

Essays

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PRE-IMPLANTATION GENETIC DIAGNOSIS, STEM CELLS AND JEWISH LAW

Reproductive genetic technology continues to advance. The ability to examine sperm, eggs, and embryos for genetic indications of illness represents one of the great horizons that is rapidly approaching as a normative activity in our society. Within the past five years Pre-implantation Genetic Diagnosis (PGD) has become a technique used to examine fertilized eggs (embryos) to determine the presence or absence of particular genetic code in a specific embryo. This article will examine PGD to determine how Jewish law ought to view this new technological development, both as a matter of technical legality and as a matter of societal values and public policy.

This article is divided into four main parts. The first section explains how PGD works as a matter of science, and why people seek such tests. The second section explores the general Jewish view toward genetic engineering and germ-line treatments. The third section explains why a person might use PGD and what its advantages over competing technologies are, both as a matter of Jewish law and as a matter of public policy. The fourth section explores the technical issues in Jewish law raised by such technology and presents a number of examples and hypothetical cases. A brief postscript following the conclusion discusses what other possibilities are on the horizon and attempts a Jewish-law analysis of them as well.

I. PRE-IMPLANTATION GENETIC DIAGNOSIS

The frontier of PGD lies at the intersection of the worlds of in vitro fertilization (IVF) and genetic screening. The development of the IVF process has enabled the creation of embryos outside the uterus for subsequent implantation. Enhanced scientific understanding of the human genome and improvements in gene-mapping technology have vastly improved the medical community's ability to test for genetic indications

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of disease. PGD combines the two: it applies genetic screening to IVF embryos. With PGD, these laboratory embryos can now be tested for genetic abnormalities or the presence of genetic material linked to disease development. PGD thus provides an earlier alternative to prenatal (or even post-birth) diagnosis as it allows testing even before implantation of the embryo in the womb. It also revolutionizes the formerly random selection of IVF embryos by now offering the ability to screen for specific traits. Following PGD, an embryo or embryos with the desired characteristics is then implanted in the uterus to initiate pregnancy. Embryos screened out for undesirable characteristics are set aside (and perhaps discarded).¹

PGD is a somewhat broad term that encompasses a number of related techniques. Doctors can analyze the polar body cells cast off from eggs following maturation and fertilization to infer the genetic makeup of the embryo. More commonly, they directly test one or two cells from an eight-cell embryo. The types of analysis also vary. The chromosomes can be evaluated to assess their number and structure; alternatively, the DNA is analyzed to detect specific gene mutations or problematic genetic sequences. These various forms of analysis inform the selection of embryos for implantation.²

Over 1000 babies have been born worldwide after having undergone this procedure and the number is growing rapidly. PGD can now be applied to detect chromosomal rearrangements such as translocation, as well as inherited chromosomal abnormalities and single-gene disorders such as Tay Sachs, cystic fibrosis, and sickle cell anemia. PGD can also be used to screen for genetic mutations linked to many ordinary diseases whose onset is only much later in life, like Alzheimer's disease, or even illnesses for which genetic makeup is only one of many risk factors predicting occurrence, such as breast cancer. Indeed, more than 100 different single-gene disorders have been diagnosed in pre-implantation embryos, and the number is increasing each year. In addition, PGD techniques have been used to detect chromosomal abnormalities in the eggs or embryos produced by women of advanced maternal age who are undergoing fertility treatment. These patients usually do not have a known inheritable disease or chromosomal abnormality; rather, PGD serves to detect chromosomal abnormalities arising in mitosis or early phase mitoses that are more common in older women—for example, Down's syndrome.³

Another application of PGD screening arises when parents seek to have a child whose HLA type (human leukocyte-associated antigens—a specific set of proteins) will closely match those of another person (typically, another sibling) who needs a bone marrow transplant. PGD

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allows these embryos to be examined for the match prior to implantation, and selected to insure that they are a perfect HLA match.

The ground-breaking and challenging aspect of PGD is that it “allows parents to identify and select the genetic characteristics of their children.”⁴ On the horizon is the possibility that PGD will be used by individuals to create children with specific positive characteristics. We have at this point very little genetic information about such complex characteristics as height or intelligence or physical ability, but it is quite possible that over time we will develop a firm enough understanding of the human genome that we will be capable of performing PGD testing, not just to screen out certain illnesses, but to screen *in* certain enhancing characteristics. PGD can already be used to screen for gender. In later sections we will return to examine in greater detail this and other related, difficult questions posed by PGD.⁵

II. JEWISH LAW AND MODERN TECHNOLOGY

The relationship between modern technology, biomedical ethics, and Jewish law has been well developed over the last fifty years. As has been noted in a variety of sources and in diverse contexts, Jewish law insists that new technologies—and particularly new reproductive technologies—are neither categorically prohibited nor categorically permissible. Rather, they are subject to a case-by-case, method-by-method analysis of the consequences of the new technology as well as the methodology employed, and both need to be permissible for a new technology to be proper in the eyes of Jewish law. The central theme and thrust of this section is that Jewish law is comfortable with humans as caretakers of nature, and that within those parameters genetic engineering is to be treated like any other form of medical treatment, which is proper when used to benefit humanity.

