasn't yet published its conclusions. But the early signs are that worries about counseling and informed consent were justified. The investigators also found something quite unexpected: People who are offered a test that doesn't have a bearing on their own health don't go for it unless they are about to have a child who may be affected.

Widespread use of the test was prevented, in part, because the American Society of Human Genetics came out against screening for CF in 1990 and 1992, on the grounds that the test wasn't sensitive enough. Meanwhile, after other agencies that fund basic research on CF declined to get involved in these clinical-social studies, NCHGR issued grants to seven investigators—an unusual group of psychologists, ethicists, and geneticists. Their goal: to scout the territory and report back on what might happen if testing for CF genes were expanded throughout the nation.

The CF consortium was to be a new type of biomedical research. It aimed to assess the social impact of genetic technology by trying it on a small scale and extracting general policy recommendations. This model was used again in 1994, when ELSI funded a second, even bigger consortium; this one focused on genes that increase a person's own risk for breast or colon cancer (see p. 496).

In an effort that ended a year ago, the researchers gathered data on how 20,000 people reacted when offered a test to determine if they carry a mutation in the CF gene. (Carriers show no symptoms of the disease but risk having offspring with CF.) Although the policy recommendations are still in the offing, most of the CF investigators have published independent reports or have papers in press.

Their main finding, "which surprised everybody," according to Collins—now NCHGR's director—is that the public responded "coolly" to the offer of CF testing, except for couples already involved in a pregnancy. And even parents-to-be seemed to want the test only if it was part of a broad prenatal screen, Collins says, such as one that also checks for neural tube defects and Down syndrome. Outside that context, "people just don't seem to be all that interested," Collins says, "especially if it's going to cause them some inconvenience or cost them some money." People just aren't that eager to find out about their genes.

The team at Vanderbilt University in Nashville, Tennessee, for example, found that less than 1% of the people who received the offer of a free test sought it. The Johns Hopkins University group found that only 3.7% of those offered a free test came in if it required a special visit, and 23.5% turned up when the test was conveniently available immediately at a clinic. The team at North Carolina, led by medical sociologist James Sorenson, reported a better response when offering the test to relatives of CF patients. According to Sorenson, 58% of members of CF families interviewed took the test. The highest response was registered by a team led by Wayne Grody at the University of California, Los Angeles (UCLA). About 53% of the women undergoing prenatal screening at a health maintenance organization clinic took the test when it was offered free, and 77% in a similar clinic at UCLA accepted it.

But even among those who embraced the test, many found it difficult to understand the results. Peter Rowley's team at the University of Rochester was "distressed," for example, that just 44% of the women who tested negative understood that they might still give birth to a child with CF. (The test only detected about 90% of CF-causing mutations; current versions do better.) Equally "worrisome," the Rowley group reports, was the unenthusiastic response of physicians. Rowley's group says that when it contacted primary-care doctors and offered free CF testing on condition that adequate counseling be given to patients, 49% of doctors declined, largely because they didn't like the time-consuming consultative process. Those who did sign up spent little time explaining the test to patients. Rowley's group concluded, however, that patients could get information by reading a good brochure.

Although the ELSI consortium has yet to issue general conclusions, a draft report prepared for the consortium warns about the "malleability ... of demand," suggesting that patients might be pressured into accepting a test they may not understand or benefit from. The Vanderbilt team has concluded that, because the test is unpopular and creates some risk that those who test positive may lose insurance, "we believe that clinicians should not routinely offer carrier screening to nonpregnant individuals who do not have a family history of CF." Grody's group at UCLA, on the other hand, felt that their testing program provided valuable information to a large, ethnically diverse group. They concluded that CF carrier testing should be offered to certain high-risk groups.

ELSI's task now is to forge this welter of data and mixed interpretations into policy recommendations, which it hopes to do at an NCHGR-sponsored meeting set for next April. The process is a "little delayed," as Neil Holtzman of Johns Hopkins University concedes, and it won't be easy. And the fact that it has been hard to reach closure on CF testing—a topic that has moved to the back burner—suggests that ELSI will have its work cut out as it tries to tackle the much more volatile topics of testing for cancer genes and, ultimately, genes that affect behavior. **–E.M.**

THE CF CONSORTIUM

Investigator	Location	CF test acceptance	Family/pop. study
Asch, D.	Univ. of Penn.	—	pop
Fanos, J.	Calif. Pac. Med. Ctr.	—	fam
Grody, W.	UCLA	53% to 77%	pop
Holtzman, N.	Johns Hopkins	4% to 24%	pop
Phillips, J.	Vanderbilt	<1%	pop
Rowley, P.	U. of Rochester	57%	pop
Sorenson, J.	U. of North Carolina	58%	fam

types looked on ELSI as a "welfare program" for ethicists, who "only talked, but didn't change the world," says Collins. ELSI policy wonks meanwhile thought that scientists and clinicians tended to ignore the consequences of their work.

This distrust was not helped by ELSI's early agenda, which concentrated heavily on conferences. One ethicist recalls that these early ELSI meetings were a traveling show in which familiar experts mulled over familiar issues at changing venues. And Watson himself concedes that he saw ELSI initially as a shield and a sounding board. "It kept us from being attacked" by those who were concerned about the consequences of genetic research, Watson says. But he recognized that the existence of genetic data banks would pose "genuine problems" to the individual and hoped ELSI would lead to new guarantees of privacy. Watson says he thought it was important to educate the public about their own genetic risks "so that they can make choices." The "great ethical failure," Watson says, "is having knowledge and not using it." The aim in funding conferences was "to get discussions started before we rushed" into genetic testing.

ELSI's supporters also point out that the program has always funded a broad array of activities beyond these public gatherings. Today, NCHGR's ELSI spends more than two-thirds of its budget on extramural grants and contracts. From its inception in 1990 through 1995, according to a summary prepared by Elizabeth Thomson, deputy director of NCHGR's ELSI, it has funded more than 125 projects, resulting in the publication of more than 150 articles and books. They cover a wide range, including a public television series on genetics, a book by Leroy Hood and Daniel Kevles (*The Code of Codes*), educational materials, a study of patents and genetics, research on how to educate clinicians, and scores of studies of genetic testing. DOE, meanwhile, has used its ELSI money to develop a high school genetics curriculum,

A more practical bent

The ELSI program shifted its focus in 1992, when it began digging into the gritty details of clinical genetics. In that year, it launched the most ambitious study ever attempted of the introduction of a new genetic test: a screen for the genetic defect that causes cystic fibrosis (CF). The study, conducted by seven investigators around the United States, focused on the social and psychological impacts of testing, and it came up with a surprising conclusion: Although the test was initially expected to be in great demand, few people, in fact, had much interest in taking it (see p. 489).

Although the CF consortium has not published general conclusions, Thomson says it has helped to develop better consent forms and educate ELSI managers on how to coordinate research. Indeed, NCHGR is using the CF study as a model for a study examining the risks and benefits of tests to detect breast and colon cancer susceptibility genes. A consortium of 11 investigators is now turning in data on these tests (see p. 496).

ELSI chiefs also point to several important accomplishments in the policy arena. An extramural group led by Thomas Murray of Case Western Reserve made recommendations on how to prevent discrimination in insurance that are echoed in other ELSI statements and are now part of mainstream thinking in Congress. In a related move, ELSI staff nudged the Equal Employment Opportunities Commission into ruling that a person who tests positive for a disease gene may be viewed under the law as having a disability and therefore be protected against discrimination by employers. And a 2-year-old task force chaired by Neil Holtzman of Johns Hopkins University is drafting what Collins describes as "muscular guidelines" for controlling the quality of genetic tests, to be issued next spring.

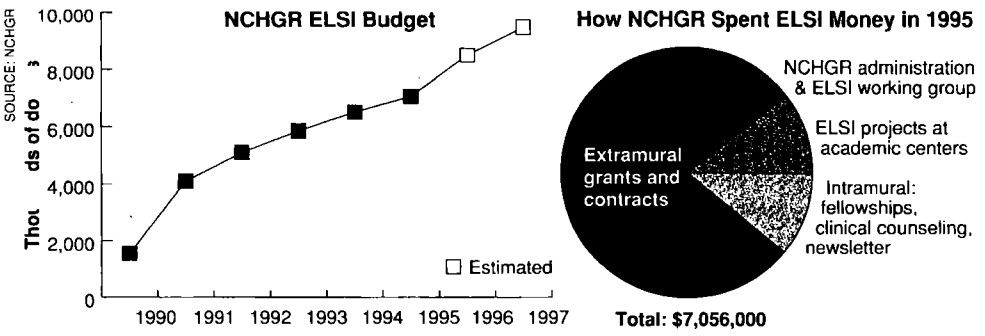
ELSI's attempt to forge a single policy on something that directly affects researchers—ethical standards for the storage and use of ELSI researcher, Ellen Wright Clayton of Vanderbilt University in Nashville, Tennessee, negotiated draft guidelines for more than a year starting in mid-1994, then published recommendations last December in the *Journal of the American Medical Association*. The report notes that experts could not agree on all issues. For example, they differed on whether it is acceptable to store tissue samples without consent if samples are stripped of personal identifiers. Some said it was; others said it was not—that consent must always be obtained if possible. And the report recommended that patients be given a complex set of options on the use of tissues in research, along with warnings about the "potential consequences." Since then, several organizations, including the College of American Pathologists, have issued independent views.

Collins is now turning to the president's newly impaneled National Bioethics Advisory Commission (NBAC) to ask for a ruling on this issue. It's not clear whether NBAC will take up his request. Nor is it clear how NBAC and ELSI will handle shared concerns in the future.

