



DNA Biobanking in Olmsted County

A Deliberative Community Engagement

A project by the Mayo Clinic Bioethics Research Program in collaboration
with the Center for Applied Ethics at the University of British Columbia

Funded by the Mayo Clinic Center for Individualized Medicine

Ethical, Legal, Social, and Policy Challenges in DNA Biobanking

Under the direction of Dr. Barbara Koenig, Mayo Clinic is conducting research projects to understand the complex ethical, legal, social, and policy issues in DNA biobanking. As part of these studies, Dr. Koenig's research team is gathering information on the views of current and potential participants in DNA biobanking at Mayo.

Dr. Koenig's projects include an interview study with Mayo patients and Native Americans, and this community engagement event, which will allow you as citizens to make recommendations to Mayo as it begins to make policies about collection and uses of DNA samples from its patients. These projects seek to identify community concerns and assure a community voice in Mayo's future plans for DNA biobanking.

These projects have been funded by the Mayo Clinic Center for Individualized Medicine and the Mayo Clinic Genomics/Proteomics Oversight Committee.

The Mayo Clinic Biospecimen Trust Oversight Group (BTOG) has been charged with planning Mayo's biobank. The results of the deliberative community engagement will be reported to that group.

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“We must begin now to prepare for the future; we cannot wait until the details are known or fully understood, nor can we expect that others will address our concerns or solve our problems. ... This engagement in the form of discussion, debate, reading, and thoughtful consideration, is in itself the educational process essential to preparation.”

— David B. Schowalter, M.D. (1960-2007)
Consultant, Mayo Clinic Department of Medical Genetics
Founder, Mayo Clinic Biospecimen Trust Oversight Group

The purpose of this booklet

This booklet is meant to stimulate discussion and reflection on Mayo’s plans for a biobank. It contains perspectives on biobanks collected from current literature. It was written in collaboration with our colleagues at the University of British Columbia. It contains specific information about Mayo Clinic’s plans.

While this booklet contains a wide variety of opinions, it does not pretend to include all possible perspectives.

A glossary of terms is included at the end of this booklet.

The importance of community engagement

People in our society are concerned about the development and regulation of science and technology. Discussion about these concerns is shifting from telling people what they need to know about science and technology, to discovering that all citizens are sources of information and therefore have important things to say about policy.

Here we aim to do both: educate and seek advice. Our goal is to inform policy more effectively by drawing on people from many different backgrounds, and with many different opinions, needs and expectations. By using the knowledge, insight and advice of an educated citizenry to create policy, we can make decisions that reflect social realities and add to the trust we can put in the outcomes of policy debates.

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Introduction

Debating biobanks

The Human Genome Project opened a new world of possibility for medical research. By associating a person's genetic makeup with environmental factors, personal history, and disease, we can attempt to conduct research that leads to the eradication of certain illnesses and a dramatic improvement in the quality of human life. Biobanks are a key element in this research.

Biobanks can also be used in forensics, personal identification, organ transplantation, blood transfusion, and for many other purposes. Some existing collections are hundreds of years old (stored as autopsy results) and are relatively simple. Modern collections are far more complex, as advances in technology make it possible to link medical and environmental records with blood and tissue collections to create collections of biological information that are useful in a wide variety of research projects.

Governments around the world are investing in biobanks, as are private companies. National biobanks such as the United Kingdom Biobank and the Estonian Genome Project involve samples from hundreds of thousands of people.

Hospitals all over the country have biobanks in the form of blood and tissue collections in pathology departments and cancer tissue repositories. Your trip to the hospital for surgery might end with your tissue being stored in such a collection.

Scientists, lawyers, ethicists, policy makers, interest groups and industry have been debating the ethics of biobanks for two to three decades. Many see great hope, others cause for concern.

Some scientists think biobanks are key to

untangling the links between disease, genetics and public health, and they debate the best way to establish and organize them so as to increase access to the information they hold.

Some groups feel biobanks and access to the information they hold should be strictly controlled. Some groups anticipate relief from disease as a result of research using biobanks, while others fear breaches of privacy and discrimination. Native American peoples, for instance, have had their blood used for research they find offensive, while pharmaceutical companies have patented collections to develop products and make profits.

A central issue in the use of biobanks is obtaining the permission of the individuals whose tissue is being collected. This is called "informed consent." But since it is not possible to predict all the ways biobanks might be used in the future, it is also not possible to tell people how that tissue might be used. Re-contacting people as each new use emerges would be difficult and costly; asking people for a blanket approval of all possible future uses is not allowed under current medical privacy laws and concerns about truly informed consent.

Mayo Clinic has not yet established standards to govern the use of its DNA biobank. The research team organizing this event believes that experts at Mayo do not have enough knowledge of the views and interests of the public to design good policy. This project is one approach to informed, democratic involvement of the community in Mayo's decision making.

Biobanks in context

Biobanks are a modern attempt to centralize collections of human blood and tissue samples along with other information including details about health, personal history, and environmental factors, as well as information from DNA, family disease histories and exercise habits. Biobanks, like collections of cancer tissue or autopsy materials, may be used for clinical care, health research, crime investigation and a number of other uses, some not yet even conceived.

How all this information works together to influence human health and well being is the focus of much current – and complex – medical research. The time, effort and cost required to investigate these relationships and to develop tests and therapies to treat human disorders will be considerable.

Biobanks speed research

Biobanks are a convenient shortcut to medical discovery, allowing scientists to conduct health research without having to seek out and find participants for each project. Research with these collections could refine what we know about disease, help us to make better choices about the way we live, pinpoint environmental toxins, accelerate the generation of scientific knowledge, provide genetic markers for diagnostic tests and determine why people respond differently to drugs.

Biobanks take many forms

Different biobanks collect different types of samples and associated information, depending on the specific purpose of the biobank. A great deal of tissue already exists in the form of clinical and diagnostic samples. For example, tumor tissue is collected and stored after removal during treatment. These samples are collected for use in patient care but they may be used for

future research. Other biobanks are designed for a specific research goal, and they organize a range of tissue, DNA, or blood samples with medical record data, historical health information (including genealogies and family histories), and lifestyle information. They may include a variety of samples collected from the same people over time.