Rabbi Judah Loew (Maharal of Prague) speaks eloquently about the power of human creativity to reshape the universe, and how that power was given to humanity at the time of creation. He states:

The creativity of people is greater than nature. When God created in the six days of creation the laws of nature, the simple and complex, and finished creating the world, there remained additional power to create anew, just like people can create new animal species through interspecies breeding. . . . People bring to fruition things that are not found in nature; nonetheless, since these are activities that occur through nature, it is as if it entered the world to be created. . . .⁶

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Rabbi Loew's point is that human creativity is part of the creation of the world, and this creativity changes the world, which is proper. The fulfillment of the biblical mandate to conquer the earth⁷ is understood in the Jewish tradition as permitting people to modify—conquer, dominate and control—nature to make it more amenable to humans. PGD and all other forms of genetic engineering are but one example of that conquest, which, when used to advance humanity, is without theological problem in the Jewish tradition.

Rabbi Loew continues, noting that even when Jewish law prohibits a certain activity (such as inter-species crossbreeding, an explicit biblical violation and the oldest form of genetic engineering), one should not assume that such conduct is immoral or unethical, but merely something Jewish law prohibits *to Jews*.

There are those who are aghast at the interbreeding of two species. Certainly, this is contrary to Torah which God gave the Jews, which prohibits inter-species mixing. Nonetheless, Adam (the First Person) did this. Indeed, the world was created with many species that are prohibited to be eaten. Inter-species breeding was not prohibited because of prohibited sexuality or immorality. . . . Rather it is because [Jews] should not combine the various species together, as this is the way of Torah. As we already noted, the ways of the Torah, and the [permissible] ways of the world are distinct. . . . Just like the donkey has within it to be created [but was not created by God] . . . but was left to people to create it. Even those forms of creativity which Jewish law prohibits for Jews are not, by definition, bad. Some are simply prohibited to Jews.⁸

What flows most clearly from this is that there is nothing *intrinsically* wrong with crossbreeding, even if it violates Jewish law; indeed, Rabbi Loew nearly states that such conduct by general society is good—and after all, there is nothing wrong with using a donkey to plow or eating a nectarine.⁹

What then about the possibility of humans “playing God,” so to speak? As the late Lord Immanuel Jakobovits stated, speaking for the Jewish tradition:

We can dismiss the common argument of “playing God” or “interfering with divine providence.” Every medical intervention represents such interference. In the Jewish tradition this is expressly sanctioned in the biblical words: “And he [an attacker] shall surely cause him [his victim] to be healed.”¹⁰ The Talmud states: “From here we see that the physician is given permission to heal.”¹¹

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This articulation of the Jewish view is deeply rooted in Jewish law and ethics. The world was not created a perfect place—people are responsible for their own conduct and condition and need not be accepting of the conditions of nature around them. Indeed, people are charged with improving on the handiwork of the Creator. The classic code of Jewish law states simply:

Jewish law gives the doctor the license to heal, and it is a good deed, and within the category of life saving activity. One who withholds medical treatment is a spiller of blood [a murderer].¹²

In the Jewish tradition, people were put on this earth to “improve the world in the image of the Divine,”¹³ and not to accept the perilous condition of the world, whatever it might be. Tampering with nature is part of the human mission in the Jewish tradition; curing illness is one facet of that mission. Genetic engineering—the making of better people—is no less a fulfillment of this religious mandate than healing the sick.

The Jewish approach is in direct tension with both of the predominant trends in American law and ethics. One trend found in American law—consistently advanced by the Catholic Church in the name of canon law—is to seek to limit the ability of science to change fundamentals of nature, whether it be in the area of assisted reproduction, cloning, or genetic engineering. In this view, playing Creator with a capital ‘C’ is the problem. As a group of Catholic physicians noted:

The cloning of human beings would be a violation of the natural moral law. Research in cloning as it applies to man is degrading. It destroys the dignity of human nature by treating the human person as a material commodity to be manipulated according to whim and fancy.¹⁴

