



Jerusalem Science Contest

החידון המדעי הירושלמי

Judaism, Genetic Screening and Genetic Therapy Part 2



The Jerusalem Science contest lecture on Judaism, Genetic Screening and Genetic Therapy – Part 2

Judaism, Genetic Screening and Genetic Therapy

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OCTOBER/NOVEMBER 1998 NUMBER 5 & 6 VOLUME 65:406-413

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Presented at the 8th annual International Conference on Jewish Medical Ethics. San Francisco, CA, February 15, 1997.



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In part 2, we continue to review a presentation and essay by Dr. Fred Rosner delivered on February 15, 1997 at the 8th annual Conference on Jewish Medical Ethics, San Francisco, California.

The Genome project and Judaism

➤ Is genetic engineering interfering with nature as God created it and changing the divine arrangement?



The majority opinion considers the acquisition of knowledge for the sake of finding cures for human illnesses..

- Divinely sanctioned.
- Divinely mandated.

➤ Genesis (1:28) "Fill the earth and subdue it"

- Ramban – use animals and insects for the benefit of mankind.
- S.R. Hirsch – master, appropriate, and transform the earth and its products for human purposes.



- ✓ Rosner's comment: Pursuit of scientific knowledge is not considered 'eating from the tree of knowledge'.
- Maimonides, Comm. To Mishneh (Section 6). -All living and inanimate things on Earth were created to benefit people.

✓ Rosner's comment: Animal experiments to find cures are sanctioned by Jewish law. Try to avoid animal pain.

➤ Psalm 115:16 – The heavens are God's; the earth is given to mankind. Talmud Berachot 35a use this verse to say that everything belongs to God until you say a blessing (Beracha). After that it belongs to you.



- Ramban (Leviticus 19:19) There is a violation of undermining God's creation of the world by manipulating nature.
- Exodus 21:19 – "He shall surely heal" – The scholar (doctor) has the right to heal (Bava Kama 85a)
- Restoration of health is a form of 'restoration of a lost object' (Deut. 22:2) according to Maimonides Commentary to Mishnah (Nedarim 4:4)

➤ Genetic healing includes



- Engineered medications (insulin, antibiotics)
- Gene therapy by which genetic sequences are altered by splicing, or removal or replacement.



Ramban



S R Hirsch

Judaism approaches application of modern techniques and technology with caution. On the one hand, there are classic Torah sources directing civilization to use the resources of God's creation without fear or impediment, for the purpose of saving life, improving health and bettering society. Mankind, as tzelem elokim, an image of God, works in partnership with God to enhance the creation of God.

On the other hand, there are Torah prohibitions designed to avoid gross manipulations of God's world.

Accordingly, every attempt to implement new technology must be accompanied with a mindfulness regarding the goals society is attempting to achieve. What are the underlying motivations? Are the actions and programs planned for the purpose of partnering with God or just plain for Mankind to be and replace God?

It appears from the classic Torah sources that the question of halacha; whether something is what we ought to do or not do, is tied up completely with what our motivations and goals are.

It's simply not enough to ask whether halacha permits or prohibits. When the answer is ostensibly "permits" the question needs to be asked: But in what situations? And for what goals? And what is the proper way if doing it? Maybe the act is usually permitted, but is wrong when viewing the whole picture of goals and motivations.

And, when the halachik answer is "prohibited" it is still ok to ask whether a differentiation

exists and whether it may still be the right thing to do in the situation at hand which may be an exception to the prohibition.

This slide explores those sources offered by Dr. Rosner in discussing whether genetic engineering interferes with nature as God created it or not.

The majority opinion considers the acquisition of knowledge for the sake of finding cures for human illnesses to be either divinely sanctioned (permitted by God) or even divinely mandated (required by God).

The Torah in Beresheet – Genesis 1:28 has God saying about mankind “ ומלאו את הארץ וכבשוה ורדו בדגת הים ובעוף המים ובכל חיה הרמשת על הארץ” - “Fill the land and conquer (or dominate it), subjugate the fish in the sea and the birds in the sky and all beasts that roam the land”.