Biobanks may be large and hold hundreds of thousands of samples, or they may be small and hold only a few hundred samples. Biobanks can be specific to particular diseases like cancer or Alzheimer's disease (disease-based), amass samples from a population on the national level (population-based), study twins, ancestry, or even attempt to track human migrations.

Biobanks have produced results

In 2006, researchers from deCODE Genetics used the Icelandic biobank to locate a version of a gene that increases the risk of diabetes. The finding suggests that people carrying one copy of this gene variant have a 45 percent greater risk of the disease. The finding could lead to a test for the gene variant that might encourage people with this risk to make behavior and diet changes and possibly avoid the consequences of diabetes.

How can an individual be identified by DNA?

DNA is completely unique to each individual. No one except you has your exact DNA makeup (unless you're an identical twin). Because DNA can be found in blood, semen, skin, bones and even sweat or saliva, it is a relatively simple and effective way of identifying individuals. A sample the size of a pinhead is sufficient to collect enough DNA to identify someone.

Examples of biobanks

Project	Location	Type	Description	Funding
Marshfield Clinic Personalized Medicine Project	Marshfield, Wisconsin	Population-based	Launched in 2002, this is the largest population-based genetic research project in the United States, involving more than 18,000 central Wisconsin residents.	Health Resource and Services Administration (HRSA); Technology Development Fund-Wisconsin Department of Commerce; and The Marshfield Clinic
Genetic Alliance Biobank	Washington, D.C.	Disease-based	Created by advocacy groups to promote research. Recruits donors to the bank from the advocacy organization's community.	Advocacy groups such as Angioma Alliance, PXE International and the National Psoriasis Foundation.
National Biospecimen Network	Various U.S. sites (e.g., Duke University and Mayo Clinic)	Disease-based	Links various preexisting collections in the U.S. to enable research on cancer	U.S. National Cancer Institute
Icelandic Biobank	Reykjavik, Iceland	Population-based	Blood samples from 270,000 Icelandic citizens and linked to Iceland Health Sector database and genealogical database	A public-private collaborations with deCODE Genetics and Icelandic government
UK Biobank	Manchester, UK	Population-based	DNA, medical records and lifestyle questionnaires from 500,000 adult volunteers, to be followed for 30 years	Publicly funded by national funding bodies like Wellcome Trust and the Medical Research Council
Biobank Japan	Kanagawa, Japan	Population-based	DNA samples from 300,000 individuals of 20+ years of age suffering from 30 common illnesses	Initiated with public funding

Scientific Perspectives

Biobanks can support research in a variety of applications. Smaller biobanks with specific types of samples and data can be used to examine the genetic, environmental and lifestyle factors that relate to a particular disease. As research explores more complex diseases – where multiple genes and more complex environmental and lifestyle factors are involved – the influence of genes becomes increasingly difficult to assess and smaller biobanks become less valuable. Larger, biobanks are increasingly necessary for research. Scientists who support biobanks anticipate that they will allow genetic information to be more predictive and medicine to be more individualized. How well researchers can achieve these outcomes depends on how biobanks are organized and what is collected – a point of disagreement among some scientists.

Collecting human tissues and data is not new

The first hospital blood bank was created in 1937 by Bernard Fantus in Chicago. Autopsy samples have been collected for much longer. In fact, the biggest and best-funded human gene banks are forensic collections used for criminal investigations.

Access to samples

Despite huge collections of human samples around the world (by some accounts 300 million human samples are stored in the U.S. alone), scientists have a hard time accessing them for research. Most collections are decentralized and uncoordinated. They often do not have standards for the types of medical information collected with the sample. Often, scientists cannot get permission to

use them for certain kinds of research. Many scientists are frustrated by these difficulties and feel that research is stalled as a result.

Biobanks can help improve drug design

The earliest benefit of biobanks, according to many scientists, is likely to be better drugs. Since most research and development of drug therapies is financed by private corporations, governments and tax payers will provide a much smaller portion of the funds needed for medical research to move forward. Biobanks will be an important part of this research through pharmacogenomics, the study of the relationship between a person's genetic make-up and drug response. Biobank research may help tailor a medication to the genetic make-up of each patient, making drugs safer and more effective.

Regional biobanks can help local populations

Large-scale biobank projects going on around the world will be useful for research everywhere. But different regions could benefit from biobanks made up of samples from local populations, since different populations experience disease differently and are likely exposed to different environmental risk factors. Regional biobanks would also allow better access for local researchers to biological materials.

Biobanks can help crack complex diseases and traits

Complex diseases like heart disease and cancer likely involve multiple genes (perhaps hundreds). Biobanks could enable more detailed, long-term studies of the genetics behind these diseases.

The potential of biobanks: three examples

Biobanks and cancer research

The National Cancer Institute is funding a biobank at Mayo Clinic called the “Biospecimen Resource for Pancreas Research.” This biobank will allow researchers to study why people develop pancreatic disease. Biospecimens (tissue or blood samples) from patients will be studied in the lab to find different factors that may affect the development of pancreatic disease. Studying these biospecimens will increase doctors’ understanding of the causes of disease and the changes that the pancreas undergoes as the disease progresses.

National Health and Nutrition Examination Survey (NHANES)

In addition to studying the biospecimens (blood, tissue, etc.) in a biobank, clinical information and medical histories that are obtained from donors are also valuable. An example of how this is used is NHANES, which is a yearly survey conducted by the National Center for Health Statistics at the Centers for Disease Control. The survey combines interviews and physical examinations to assess the health and nutritional status of adults and children in the United States. Survey results are used to determine the prevalence of major diseases as well as risk factors for certain diseases. NHANES findings are the basis for developing public health policy and strategies for improving health nationwide.