Reproduction, according to this argument, is solely God’s domain. When we take it upon ourselves to create humans through reproductive cloning, we are infringing on the divine domain, “playing God,” as it were. In this view, finite and fallible beings should not make decisions properly limited to the infinite and infallible.¹⁵

The second trend in American law is to defer to individual choices and abhor governmental regulation.¹⁶ A recent *New York Times* article accurately captures the spirit of modern medical ethics in America in the reproductive area by noting:

In the hubbub that ensued (after Dolly was cloned), scientist after scientist and ethicist after ethicist declared that Dolly should not conjure up fears of a Brave New World. There would be no interest in using the technology

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to clone people, they said. They are already being proved wrong. There has been an enormous change in attitudes in just a few months; scientists have become sanguine about the notion of cloning and, in particular, cloning a human being. “The fact is that, in America, cloning may be bad but telling people how they should reproduce is worse. . . .”¹⁷

In secular America, freedom to choose one’s own reproductive method, and market forces that make such choices profitable, will determine who the parent is, and what the law should permit. “America is not ruled by ethics. It is ruled by law.”¹⁸

Such is, simply put, not the methodology of Jewish law—Jewish law focuses as much on use and purpose as on process and procedure. Thus, understanding why a person might undergo PGD affects very much how we view a technology. Of course, one might decide that this technology can be used for good or bad and permit it as a matter of public policy, while telling adherents of Jewish law that this technology may only be used in particular cases; on the other hand, one might decide that the amount of bad from the technology so overwhelms the good that one should simply prohibit it in all cases, notwithstanding the potential good that is present from a smaller number of cases. Consider the comments of Rabbi Gedalya Dov Schwartz, Av Beth Din of the Beth Din of America, in the context of stem cell research:

Halakha does not consider any embryonic development within forty days of conception as having the sacred protected status of a human being. Therefore, the use of embryos for stem cell research is not considered an act of destruction of life. This use of the embryo does not come under any category of abortion after forty days of conception, which is forbidden by Halakha, unless the mother’s life is in danger. Consequently, in view of the possible, very positive results of stem cell research for the cure of various diseases, it is not only permitted but it is an imperative to support and proceed with this field of science.

At this time, this decision is limited to the removal of stem cells from embryos resulting from in-vitro fertilization developed for reproductive purposes. The decision is based on the current assumption that such embryos provide sufficient quantities and variety of types to proceed with stem cell research, to the end of scientific knowledge for the relief of serious illness and the saving of lives. Should this category of embryos prove to be insufficient in quantity; or should it consist of too narrow a profile of humanity, and not reflective of the variety of genetic and histological types, thus limiting the potential for healing and for saving lives, then it will be necessary to reconsider the scope of this decision.¹⁹

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A Jewish law analysis of PGD presents a series of conversations similar to those raised by stem cell research.

III. GENETIC ENGINEERING: PERMITTED OR PROHIBITED?

The previous section's analysis was limited and theoretical. How to respond to attempts at genetic engineering abstractly, and PGD testing directly, is more complex, and requires a certain amount of categorization and analysis. Enhancement of the human gene pool has not less than three different permutations, each with its own set of issues and complexities.

1. Gene enhancement can take place in the somatic (non-reproductive) cells of people (or fetuses). This form of therapy would introduce genetic material into a person with the goal of changing this person's cell line to provide some missing chemical or enzyme, needed by this person.²⁰

2. Gene enhancement can take place in the germ (reproductive) cells of people (or fetuses). This form of therapy would introduce genetic material into a person with the goal of changing the reproductive cells of the person, such that their progeny have characteristics that they lack, or lack characteristics that they have.²¹

3. Gene enhancement can take place through genetic testing for specific genes with the results from the testing being used to prevent reproduction by the bearers of specific (bad) genes. This can be done through PGD, selective abortion, voluntary or mandatory restrictions on whom one may marry, and even forced sterilizations.²²

Of these three cases, somatic-cell enhancement seems to be the easiest to address from a Jewish point of view. These genetic enhancements, grounded in health-care tools derived from genetic engineering, would appear to be a form of medical therapy aimed at treating the sickly, and thus a proper activity in the eyes of the Jewish tradition.²³ The options of treating a Type I diabetic by daily injection of insulin or by monthly injection of insulin-producing cells (a remedy not yet available) or by a once-in-a-lifetime treatment of gene therapy of insulin-producing genes seem to be, from a Jewish ethical perspective, identical. Medical treatment, once it is proven to treat illness effectively, is mandatory in the Jewish tradition.²⁴ Until the point where it is well-accepted medically, such treatments (so long as they are designed to be medically palliative for each particular patient) are permitted to be used according to Jewish

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law or ethics, although they are not mandatory.²⁵ While undoubtedly some will object to gene therapy by pointing to the unknown or the possibility of abuse, these objections are no more persuasive in this form of medical treatment than in any other—that is not to say that significant abuse is impossible, but absent clear definitive evidence of harm, improving the human lot by providing effective medical care is part of the human mission, and should be done.²⁶ One should not stop medical treatments and scientific advances merely because of the unknown and not-quantifiable possibility of abuse.