Collins's move to seek outside advice is part of a more aggressive effort to translate ethical debate into public policy—a move that some observers say has long been needed. Policy analyst Kathi Hanna, for example, wrote in a 1993 paper published by the Institute of Medicine that the ELSI program lacks a "clear-cut mechanism" for focusing on practical issues and transmitting findings to policy-makers. Many ethicists, including philosopher Daniel Wikler of the University of Wisconsin, Madison, agree. But some researchers, including Juengst and Billings, caution against focusing ELSI studies too heavily on specific goals at the expense of independent inquiry. ELSI could become "politicized," Billings warns.

Collins, for his part, is satisfied that ELSI supports a "cadre of really superb, world-class investigators who come at these problems from various directions" ranging from theology to law to basic science. And at the same time, Collins says, ELSI has made "substantial progress" in getting "all of that scholarship turned into policies that actually protect the public."

Keeping those competing interests in balance will be a challenge that is likely to become increasingly difficult as the genome program becomes more deeply involved in the world of applied medicine. Nobody with whom *Science* spoke doubted the wisdom of Jim Watson's decision to involve the genome program directly in ethical, legal, and social studies of its own products—or the scale of the challenges this effort will face in



Steady growth. NIH's ELSI program gets a 5% share of genome project funds; it spends more than two-thirds of its budget on extramural grants and contracts.

Coming to Grips With Genes and Risk

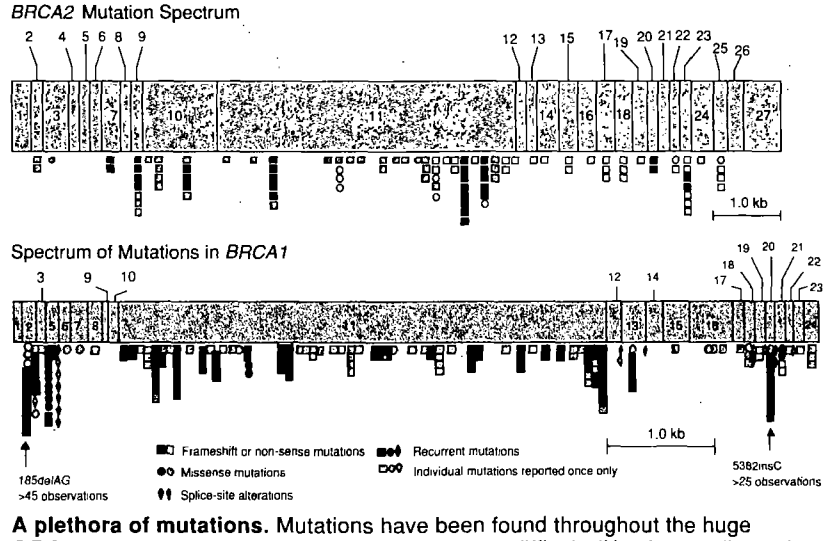
As experience with the breast cancer susceptibility genes *BRCA1* and *-2* shows, there can be a long road between finding a disease gene and understanding what it means

A little over 2 years ago, cancer geneticists made a long-awaited discovery: After years of struggle, they finally bagged the first gene linked to hereditary breast and ovarian cancers. The discovery of the gene, called *BRCA1*, was followed a mere 15 months later by the identification of a second, unrelated gene (*BRCA2*) linked to these same cancers.

Coming after intense, highly publicized searches, the news was greeted with elation by scientists, doctors, media, and the public. Although hereditary syndromes account for only 5% to 10% of breast cancers—and mutations in *BRCA1* and *-2* together play a role in only about two-thirds of these—the findings sparked high hopes that the new genes would be the keys to better understanding of all forms of these deadly cancers, and to more effective therapies for their victims. At the least, it was expected that these discoveries would make it possible to identify and help those most at risk of developing the cancers.

Now, however, high hopes are mixed with sober realities. Within the next week, Myriad Genetic Laboratories, a Salt Lake City, Utah, genomics company, will launch commercial tests for the genes, according to its president, Janet Haskell. And the Genetics and IVF Institute in Fairfax, Virginia, now offers tests for four specific mutations that are particularly common in Ashkenazi Jewish people—glaring exceptions to the relative rarity of *BRCA* mutations in the general population. But even as screening tests hit the market, there are still uncertainties surrounding these potentially lifesaving measures—and clear answers, which require huge studies on large numbers of women and their families, will take time.

The normal functions of *BRCA1* and *-2* are poorly understood (*Science*, 10 May, p. 799), and hundreds of mutations have



A plethora of mutations. Mutations have been found throughout the huge *BRCA1* and *-2* genes, making their detection very difficult. (Numbers indicate the protein-coding exons.)

what they mean: Are these women almost certain to get cancer, or are the odds less grim? "There's a hell of a lot of uncertainty in risk estimates, which very few people appreciate," says epidemiologist John Hopper of the University of Melbourne, who is helping to develop criteria for *BRCA* screening within Australia's public health system.

That wouldn't be so bad if there were routine ways to prevent these cancers, or to detect them very early when treatment is most likely to succeed. But women face a choice either of methods whose efficacy in *BRCA* carriers is completely unknown—such as mammography or chemoprevention—or drastic surgery, according to the report of an expert panel presented to the National Center for Human Genome Research (NCHGR) in Bethesda, Maryland, last May, by Wylie Burke of the University of Washington Medical Center in Seattle. Even with prophylactic removal of breasts or ovaries or both, cancers have been known to recur, the panel found, perhaps because not all tissue at risk can be removed.

As a result, experts are split about the tests going commercial. "I'm quite concerned that we don't yet have enough information ... [and that] private physicians may jump in who have had little exposure to some of these issues," says NCHGR director

testing programs. Hopper agrees: "[A commercial test] will make money out of raising anxiety and exploiting women. We should all take a deep breath and wait until there are decent data on the general population."

Others disagree. Ambiguity is the state of the art, one that patients can't be spared, says Barbara Weber, director of the Breast Cancer Program at the University of Pennsylvania Cancer Center. "I don't have any problem with commercialization of the test—although it's essential to have pretest education and posttest follow-up," she says. "Medical people understand that this is a significant responsibility." Says Mark Skolnick, Myriad's vice president of research, who played a key role in isolating both *BRCA* genes: "First, you save lives, especially with closer breast monitoring and prophylactic removal of the ovaries. ... Then, by testing large numbers of women and collecting information on as many as are willing, we can fine-tune our knowledge."

L. BRODY

Mutations galore

One big hurdle in coming to grips with the *BRCA* genes is the sheer number of mutations: So far, researchers have reported over 235 different sequence variations in *BRCA1*, scattered all through the gene—which spans nearly 100,000 bases of the genome and encodes a protein of 1863 amino acids. For *BRCA2*, which is less well studied, about 100 different mutations have been documented in the huge gene, which encodes a protein of 3418 amino acids (see the Breast Cancer Information Core (BIC) database, http://www.nchgr.nih.gov/Intramural_research/Lab_transfer/Bic/). And the list of mutations is still growing, with new reports coming into BIC every week, says Weber.

This high number of mutations means that full sequencing of the genes is the only reliable way to screen them. But that is time-consuming, difficult, and costly—"a huge block" to research in the field, says Weber,

Susceptibility Genes: Pointing a Way to Prevention?

Human genes are not islands: A host of other genes as well as factors in the outside world can affect their activities. That web of influences can make it hard to know how much risk a disease gene poses on its own (see main text). But there's a bright side to this complexity: If environmental factors shaping the effects of a disease gene can be tracked down, they can provide keys for treatment and prevention.

In 1994, for example, William Cookson and his colleagues at the Wellcome Trust Centre for Human Genetic Diseases in Oxford, U.K., found the first susceptibility gene for asthma and related allergic diseases. This gene turned out to encode part of the receptor for immunoglobulin E, a type of antibody that triggers allergic responses. Now several groups of researchers, including Cookson's, are closing in on some half-dozen additional asthma-susceptibility genes.

Even without knowing precisely how the genes work, Cookson says, once they are in hand researchers can begin linking particular gene variations (polymorphisms) in asthmatic people to the environmental exposures that set off their attacks. "With genetics, we may be able to say that people with this polymorphism have this sensitivity, and others have this one," says Antony Newman Taylor of the Royal Brompton Hospital in London, who coordinates a European study that will follow several thousand newborns for at least 5 years and look at these issues. "It gives us the potential to address issues we can actually do something about."

For some people—for example, those with genes that may make them sensitive to cat hair or tobacco smoke—the best strategy could be avoidance early in life, when a lifelong allergic reaction is probably first triggered. Others may be at risk from allergens such as house dust mites or pollen that are impossible to banish, says William Musk, a respiratory physician who, together with Cookson, is studying allergies in thousands of people in western Australia. Here, he says, "our aim is to figure out how to introduce genetically sensitive people early in life to specific allergens they can't avoid," in a way that could prevent the allergy from ever starting.

Other researchers are hoping to identify the triggers for juvenile diabetes (insulin-dependent diabetes mellitus, or IDDM), which starts when genetically susceptible people encounter agents, probably viruses or dietary factors, that set off an autoimmune reaction which slowly destroys the insulin-producing cells of the pancreas and eventually leads to disease. "We need to prevent autoimmunity from happening in the first place—which means knowing what triggers it," says pediatric endocrinologist Marian Rewers of the University of Colorado, Denver.

Rewers is leading a long-term study that should help find this out, monitoring exposures to risk factors and looking for autoimmune antibodies in thousands of children who carry specific versions of the major histocompatibility genes that increase their IDDM risk about 20-fold. And more help should come as geneticists zero in on up to a dozen other genes that could play a role in IDDM, which in turn will allow a more complete picture of which environmental factors set off IDDM—knowledge that's key to prevention. As Rewers says, "It's easier to change the environment than to change your genes."