Pharmacogenomics and personalized medicine

Pharmacogenomics is the study of how people respond to drugs and how their genes influence those responses. Mayo Clinic researcher Dr. Richard M. Weinshilboum, M.D., and his colleagues

studied the responses of children with leukemia to the drugs designed to treat the disease. Some children were cured by the treatment, while others died. The researchers discovered that individual genes determined whether the medication would be therapeutic or toxic for each child. This led to the development of a simple DNA test that protects patients from life-threatening drug reactions.

By having access to a DNA biobank, researchers can study large groups of patients to find genes that may affect responses to drugs. Doctors could choose a medication based on the genetic makeup of an individual.

Is the genetics focus in research too strong?

Some scientists believe that a focus on genetics distracts attention from environmental and economic factors in the development of disease, such as unequal access to health services. They argue that industry’s focus on profitable research is too influential on biobanks and research. Most common chronic diseases (e.g., heart disease) are the product of complex interactions between genes, time, and the environment. It is unlikely a genetic silver bullet exists that will quickly and significantly improve the population’s health with regard to complex diseases.

The complexities of common chronic diseases will make biobanking effective for improving public health only if steps are taken to design biobanks that can monitor such complexity. Some suggest this can be done with large-scale biobanks that follow a cohort of people and collect both genetic and environmental measurements over each participant’s lifetime. Alternately, we might abandon biobanks altogether and be better served by focusing our time and resources on lifestyle and environmental changes that seem to be of general benefit, such as urging people to stop smoking.

Biobanks and Native Americans

Native Americans in the United States have diverse opinions about biobanking. Some see genetic research as a violation of the sacred human body, while still others think it is a political threat, or an attempt to harm them. Others are happy to donate DNA samples. They support research that promises improved health for their families and communities. Many also see the pros and cons and want to review each research project to assess whether the benefits justify the risks.

Native Americans may have unique concerns about DNA biobanking

Concerns of Native Americans help to show the unique ethical and cultural implications of DNA biobanking. Because Native Americans have suffered greatly in the past from the expansion of politically dominant cultures that tried to overpower, remove, or forcibly integrate them into American society, they are especially likely to have unique concerns. Native Americans may be concerned that:

- research will be carried out without respect to their beliefs
- their resources will be exploited for uses that will benefit non-Native people
- research will not address the most pressing problems for Native populations
- they will suffer from the danger of genetic stereotyping and discrimination, which is more of a risk for vulnerable populations who already experience prejudice.

Science threatens creation stories and political rights

After the Human Genome Project was underway, in 1999, the Human Genome

Diversity Project began. This project was to collect the genomes of isolated native populations to study global migration patterns. Native peoples around the world were upset that they weren't consulted. Some groups, including the Ottawa-based Indigenous Peoples Council on Biocolonialism, feared the project might contradict their origin stories and support the Bering Straits Theory (that their ancestors migrated from Asia across the Bering land-bridge), thus challenging their land rights.

This incident suggests the importance of including the voices of native peoples in designing comprehensive biobanks. If the banks are designed to cover a broad population, then native peoples should be included both to enhance the research and to allow them to share in the benefits.

Should Native Americans' DNA be used in the research it was collected for and nothing else?

The Havasupai Tribe brought a lawsuit in 2005 against researchers at Arizona State University when they discovered that samples donated for diabetes research had been used for other purposes. Researchers were using the tribe members' samples to look at human migration patterns and to look at genes for schizophrenia, without their permission. The tribe sued Arizona State University, the two institutions that performed gene analysis, and individual scientists for damages up to \$75 million.

Donated samples make money and drugs for the rich

Some people think that making profits from human samples is wrong in principle. Individuals, nations, and international corporations take tissue samples as donations, patent the research products, and make large profits. They also produce drugs that only the wealthy can afford. Others argue that biobanks are the latest form of conquest of Native American culture and property.

Genetic research could cause discrimination and prejudice

Some native and non-native people share fears that they won't have jobs or insurance if employers and insurers know their risks of genetic disease. Much research is carried out on representative samples of entire populations, which increases the probability that an entire tribe could be linked to a genetic condition. People also fear that researchers might discover genetic links to common conditions on reservations, such as alcoholism, increasing prejudice against native people.

Past research has been harmful to Native American communities

Many Native American groups have suffered greatly in America's past, from the school system which broke apart family and cultures, to the taking of land. Today, their health is far worse than that of most Americans. For example, Native Americans in the U.S. live an average of 5.2 years less than non-natives. Health and social researchers have also treated native communities as laboratories for research in the past, without concern for their wishes, culture, or beliefs.

DNA on loan

A new idea – DNA on loan – is becoming useful for both researchers and native peoples. When a researcher takes DNA, he or she becomes a steward of that sample for the purposes the donor consented to. The donor or donating community retains ownership. Even samples that have been stripped of identifying information cannot be used for secondary purposes without consent. This approach reflects the needs of native communities and their desires for self-determination.

In Canada, a new set of guidelines from the Canadian Institutes of Health Research states that native communities have a right to collectively consent to research. Biological samples should be taken "on loan" for research projects

Biobanks and Race

Most human DNA is common to all people and is found around the world. A small percent of variation in DNA reflects the diversity of the human population. Variation that occurs between human groups is tiny compared to the variation that exists within any one group, such as those labeled “white” or “black.” In some cases, the differences in genes are caused by the environment, especially boundaries between human groups like oceans and mountains. These genetic groupings sometimes mirror the differences between us that are defined as “race,” but they raise controversial questions. Spurred on by historical events like the eugenics movement, many people are concerned about any research that links race and genetics. Some people question whether the term race should even enter into genetic research. How will our understanding of the concept of race be affected by biobanks? Should samples be collected and organized by race? How will people be affected?