Ramban – Nachmanides understands this verse to mean that God gave mankind the right to use all natural resources, inanimate and animate, for use in societal benefit.

R. Shimshon Hirsch explain the same verse to mean that mankind may “ master, appropriate, and transform the earth and its products for human purposes”

Dr. Rosner writes that, according to R. SR Hirsch, “Pursuit of scientific knowledge is not considered ‘eating from the tree of knowledge” Although that statement is not incongruent with R. Hirsch’s outlook, I was unable to find that specific statement by R. Hirsch.

Rambam – Maimonides writes in his Introduction to the Mishna (section 6) that All living and inanimate things on Earth (under the Moon’s orbit) were created to benefit people. Dr.

Rosner comments “Animal experiments to find cures are sanctioned by Jewish law. Try to avoid animal pain.” That last statement is not in the Rambam.

Psalm 115:16 – The heavens are God’s; the earth is given to mankind. Talmud Berachot 35a use this verse to say that everything belongs to God until you say a blessing (Beracha). After that it belongs to you. Dr. Rosner is expanding the intent of this piece of Talmud to include that the idea of “the land” meaning all resources are given by God to man to use. To me, it’s a bit of stretch to use this citation which appears to be limited to the right to eat something after saying a blessing. However, conceptually, if “making a blessing” means that resources are used with mindfulness that they are being used to promote God’s purposes in the world, one can see this concept in this citation.

Ramban (Leviticus 19:19) There is a violation of undermining God’s creation of the world by manipulating nature.

Exodus 21:19 – “He shall surely heal” – The scholar (doctor) has the right to heal (Bava Kama 85a)

Restoration of health is a form of ‘restoration of a lost object’ (Deut. 22:2) according to Maimonides Commen. To Mishnah (Nedarim 4:4)

Genetic healing includes

Engineered medications (insulin, antibiotics)

Gene therapy by which genetic sequences are altered by splicing, or removal or replacement.

Genetic Screening and Judaism – Rabbinical Decisions

❖ Rabbi Moshe Feinstein, regarding premarital Tay Sachs testing.

- Have premarital testing
- Publicize availability of the testing.
- Extreme confidentiality.
- Private testing only; no large groups or school testing.
- Extreme sensitivity for psychological stress.
- No men under 20 or woman under 18 to be tested.
- Abortion of Tay Sachs fetuses is prohibited.
- Amniocentesis may also be prohibited.



❖ Rabbi Eliezer Waldenberg – Tzitz Eliezer

- Abortion
 - ✓ Allows abortion after amniocentesis during 1st trimester if Tay Sachs is present.
 - ✓ Allows abortion up to 7th month if Tay Sachs is now detected and not detected earlier; due to defect, shame, anguish, physical and mental pain /suffering of parents.



❖ Rabbi J. David Bleich

- Parents who are carriers must still bear children.
- Abortion may never be considered as a permitted option.
- Testing to be done in childhood and early adolescence to have early awareness of carrier status.
- Screening programs should be supported.



What have been some of the responsa decisions by contemporary sages regarding the implementation of genetic screening programs?

- ❖ Rabbi Moshe Feinstein, writes regarding premarital Tay Sachs testing.
 - He encourages premarital testing programs and the community should publicize their availability.
 - Strong measures need to be taken to ensure confidentiality.
 - Screenings should be done privately; no large group or school testing.
 - Organizers and professionals must exhibit extreme sensitivity for any foreseen psychological stress that can be caused by the screening program.
 - No men under 20 or woman under 18 are to be tested.
 - It should be explained and understood that abortion of Tay Sachs fetuses is prohibited by Jewish law.
 - Amniocentesis may also be prohibited

- ❖ Rabbi Eliezer Waldenberg – Tzitz Eliezer
 - Writes in regard to abortion under Jewish law, that in his opinion.
 - ✓ Abortion is permitted during 1st trimester if Tay Sachs is present upon amniocentesis.
 - ✓ Abortion up to 7th month if Tay Sachs was not detected earlier; his rationale is related to the Tay Sachs defect: the shame, anguish, physical and mental pain /suffering of parents.