—P.K.

logical effort: Myriad's *BRCA1* and *-2* screen involves sequence analysis of about 16,500 base pairs and will cost $2400, according to Haskell. Screening for a specific mutation is much simpler and cheaper, however, for it only requires examining one spot in the gene.

For women found negative for specific mutations, such as one already identified in their family or any of those common to the Ashkenazi Jewish population, the test can spare them lifelong anxiety and even major surgery—although it doesn't mean that they will never get cancer for another reason. But not every mutation associated with breast or ovarian cancer can be detected, so negative results without adequate genetic counseling can raise false optimism. A few families have cancers that show genetic linkage to either *BRCA1* or *-2*, but, says Mike Stratton of the Institute of Cancer Research in Sutton, England, "we can't find any mutations." This suggests that the change lies outside the genes' protein-coding regions, perhaps in sequences affecting gene activity or levels of the protein products in the cell. And about one-third of all breast cancers that seem to run in families don't show linkage to either *BRCA1* or *-2*—which has prompted a search for a third BRCA gene.

When tests detect a mutation, its meaning must also be looked at carefully. The clearest cases are lesions already found in other family members with cancer and that—like most known *BRCA1* and *-2* mutations—cause the gene to make either a shortened protein product, or none at all. Another class of *BRCA1* mutations that most researchers consider harmful causes a single amino acid change in a region of the protein thought to be crucial for function because it contains a "ring finger" motif, a putative site of protein-DNA or protein-protein interaction.

A third, much smaller group of mutations are those causing amino acid substitutions in other regions of the protein. These can be hard to classify as either harmful or as benign variations (polymorphisms), especially when there are no other relatives with cancer to check whether they, too, carry the mutation. So such test results must be considered uninformative. From the perspective of screening, "these missense mutations will plague us," says Collins.

Are all mutations created equal?

But even women who test positive for a known, harmful mutation face some ambiguity, because there are questions about the degree of risk these lesions carry. Several researchers who spoke with *Science*, especially the epidemiologists, criticized the often-cited figures that *BRCA* mutations carry an 80% to 90% lifetime risk of breast cancer and a 44% risk of ovarian cancer. One problem, says epidemiologist Hopper, is that estimates like these are average probabilities and don't take into account other factors that could strongly affect risk for an individual woman, such as hormonal and childbearing history, and other genes. "One often gets a very deterministic view that you have gene X and this is what it does—finished," he says. "That's nonsense."

Stanford University epidemiologist Alice Whittemore provides some examples. Because *BRCA1* appears to be a tumor-suppressor gene, which tends to protect against cancer, both copies must be lost or inactivated for cancer to develop. The inherited mutation eliminates one copy; the other still must be lost—which is where other risk factors, such as a woman's past exposure to radiation, might be crucial. So could other genes, like the ataxia telangiectasia (*ATM*) gene, whose protein product repairs radiation damage. Mutation of one *ATM* gene raises cancer risk slightly. So a woman with mutations in both *BRCA1* and *ATM*, who also received radiation—perhaps even from mammography—could have a higher cancer risk than another woman with the same *BRCA1* mutation.

In contrast, because prolonged use of oral contraceptives reduces ovarian cancer incidence by half in the general population, *BRCA1* carriers taking birth control pills might also have lower risk—an issue Whittemore calls "one of the most important questions to me" because of its implications for preventive therapy in these women.

But the biggest quarrel with the commonly cited *BRCA1* and *-2* risk estimates is that they are based on atypical, "cancer-dense" families—those with multiple cases of breast and ovarian cancer, especially in members under age 40, and often significant (but smaller) increases in certain other cancers. So these estimates could be biased upward, says Whittemore: "We could be skimming off the top only those families where *BRCA* mutations are especially penetrant [have very strong effects], for whatever reason." An accurate risk assessment requires studying many people outside such families, she says, to see whether *BRCA* mutations are present in breast cancer patients without striking family histories. Because other family members would presumably also be carriers, such families "would lower our risk estimates," she says. Such data will be a while in coming. A few reports in the literature have suggested that these families exist—but numbers are small, and some researchers who spoke with *Science* remain skeptical.

Still, there are other glimmers of lower penetrance *BRCA* mutations. In another recent study looking outside high-risk families, David Barker at the University of Utah found a new missense mutation that may be associated with breast cancer in older women and may therefore be less severe. This work, to be published soon in *Genetic Epidemiology*, raises the crucial issue of penetrance and age: Women carrying *BRCA* mutations that increase their risk for breast cancer at age 65 rather than at 30 or 40 might make very different choices about medical intervention.

But the strongest hint of lower penetrance mutations so far comes from studies on the Ashkenazi Jewish population, the only one known so far where *BRCA* mutations can be called frequent. Two specific mutations—one in *BRCA1* and one in *BRCA2*—are each present in about 1% of this population, "an astonishingly high fr[illegible]

I can think of," says Francis Collins, who collaborated with the lab of NCHGR colleague Lawrence Brody on these mutations.

Because the two mutations are so common, researchers have been able to study much larger numbers of carriers than for any other single *BRCA* lesion. And such studies have now led two groups of researchers to propose that the *BRCA2* mutation is three- to fourfold less penetrant than that in *BRCA1*. (The results appeared in the October 1996 issue of *Nature Genetics*.) The difference is not yet proven, says Ken Offit of the Memorial Sloan-Kettering Cancer Center in New York, an author on one of the papers, but it jibes with clinical experience. "We sometimes get patients with [the *BRCA2* mutation] with no family history," he says. "We never saw that with the [*BRCA1*] mutation."

An ongoing joint study between the National Cancer Institute (NCI) and NCHGR should provide firmer estimates of penetrance for both mutations. The researchers are analyzing the family cancer histories of 5300 Ashkenazi Jewish people who were screened for the two mutations. By looking at cancer incidence in the mothers of the mutation carriers, about half of whom should also be carriers—and are now old enough to have developed many *BRCA*-associated cancers—the researchers expect to make at least an indirect estimate of penetrance, perhaps within the next month, says NCI's Jeff Struewing, who is a study participant.

From the cancer patient's perspective, the fewfold difference in penetrance, assuming it holds up, may not mean much, Offit points out. "Women seem to be just as concerned by a ninefold increase in risk as by a 30-fold increase," he says. But by studying a large group of women with the lower penetrance mutation, researchers hope to get at another key question: What distinguishes those who get cancer from those who don't? point to ways that *BRCA* mutation carriers can lower their risk—just as researchers on other diseases involving genetic susceptibilities are attempting to do (see box on p. 497).

STUDIES OF *BRCA* GENES AND RISK

Registry	Special Features
Metropolitan New York Registry Cancer Families, Memorial Sloan-Kettering Cancer Center	Wide ethnic representation; of Ashkenazi-Jewish (AJ) study
Philadelphia Familial Breast Cancer Registry, Fox Chase Cancer Center	Informatics; links to NCHGR-ELSI committee AJ study
Utah Cooperative Breast Cancer Registry, Huntsman Cancer Institutes	High-risk families only; some very large
Northern California Cooperative Family Registry, Northern California Cancer Center	Wide ethnic representation; AJ study; Li-Fraumeni families
Australian Breast Cancer Family Study, University of Melbourne; New South Wales Cancer Council	Twins registry; AJ study
Ontario Registry for Studies of Familial Breast Cancer, Ontario Cancer Treatment and Research Foundation	AJ study

Big studies

The umbrella for addressing these questions is an ambitious project—the Cooperative Breast Cancer Registry, organized at NCI—that is now taking off. Over the next 4 years, six participating sites will collect blood cells and tumor specimens from about 6000 women with breast cancer and 20,000 of their relatives. Many women will be chosen based on their degree of familial risk (high, medium, or low), while others will be unselected for family history. The sites will also collect clinical and epidemiological data on everything from age of menarche, contraceptive use, pregnancies, and hormone therapies to smoking histories, environmental exposures, exercise habits, and diet. Records will be updated every year with data on who has developed cancer and the progression and treatment of their disease. The resource will be available for outside researchers, following stringent peer review, to tackle issues such as who is most likely to get breast cancer, why, and how to lower that risk, says project coordinator Daniela Seminara, program director for Genetic Epidemiology in NCI's newly formed Division of Cancer Epidemiology.

Across the Atlantic, the European Breast Cancer Consortium is coordinating prospective studies of known *BRCA1* and *-2* carriers. By following these individuals over the coming years, they hope to get at several issues, says member David Goldgar of the International Agency for Research on Cancer in Lyon, France. One is risk, not only for breast and ovarian cancer, but also for other types that are somewhat more frequent in carriers. Another is whether mutations in different regions of each gene cause a different spectrum of cancers, as first suggested for *BRCA1* by consortium members Stratton and Simon Gayther, Doug Easton, and Bruce Ponder of the University of Cambridge, U.K. The consortium will also collect clinical data for tackling the various medical issues about screening and treatment for mutation carriers.

And Myriad itself is planning a registry to follow up on women who test positive for *BRCA* mutations, provided they consent, says Skolnick. The project, to be carried out at an academic center not yet named, will collect clinical information similar to that of the others.