The case for including race in genetic research

The concept of race has a place in genetic research because small differences do, in fact, exist among people from different parts of the world. Genetic variation occurs in three main ways: 1) at random when people pair up and reproduce, mixing their genes within a group, 2) the flow of people (and therefore their genes) in and out of groups, and, 3) spontaneous changes in DNA (mutations). Individuals who live in small populations that have grown in isolation likely contain fewer genetic differences. However, comparing one population to another geographically distinct population may reveal genetic differences, leading us to classify the populations as two distinct races. “Reading” an individual’s DNA at 100

random places along their genes is enough to distinguish his or her ancestry. Several scientific projects (the Human Genome Diversity Project and one organized by the National Geographic Society) have been set up to study human genetic diversity by examining DNA changes in populations that appear to be unique based on what we know historically and socially. Differences among races may be discovered, determined or made clearer with continued genetic research.

Race and medicine

Genetics is one factor that contributes to health and disease. If a disease gene is found by chance more often in people from one race it may prove helpful in diagnosing or treating the disease. Sickle cell anemia is found more often in humans who lived in areas where malaria was present. This includes those from Africa, but also includes people from other parts of the world. With good research, methods to prevent or treat a particular disease could be appropriately targeted to the group that would benefit the most. Race may therefore be useful in medicine.

Research has shown that African Americans are more likely to suffer from heart failure than other racial groups. In 2005, the drug BiDil was approved specifically for cutting the risk of death by heart failure in African Americans. Studies showed that the drug reduces the risk of death in black patients. It is the first drug approved by the FDA (food and drug administration) for one race. Some researchers have been critical of this, arguing that the drug actually works in all patients. There is no clear answer as to which opinion is correct.

The case against including race in genetic research

Sequencing the human genome revealed just how similar we are to each other. Scientists believe that the human species evolved from a small number of African tribes nearly 100,000 years ago and, while genetic differences do exist across groups, we have not had the time or the ecological pressure to develop truly distinct races. They argue that biologically, race does not exist. Instead, they believe that race is primarily a social category. And social categories can also be useful for medical care.

There are more useful categories than race for genetic research

Dividing the human population into racial groups may make genetic research less effective because such groups are really social categories and include much genetic variation. Hispanic, for example, is hard to use as a marker of genetic disease or appropriate treatment since Hispanic people come from all over the world and share genes with those from Africa and with Native Americans, as well as Europeans. Some scientists believe it is more appropriate to consider the genetics of individual people and divide human groups in other ways, such as geographically, for research.

Ethnicity may be a more useful classification for genetic research, since it includes both genetics and culture (history, tradition, language and location), which in some cases are very important when studying disease.

Race and society

By itself, race is not a strong predictor of health outcomes compared with wealth, education, or a polluted environment. (The one exception is that racial discrimination may cause bad health.) While it may be

important to recognize race in some circumstances, it is also important not to encourage racism. Separating the population into races for biobank research could cause discrimination and, misused, may become a scientifically-justified source of social injustice.

How is race useful in genetic research?

- To label divisions in the human population and make research more organized.
- To increase the involvement of under-represented minority populations in research.
- To inform studies about the origins and migration patterns of the human population.
- To generate and explore race-specific connections between genetics, environment, and lifestyle.
- To target populations for specific treatments or disease prevention.

What are the negative consequences of using race in genetic research?

- May discourage genetic research that is beneficial to everyone.
- Might lead to discrimination against certain groups.
- Could delay scientific progress, by focusing on racial difference rather than on each individual's unique genetic signature.
- Might lead policy makers to focus on genes, thus minimizing social conditions that determine health status.

Biobanks and the Disabled Community

The term 'disabled community' is used very loosely to encompass many different physically and mentally impaired individuals who have identified themselves as a disabled group and may include the family and friends of people with a genetic condition, as well as disability advocates and researchers.

Concerns and criticisms from the disabled community

Prenatal testing

Genetic research using biobanks will likely add to the number of genetic traits we are able to detect in embryos and fetuses. People with disabilities and disability advocates worry that as genetic technologies advance, more and more genetic traits will be labeled as "abnormal" and will be screened for with prenatal testing and preimplantation diagnosis (see glossary definition). Speculation and inaccurate assessments about the quality of life of people with detected genetic traits might lead to the decision to terminate these pregnancies.

Widespread support of terminating pregnancies based on detecting certain genetic traits may send unintended societal messages to people living with genetic impairments. For example, are the lives of people with genetic impairments less worth living, or even not worth living at all? If the number of people with impairments decreases, will the services available to help those with disabilities also decrease?

A recent example

The National Down Syndrome Society recently argued against the recommendation put forth by the American College of Obstetricians and Gynecologists that all women who are pregnant should have prenatal genetic screening for Down Syndrome. This genetic test was previously only available to women more than 35 years old. The Down Syndrome Society voiced concerns that this recommendation would lead to eugenic ideals and that Down Syndrome is a naturally occurring chromosomal arrangement that "has always been a part of the human family."

An Important distinction

Impairment is a physically or mentally limiting condition (e.g., heart disease, cancer, diabetes, Alzheimer's, Down Syndrome)

Disability is the disadvantage people have due to social arrangements (e.g., not accommodating people with disabilities in jobs, lack of effective social support systems, lack of elevators.)

Disability discrimination and social support

People with disabilities are concerned that research using biobank materials could further stimulate discrimination and justify not making social changes that would provide them with equal opportunities.

Some members of the disabled community view genetic research as a threat to their personal identity in a society that fails to accommodate their needs, and fails to provide impaired individuals better social support. They fear that:

- Research to treat or prevent genetically-caused impairments promotes the unintended message that those with impairments have a lesser social value and lower quality of life.
- If disability continues to be defined in biological terms, then it will not be seen as a condition that can be reduced or avoided through social and political change.
- Research, prenatal testing, and treatments for genetic impairments narrow the scope of what is considered “normal”, which may lead to intolerance of genetic impairment.
- Intolerance of genetic impairment may lead to eugenic efforts, such as sterilizing people with Down Syndrome or recommendations to terminate genetically “abnormal” pregnancies.
- People with genetic impairments may be encouraged to treat their condition with medical therapies, rather than challenging society to improve the circumstances that lead to disability.