- ❖ Rabbi J. David Bleich
 - Parents who are carriers must still bear children.
 - Abortion may never be considered as a permitted option.
 - Testing should be done in childhood and early adolescence to have early awareness of carrier status.
 - Community screening programs for groups and schools should be supported.

Permitted Alternatives under Jewish Law

- Alternatives to prenatal screening methods
 - Premarital screening – Dor Yesharim
 - Preimplantation screening of the vitro zygotes if both parents are carriers and only use the healthy zygotes for implantation.
 - ✓ Discarding of non-used zygotes is not abortion and is permitted.
 - ✓ Abortion only applies to implanted fetuses.
- Newborn screening for treatable diseases such as phenylketonuria and congenital hypothyroidism is mandatory by parents in seeking medical healing.

Areas of doubtful permissibility in Jewish law for screening:

- No effective treatment exists. Causing emotional burden may be prohibited.
- Prenatal testing for the purpose of aborting an affected fetus.

Dr. Rosner's analysis of the rabbinic opinions arrives at the following conclusions:

Permitted Alternatives under Jewish Law

- Alternatives to prenatal screening methods. In cases of prenatal, the pregnancy is already in progress.
 - Premarital screening programs done by organizations such as Dor Yesharim and others, to detect carriers and compatibility of couples before marriage or pregnancy.
 - Preimplantation screening of the vitro zygotes. If both parents are carriers, vitro zygotes are started in the lab. Then, only the healthy zygotes will be implanted into the mother.
 - ✓ Under Jewish law, discarding of non-implanted zygotes is not considered abortion.
 - ✓ Abortion only applies to implanted fetuses.
- Newborn screening for treatable diseases such as phenylketonuria and congenital hypothyroidism is mandatory by parents in seeking medical

healing.

Areas of doubtful permissibility in Jewish law for screening:

- If no effective treatment exists for the syndrome, screening may be prohibited because it could unnecessarily cause an emotional burden.
- Dr. Rosner mentions prenatal testing for the purpose of aborting an affected fetus is an area of doubtful permissibility. I am not sure why else one would do prenatal testing. According to Rabbi Waldenberg, it would appear that surely a genetic screening of amniocentesis material during the 1st trimester resulting in a positive result is basis for an abortion.

Confidentiality

- Talebearing (Levit. 19:16)
- לא תלך רכיל בעמך – Do not be a gossip
- Evil gossip (Psalms 34:14)
- נצור לשונך מרע ושפתיך מדבר מרמה – Hold your tongue from evil and your lips from deceit.
- Discussed at length in Talmud Yoma 4b and Sanhdrin 31a.

- Rambam, Mishna Torah, Deot, 7:2

- Chafetz Chayim

- Physician is obligated to keep all information confidential.

- Physician may not share any non-pertinent information with other physicians. Non-pertinent is any information from which no benefit to the patient, can be derived.

- Information can be shared to save another person from danger.



Gene Therapy – need for more responsa

- Rabbi Moshe Hershler:
 - Gene therapy gone awry could kill someone.
 - May show a lack of trust in God
 - May be considered forbidden grafting
- Rabbis S.Z. Auerback and Yehoshua Neuwirth:
 - Not grafting. This is for healing. Grafting is for growing trees.
 - No different than organ grafting which is permitted according to all opinions.
- Types of Gene therapy
 - Modification of defective gene in an ovum, sperm or zygote
- Appears to be permitted
 - Rabbi Azriel Rosenfeld (Judaism and Gene Design, Tradition, Vol. 13, 1972, pp.71-80). As submicroscopic particles and their processes are invisible to human eye; hence they are permitted. (forbidden foods, priestly declaration of tzara'at)
 - Ovum, sperm and zygote are pre-implantation and are not people.
 - Any surgery permitted on a live person is also permitted on sperm, ovum or zygote.

Gene therapy is the process by which the organisms genetic sequences are modified. How does Judaism speak to gene therapy?

1. Is it forbidden manipulation of God's creation in accordance with the Ramban's interpretation of Kilayim?
2. Will it make food or plants unkosher?