Eventually, the results of such studies should help women with *BRCA1* or *-2* mutations make informed decisions about how to protect themselves from breast and ovarian cancers. For now, these women face wrenching, potentially life-and-death decisions—

Should Be Released Immediately and Freely in the Public Domain

David R. Bentley

Progress in understanding is best achieved by the free exchange of knowledge and ideas. To understand the biology of humans and other organisms through genome interpretation, all genomic DNA sequence information should be "freely available and in the public domain in order to encourage research and development and to maximise its benefit to society" (*1*). This statement (applied to human sequence generated by large-scale sequencing centers) was unanimously endorsed by participants at the International Strategy Meeting on Human Genome Sequencing, held in February of this year. The key question in the current debate is whether to immediately release sequence information and, if so, in what form. The answer presented in this article is yes. The finished sequence should be released directly upon completion. Furthermore, there should be an earlier prerelease of unfinished sequence and additional mapping information. This is required to optimize coordination, independent checking, and exploitation in both academic and commercial laboratories (*2*).

Immediate sequence (and map) release permits coordination. Genomic sequence is typically produced in 40- to 200-kilobase segments, each of which is represented by a single bacterial clone [for example, a cosmid, fosmid, bacterial artificial chromosome (BAC), or P1 artificial chromosome (PAC)]. DNA from the clone is prepared and subcloned, 800 to 2000 templates are sequenced and assembled in a random shotgun phase, and ambiguities are resolved in a final directed phase ("finishing"). The completed consensus sequence is then annotated and submitted to the public database. The entire process can be done in 4 to 6 weeks, but can take longer, depending on the problems encountered during finishing of each clone. At large centers, 500 or more clones may be at intermediate stages of the process at any given time. To optimize coordination, it is therefore important to make the status of each clone as visible as possible to the rest of the world. It is not adequate to rely purely on release of the finished sequence of each clone as an indicator of progress; the risk of accidental duplication is high and any duplication is costly. This risk is minimized by providing regularly updated maps of all clones as soon as they enter the process, if not earlier still. Actual progress is then monitored conveniently by prerelease of the unfinished sequence (that is, the assembled shotgun sequence data) of each clone. This informal prerelease also provides most of the sequence information to the public promptly, before the stage that is subject to possible delays (the "finishing" stage).

Unfinished sequence is of immediate value to others and is not misleading. The biochemical process of sequence determination is extremely robust, and each template provides raw data of high quality. As a routine precaution, raw shotgun data are assembled and orphan reads (along with vector sequences and any reads of poor quality) are removed, thus eliminating virtually all artifacts before the prerelease. The resulting sequence data are thus of defined quality and contain information of sufficient accuracy for many biological and genetic studies (*3*). For example, the availability of the unfinished genomic sequence allowed the determination of the complete structure of the *BRCA2* gene as well as the detection of mutations that provided conclusive proof of the association of this gene with familial breast cancer (*4*).

Unfinished sequence does not clutter public databases. It is an internationally agreed aim that human genomic sequence will be finished to high accuracy (99.99%) (*5*). Given this commitment, the unfinished sequence is not a substitute for the finished product but constitutes a transient, dynamic buffer of finite size. The sequencing center has the responsibility of ensuring that sequence does not languish in the unfinished category (which would inflate the buffer unnecessarily). As the buffer of unfinished sequence is finite, it is possible to set up mechanisms to handle the data adequately. The situation would be quite different if the decision had been taken to skim the entire genome first. This would have resulted in an unmanageable amount of information of much lower intrinsic value requiring long-term storage.

Does immediate sequence release promote or hamper its use? The major aim is to promote both the academic and commercial sectors. Immediate release of sequence provides valuable data as quickly as possible to laboratories focusing on specific biological or clinical problems (usually associated with one or more limited regions of the genome). Historically, the absence of a reference map or sequence of the genome has meant that mapping and sequencing forms a major part of the effort of the researchers undertaking such a targeted study. In some cases, patents have been filed on gene sequences in an attempt to establish exclusive ownership and thus protect biotechnological inventions arising from knowledge of the gene sequence. Alternatively, the interests of the funding agency and participating laboratories have been protected by maintaining confidentiality.

We have now entered a transition phase in which the mapping and sequencing is increasingly being carried out in large-scale centers. However, because only a fraction of the human genome sequence (currently around 1%) has been determined as yet, collaborations are being established between the sequencing centers and groups pursuing specific targets in regions not yet sequenced. In this situation, the data release policy of the sequencing center cannot be compromised to protect the interests of the targeted study: If small parts of the emerging genome sequence were held back for this reason, the sequencing centers would be exercising control in using the resources of the large-scale public domain program to confer a selective advantage on certain laboratories over other groups. This is not acceptable. There must be no opportunity for selective retention. It can only be avoided effectively by adopting a strict policy of immediate data release along the lines defined above, so that a transparent view of the process of data generation is provided to the rest of the world and the data are made available freely and simultaneously to all. Furthermore, imposing any form of selective access of the data to certain groups will tend to impede progress. Identification of a target is not achieved from the genomic sequence alone. It requires expert interpretation of sequence by specialist knowledge derived, for example, from patient collections, biochemical knowledge, or further experiments using complementary DNA analysis, exon trapping, or mutation screening techniques. Withholding the genomic sequence ingredient from any academic or commercial laboratory with such knowledge impedes scientific progress and is not in the international public interest.

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How does immediate sequence release affect commercial exploitation? As observed by HUGO (6), it is important that the necessary incentives for commercial investment are preserved so that the development of products (particularly diagnostic tests and therapeutic agents) can continue without unduly interfering with scientific research. There has been much debate on the feasibility and advisability of protecting commercial interests by patenting gene sequences. It is now widely accepted that the patenting of raw human genomic DNA sequence or partial or complete gene sequences of unknown function is inappropriate (6–8). Such action might well discourage further research and development by others, for fear that future inventions downstream of the gene sequence itself could not be adequately protected. Given that raw human genomic sequence does not fulfill the requirement of patentability under existing patent law (that is, it must be novel, nonobvious, and have demonstrable utility), the best course of action is to release it freely. As a result, the value of the sequence will increase as it accrues additional information from other public domain sources, leading to the definition of novel gene structures, regulatory mechanisms, and functions. Free release of sequence data will also encourage exploitation by a maximum number of commercial and academic centers that are keen to compete in the development of new therapeutic agents. Encouraging such competition is healthy: The best possible advances, protected by the most appropriate well-defined patents, are more likely to emerge in a nonexclusive environment rather than in an environment in which a single company maintains an exclusive position to develop useful health care products at its own pace using its own preferred approaches. It is therefore vital that genomic sequence data are made immediately and freely available in the public domain to maximize their benefit to society.

REFERENCES AND NOTES

1. The first International Strategy Meeting on Human Genome Sequencing, organized by the Wellcome Trust, was held in Bermuda, 25 to 28 February 1996. Participants included representatives of laboratories involved in human genome sequencing and of funding agencies, who met to discuss strategy, progress and plans, policies for data release, and the implications of such policies. The "Bermuda statement" was endorsed unanimously by all participants. See *Human Genome News* **7** (no. 6), 19 (1996).
2. The provision of genomic information to the public in three stages—as sequence-ready maps, as assembled shotgun sequence data, and as finished and annotated consensus sequence of each bacterial clone—was first practiced from the outset of the *Caenorhabditis elegans* genome project by the groups of R. Waterston (Washington University, St. Louis) and J. Sulston (the Sanger Centre, Cambridge, UK). This data release policy is endorsed by both the Wellcome Trust and the National Institutes of Health. Other centers are also practicing or planning forms of data release, including the Whitehead Institute, The Institute for Genomic Research (TIGR), Baylor College of Medicine, and others. See also (*8*); E. Marshall and E. Pennisi, *Science* **272**, 188 (1996); National Science Council, *Report of the Committee on Mapping and Sequencing the Human Genome* (National Academy Press, Washington, DC, 1988).
3. In most cases, the preliminary assembled shotgun sequence data provide sequence representing around 90% of insert of the bacterial clone in a few large contiguous sequences that are virtually free of artifacts. Ongoing refinement of the shotgun strategy and sequencing biochemistry is resulting in further improvements to the quality and coverage of the initial assembled sequence. In addition to the prerelease of unfinished sequence at the FTP sites of the sequencing centers, the National Center for Biotechnology Information and the European Bioinformatics Institute are planning to provide centralized access to the unfinished sequence in the public domain.
4. R. Wooster *et al.*, *Nature* **378**, 789 (1995); S. Tavtigian *et al.*, *Nature Genet.* **12**, 333 (1996).
5. The proposal to determine the genomic sequence representing more than 90% of the human genome at an accuracy of 99.95% or greater was reported by E. Marshall, *Science* **267**, 783 (1995). The agreement to aim for completion of contiguous sequence at an accuracy of 99.99% (equivalent to the standard achieved for *Caenorhabditis elegans*) was promoted at the Bermuda meeting [see (*1*)].
6. Human Genome Organization Statement on Patenting of DNA Sequences, 1995.
7. Bioindustries Association. *The Patentability of Human Genes* (1995).
8. National Center for Human Genome Research, Policy on Availability and Patenting of Human Genomic DNA Sequence Produced by NCHGR Pilot Projects, 9 April 1996.
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Should Non–Peer-Reviewed Raw DNA Sequence Data Release Be Forced on the Scientific Community?

Mark D. Adams and J. Craig Venter

The ability to sequence DNA accurately and efficiently has revolutionized biology and medicine and has ushered in the new era of genomic science, the study of genes and genomes. An argument has been made by some that the inherent value of DNA sequence data is so great, regardless of quality, that it should be downloaded nightly onto Internet sites (*1*). Coupled with this is the notion that it is somehow inappropriate for the scientific teams that generate sequence information to extract scientific value from their data before releasing these data to others. This proposal represents a radical departure from the way in which scientific research is traditionally conducted and should raise concerns in the scientific community.