So too, developing genetic tests as an application of genetic engineering in its broadest sense is not inherently problematic in Jewish law. That, of course, forces one to ask what the tests will be used for, and that remains the crucial question that can only be answered with a great deal of uncertainty. As others have noted, amniocentesis is a genetic test, which, independent of the value of the test itself, must be evaluated in the context of the possibility of abortion. Presumably, the correctness of a fetal genetic test very much depends on what one does with the data after the test is done. Genetic tests designed to induce abortion when the ‘wrong’ genotype is found as a result of the test, would presumably violate Jewish law except in one of the few situations where abortion is permitted.²⁷ On the other hand, the exact same test, when its results are used for treatment or therapy of the fetus or child, or merely to address pastoral concerns of the parents, is without any intrinsic Jewish law controversy.

Indeed, many have argued that the moral problems with genetic engineering have nothing to do with the technical issues relating to it; rather, it is the fear that the individuals produced through genetic engineering will give rise to two closely related problems.

The first is the problem of social inequality. Enhanced individuals will achieve social success more easily than those who remain un-enhanced. For example, studies show that people who are tall and physically attractive are more likely to be hired and promoted than people who are short or unattractive. Although Western democratic societies can accommodate a certain degree of inequality, the difference in prospects between the enhanced and the un-enhanced could become so pronounced that serious social instability would ensue. Taken to the extreme, enhancements could be installed by manipulating germ lines, resulting in social advantages that are inherited by succeeding generations. This could eventually create a political system dominated by a genetic aristocracy, or “genobility,” that possesses a lock on wealth, privilege, and power.

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The second, and related, problem created by wealth-based access to genetic enhancement is the individual unfairness that would arise at the micro level if genetically enhanced individuals competed for scarce resources, or found themselves in conflicts of interest, with persons who were un-enhanced. Genetic enhancement could confer a decisive advantage in social interactions.²⁸

In essence, this moral argument posits that the advances genetic engineering will provide may lead to a number of gross violations of normative laws and ethics—both Jewish and secular.

The correctness or incorrectness of this assertion of prospective ethical violation in human social conduct is difficult to evaluate in the Jewish tradition, but in the end, it simply cannot be accepted as grounds for halting all scientific progress and advancement—as a public policy, it is unacceptable. Many medical advantages initially accrue to the benefit of the wealthy or privileged, and allow certain advantages to go to those who have better access to health care. While one can express some social sadness over the inequitable division of resources, and even seek increased social justice to insure the proper allocation of the right to medical care, solving this problem by preventing the development of genetic engineering and related tests or procedures (as some explicitly advocate²⁹) seems to deny the fundamental Jewish obligation to cure people of illness, something which genetic engineering can (we hope) do. Retrospectively insisting that the development of insulin to treat diabetics was unethical because the initial beneficiaries of the development for insulin were the wealthy, who could pay for insulin,³⁰ seems incorrect—we instead hope that treatments that were once expensive become available to all, and that is a better alternative than halting medical advancement, and preventing cure.³¹

Yet others fear that society will mislabel such genetic-engineered individuals as something other than human, and engage in activities tantamount to murder or enslavement, by treating these individuals as organ sources, or as individuals to be experimented upon, or as forced labor. One could imagine a rabbinic authority, aware of the possibility of ethical lapses in our society, arguing that as a temporary measure based on the exigencies of the times, genetic engineering should not be engaged in until such time as the appropriate educational activity can be embarked on to teach people that genetic engineering is a form of medical treatment and products of genetic engineering are human beings entitled to be treated with full and complete human dignity.³² However, this type of prophylactic rule, which argues that permitted activity

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should be prohibited in light of the ethical failures of the times, is not the same as asserting as a normative rule of Jewish law that such conduct is prohibited. Rather, it is a temporary measure to prohibit that which is intrinsically permissible.³³

The same is true about arguments against genetic engineering grounded in efficiency. Some have argued that Jewish law should prohibit genetic engineering because so much human reproductive material has to be expended to produce a single successful genetic engineering cure.³⁴ Whatever the merits of this argument, it is likely that the march of scientific progress will vastly reduce the inefficiency of this process.