Rabbi Moshe Hershler seems to be one voice against many that prohibits gene therapy in humans and gene modification in plants.

Gene transplants

- ✓ Is it under forbidden Arayot?
- ✓ Does it make someone a mamzer?
- ✓ Could it cause people to become relatives?



Gene modification

- ✓ When does an etrog become a lemon?
- ✓ Can a catfish grow scales and become kosher?
- ✓ Can an annual become a perennial and be permitted during Shmitta?

Alteration of features

- ✓ Eye and hair color
- ✓ Height, personality, intelligence, facial features?
- ✓ Rabbi Feinstein allows surgery to enhance beauty to help in spouse selection.
- ✓ Pesachim 54a – Adam produces mules. Chullin 7b – Mules are ‘Yemim’ because they produce fear.
- ✓ Ramban (Levit. 19:19) – Inappropriate use of nature is condemned by God as it denies creation and is a show of lack of belief in God.

In today's world of genetic research, a flurry of new breakthroughs and applications are challenging Judaism for responses. Not just a halachic response but ethical responses. Many of the issues that have arisen are beyond the scope of this lecture. But we will list a few just to give an example of those areas in which Torah should and does respond. If genetic material is used from a person who is a close relative or from someone else's spouse, is the material forbidden under the laws of arayot, forbidden unions. The same question can be asked if genetic material from forbidden relatives is used in an ovum or sperm. Does such a process create a state of mamzerut in Jewish law? Could it cause people to become relatives?

If you modify etrogim genetically, can you turn them into lemons and vice versa? Can you modify a catfish to have scales and become kosher? How about changing an annual plant into a perennial tree thereby changing its fruit's status under the shmitta laws?

Is gene modification permitted to alter hair color, eye color and facial features? Are we allowed via gene modification to enhance looks such as height or intelligence or personality?

Rabbi Feinstein did allow cosmetic surgery for the purpose of enhancing a person's ability to find a spouse. How far can we take this?

If a couple has had children of one gender and has not fulfilled the command of being fruitful and multiply with a son and daughter, could pre-implantation techniques be used to choose the opposite gender?

Talmud Pesachim 54a records that Adam produced mules. The Talmud is saying that animal grafting has occurred since the beginning of time.

As we said, Ramban writes that the prohibition of kilayim is an inappropriate use of nature. It is a form of denial of God's creation and a show of a lack of trust in God's plan.

We go back to the original Torah direction: To save life and to enhance the world as a service of God is the way that all these techniques are permitted. Questions must be asked. Am I saving a tzelem elokim? Will what I'm doing promote a connection to God? If the answer is yes, more often than not it is permitted. If the answer is no, more often than not, it is prohibited.

Conclusion



- Jewish law attempts to find ways to permit techniques designed to prolong life.
- Techniques to enhance life must be scrutinized under Jewish law for classification to either enhancing or changing creation.
- Jewish law forbids techniques designed to change creation.
- Gene research must be performed under the guidance of Jewish ethics and law.

Organizations offering genetic testing for Jewish diseases



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Genetic disease was recognized by Maimonides, who prescribes a regimen of health for all Jews to remain healthy, since one cannot serve the Lord when one is ill (Mishneh Torah, Deot 4:1). He guarantees that anyone who follows his regimen will be healthy all his life, except for those who were born with hereditary or genetic defects (Ibid. 4:20).

END REQUIRED READING FOR PART 1

The Genome Project and Judaism

Is the genome project an encroachment on the Divine plan for this world by interfering with nature as God created it? Would genetic engineering tamper with the Divine arrangement of Creation? Although one rabbi answers in the affirmative (25), most rabbis consider the acquisition of knowledge for the sake of finding cures for human illnesses to be divinely sanctioned, if not in fact mandated. God blessed mankind with the phrase: replenish the earth and subdue it (Genesis 1:28).