The Human Genome Project has seen a wide range of conduct in the publication of research findings, particularly physical and genetic map resources as they relate to the highly competitive field of human genetics. These variations in data release prompted the National Institutes of Health (NIH) and the U.S. Department of Energy (DOE) to review data release policies and to set standards for genomic research. The current official NIH-DOE genome data release policy requires scientists to release their data within 6 months of generation (*2*). However, in conjunction with the awarding of pilot project grants for human genome sequencing, NIH asked each awardee to abide by a plan for the rapid release of data, essentially as proposed by the Sanger Centre (*3*).

At first glance, there might seem to be few, if any, compelling reasons for all genome research labs not to adopt the policy to immediately download sequence data directly from an Applied Biosystems sequencer to an Internet site (or to do so after a swift and cursory form of automated quality control, such as vector removal or partial assembly). After all, the modern molecular biologist is sophisticated enough to analyze unfinished DNA sequence data and incorporate it where appropriate into ongoing research projects, and much of the DNA sequence data available at genome laboratories' Internet sites comes with a user-beware warning and, in some cases, restrictions on use (*4*). However, this policy has not yet been subjected to a rigorous test of its true utility and benefit to the scientific community at large.

We believe there are substantial reasons why scientists should be cautious about using or releasing data and results that have been neither peer-reviewed nor extensively self-reviewed. Although we do not object to the policy of nightly data release adopted by some genome centers, we do object to having these terms applied across the board to all labs involved in genome research.

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of immediate data availability outweigh the potential serious errors that raw data may contain and the consequent waste of time, intellectual energy, and resources that the community will necessarily have to expend to bring scientific clarity to the data.

Looking forward, not backward. Fewer than 600 million base pairs of DNA sequence reside in the public databases, most of it redundant. If the human genome is to be completely sequenced over the next 7 to 10 years, then in each of these years the human genome sequencing community must produce accurate genomic sequence data and analysis equivalent to the sum of all DNA sequencing done to date. Such an effort would require the finishing and publication of, on average, 500 million base pairs of sequence each year—the equivalent of the *E. coli* genome being published every 2 days for the next 7 years. The nightly addition of the raw, unedited data to Web sites would double or triple the amount of information to be processed. This scenario considers only the Human Genome Project; however, projects are under way or planned for a large number of other genomes, including mouse, *Drosophila*, plants, parasites, and microbes. Given the enormous scope of the genome project, we feel that the sequencing labs need to focus on ensuring the highest quality data, analysis, and scientific interpretation, made available as soon as practicable upon completion and published in a timely fashion in peer-reviewed journals. In fact, early release of unedited, unfinished data may be detrimental to small molecular biology labs, which do not have the resources or computational tools to deal with the deluge of information.

Despite its tone of fairness, the argument for daily data release suggests indifference toward the intellectual effort that the scientific research community has set as a standard for itself in the publication and release of its work. Scientific custom has held that the scientist should be allowed to communicate to the research community what was achieved and how it was done, to analyze and comment, not only so that careful critical evaluation can be made, but also out of respect for the researcher and the achievement. Some have argued that genome sequencing is different from other scientific pursuits in that it is a public service—but what taxpayer-funded research is not a public service?

We propose that for genome sequencing projects that cannot be completed in 12 to 18 months, finished sequence data (of, for example, BAC clones) should be made available to the wider community immediately, without restriction or delay, as soon as these data have passed a series of rigorous quality control checks and have been annotated. Within a reasonable interval, these releases of data should be followed by complete scientific papers that not only describe the methods used for data generation and analysis, but also attempt to place the data in a broader biological context. We hope that the scientific journals, the scientific community, and the funding agencies will be tolerant or even encouraging of a variety of approaches to data generation, interpretation, and scientific publication to advance this exciting field of genomics.

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4. The Washington University Genome Sequencing Center FTP site (ftp://genome.wustl.edu/pub/gsc1/sequence/README) reads: "This archive site contains prerelease versions of the data, and we ask that you keep the following in mind:

   1) These data should be used for internal research purposes only and not for redistribution. If other researchers request a copy of the sequence, please have them contact the *Caenorhabditis elegans* sequencing project directly.

   2) This is not the final version of the sequence and may contain errors, this is especially true of the data in the shotgun and finishing directories. However, we feel it is of sufficient interest to be prereleased.

   3) Please consult with us before publication of any results related to this sequence until this sequence has been officially released. After it has been released, you are welcome to publish the results of your research as long as Washington University and the *C. elegans* sequencing project are acknowledged appropriately."
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The New Genomics: Global Views of Biology

Eric S. Lander

The Human Genome Project was designed as a three-step program to produce genetic maps, physical maps, and, finally, the complete nucleotide sequence map of the human chromosomes. In the past year, the first two milestones have essentially been reached (*1*) and pilot sequencing projects have begun with the aim of increasing speed and efficiency. Although only 1% of the human genome has been sequenced so far, there is growing confidence that the annual production rate can climb over the next 3 years to more than 500 megabases (Mb) worldwide—ensuring that the goal will be comfortably reached by the original, projection of 2005. The mouse, the leading biomedical model system, can likely be sequenced in parallel, although funding has not yet been committed.

With success in sight, thoughts are already turning to what should come next. The answer depends in part on how one understands the significance of the Human Genome Project. Commentators have sought to set the project in historical context by likening it to the Holy Grail, the Manhattan Project, and the moon shot. Each analogy is rich with implications about the appropriate follow-up. However, none of these precedents rings true.

Rather, the Human Genome Project is best understood as the 20th century's version of the discovery and consolidation of the periodic table. In the period from 1869 to 1889, chemists realized that it was possible to systematically enumerate all atoms and to arrange them in an array that captured their similarities and differences. The building blocks of chemistry were rendered finite, and the predictability of matter gave rise to the chemical industry on one hand and the theory of quantum mechanics on the other.

The Human Genome Project aims to produce biology's periodic table—not 100 elements, but 100,000 genes; not a rectangle reflecting electron valences, but a tree structure depicting ancestral and functional affinities among the human genes. The biological periodic table will make it possible to define unique "signatures" for each building block. Just as chemists can recognize atoms by mass and charge alone, biologists will be able to build detectors that allow each gene to be recognized from 20 well-chosen nucleotides or each protein from a distinctive fragment. Molecular biology has tended to

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examine genes individually. It is now time to gain a global perspective on the cell by asking genome-wide questions, in many cases by studying all 100,000 genes and gene products simultaneously.

With the aim of stimulating ferment, I propose 10 goals for the next phase of genomics. The goals focus on infrastructure, inventories, and technology (rather than specific biological problems or medical applications) because scientific planning fares better at choosing paths than precise destinations. Broad dissemination of the resulting tools will clearly spawn myriad individual projects, with dramatic consequences for understanding life and curing disease.

DNA

1) *Routine re-sequencing of multi-megabase regions of human and mouse DNA.* The human genome will need to be sequenced only once, but it will be re-sequenced thousands of times in order, for example, to unravel the polygenic factors underlying human susceptibilities and predispositions. Geneticists can now trace inheritance patterns to locate chromosomal regions harboring genes for common diseases (including diabetes, hypertension, and schizophrenia), as well as modifier genes in mice that reveal surprising interactions (including suppressors of colon cancer or neurodegeneration). However, the resolution is limited, with regions often exceeding 10 Mb. Rather than assembling the thousands of human families or animal progeny needed to boost genetic resolution, the pragmatic solution in a post-genome world will be to re-sequence the entire region (or perhaps just coding regions within it) from the DNA of a few dozen affected and unaffected individuals to spot the telltale sign of correlated variation (*2*). Similarly, studies of cancer initiation and progression will involve large-scale re-sequencing of all known or suspected cancer-related genes in tumor and normal tissue. Re-sequencing will also provide the ultimate tool for genotyping studies.

Fortunately, sequencing is easier the second time around. Given a DNA sequence, one can build detectors to recognize variations on the theme. For example, Chee *et al.* (*3*) report in this issue the use of massively parallel DNA arrays to resequence by hybridization the 16 kb of the human mitochondrion. If the detector elements could be shrunk from 40 μm to the 1-μm range used in semiconductor manufacture, a set of DNA chips might someday allow re-sequencing of hundreds of megabases in a single hybridization.

2) *Systematic identification of all common variants in human genes.* The human population has vast genetic diversity, with thousands of alleles at most gene loci. Indeed, the typical mutation rate of $\approx 10^{-9}$ per nucleotide implies that every possible single base change occurs about once per generation somewhere in the population of $\approx 6 \times 10^9$ humans. Yet, human diversity is also quite limited in that most genes have only a handful of common variants in their coding regions, with the vast majority of alleles being exceedingly rare. The effective number of alleles (defined as the reciprocal of the chance that two randomly chosen alleles are identical) is rather small, often two or three (*4*). This limited diversity reflects the fact that modern humans are descended from a relatively small population that underwent exponential explosion in evolutionarily recent time (*5*).

Tantalizing examples suggest that common variants may hold the secret to many disease susceptibilities. The apolipoprotein E gene has three major variants (E2, E3, and E4) that explain a large fraction of the risk for Alzheimer's disease, as well as risk for cardiovascular disease. The MTHFR, Factor V, ACE, and CKR-5 genes each have common variants associated with, respectively, homocysteine levels, risk of thrombosis, heart disease, and resistance to HIV.

If the genes are the human "elements," the common variants are the abundant "isotopes." Creating a comprehensive catalog of common variants is a feasible task: most will be encountered by simply re-sequencing the coding regions from 100 random individuals (*6*). (This effort should be distinguished from the Human Genome Diversity project, which seeks to identify rare alleles in far-flung populations in order to reconstruct human evolution and migration.)