It could be argued that genetic engineering should be prohibited based on the various Talmudic dicta that seem to praise the importance of genetic diversity.³⁵ This, however, paints with too broad a brush. Eliminating the Tay Sachs gene or the sickle cell anemia gene seems to reduce genetic diversity in a positive way, in that it is part of the divine license to heal people—indeed, genetic cures can be more permanent and thus more effective. It is clear that the Jewish tradition views the natural process of genetic diversity as some sort of ideal, for a variety of reasons, including that it allows for the expression of a vast multiplicity in God's world—and thus intense genetic engineering, for a variety of reasons, falls far short of the ideal and should not be used absent illness or significant need. However, to claim that a single case or single category of genetic engineering, as an alternative to children being born with significant health problems, should be prohibited based on this analysis is no more persuasive than to claim that Jewish law should forbid artificial insemination or in vitro fertilization since it is less than ideal. The correct response should be that these less-than-ideal methods should only be used in circumstances where the ideal method does not or cannot work. The Talmudic dicta about genetic diversity stand for the proposition that wholesale genetic engineering should be discouraged, and nothing more.

More generally, Jewish law denies the authority of the post-Talmudic rabbis to make prophylactic decrees permanently prohibiting that which is permissible on these types of grounds.³⁶ This is even more so true when such a decree (*takkana*) would permanently prohibit an activity which is, in some circumstances, the only way a person can fulfill the obligation to cure themselves (or others) of a life threatening illness and could, in a variety of circumstances, have incredibly positive results.

So too, the Jewish tradition would not look askance at the use of genetic engineering to produce individuals when they are created primarily to be of specific assistance to others in need of help. Consider

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the case of an individual dying of leukemia, in need of a bone transplant, who agrees to participate in a cloning experiment with the hopes of producing another like him or her who, in suitable time, can be used to donate bone marrow and save the life of a person (and even more so, the donor). The simple fact is that Jewish law and tradition view the donation of bone marrow as a morally commendable activity, and perhaps even morally obligatory such that one could compel it even from a child.³⁷ Jewish law and ethics see nothing wrong with having children for a multiplicity of motives other than one's desire to "be fruitful and multiply." Indeed, the Jewish tradition recognizes that people have children to help take care of them in their old age, and accepts that as a valid motive.³⁸ There is no reason to assert that one who has a child because this child will save the life of another is doing anything other than two good deeds—having a child and saving the life of another.³⁹ The same is true for a couple who conceive a child with the hopes that the child will be a bone marrow match for their daughter who is dying of leukemia, and is in need of bone marrow from a relative. While the popular press condemns this conduct as improper, the Jewish tradition would be quite resolute in labeling this activity as completely morally appropriate. Having a child is a wonderful, blessed activity; having a child to save the life of another child is an even more blessed activity. Such conduct should be encouraged rather than discouraged. Motives for genetic engineering ought not to be seen as so important.

IV. PRE-IMPLANTATION GENETIC DIAGNOSIS AND JEWISH LAW

PGD might lay claim to a near uniqueness as a matter of public policy in the Jewish tradition, given its relationship to abortion. However, it is quite clear that normative Jewish law does not view pre-embryos as human life, no matter what one's general views are on the status of an implanted fetus in Jewish law. As Rabbi Gedalya Dov Schwartz stated in his letter in the name of the Beth Din of America concerning stem cell research:

Halakha does not consider any embryonic development within forty days of conception as having the sacred protected status of a human being.⁴⁰

A similar such view is endorsed in a recent article by Rabbi Yitzchok

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Breitowitz on this topic.⁴¹ Indeed, it is the common practice within the halakhic community to accept this view, and not require that all pre-embryos be implanted.

PGD is simply another variation of the process of in vitro fertilization, albeit one that, by incorporating genetic testing, allows for a higher degree of analysis of the embryo prior to implantation.

(On a parenthetical level, even if one were to disagree with this halakhic analysis, a strong public policy case could be made that, in fact, in our society the common alternative to PGD would be abortion; the destruction of the fetus after its implantation, as such, is permitted in American law. Given that reality, PGD might be the acceptable, and indeed preferred, technique given the wide presence of legal abortion. This is even more so true given the common, but rarely discussed, practice of declining to provide even life sustaining treatment for a child who is born with a serious genetic illness. Given that the alternative to PGD is typically either a post-implantation abortion or an even worse alternative, Jewish public policy ought to support the ready availability of PGD. Public policy is sometimes a matter of seeking the best alternative in the real world.)