Criticisms against using genetic research as a way to eliminate or cure disability can be summarized in four statements:

- Cures may not deliver the promised

solutions, have little effect, or may have side effects as serious as the original disability.

- Cures distract from the important goal of removing social barriers. Social and political changes, such as improved housing, education, and social support programs are more important and effective than individual therapy. Social justice should come before genetic research.
- The need for a cure implies that there is something “wrong” with the impaired person.
- Cures challenge the right of disabled people to be themselves, to do things their own way, to be diverse and culturally distinct. “Cure” and “prevention” express a negative valuation of the lives of disabled people.

Another recent example

One of the discoverers of the double helix shape of DNA, James Watson, recently made the headlines once again. He has become one of the few individuals in the world to have his entire genome sequenced—which means that any known markers for genetic impairment can be readily identified. Interestingly, Dr. Watson has chosen to make his genome public to researchers, with the exception of one gene that can signal a risk for Alzheimer’s disease. When questioned about this exception, he said that he did not wish to know his genetic status. This personal preference may be based on the possibility of discrimination or stigma associated with the disease.

Biobanks and Religion

Different religions have different views on science, research and genetic discovery. Some express openness to science and struggle to integrate it into lives of faith. Others are more or less opposed to these scientific endeavors. Some religious objections to genetic research are based on concerns about the applications of genetic knowledge (e.g., testing embryos and fetuses or human enhancement). Religious views must be considered when talking about biobanks because issues of informed consent and concerns about justice will be influenced by these perspectives.

Religious groups have been active in voicing their perspectives on genetic research through academic and news articles, magazines and websites. Most groups have not specifically talked about DNA biobanking. However, their views on genetic research and on the body can explain how people might consider their faith-based commitments thinking about DNA biobanking.

Some Christian views

God is the creator of life, and we are created in God's image (Gen 1:26-27). Our bodies, therefore, are sacred and should be respected. However, donation of body parts (organs, blood, tissue) for the good of others is acceptable as it emphasizes the Christian notion of love of one's neighbor. Some Christians believe that genetic research is acceptable because it can help others. Others are against genetic research, as it can be seen as "playing God" and taking over God's role as creator.

Some Islamic views

Islamic traditions view medical research to be a form of worship because it reveals to

human beings the qualities of God. The mapping of the human genome is part of our endeavor to understand ourselves and appreciate God's powers of creation (Quran, Fussilat 41: 53). However, such research should only proceed if human dignity and rights are respected.

Some Jewish views

Also following the view that humans are created in God's image, Jewish traditions acknowledge that bodies are sacred. It is important to respect the body in its wholeness and protect it from harm. However, medical research, including biobanking using body tissue is acceptable because the duties of healing (*tikkam olam*) and preserving human life (*pikuach nefesh*) are greater than the duty to preserve the body.

Some Native American views

For many Native Americans, the body is an integral part of the self and is specially sacred. Many believe that the body should remain intact throughout life and after death. Therefore donation of samples into biobanks would not be acceptable. Native American views are described in detail on pp. 6-7.

Views from Eastern religions (Buddhism and Hinduism)

Eastern religions such as Buddhism and Hinduism are based on a religious quest to achieve liberation from suffering. Since the body is an instrument in this quest, but not the essential self, research on body tissue and genes is acceptable so long as it is carried out with compassion, and an intent to relieve suffering, and does not violate the duty of no-harm (*ahimsa*).

Oversight of Biobanks

Federal regulations for genetic research and biobanks

Regulation of biobanks has an important role in guarding against misuse of samples, and in building and maintaining the public trust. Biobanks for research are governed by the ethical principles for human subjects research established by federal guidelines. These regulations define expectations for responsible conduct of research involving human participants, including informed consent and the involvement of an Institutional Review Board (IRB).

IRBs

An IRB is an independent committee within an institution that oversees research involving humans and protects their interests. An IRB is made up of doctors, nurses, pharmacists, scientists, ethicists, and people from the local community, who ensure that human research is well-planned and ethical. The purpose of the IRB is to assure that appropriate steps are taken to protect the rights and welfare of human subjects participating in research. Most research involving human subjects requires IRB approval.

IRBs assess and evaluate the study design, how participants will be recruited, the risks and potential benefits of the research, privacy and confidentiality considerations, and whether procedures are in place for subjects to give informed consent. (Informed consent is discussed in detail on p. 15.)

IRBs and biobanks

IRBs are responsible for the review and approval of human research using biobanks. They often also review proposals

for the creation of biobanks. Some people feel that IRBs should take primary responsibility for the legal and ethical issues that pertain specifically to biobanks.

However, asking IRBs to take on the regulation of biobanks is problematic because:

- IRBs are already overworked.
- Board members are typically volunteers and the volume of work they must perform is significant.
- There is significant inconsistency in how IRBs operate across the country.

Some people argue that the responsibilities of IRBs vastly exceed what they can accomplish. Boards often focus more on the informed consent process and written consent form than on other important elements that are more difficult and time consuming to review. In light of these and other concerns, some suggest that we need to create new, independent organizations to oversee and monitor biobanks.

Community Involvement

An example of a biobank very similar to the one Mayo Clinic plans to open can be found nearby at the Marshfield Clinic in Wisconsin. The Marshfield Clinic biobank is a privately owned collection of DNA (blood) samples, designed to aid in scientific research. Marshfield Clinic has also included community members in its oversight of the biobank, something Mayo is considering. The biobank is governed by three external boards: the Ethics and Security Advisory Board; the Scientific Advisory Board; and the Community Advisory Group.

International Regulations

The regulation of biobanks differs in countries around the world. Iceland and Estonia have enacted specific legislation to govern legal issues raised by biobanks such as ownership, consent, feedback, benefit sharing and access to the database. Even so, the legislation does not adequately address all the patent and ownership issues that biobanks raise. Canada, Sweden and the UK do not have regulations specifically governing biobanks but instead rely on preexisting legislation.