The catalog of common variants will transform the search for susceptibility genes through the use of association studies. Association studies test whether a genetic variant increases disease risk by comparing allele frequencies in affecteds and controls (*7*). They are logistically simpler to organize and potentially more powerful than family-based linkage studies, but they have had the practical limitation that one can only test a few guesses rather than being able to systematically scan the genome. In the post-genome world, however, it would be possible to test disease susceptibility against every common variant simultaneously (for example, by genotyping a well-characterized clinical population with a comprehensive DNA array). Notably, testing hundreds of thousands of alternative hypotheses requires only a modest increase (about eight-fold) in sample-size (*8*).

Noncoding regions are also important in determining disease risk (as known for the insulin gene in juvenile diabetes). Similar approaches could be used to pinpoint the role of noncoding variation, either by systematic collection of variation in regulatory regions or by use of a dense genetic map to recognize ancestral chromosomal segments in the human population (*9*). Increasingly, population genetics will become a mainstream tool for biomedical research.

3) *Rapid de novo sequencing from other organisms.* Comparative DNA sequencing will unlock the record of 3.5 billion years of evolutionary experimentation. It will not only reveal the precise branches in the tree of life, but will elucidate the timing and character of major evolutionary innovation [including the frequency of invention of truly novel genes and the role of whole-genome duplication events, as have occurred at least twice in the vertebrate lineage (*10*)]. Sequence conservation will provide a powerful way to discern the real functional constraints on genes and gene products. Comparison of related organisms will directly reveal regulatory regions and key architectural features of proteins (*11*). Sequence differences hold the key to understanding how nature generates such diversity of form and function with such an economy of genes—producing, for example, elephants, gazelles, mice, and humans from the same basic mammalian repertoire of genes. The solution will require correlations of sequence variation with temporal and spatial differences in gene expression across organisms. It will likely reveal secrets about the fine-tuning of genes and gene networks, with valuable lessons for human medicine.

Unleashing the full power of DNA sequence comparison will depend on dramatic increases in the efficiency of sequencing. Sequencing of compact bacterial genomes has recently exploded as costs have dropped to below 50 cents per finished base. Labor and reagent costs could, in fact, be slashed through automation and miniaturization (as well as the eventual expiration of a few patents). It should be possible eventually to reach 1 cent per base with conventional automation and perhaps 0.1 cent per base with approaches such as a micro-electromechanical device that incorporates a fully integrated sequencing system on a chip. For the longer term, radical approaches such as single-molecule detection deserve attention.

RNA

4) *Simultaneous monitoring of the expression of all genes.* The mRNA levels sensitively reflect the state of the cell, perhaps uniquely defining cell types, stages, and responses. To decipher the logic of gene reg-

ulation, we should aim to be able to monitor the expression level of all genes simultaneously, with a quantitative sensitivity level of less than one copy per cell, a qualitative sensitivity to distinguish all alternatively spliced forms, and the ability to assay single cells. Recent technological advances in DNA microarrays (*12*) augur well for the eventual feasibility of this goal.

The deluge of data from whole-genome expression studies can be exploited in a variety of ways: (i) *Description*. At the simplest level, straightforward catalogs of the tissue distribution of proteases or G protein–coupled receptors may suggest roles for the gene products. (ii) *Classification*. At a deeper level, global expression profiles may reveal previously unrecognized subtypes among patients, tumors, and drugs—explaining differences in underlying mechanisms, responses to treatment, and side effects. Classification does not require specific knowledge of gene function because expression profiles may serve simply as markers in mathematical cluster analysis. (iii) *Dissecting circuitry*. The greatest challenge will be to decipher the logical circuitry controlling entire developmental or response pathways. The task is perhaps akin to reverse engineering a microprocessor based on recordings from each register. Typical experiments will involve sampling expression throughout a time course after a stimulus or set of related stimuli. In the end, it will include understanding the activation and identifying the target of every transcription factor and assembling the components into a finite list of regulatory modules and sequential cascades. Whole-genome expression studies will require new mathematical tools to analyze the data (*13*) and visualization tools to render them comprehensible.

Spatial localization of gene expression during development will also hold critical clues about function. DNA arrays will not be suitable for such investigations, but high throughput, in situ hybridization to mouse embryos should be feasible.

5) *Generic tools for manipulating cell circuitry*. To understand biological function, it is necessary not just to monitor gene expression, but to disrupt and manipulate it. The coming era will require an arsenal of generic reagents and methods for both germline and transient gene disruption.

For the most tractable genetic systems (yeast, nematodes, and fruit flies), it will be feasible to create a menagerie containing a mutant for every possible gene. These strains will help elucidate function both through direct characterization of the null phenotype and through the identification of interacting genes by screens for suppressors, enhancers, and synthetic lethals. These model organisms are likely to reveal all basic eukaryotic and metazoan functions.

There will be a similar explosion in mouse mutagenesis. Homologous recombination allows disruption of any gene, although a comprehensive program to target every mouse gene seems prohibitively expensive ($10 billion, even before the cost of long-term maintenance). Random mutagenesis with point, deletion, and insertion mutagens will undergo a revival, as global tools for DNA and RNA analysis make it easier to identify mutations and characterize their physiological effects. Interspecies hybrids will also shed light on function, through natural allelic incompatibilities.

Transgenic studies will require not only disruption, but the ability to redesign cellular wiring diagrams. One can envision a growing handbook of reusable modular components, much as architects of electronic circuits use today, that would propel studies ranging from basic research to applied gene therapy.

Transient disruption of gene expression will be more appropriate for the study of many physiological processes and essential for the study of human cells. Focused efforts are needed to improve the efficacy and availability of research reagents for disrupting mRNAs, including anti-sense oligonucleotides and ribozymes. High throughput approaches would advance the state of the art in production and evaluation of such generic tools.

For many aspects of cellular physiology, the most important circuitry occurs at the level not of RNA but of protein. Although generic manipulation of protein function is more difficult than for nucleic acid function, new advances in combinatorial chemistry hold the promise of efficient production of chemical knockout reagents that activate and inactivate proteins.

Protein

6) *Monitoring the level and modification state of all proteins*. The case for global monitoring of RNA applies with equal force to proteins, with the added twist that it will be necessary to follow post-translational modifications, which play key roles in protein circuitry. The concept of global protein monitoring dates back to the use of two-dimensional (2D) protein gel electrophoresis to visualize cellular changes. The approach is conceptually sound but technically limited, in being hard to standardize and automate and capable of detecting only a few thousand of the most abundant proteins. Instead, a future version of the 2D gel might involve an automated system to take total cellular protein, partially separate it chromatographically, proteolytically cleave each fraction, analyze it by mass spectrometry, and recognize the resulting peptides by comparing their signatures to the complete protein database. Modern mass spectrometers can provide sufficient information to allow unique recognition of protein fragments, as well as detection of secondary modifications such as phosphorylation and glycosylation. Alternatively, it may be possible to devise "chip" detectors for proteins.

7) *Systematic catalogs of protein interactions*. One approach to reconstructing cellular machinery and inferring function is to identify protein interactions, because proteins engaged in a common task (such as a signalling cascade or a macromolecular complex) often contact one another. Methods for identifying partners include generic interaction traps (such as the yeast-two hybrid system) and specialized traps (for example, to find proteins targets of kinases or DNA targets of zinc finger proteins). Improvements are needed to ensure that apparent interactions are biologically relevant, by decreasing nonspecific background and exploiting information about temporal and spatial localization of proteins.

Once all proteins are known, it should be possible to assemble comprehensive "interaction maps" of genomes. This has already been accomplished (*14*) for bacteriophage T7 (which has 55 genes), and it should be possible to automate the approach to tackle yeast or even the human genome. Finally, methods for discerning pathways on the basis of principles other than physical interaction should also be explored.

8) *Identification of all basic protein shapes*. Biochemists increasingly believe that it will be possible to infer most protein structures by analyzing their amino acid sequences against a limited compendium of basic shapes (*15*). Although it is not yet clear how rapidly this catalog will approach saturation or whether high throughput, genome-style techniques could accelerate progress, the possibility of a comprehensive approach should be considered.

Society

The societal issues raised by genomics require much more extensive discussion than is possible here, but they must not go unmentioned.

9) *Increased attention to ethical, legal and social issues* (ELSI). As genetic readouts increase in power and decrease in cost, the potential for intrusive applications will skyrocket. Future ELSI efforts will require acute scientific vision to anticipate the problems and propose safeguards.

10) *Public education*. Individuals will be faced with the choice of whether to obtain global views of their own genomes and the

need to interpret the information. At present, the general public has only a rudimentary grasp of genetics and lacks accessible ways to learn more. Although the current ELSI effort includes some educational projects, a distinct and expanded program should be launched that is aimed at education of school children, the general public, physicians, and genetic counselors.

Conclusion

The challenge ahead is to turn the periodic table produced by the era of structural genomics into tools for the coming era of functional genomics. Initial prototypes suggest that the goals are feasible, although more elegant and powerful approaches are surely needed.

It remains to be seen whether the best model to seize the opportunities ahead is a second Human Genome Project, a collection of mini-projects, many investigator-initiated grants, or all of the above. The diverse nature of the goals suggests that multiple efforts will be required rather than a single monolithic project. Some organization will surely be needed: infrastructure is not built by accident.

Whatever the organizational choice, three things are clear. The program should start now, long before the completion of the human sequence; global approaches can already be applied to the complete yeast sequence and can be implemented piecemeal as the human sequence becomes available. The program must include a major commitment to interdisciplinary training of young scientists. Finally, it must ensure broad dissemination of new technologies to every benchtop.