This phrase is interpreted by Nachmanides (Ramban) to mean that God gave man dominion over the world to use animals and insects and all creeping things for the benefit of mankind (Ramban, Genesis 1:28). To subdue the earth, according to Samson Raphael Hirsch (Hirsch, Genesis 1:28), is to master, appropriate, and transform the earth and its products for human purposes. To have dominion over the fish and over the birds and over every living thing on earth (Genesis 1:28) means to use them for the benefit of mankind. The pursuit of scientific knowledge does not constitute prohibited eating from the tree of knowledge (Genesis 2:17). Whatever is good for mankind must be permissible and praiseworthy. However, good often is not pure good, but may contain potentially dangerous elements. Although the genome project is intended to cure diseases, it has raised many concerns.

In the general introduction to his Commentary on the Mishnah (26), Moses Maimonides discusses the existence and purpose of all living and inanimate things in the world. He clearly enunciates the thesis that the purpose of everything that God put on this earth is to serve mankind. Thus, scientific experiments on laboratory animals, during the course of medical research that might find cures for human illnesses, are sanctioned in Jewish law as legitimate utilization of animals for the benefit of mankind (27). However, whenever possible, pain or discomfort should be avoided or minimized in order not to transgress the prohibition in Jewish law against cruelty to animals.

King David said that The heavens are the Lord's heavens but the earth He has given to mankind (Psalms 115:16), further supporting the concept that knowledge and its pursuit are legitimate activities for human beings and not considered an encroachment upon Divine prerogatives. Thus, therapeutic genetic engineering and gene therapy that may result from the knowledge derived from the genome project do not undermine God's creation of the world by manipulating nature (Ramban, Leviticus 19:19). On the contrary, it is a legitimate modification of the natural order. The use of scientific knowledge to benefit mankind is biblically mandated (Ramban, Genesis 1:28). The use of such knowledge to heal illness and cure disease is also allowed biblically, based on the Talmudic interpretation (Baba Kamma 85a) of the phrase and heal he shall heal (Exodus 21:19), or even biblically mandated, based on Maimonides' interpretation (Mishnah Commentary, Nedarim 4:4) of the biblical obligation to restore a lost object (Deuteronomy 22:2) to include the restoration of one's lost health. The healing of illness

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includes the use of genetically engineered medications such as insulin and various antibiotics. The cure of disease by gene therapy, if possible, is also sanctioned in Jewish law.

Genetic Screening and Judaism

Many years ago, Rabbi Moshe Feinstein (28) was asked whether or not it is advisable for a boy or girl to be screened for Tay-Sachs disease and, if it is proper, at what age the test should be performed. His answer was:

“. . . it is advisable for one preparing to be married, to have himself tested. It is also proper to publicize the fact, via newspapers and other media, that such a test is available. It is clear and certain that absolute secrecy must be maintained to

prevent anyone from learning the result of such a test performed on another. The physician must not reveal these to anyone . . . these tests must be performed in private, and, consequently, it is not proper to schedule these tests in large groups as, for example, in Yeshivas, schools, or other similar situations.”

Rabbi Feinstein (29) also points out that most young people are quite susceptible to nervous tension or psychological stress and, therefore, young men (below age 20) and women (below age 18) not yet contemplating marriage should not be screened for Tay-Sachs disease. Finally, Rabbi Feinstein strongly condemns abortion for Tay-Sachs disease and even questions the permissibility of the amniocentesis which proves the presence of a Tay-Sachs fetus, since amniocentesis is not without risk, albeit small.

Rabbi J. David Bleich (30) indicates that the elimination of Tay-Sachs disease is, of course, a goal to which all concerned individuals subscribe. He points out, however, that the obligation with regard to procreation is not suspended simply because of the statistical probability that some children of the union may be deformed or abnormal. While the couple may quite properly be counseled with regard to the risks of having a Tay-Sachs child, according to Jewish law (Halachah) the failure to bear natural children is not a viable alternative. He further voices concern that if the fetus is found to have Tay-Sachs disease by prenatal testing, abortion may not be sanctioned in Jewish law. Rabbi Bleich concludes that screening programs for the detection of carriers of Tay-Sachs disease are certainly to be encouraged. He suggests that the most propitious time for such screening is childhood or early adolescence, since early awareness of a carrier state, particularly as part of a mass screening program, is advantageous. He is critical of Rabbi Waldenberg, pointing out that the latter's permissive ruling on abortion for Tay-Sachs disease is contrary to the decisions of other contemporary rabbinic scholars, including Rabbi Feinstein.