The need for clarity

We need greater clarity around the ethical, legal and organizational issues associated with biobanks in order to reduce risks and promote fair distribution of benefits. Policies must be created to define biobanks and their contents and develop procedures for collecting and handling them. Such procedures will have to address a range of different, and often competing, interests including consent, confidentiality, privacy, and rules for access by researchers.

Criminal and Military Biobanks

The U.S., Canada, and the U.K. all use DNA databanks for the purposes of criminal identification. The FBI's DNA database has been used as a tool to identify criminals and prove innocence. Military databases are used to help identify the remains of deceased Armed Forces personnel.

Although the use of DNA for identification does not produce useful information beyond the identity of the person, the collections could be examined using different research methods.

Informed Consent

In the United States, voluntary and informed consent for the use of blood and tissue is the primary mechanism for dealing with the ethical and legal issues associated with research involving human subjects. Donors of blood and tissue to a biobank are similarly often asked for their permission to use their samples for research.

Conditions of informed consent

- The person must have the capacity to consent. For example, a child or a person suffering from a condition which doesn't allow him to understand what is being proposed and its risks and benefits would be considered incapable of providing informed consent.
- Consent must be given voluntarily, without pressure from the researcher. Where an individual has reason to think that not giving consent might have a negative impact on her medical care, for example, such consent would not be voluntary.
- The person must have all the relevant information. The person must be told the purpose of the research, what will happen to him, about the risks, any costs, and what potential benefits might result from the research. The person needs to be told about how her information will be kept private.

With this information, the person can make a decision to participate based on his on needs, values, and interests.

Consent is more than just a form

Informed consent is not a one step process, although it is often reduced to this when the focus is exclusively on the written consent form. The informed consent process is meant to ensure that those involved understand what they are agreeing to, and

the associated risks and benefits. In the biobank context, part of this process might involve prior and continuing communication with the public or with individual participants. This could help promote individual and public trust.

Problems with consent

Informed consent rules were developed for researchers doing specific research projects. Biobanks, on the other hand, are a resource for many projects. Biobank researchers may be unable to meet the requirements of informed consent because they cannot determine all the future uses of a participant's donated biological sample or health related information.

Some people are frustrated with the consent process. Consent forms are often long and complicated, and many patients find them confusing, overly time-consuming, or irrelevant. Some patients may miss important details because they are overwhelmed by all the information. Other patients may feel pressure to sign the forms because they are used to following their doctor's instructions.

Is consent always required?

Consent is not required for use of already existing collections of anonymous tissue samples. Consent is generally required where the sample or the information derived from that sample can be linked back to any information about the donor.

Can consent be withdrawn?

Participants can withdraw consent to participate at any time which, in the biobank context, might mean withdrawing the donor's sample. Researchers have different ways of withdrawing people from participation from a biobank. They might destroy the sample, make the sample completely anonymous so that the donor cannot be identified, or destroy information

associated with the sample to prevent future use.

Privacy and Confidentiality

Privacy issues have implications for both individuals and groups in the context of genetic research. Both state and federal governments have focused on efforts to protect the privacy of health information in recent years, and they have produced various guidelines, policies, and regulations. Difficulties can arise when rules that are intended to protect privacy interests conflict with research that requires personal information to pursue its objectives.

Biobanks can support research using samples protected in various ways. Samples can be completely anonymous, collected without any personal information about the donor. Or, samples can have code numbers that link the sample to the person's identity. Only people who hold the key to the code would know who the sample came from.

Is a sample ever truly private?

The more information researchers have relating to a given sample, the easier it is for them to identify the donor, even where the samples are anonymous. In reality, even a fully anonymous sample containing your DNA could be re-identified if you provided a sample of your DNA to match it against, or if your DNA was in a criminal database.

Genetics and privacy

Some argue that genetic information is different from other kinds of information. Some view genetic information as special because it is shared with your family members. Others view it as special because it can be used for identification (like at crime scenes or for paternity testing).

As discussed in earlier sections, the use of genetic information can lead to negative outcomes for both individuals and groups. While privacy policies can go a long way to safeguard against unintended uses, the possibility of negative outcomes remains.

Who's your daddy?

Companies now offer "Discreet" DNA testing for the purposes of paternity identification. For approximately \$700, the companies will send out a kit to be filled and returned, or the interested party can send in DNA samples such as earwax, dried blood, sweaty t-shirts, used mugs, cigarette butts. The company tests the samples to determine paternity. Results are often available in 2 weeks, with an apparent 100 per cent accuracy (according to the companies).

HIPAA and medical research

HIPAA stands for the Health Information Portability and Accountability Act. Since 2003, the federal HIPAA rule has required that medical information about a person must be kept private. It can't be shared with anyone that you don't authorize to have your information. Usually, you are asked to authorize who (for example your insurance company) may have access to your medical information by signing a HIPAA form.

In biobanking research, part of the consent form includes a HIPAA authorization that will allow researchers to access your health information and use it for research. The researchers may share your information with other researchers at other institutions (with approval from an IRB).

1997 Minnesota Medical Record Law Amendment

Since 1997, Minnesota has had a special privacy law for research with medical records. In Minnesota, none of your medical information can ever be used for research purposes without your consent. Mayo Clinic, for example, asks all new patients for a research authorization that will allow Mayo researchers to access their medical record for research. Without signing this authorization, none of your medical information will be used for research without your permission.

Info, info everywhere ...

Privacy of health information is often hotly debated. Nevertheless, we give out our personal information every day to people we don't even know. For example, when shopping online certain pieces of information are automatically collected, stored, and redistributed, such as your name, contact information and even aspects of your financial information. Every time you purchase your food at the grocery store with a consumer card, your personal information is stored on the grocery store's database. Why do we view health information as something that should be kept private when we give out so much personal information every day?

Genetic Research and Property Rights

Are our bodies and donated tissue our “property”? Who should benefit from the knowledge and products that such donations help create? Neither law nor courts have been able to address fully the notion of property around biobanks.