We live in a time of breathtaking transitions in the biological sciences. Molecular genetics has spawned a new revolution every decade and has now brought us to the brink of a global vista on life.

Note added in proof: Statistical aspects of whole-genome association studies are also discussed by Risch and Merikangas (*16*).

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2. Because sites of human polymorphism occur roughly every kilobase, it will not suffice to compare a single affected individual and a single unaffected individual. However, comparison of many individuals will likely implicate the correct gene as having a high proportion of variants in affecteds.
3. M. Chee *et al.*, *Science* **274**, 610 (1996).
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5. Under classical simplifying assumptions, the effective number of alleles at a locus is expected to be $n = 1 + 4N\mu$, where N is effective population size and μ is mutation rate. The human population was perhaps $N \approx 100{,}000$ individuals roughly 100,000 years ago [F. Ayala, *Science* **270**, 1930 (1995)] and the mutation rate for a typical gene is perhaps $\mu = 2 \times 10^{-6}$. Although only approximate, the model clearly indicates that n is small.
6. Given the limited information about population variation, I am deliberately vague about the precise populations to study. Studies of coding variation in a few dozen genes in several large populations would provide an adequate answer.
7. See, for example, E. S. Lander and N. J. Schork, *Science* **265**, 2037 (1994).
8. A Z score of $Z_1 = 1.96$ standard deviations (SDs) corresponds to the 5% significance level when testing a single variant, whereas $Z_2 = 5.3$ provides the same significance level after correction for testing 500,000 independent hypotheses (five variants in each of 100,000 genes). The required increase in sample size is roughly $(Z_2/Z_1)^2 = 7.3$.
9. The use of genetic markers to recognize chromosomes descended from a common ancestral haplotype, called linkage disequilibrium mapping, is a powerful method for fine-structure mapping of Mendelian traits in isolated populations, such as in Finland [J. Hastbacka *et al.*, *Cell* **78**, 1073 (1994)]. With a sufficiently dense genetic map, ancestral haplotypes should be detectable in larger and older populations. For example, an ancestral mutation introduced into a population 1000 generations ago (≈20,000 years) will reside in a region of about 0.2 cM (or about 200 kb) in which recombination has not altered the ancestral haplotype. The density of polymorphism should permit unique recognition of such a region.
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FRANCE

New CNRS Chief Gets Marching Orders

PARIS—Geochemist Claude Allègre, France's new minister for education and research, is hoping this week to kick off his promised campaign to re-energize French science by appointing physicist Catherine Bréchignac as the first woman director-general of France's giant research agency, the Centre National de la Recherche Scientifique (CNRS). As *Science* went to press, the Council of Ministers of the new Socialist government was expected to approve the appointment at its 16 July meeting. Bréchignac, highly respected as both a researcher and an administrator, will be charged by Allègre with slimming down the CNRS's weighty bureaucracy and attracting more young scientists into its ranks, in what many see as the first step in a far-reaching shake-up of French scientific institutions.

New broom. Physicist Catherine Bréchignac.

The CNRS, with 11,600 researchers and a $2.45 billion annual budget, is France's largest public research agency and the backbone of its fundamental research effort. Bréchignac will replace Guy Aubert, whose term as CNRS director-general expires on 18 July. Aubert was appointed by the previous conservative government and was closely associated with its budget-pruning policies. Bréchignac's appointment was warmly welcomed by colleagues who spoke to *Science*. "Her scientific qualifications are incontestable," says Michel Broyer, director of the CNRS's Ionic and Molecular Spectrometry unit at the University of Lyons. Mathematician Jean-Pierre Bourguignon, director of the Institut des Hautes Études Scientifiques near Paris, adds that Bréchignac "is an extremely direct woman, who presents her point of view but is capable of listening to others and changing her mind if she is convinced."

Bréchignac, who has an international scientific reputation in the field of atomic clusters, is no stranger to the CNRS administration. In 1995, after 6 years as director of the Aimé Cotton physics laboratory at the University of Paris's Orsay campus, she was named scientific director of the CNRS's physics and mathematics department. Bourguignon says that during her tenure as department chief, Bréchignac "always gave priority to research. ... She is passionately engaged in science."

Bréchignac will need to muster all her administrative skills to fulfill what the government expects her to do as the new CNRS head. Geophysicist Vincent Courtillot, Allègre's chief adviser, says that she will soon be receiving a detailed "assignment letter" from Allègre, spelling out an ambitious program of changes at the agency. One of her first tasks will be to ask the scientific directors of all seven departments to resign. Although many of them may be reappointed to the new team, in some cases new people will be asked to take over. Bréchignac will also be expected to carry out a sweeping program of "debureaucratization" at the agency. "The central administration of the CNRS is too fat and complex," Courtillot says. "We are thinking of cutting down by a factor of 2." Similarly, the plethora of committees and meetings that fill researchers' time will also be drastically reduced. At present, "any ranking scientist over 45 thinks he must be on a plane traveling to a meeting in Paris twice a week," says Courtillot. "This is a disaster."

Another major priority for the new director-general will be to recruit young scientists to gradually replace the CNRS's aging scientific talent pool. Allègre had earlier announced his intention to end a freeze on scientific employment and to hire several thousand young researchers in the universities and public research agencies, beginning this autumn (*Science*, 13 June, p. 1638). Moreover, Courtillot says, the government expects the CNRS and other agencies to do more to accommodate researchers from the universities and industry who want to spend time in CNRS labs, and vice versa. Another possible change, which is certain to be controversial, is to limit how long senior scientists are encouraged to do research. "We are not so sure all of them should expect to continue in a full-time research career," says Courtillot.

But one change that will be welcome to many researchers is a reversal of the previous government's policy of earmarking large sums of money for special programs and projects, often at the expense of individual labs. "We want the CNRS to restore funding to the labs, so they can function on the philosophy that you can't program discoveries," Courtillot says. "A research policy does not consist of programs, but of hiring high-quality scientists. When you hire someone good, you've made your research policy for the next 20 years."

–Michael Balter

GENETIC RESEARCH

Clinton Backs Broad Genetic Safeguards

In an effort to prevent the misuse of human genetic data—and remove a potential roadblock from some types of genetic research—President Clinton this week urged Congress to pass a new federal law forbidding discrimination based on a person's genes. Speaking to a select audience of Administration officials, legislators, and health care activists at the White House on 14 July, Clinton said he wants to make it illegal for any health insurance company to deny coverage to a healthy person simply because medical data indicate that the person is at risk for an inherited disease. He said he will join forces with a bipartisan group in Congress to write legislation to that effect.

"It is wrong for an insurance company to use genetic information to deny coverage," Clinton said, adding that "we cannot allow our progress in science to be undermined" by concerns over the misuse of genetic data. Clinton said that people are so worried that negative genetic test results will cause them to lose insurance coverage that many are afraid to participate in genetic research.

Although the president did not release the text of his proposed legislation, he said that he aims to build upon several existing bills, including the Kassebaum-Kennedy package that became law in 1996. That legislation makes it illegal for anyone who provides group health insurance to deny coverage on the basis of genetic information. According to a White House information sheet, the president would like to extend this protection to people who buy individual policies. He would also like to make it illegal for companies to raise premiums on the basis of genetic data.

In addition to banning discrimination, Clinton is calling for new regulatory controls to prevent the "inappropriate disclosure of genetic information." Although the details are yet to be worked out, a White House statement says the president would like to protect privacy by "preventing health plans from releasing or demanding access to genetic information" without the consent of clients. He would specifically limit the sharing of genetic data among insurance providers and authorize the secretary of the Department of Health and Human Services

to prohibit other types of data transfer as necessary. Some researchers are concerned that draconian privacy rules could interfere with the flow of research data. But the Administration promises to provide "safe harbors" for "beneficial uses" of genetic data, "including for important biomedical research efforts."

This package of not-fully-defined ideas was put together on short notice, according to congressional staffers. "It all happened on Tuesday night [8 July]," says a Senate aide, "when the White House called saying, 'We want you to look at this bill and introduce it on Monday [14 July].' " It did not get introduced in the Senate. Instead, Administration staffers now say they plan to cooperate with members of Congress to improve existing or pending legislation—such as a proposal originally introduced in 1995 by Representative Louise Slaughter (D–NY). It has been reintroduced in the House as HR 306 and has won 135 co-sponsors. Senator Olympia Snowe (R–ME) introduced a companion bill in the Senate and may do so again. In a minor coup for the Administration, two Senate Republican leaders—James Jeffords (R–VT), chair of the Labor and Human Resources Committee, and William Frist (R–TN), chair of the Subcommittee on Public Health and Safety—said they support the president's goals and will include them in legislation.

However, one ambitious, genetic privacy bill that proposed to put extensive controls on the collection and use of genetic data—introduced by Senator Pete Domenici (R–NM)—has been quietly pulled back for an overhaul. Biotech outfits and basic researchers alike protested its broad reach, says a Domenici staffer. As a result, the "snags" are now being removed.

A key problem that surfaced in the Domenici bill—and one that may haunt the Administration proposal as well—is the question of what is meant by the term "genetic information." It has not been spelled out as yet, but if the proposed legislation adopts a very broad definition, Congress may soon find itself debating big changes in the way medical records are handled. A Frist staffer predicts that hearings on protecting genetic data will begin in the Senate this fall.

–Eliot Marshall

MALARIA RESEARCH

Global Initiative Takes Shape Slowly

THE HAGUE—Leaders of the world's wealthiest biomedical and financial aid organizations met here last week to discuss how they might pay for a new assault on malaria, a disease that kills more than 2 million people a year. The meeting followed the lead of a gathering of scientists, held last January in Dakar, Senegal, which called for a cooperative effort to aid scientists and build up research networks in Africa. The U.S. participants were eager to create a "common pot" of funds, as National Institutes of Health (NIH) director Harold Varmus said last winter (*Science*, 17 January, p. 299). Varmus was also interested in joint peer review.