Two methods now exist for totally eliminating the need for prenatal screening for Tay-Sachs disease and thus averting the serious halachic objections to abortion if the fetus should be found to be affected.

The first method is to perform confidential premarital screening and to strongly discourage the marriage of two carriers. This approach, widely utilized in many Orthodox Jewish communities, is sponsored by the Dor Yeshorim organization (160 Wilson Street, Brooklyn, NY 11211, [718] 384-6060), which claims to have tested more than 70,000 people and identified more than 100 at-risk couples, who were advised not to marry. In the United States, the program has significantly reduced the number of Jewish babies born with the disease. And in Israel, a similar screening program has resulted in no Tay-Sachs children being born to newlywed couples in the ultra-Orthodox Ashkenazi Jewish community in over 10 years (31).

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The second method of preventing the birth of a baby with Tay-Sachs disease, hemophilia, or Huntington's disease is to perform preimplantation screening of in vitro fertilized zygotes if both husband and wife are known carriers and to use only the unaffected ones for implantation. Whether one may screen these in vitro fertilized zygotes for genetic diseases has yet to be ruled on decisively by modern rabbinic authorities. However, in vitro fertilization is sanctioned by many rabbis for couples who cannot conceive in the normal way (32). Moreover, the discarding of the affected zygotes would not be considered abortion, since Jewish law considers life to begin only when the living embryo has become implanted in the mother's womb and continues to grow.

It is not clear whether Judaism sanctions genetic screening for diseases for which no effective treatment yet exists. The rabbis are greatly concerned about the emotional burden (*tiruf hadaat*) that such knowledge may place upon a person found to have the gene for Huntington's disease in the presymptomatic stage. Judaism would not sanction amniocentesis or chorionic villi sampling to rule out Huntington's disease if the only purpose is to abort the fetus if it is found to be affected.

However, preimplantation screening of Huntington's disease and choosing only unaffected zygotes for implantation may be permissible, to prevent the birth of an affected child, as described above for the prevention of Tay-Sachs disease. The same permissive view might apply to the prevention of hemophilia births by preimplantation screening.

Newborn screening for treatable diseases such as phenylketonuria and congenital hypothyroidism should certainly be done. Judaism subsumes such testing under the biblical and rabbinic mandates to seek healing from the medical profession.

Judaism requires that confidentiality of test results for all types of genetic screening be maintained. The prohibitions in Judaism against talebearing (Leviticus 19:16) and evil gossip (Psalms 34:14) are discussed at length in the Talmud (Yoma 4b, Sanhedrin 31a) and in the Codes of Jewish law such as Maimonides' *Mishneh Torah* (Deot 7:2). An entire book was written on this subject by Rabbi Israel Meir Hakohen of Radin, popularly known as "Chafetz Chayim" (33).

Whenever the physician obtains confidential medical information, genetic or otherwise, he is forbidden to disclose that information or share it with anyone, including the patient's family and even professional colleagues, if no benefit to the patient would result. However, if keeping confidence might impact adversely on the health of another person, the latter may be informed. In Jewish law, a person who is the carrier of a serious and potentially lethal genetic disorder is obligated to divulge that information to a prospective spouse.

More difficult to resolve is the question as to whether or not an Ashkenazi Jewish woman with the gene for breast cancer BRCA1 or BRCA2 is obligated to tell that to a prospective spouse or to her husband if she is already married. Modern rabbinic authorities have not yet ruled on whether it is even appropriate to test for that gene in all Jewish women. It may be reasonable to do so in women with very strong family histories of breast cancer. But to what end? If they are found not to have the gene, the risk of developing breast cancer is still high. But women found to be positive for the gene may wish to take action such as more frequent mammography, prophylactic

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hormonal treatment, or even prophylactic mastectomies. Current rabbinic authorities need to address how such matters might impact on therapeutic choices within the context of Judaism.