The question of what form of PGD ought to be permitted according to Jewish law, and who should decide these questions, remains a difficult question. However, Jewish law generally assigns to adults, as the lawful guardians of children—and certainly to parents as guardians of their own children—the right to make decisions that are reasonably in the best interests of children. Using PGD to create a child without a specific illness would seem to be permitted according to Jewish law at the discretion of the child's parents. The same can be said for PGD that is designed to enhance any given characteristic in a child that increases the child's ability or functionality, in the discretion of the parents. However, were PGD to be used in a manner that were designed to harm children, even if the parents sincerely believed that the conduct they were embarking on was not harmful, such activity would seem to violate Jewish law and in this circumstance would empower a Jewish court (as well a secular court) to intervene to prevent such conduct from occurring.⁴² When it comes to the rights of parents, Jewish law only gives parents the right to conduct themselves in the best interests of their children, bounded by the range of activities found in the best interest of the child.⁴³

This, of course, returns us to the conversation about whether PGD is a *mitsva* according to Jewish law. It would seem to this writer that PGD,

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once it becomes established as a non-experimental form of medical treatment and a form of standard medical care that is used in a certain set of cases, becomes mandatory in those (medically appropriate) cases. While assisted reproduction is not mandatory in Jewish law, PGD is different, precisely because it is a treatment not for fertility but of the child's underlying illness. Of course, determining whether a particular form of treatment is an established cure (*refu'a beduka*) or experimental treatment is a complex matter.⁴⁴ However, it is well established in Jewish law that just as treating illness is mandatory, avoiding illness is mandatory. People who have the ability to take a vaccine that will immunize them from a particular medical problem would seem, in this author's opinion, to be mandated by Jewish law to do so. PGD is an inoculation of some sort, in certain cases.⁴⁵

Consider three different cases where PGD might be used. The first, and perhaps most troubling, is sex selection. PGD is a biologically simple, readily available technique for sex selection without engaging in the prohibited activity of abortion.⁴⁶ As a general matter, Jewish law treats sex selection as a trivial decision in its typical circumstances, and thus not a valuable or proper use of PGD (according to Jewish law). One could imagine situations where sex selection might be proper according to halakha—perhaps in the (rare) instances of personal status where such Jewish law status applies disadvantageously to members of one gender⁴⁷ or in situations where for a particular medical reason one gender poses a greater risk of a specific illness, although PGD ought to prevent that from happening in almost all cases. Simple selection in order to have a boy or a girl, would seem to be a violation of a sense of Jewish law in that pre-embryos ought not be discarded for trivial reasons.⁴⁸

Another case where PGD testing can play a vital role is in illnesses like Huntington's disease (which is an adult-onset dominant genetic characteristic that typically kills its carrier when the carrier is in his or her mid-30s). PGD would be a way of preventing Huntington's disease from being transmitted to the next generation. It would seem to this writer that the use of PGD to avoid the transmission of Huntington's disease (or Tay Sach's) unquestionably would be proper according to Jewish law. The goal would be to produce children who are more viable—this is a form of inoculation against such a disease.

A further situation that might be just over the horizon is the use of PGD in combination with gene transfer technology. This poses the question of genetic engineering and designing one's children. PGD and genetic engineering together appear ready to allow one to have robust gene therapy in order to provide certain genetic characteristics to be

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implanted in embryos, heightening genetic resistance or immunity to certain characteristics. Consider for example, the P53 gene, which is commonly referred as a cancer vaccine, in that the presence of this gene seems to vastly reduce the likelihood of suffering from certain cancers (by more closely monitoring DNA replication), and it is quite possible that this gene can simply be encoded in individuals in embryo through gene therapy and PGD. As explained above, the introduction of genetic sequences into the human genome as a way of increasing human health would not be controversial according to Jewish law—that is not to say it is medically wise or scientifically possible. It is, however, merely to note that Jewish law does not perceive a ready difference between a genetic cure and a non-genetic cure for an illness. If P53 is in fact a cancer vaccine, we ought to use it. If it has other consequences, then we ought not to use it. But the fact that it is genetic rather than non-genetic seems to pose no significant variant in Jewish law.

Another application of PGD screening which is not undertaken to detect the child's own illness, arises when parents seek to have a child whose HLA type (human leukocyte-associated antigens—a specific set of antigens) will closely match to another person (typically, another sibling) who needs a bone marrow transplant. PGD allows these embryos to be examined for the match prior to implantation, and selected to insure that they are a perfect HLA match. Without PGD testing, the odds of naturally producing an HLA match is less than 15%, whereas with PGD, the odds can be raised to nearly 100%. This child will be born to save the life of the sibling. Although contemporary American culture seems to find this “designer children” issue to be problematic, we have already seen that the Jewish tradition would not look askance at the application of PGD technology to produce individuals who can be of specific assistance to others. It is worth repeating that one who has a child because this child will save the life of another is doing nothing other than two good deeds—having a child and saving the life of another.⁴⁹ Having a child is a wonderful, blessed activity; having a child to save the life of another child, even more so. Such conduct should be encouraged rather than discouraged.