In the U.S., the right of patients to control parts removed from their bodies, be it a piece of tissue or genetic data, is based on informed consent and confidentiality. Informed consent allows researchers to use identifiable health information and tissue for research purposes. Through consenting, the patient maintains a clear interest in what happens to a sample, while not necessarily controlling access to it.

Patents stimulate research but raise ethical questions

DNA and products developed from genetic research can be patented. Patents encourage investment in research in the hopes of producing beneficial products like drugs and diagnostic devices. Patent owners are usually inventors or employers who contribute to the invention. Sometimes the patent holder is the person who made the investment in the research.

In the case of *Moore vs. the Regents of the University of California*, researcher David Golde at the University of California was granted exclusive intellectual property (or patent) rights to a cell line developed from tissue taken from patient John Moore. Moore sued Golde but the California Supreme Court denied him property rights in his donated cells and therefore a share in potential profits. The ruling expressed that cells were not the property of the patient.

Who, if anyone, should have property rights to donated samples?

Biological samples and personal information may have high commercial value even though no property rights have been allocated to human tissues in the law. Some people consider the current arrangements (such as those expressed in *Moore vs. Regents*) as unfair, saying patients should be rewarded for their contributions and investment. Some suggest patients should not only be partners in donation, but also partners in the establishment, facilitation, and promotion of the research that uses their samples. An individual’s sample is often not that important for a large biobank and research, but samples from some groups might be very important. Should this make a difference to donors?

On the other side, investigators, companies and universities argue that advances in medicine could be threatened if donors’ property rights in excised tissues and their resulting products become widely recognized.

HUGO and benefit sharing

The international Human Genome Organization (HUGO), with United Nations Convention on Biodiversity as a basis, proposes that all humanity should have access to and share in the benefits of research. HUGO recommends that profit-making ventures should devote between 1 to 3 percent of their net profits each year to healthcare infrastructure and humanitarian efforts. How this would be allocated is not clear.

Sharing the benefits of research

Benefit sharing is not a new concept. It has been explored and established in other areas, such as oil and mineral exploration, pharmaceuticals and agriculture. The United Nations Convention on Biodiversity is a good example. It has incorporated the concerns of less-developed nations and native communities over biodiversity and made provisions to compensate affected communities through licensing agreements, development programs, technology transfer and royalties.

In the context of biobanks, benefit sharing might mean: sharing profits from future products, giving people who donated access to benefits of research, or investment by the owner of a biobank into health infrastructure in the donors' communities.

But without knowing exactly what benefits a biobank may give rise to, it is difficult to decide what to share. Are donors willing to wait the 15-20 years it may take for profits from a biobank-derived pharmaceutical? Or by benefit sharing do we mean that a biobank should help the donors' communities by investing in health care in those locations today? Or might there be other ways that we could address the use of people's tissues while helping to promote scientific progress and society's well-being?

A new kind of benefit sharing in biobanking

The Genetic Alliance Biobank is owned and managed by patient advocates with genetic diseases. Researchers apply to a disease advocacy organization for permission to use biobank samples.

One of these organizations is PXE International. PXE is a rare genetic disease, and this organization participated in research and discovery of the gene that caused the disease. PXE International shares in the patent rights to this gene and proceeds benefit the organization and its members, including patients and families with this disease.

Mayo Clinic Plans for a DNA Biobank

Individual researchers at Mayo Clinic already have collections of DNA samples from blood or tissues. Most of these collections have focused on specific diseases, like cancer, heart disease, or diabetes. However, there is no central structure for DNA biobanking at Mayo Clinic in Rochester or at the Mayo Clinic sites in Jacksonville, Florida, and Scottsdale, Arizona.

Mayo Clinic would now like to plan for a central biobank that will bring together samples that have already been collected, as well as collect new samples. A central biobank will make it much easier for doctors and scientists to make use of and share these resources.

Collection of 20,000 DNA samples

As a first step to creating a shared, central DNA biobank, Mayo Clinic is planning to create a collection of 20,000 samples from healthy patients for genetic research. Information from these 20,000 people can be compared with DNA samples from people with diseases to try to find differences in their genes. Mayo Clinic already has some collections of DNA samples from patients with different diseases, like cancer.

By combining DNA markers with information from donors' medical records, personal history, and environmental exposures, scientists can learn about the genetic and environmental bases of disease. Hopefully, this research can lead to better treatments or prevention strategies.

How should decisions about the administration of the biobank be made?

There are a number of decisions about the organization of the DNA biobank that Mayo will need to make. For example, who will have access to the samples, and for what uses? How will this be managed? How should the community be involved? Mayo research using the biobank is regulated by our Institutional Review Board, which is the standard method for protecting the interests of humans asked to participate in research. In addition, we have formed a new group, the Biospecimen Trust Oversight Group (BTOG), to oversee the operations of the biobank and to make some of these decisions.

Right now, the BTOG includes scientists, administrators, a lawyer, and an ethicist. Should a community member be part of this group? If so, how should this person be chosen? Should Mayo follow Marshfield Clinic's model and have a community board?

What important questions might community members have about the organization of the biobank?

We don't know yet how to balance the benefits of research with the necessary protections and safeguards for DNA donors, or what role the community will have in the operation of the biobank.

We also don't know how potential benefits from the biobank should be shared. We want to find out what concerns Mayo research participants have about the privacy and confidentiality of their DNA and medical information. Finally, will participants want their samples used in certain kinds of research and not others? How should these decisions be made? Your participation in the deliberative community engagement will help Mayo answer these questions by providing advice to the BTOG.

Glossary

Autonomy: Freedom from external control or influence; independence.

Benefit sharing: Sharing the rewards derived from research into human genetics with tissue donors, patients and/or humankind.

Biobank: A collection of tissue samples and associated health information. Although some collections may not initially be intended for research, biobanks are becoming very important for research.

Biomarkers: A specific genetic trait that has a molecular feature that can be used to measure or indicate the effects, progress or potential to develop a disease.

Biopiracy: Exploiting knowledge about plant and animal species, which is often learned from Native Americans. The information is abused by restricting its general use by other individuals or research companies, often by obtaining a patent.