Gene Therapy and Genetic Engineering

The literature in Jewish law on gene therapy and genetic engineering is very sparse indeed. Two rabbinic articles with genetic engineering in their titles (34, 35) deal primarily with artificial insemination, in vitro fertilization and surrogate motherhood, and only briefly mention cloning. The production of hormones such as insulin and erythropoietin, and antibiotics and other therapeutic substances, by genetic engineering through recombinant DNA technology is certainly permissible in Jewish law, because nature is being used properly by man to his benefit in the treatment and cure of illnesses. Gene therapy, such as the replacement of the missing enzyme in Tay-Sachs disease and the missing hormone in diabetes, and the repair of the defective gene in hemophilia or Huntington's disease, if and when these become scientifically feasible, are also probably sanctioned in Jewish law, because they are done with the intention of restoring health, and preserving and prolonging life. The technical medical problems of modifying the defective gene or genes in an individual sperm, ovum or zygote by gene surgery and implanting the replaced or repaired genes into the mother in order to produce a healthy child have not yet been surmounted. However, assuming such surgery can be performed successfully, gene surgery will probably be sanctioned by rabbinic authorities as a legitimate implementation of the mandate on physicians to heal the sick.

Another argument favoring the permissibility of gene surgery or genetic manipulation is the fact that neither the sperm nor ovum nor even the fertilized zygote is a person. Thus, gene manipulation is not considered to be tampering with an existing or even a potential human being, since that status in Jewish law is only bestowed upon a fetus implanted in the mother's womb. One can also argue that any surgery performed on a live human being must certainly be permitted on a sperm or ovum or fertilized zygote. For example, if a surgical cure for hemophilia, Tay-Sachs disease or Huntington's disease were possible, it would surely be permissible. Hence, it should certainly be permissible to cure or prevent these diseases by gene surgery.

Rabbi Moshe Hershler (25) warns against blinding ourselves to the potential of genetic engineering and gene therapy, which is no longer a dream or a fantasy but becoming a medical and scientific reality. Hershler raises the question of the permissibility (or lack thereof) of experimenting with gene therapy to try to save the life of a child with thalassemia or Tay-Sachs disease if the unsuccessful outcome of the experimentation would be a shortening of the child's life. Hershler is of the opinion that gene therapy and genetic engineering may be prohibited because Ahe who changes the [Divine] arrangement of creation is lacking faith [in the Creator],@ and he cites as support for his view the prohibition against mating diverse kinds of animals, sowing together diverse kinds of seeds, and wearing garments made of wool and linen (Leviticus 19:19). This line of reasoning is rejected by Rabbis Shlomo Zalman Auerbach and Yehoshua J. Neuwirth (36), since genetic engineering does not seem to be comparable to the grafting of diverse types of animals or seed. The main purposes of gene therapy are to cure disease, restore health, and prolong life, all goals within the physician's Divine license to heal. Gene grafting is no different than an Aorgan graft,@ such as a kidney or corneal transplant, which nearly all rabbis consider permissible.

Ethical and halachic problems associated with genetic engineering include "speciation". Does a certain species lose its identity if other genes are introduced into it? Would the citron or ethrog (*Citrus medica* Linn) used on the

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Tabernacles holiday (Sukkot) for religious purposes lose its identity if lemon genes were introduced into it? How many transplanted lemon genes are needed to consider the ethrog to be a lemon? Can the rabbinic concept of nullification (bitul), whereby one part of a prohibited substance becomes nullified if mixed within sixty parts of a permitted substance, be applied to this situation? Another example is the need for fins and scales for fish to be kosher for consumption. If genes introduced in a scaleless catfish induce scalation, does the catfish then become a kosher fish? Yet another example is the conversion by genetic engineering of annual plants into perennials. The latter are not subject to some of the laws of the Sabbatical year. thus, perennial wheat, corn or tomatoes would be permitted in Jewish law even if grown during the Sabbatical year. These problems and issues have not yet been decisively discussed and resolved by current halachic authorities.

It seems clear that genetic engineering and gene therapy can and should be used to promote the human condition and treat, cure and prevent disease. But should these techniques be allowed to alter human traits such as eye color, height, personality, intelligence and facial features?