Both ideas received a cool reception at The Hague. The meeting-goers made no funding decisions, continuing this Multilateral Initiative on Malaria (MIM) strictly as a planning effort. Representatives of major organizations departed with promises to "improve communication and coordination," as a communiqué stated. While the participants made no firm commitments, many were, at least, encouraged by the involvement of big-league development agencies—including the World Bank—which are seeking ways to engage industry in the battle against malaria.

Varmus had pushed initially for quicker action, asking agencies to "take risks ... on interagency funding" of research through schemes that would be "not permanent, but experimental." He also suggested "coordinated peer review of subsets of the research enterprise." In support, meeting co-organizer Barend Mons of the Netherlands Organization for Scientific Research noted that "we research managers are lagging 10 years behind the scientists." He said, "We need to work to share resources like the scientists do." However, Robert Howells of the Wellcome Trust countered these suggestions, pointing out that "collaboration and cooperation are a reality at the level of the investigator" already, because "over 80% of Wellcome Trust–supported investigators also receive funding from other agencies."

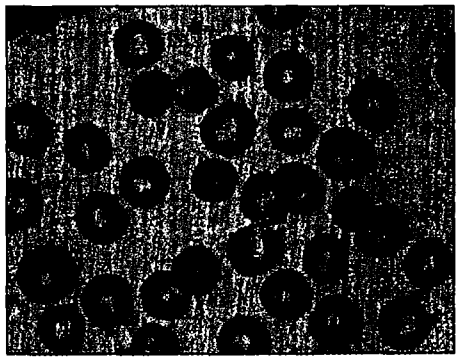
Shared peer review also met resistance on the grounds that it would be too cumbersome. George Radda of the U.K. Medical Research Council and Mark de Bruycker of the European Commission raised both legal and practical difficulties. Some scientists also argued against such moves: Bruno Gryseels, director of the Prince Leopold Institute of Tropical Medicine in Antwerp, Belgium, felt that "momentum would suffer" if agencies agreed to "installing another administrative, secretariat, or triage level without any increase of funds."

Organizers of the Dakar meeting last winter had encouraged African researchers to send letters of interest describing ideas deserving support. Although NIH officials had hoped to review and take joint action on the letters this summer, that now seems unlikely. Tore Godal of the World Health Organization has agreed to coordinate a response to the applicants, and the communiqué says that the letters will be used to develop workshops on projects focused on individual proposals. A planning group will continue to explore mechanisms of collaboration.

Researchers said they were heartened to see major pharmaceutical company officials at the meeting, although industry has invested relatively little in antimalarial vaccines or drugs. According to Jerry Sadoff of Merck & Co. in Whitehouse Station, New Jersey, however, companies are still waiting to be convinced that new products can be made efficiently and that there would be "a guaranteed marketplace" for them.

Ok Pannenborg of the World Bank and David Namarro of the U.K. Department of International Development said that their agencies may be prepared to become involved at two levels to help win over industry: in upstream subsidies for drug development and in lending money to buyers specifically to purchase new products at reduced prices. But overcoming industry skepticism will continue to be a challenge.

For now, MIM will operate as "a loose confederation," says John LaMontagne of NIH's National Institute of Allergy and Infectious Diseases. Before leaving The Hague, participants made some new pledges. The U.S. National Library of Medicine's Elliot Siegel, along with other aid agencies, volunteered to develop a strategy for Internet connectivity for major African institutes. The Malaria Foundation of New York offered to develop a public relations strategy. Pannenborg committed the World Bank to undertaking a macroeconomic and marketing analysis for new antimalarial products. And all agreed to meet again under the auspices of the Wellcome Trust—probably in the United Kingdom 6 months hence—to continue these discussions.



CNRI/PHOTOTAKE/PNI

Prime target. Malaria parasite *Plasmodium falciparum* is the focus of vaccine and drug research.

–Richard Gallagher

With additional reporting by Eliot Marshall.

S. 1322/H.R. 2457
The Genetic Nondiscrimination in Health Insurance and Employment Act of 1999

* Indicates provisions also in S.326, the GOP bill; provisions without asterisk are unique to S.1322/H.R. 2457

TITLE I. PROHIBITION OF HEALTH INSURANCE DISCRIMINATION ON THE BASIS OF PREDICTIVE GENETIC INFORMATION

Applies to four areas of health insurance:

1. Self-insured or other health insurance plans governed by the Employee Retirement Income Security Act of 1974.*

2. Group health insurance plans governed by the Public Health Service Act.*

3. Individual insurance policies governed by the Public Health Service Act.*

4. Medigap insurance policies governed by the Social Security Act.

The protections outlined below are applied to all four areas.

Discrimination

- Prohibits health plans or health insurance issuers from restricting enrollment based on predictive genetic information or information about genetic services.*

- Prohibits health plans or health insurance issuers from adjusting premium or contribution rates for individuals or groups based on predictive genetic information or information about genetic services.*

Genetic Testing

- Prohibits health plans or health insurance issuers from requesting or requiring an individual to undergo genetic testing. A health care professional treating a patient may suggest that a patient undergo a genetic test.

Collection of Predictive Genetic Information

- Prohibits health plans or health insurance issuers from requesting*, requiring*, collecting*, or purchasing predictive genetic information or information about genetic services. (Exception for payment of claims in strictly limited circumstances.)
  GOP bill allows requests for diagnosis, treatment, and payment. No limitation on

circumstance where request for payment purposes is allowed.

Disclosure of Predictive Genetic Information

- Prohibits disclosure of predictive genetic information or information about genetic services to:
  - Health plans or health insurance issuers (except for payment for health care under strictly limited circumstances).
  - Employers.
  - The Medical Information Bureau, or other entities that collect or disseminate insurance information.
  - Other persons the Secretary of Labor or Health and Human Services may specify in regulations.

Enforcement

- Individual may bring private right of action in state or federal court. The court may award any appropriate legal or equitable relief.

- Secretary of Department of Health and Human Services or Secretary of Labor may bring an action in federal court for civil monetary penalties of up to $50,000 for first violation, up to $100,000 for subsequent violations.

Relationship to Other Laws

- This Act would not supersede any more protective state law on the confidentiality of genetic information or prohibiting discrimination on the basis of genetic information.

Definitions of Predictive Genetic Information and Genetic Test

- Predictive genetic information is defined as information about an individual's own genetic tests and information about genetic tests, diseases, or disorders of an individual's family members. Predictive genetic information does not include information about an individual's current health status, but predictive genetic information is protected regardless of health status.*
  GOP definition only protects genetic information in the absence of symptoms, clinical signs, or a diagnosis.

- Definition of genetic test includes analysis of DNA, RNA, chromosomes, proteins, and metabolites to detect genotypes, mutations, or chromosomal changes. The definition was developed from language created by the Task Force on Genetic Testing convened by the NIH-DOE Working Group on the Ethical, Legal, and Social Implications of Human Genome Research.*
  GOP definition only considers genetic tests in asymptomatic or undiagnosed individuals to be genetic tests. Test must be for the purpose of predicting risk; excludes genetic

information revealed inadvertently.

TITLE II. PROHIBITION OF EMPLOYMENT DISCRIMINATION ON THE BASIS OF PREDICTIVE GENETIC INFORMATION

Definitions:

- The definitions of genetic test and predictive genetic information are the same as those in Title I. Definition of employer and employee are from the Civil Rights Act.

- Genetic monitoring is defined as periodic examination to detect any damage to genetic material which might occur as a result of exposure to toxic substances in the workplace.

Discrimination (Applies to Employers, Employment Agencies, Labor Organizations, and Training Programs)

- Predictive genetic information or information about genetic services may not be used as a basis for:
  - Hiring, discharging, compensation, terms, or privileges of employment
  - Limiting, segregating, or classifying individuals
  - Representation by or referral for employment by an employment agency
  - Exclusion, expulsion from membership or other discrimination in a labor organization
  - Discrimination in admission to or employment by any training program

Collection of Predictive Genetic Information

- Predictive genetic information may not be requested or required by an employment agency, labor organization or training program.

- An employer may request genetic information only:
  - For monitoring of effects of toxic compound in the workplace, if employee has provided prior written authorization, the employee is informed of the results, the monitoring conforms to regulations that the Secretary of Labor may promulgate, and the employer only receives the results in aggregate.
  - If genetic services are directly provided by the employer with employee consent, and only the employee receives the results of the services.

Maintenance and Disclosure of Information

- Any predictive genetic information in the possession of an employer must be kept as a confidential part of the employee's medical record.

- Predictive genetic information may be disclosed only:
  - to the employee at his or her request

- to an occupational safety or public health researcher under 45CFR46 (the "Common Rule")
- under legal compulsion of a Federal court order
- to government officials for investigation of compliance with this Act.

Enforcement

- Individual may bring private right of action or class action in state or federal court. The court may award any appropriate legal or equitable relief. Action may be brought under the Equal Employment Opportunity Commission.

Relationship to Other Laws

- This Act is not intended to limit rights or protections under the Americans with Disabilities Act of 1990 or the Rehabilitation Act of 1973.

- This Act would not supersede any more protective state or federal law on the confidentiality of genetic information or prohibiting discrimination on the basis of genetic information.

- This Act does not apply to the Armed Forces Repository of Specimen Samples for the Identification of Remains

- The Act does not limit the statutory or regulatory authority of the Occupational Safety and Health Administration and the Mine Safety and Health Administration.