Biospecimen: Materials from the human body, such as tissue, blood, plasma, and urine that can be used for diagnosis and analysis of patients.

Blanket consent: Consent given by an individual allowing research for purposes unspecified at the time of consent to be carried out using his or her tissue. If blanket consent is given, the researcher is not obligated to re-contact the individual for future research projects.

Chromosome: The structure in the cell's nucleus carrying the genes. Each human has 23 chromosome pairs (46 total), half inherited from the father and half from the mother. Males have an X and a Y chromosome, while females have two X chromosomes; both have pairs of chromosomes 1-22.

Clinical Research: Study of a drug, biological compound, or device in human subjects to determine its effect on health or disease.

Clinical Trial: Researchers test hypotheses about the effect of a particular intervention (such as a new drug) upon a disease condition in comparison with another drug or an inactive substance (placebo).

Cohort Study: A study that follows a group of people with a certain condition, receiving a treatment or exposed to environmental factors over a period of time and compares them to a control group not exposed to the condition, treatment or environmental factor.

Commercialization: To arrange activities and products for the purpose of gaining profit and/or stimulating investment.

Confidentiality: The protection of information from being circulated outside of an authorized group.

Deliberation: Respectful discussion in which participants offer views, reasons and other representations of their views in an attempt to understand each other and determine agreements and disagreements.

Deliberative Democracy: A form of representative democracy which involves groups of citizens who discuss and decide policy issues; an approach focused on enhancing the nature and form of political participation.

DNA: An abbreviation for deoxyribonucleic acid, the essential molecule of heredity. The twisted ladder of the base pairs (also more famously known as the double helix) of the DNA molecule contains the chemically coded instructions to construct and maintain a living organism.

DNA data mining: A process of searching large collections of data for patterns or trends to extract usable information.

Drug development: The process of bringing a drug discovery through the stages needed for it to be tested in a human clinical trial.

Eugenics: Term coined in 1883 by Sir Francis Galton (1822-1911) meaning "wellborn." The term is rooted in the belief that nature is more important than nurture and the social philosophy that humanity can be improved through intervention. Historically associated with Nazi abuses such as the extermination of certain populations, but today is debated with reference to reproductive and genetic technologies.

Gene: Genes are both units of inheritance and encoded messages for the creation of a functional unit in a cell. These functional units influence, to varying degrees, an organism's appearance, its metabolism and sometimes even its behavior, among other things.

Genetic Determinism: The belief that genes largely determine physical and behavioral characteristics of an organism. The term may be applied to the mapping of a single gene to a characteristic or to the belief that most or all characteristics are determined mostly or exclusively by genes.

Genetic disease: A disease caused (or strongly influenced) by abnormalities in an individual's genetic material (genome). For example, Huntington's disease, Tay-Sachs disease and Parkinson's disease are all considered genetic diseases or disorders.

Genome: (1) The full set of genes carried by a single organism and (2) the set carried by that organism's species. The precise ordering of As, Ts, Cs and Gs in organisms' genomes is the foundation of life's diversity. It dictates whether an organism is human or another species such as yeast, rice, wombat, gnat or fruit fly, all of which have their own genomes and either are or could be the focus of a genome project. Because all organisms are related through similarities in DNA sequences, insights gained from nonhuman genomes often lead to new knowledge about human biology.

Genetic Testing: Any procedure to determine whether a person has a gene that is associated with a disease or characteristic.

Genomics: A discipline dedicated to the understanding of the entire genetic information content of an organism and its relation to environment and the whole organism.

Governance: The use of power to direct behavior through law, policy, professional practice standards or social conventions.

Human Genome Diversity Project: An international project that seeks to understand the diversity and unity of the entire human species by understanding global migration patterns.

Human Genome Project: Collective name for several research projects in human genomics begun in 1986 by the U.S. Department of Energy (DOE). The primary goal of the HGP was to discover the full sequence of DNA bases in the human genome. It became an international research effort, led by the DOE and the National Institutes of Health. The project was completed in April of 2003.

Institutional Review Board (IRB): Committees at health care institutions, universities and in some corporate environments that are responsible for protecting human subjects involved in research through multidisciplinary review of research protocols. Where the IRB is not satisfied that the protocol meets established ethical standards, it can prevent the research from starting or, where concerns arise in relation to ongoing research, from continuing.

Intellectual Property (IP): In law, a term for various legal entitlements for certain names, written and recorded media and inventions. The term reflects the idea that IP is the product of the mind or the intellect of inventors or their sponsors (e.g., institutions, investors, corporations).

In vitro Fertilization (IVF): Chemical stimulation of egg development in a woman, followed by surgical retrieval of eggs, fertilization of eggs with sperm in a glass dish and the transfer of resulting embryos to produce a pregnancy.

Multifactorial: A term that suggests many factors are at play. For example, in some cases multifactorial could mean two genes plus environment; in others, several genes working together. Most common traits like skin color and height are multifactorial.

Mutation: Errors in copying base pairs of DNA when cells are dividing. Most mutations are silent, meaning that they do not change the protein specified by the gene. Other mutations are fatal to embryos or the basis for the evolution of new characteristics.

Patient: A person receiving or registered to receive health care.

Personalized medicine: The use of detailed information about a patient's genotype or level of gene expression and a patient's clinical data in order to select a medication, therapy or preventative measure that is particularly suited to that patient.

Pharmacogenomic: Studies of the genetic basis for responses to drug therapy, with the intention to ensure maximum efficacy with minimal adverse effects. The basis of claims about personalized medicine, in which drugs and drug combinations are optimized for each individual's unique genetic makeup.

Phenotype: The characteristics of an organism associated with its genome.

Population health: The measures of health, including lack of disease, longevity and other factors, across the members of a group.

DNA Biobanking in Olmsted County

Pre-implantation Genetic Diagnosis (PGD): The genetic testing of embryos created by *in vitro* fertilization before embryos are implanted in a woman's body.

Stigmatization: To characterize or brand as disgraceful or undesirable.