The Talmud relates (Pesachim 54a) that God inspired Adam with a type of Divine knowledge, and he took two heterogeneous animals and crossed them and created a mule. Elsewhere, the Talmud asks (Chullin 7b) why they are called mules (Hebrew yemim) and answers “because they cast fear [Hebrew emah] upon men.” This inappropriate use of nature by Adam is what Ramban condemns in his biblical commentary (Leviticus 19:19) as “changing and denying the Divine creation of the world”.

There is no specific halachic prohibition against attempting to clone a human being. An example of the creation of an artificial human being or golem is cited in the Talmud (Sanhedrin 65b). The golem, however, was not formed in and born from a woman’s womb. It was therefore not considered to be human and was destroyed without that being considered an act of murder. A cloned human being, on the other hand, has the full status of a human being. Although it is not prohibited in Jewish law to clone a human being, one should be very cautious and not do so indiscriminately. Many potential scientific and Jewish legal problems would first need to be dealt with. The risks of producing serious birth defects through human cloning are not known. In Judaism, paternity is determined by the sperm (37). But in human cloning, no sperm is used; so who is the father? The possible deleterious effects of genetic engineering and gene therapy are not yet fully known. And in addition to the medical and scientific aspects of genetic engineering, DNA recombinant research and human cloning, the spiritual and theological aspects also require exploration. Rabbis must examine these issues from the Jewish viewpoint and offer halachic guidance to the medical and lay communities.

Conclusion

Genetic screening, gene therapy and other applications of genetic engineering are permissible in Judaism when used for the treatment, cure, and prevention of disease. Such genetic manipulation is not considered to be a violation of God’s natural law but a legitimate implementation of the biblical mandate to heal. According to Jewish law, if Tay-Sachs disease, diabetes, hemophilia, cystic fibrosis, Huntington’s disease or other genetic diseases can be cured or prevented by “gene surgery”, it is certainly permitted.

Genetic premarital screening is encouraged in Judaism for the purpose of discouraging at- risk marriages for a fatal illness such as Tay-Sachs disease. Neonatal screening for treatable conditions such as phenylketonuria is

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certainly desirable and even required under Jewish law. Preimplantation screening and the use of only unaffected zygotes for implantation into the mother's womb to prevent the birth of an affected child is probably sanctioned in Jewish law. Whether or not these assisted reproduction techniques can be used to choose the sex of one's offspring to prevent the birth of a child with a sex-linked disease such as hemophilia has not yet been ruled on by modern rabbinic authorities (38). Prenatal screening with the specific intent of aborting an affected fetus is not allowed according to most rabbinic authorities, although a minority view permits it "for great need".

Not to have children if both parents are carriers of genetic diseases, such as Tay-Sachs, is not a Jewish option. Preimplantation screening is preferable. All screening test results must remain confidential. To improve physical traits and characteristics such as height, eye and hair color, facial features and the like, is frowned upon in Judaism if it serves no useful medical or psychological purpose. The cloning of man is not prohibited as a violation of the Divine arrangement of the world and the creation of man in the image of God. However, Lord Rabbi Immanuel Jakobovits (19) expresses sentiments which we should all take to heart:

"It is indefensible to initiate uncontrolled experiments with incalculable effects on the balance of nature and the preservation of man's incomparable spirituality without the most careful evaluation of the likely consequences beforehand "Spare part" surgery and "genetic engineering" may open a wonderful chapter in the history of healing. But without prior agreement on restraints and the strictest limitations, such mechanization of human life may also herald irretrievable disaster resulting from man's encroachment upon nature's preserves, from assessing human beings by their potential value as tool-parts, sperm donors or living incubators, and from replacing the matchless destiny of the human personality by test-tubes, syringes and the soulless artificiality of computerized numbers. Man, as the delicately balanced fusion of body, mind and soul, can never be the mere product of laboratory conditions and scientific ingenuity."

Acknowledgments

The author is indebted to two anonymous reviewers and to the Editor-in-Chief for helpful suggestions.

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