CONCLUSION

The combination of in vitro fertilization with PGD is a less than an ideal way to have children, as all assisted reproduction removes fertilization from loving sexuality, which is the Biblical ideal. Nonetheless, the

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Jewish tradition favors healing people from their illnesses even in situations where to effectuate a cure, deviation from the ideal is needed. Human life is sacred, and the eradication of illness a *mitsva*. It is a brave and very new world in the medical sciences, and we await our opportunity to fix the world—by curing illness, inventing vaccines, and otherwise changing nature to make it more amenable to human life. PGD could be such.

POSTSCRIPT

Advancements in human reproductive genetic technology move forward at an astonishingly rapid pace. (As this paper was being finalized, a report came from the South Korean scientific community announcing the creation of human embryos through cloning and the extraction of embryonic stem cells.⁵⁰) These developments may be hard to ponder, but they nonetheless deserve careful consideration from the perspective of Jewish law. This section will briefly present five of them to contemplate what the future could look like in certain circumstances and speculate as to how Jewish law might approach them.

The first is the human artificial chromosome (HAC). Rather than using a virus to add genes to cells, researchers are working to create entire chromosome structures in a laboratory from synthetic material. This technology is a long way off, and at first would be used alongside natural chromosomes for gene therapy purposes. But the HAC scenario raises the possibility that one day the root source genetic material implanted into a particular sperm or egg will not come from humans at all but will be an artificially created string of genetic code that serves the function of either sperm or egg and resembles neither parent in any genetic way. Rather, it is simply a programmed sequence of DNA taken out of a data-bank code and then synthesized to have certain characteristics. It would seem to this author that there is no father according to Jewish law in that situation, although this author remains convinced of the correctness of the view that the mother is the person who carries the child to term independent of any other genetic contribution; but this matter is quite disputed.⁵¹

A second development, much closer to actual implementation, is “ooplasm transfer,” in which a woman of advanced reproductive years who suffers from mitochondrial disabilities is given mitochondria (cytoplasm) from another woman. (This was done briefly already in the

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United States, but was subsequently prohibited through a directive of the Food and Drug Administration.) In this model, a child would be born with the sperm from one person, the genetic material in the nucleus of the egg is from another person, and the mitochondrial DNA from yet another person. This creates complex models of motherhood, in that one has to evaluate the various contributions of the possible mothers. However, as noted above, the author's view is that the mother is the person who carries the child to term independent of any other genetic contribution.

Yet a third genetic technology to consider is intentional human chimerism, in which the embryonic material of two fetuses is intentionally mixed at the two, eight, sixteen, or thirty-two cell level, creating a human being who is a mixture of two different fetuses. (This sometimes, albeit very rarely, occurs in nature when fraternal twins are created but then one is subsumed in utero into the other, giving rise to a human being who has two distinctly different genetic sequences and codes.) The creation of a human chimerism is a distinctly real possibility in modern technology.⁵² In essence, two blastospheres are combined producing only a single fetus but with diverse characteristics. This might be done medically in order to give the child enhanced immunities that can't be provided through a single direct genetic manipulation. (It also might be designed for social-cultural reasons in order to create a child with more than one mother or more than one father.) This child would appear to have more than one father and/or maybe more than one mother, depending on the genetic contributors in each case, and depending further on one's view of the birth mother as the mother according to Jewish law, at least as a matter of doubt, and maybe even as a matter of certainty. There is some precedent in halakha for the possibility of more than one mother or father, and doubt about these matters is clearly a possibility in halakha. On the other hand, one could well see halakha simply following the rule of majority to determine who is a parent, and the other potential parent is just a '*safek*' (uncertain).

A fourth case is a different form of chimerism, in which cells of a human are mixed with cells of another mammal,⁵³ so as to provide heightened immunity or other characteristics that cannot be found in the human genetic sequence. This case raises basic questions of human identity. It is the author's view that basic questions of humanness are resolved by asking whether the living creature in question had either a human mother, in which case it is human independent of its mental abilities, or by looking at its mental function. High level mental function, like that

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found in a small child, makes one ‘human’ according to halakha. Indeed, support for the proposition that “humanness” is determined by human function in cases where apparent definition of humanness—birth from a human mother—does not apply, can be found in an explicit discussion of humanness along these lines in the Jerusalem Talmud.⁵⁴

A fifth (but by no means final) issue to consider is reproductive xenotransplant—the placing of a fertilized embryo of one species into the uterus of another species. I think this case is easier, and not harder, than the case discussed above and it has some Talmudic precedent in the discussion about mermaids, and whether they are human or kosher,⁵⁵ where Rashi seems to claim that these mermaids can be impregnated by humans. So too, there seems to be a discussion in the Mishna of the humanness of orangutans (in Hebrew, *adnei ha-sadeh*).⁵⁶ Both Tiferet Yisrael and Rambam appear to grant these creatures human status with regard to certain issues. This might relate to the substantive discussion in the previous paragraph.

NOTES

1. This material is taken from the Genetics and Public Policy Center manual entitled “Reproductive Genetic Testing: The Science and Regulatory Environment,” distributed at the conference of January 6-7, 2003, Washington, DC, and their preliminary report, *Preimplantation Genetic Diagnosis: A Discussion of Challenges, Concerns, and Preliminary Policy Options Related to the Genetic Testing of Human Embryos*, dated January 2004, available at their website, www.dnapolicy.org.

In the real world, PGD serves as an alternative to prenatal testing in which one diagnoses a genetic disease or condition in a developing fetus. Two broad categories of prenatal testing are available. Invasive procedures, such as amniocentesis or chorionic villus sampling, are those in which a sample of fetal cells or tissue is obtained. The non-invasive procedures are ultrasound or taking a sample of the mother’s blood. All of these prenatal testing techniques lead to abortion as a way of avoiding the birth of a child with a defect, although CVS testing is at a much earlier stage in pregnancy than amniocenteses.

2. *Ibid.*
3. *Ibid.*
4. Kathy Hudson, Director of the Genetics and Public Policy Center, in preface to the preliminary PGD options report, *ibid.*
5. This analysis raises a set of very complicated conversations about what is a disease and what is a trait and what are the limits of human variability. Illnesses such as sickle cell anemia can confer immunity to malaria, which has advantages in certain—likely tropical—societies. It is commonly

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believed that cystic fibrosis for example produces heightened immunity against the bubonic plague and this accounts for its wide presence in eastern European and western European communities. It is a result of the heightened survivability of cystic fibrosis sufferers had in the Black Death of the Middle Ages. So too, undoubtedly even Tay Sachs provides a form of heightened immunity to some illness or another.

6. Judah Loew of Prague (Maharal), *Bi'ur ha-Gola*, pp. 38-39 (Jerusalem, 5731).
7. *Genesis* 1:26.
8. *Bi'ur ha-Gola*, pp. 38-39.
9. Jewish law permits this enjoyment. Such conduct was prohibited by Jewish law because it was not part of the Divine mission for the Jewish people. Jewish law is not a general ethical category governing the conduct of all, but its scope and application is limited to Jews, not merely jurisdictionally, but even theologically. This point of view would seem apparent from the general attitude that the Jewish tradition takes to a number of proselytizing issues; for more on this, see Michael Broyde, "Proselytizing and Jewish Law," in John Witte, Jr. and Richard C. Martin, eds., *Sharing the Book: Religious Perspectives on the Rights and Wrongs of Proselytism*, pp. 45-60 (Maryknoll, NY, 1999).
10. *Exodus* 21:19.
11. "Will Cloning Beget Disaster?" *Wall Street Journal*, Friday, May 2, 1997.
12. *Shulhan Arukh, Yoreh De'a* 336:1.
13. The Hebrew phrase *le-takken olam be-malkhut Shaddai* is taken from the *Alenu* prayer, which is recited three times daily in the traditional liturgy.
14. Catholic Medical Association, *Human Cloning: Position Paper of the Catholic Medical Association*, reprinted in *Issues of Law & Medicine* 15:323, pp. 323-324 (2000).
15. See *Hastings Law Journal* 53:1143, 1182.
16. See Laurence Tribe, "Second Thoughts on Cloning," *New York Times*, Dec. 5, 1997 (advocating the free market approach to cloning).
17. Gina Kolata, "Human Cloning: Yesterday's Never Is Today's Why Not?" *New York Times*, Dec. 2, 1997.
18. *Ibid.*
19. Press release dated August 21, 2001, which can be found online at www.jlaw.com/PressReleases/01-08-21.html
20. See Leroy Walters and Julie Gage Palmer, *The Ethics of Human Gene Therapy* (1997) and *President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research: Splicing Life*, pp. 25-30 (1982).
21. *Ibid.*
22. *Ibid.* See also "Note, Regulating Human Gene Therapy: Legislative Overreaction to Human Subject Protection Failures," *Administrative Law Review* 53:315, pp. 320-321 (2001).

It may not be readily apparent to all readers that this third category—testing—belongs in a discussion of genetic engineering. Examination and analysis, after all, is a far cry from actually altering the structure of genetic material within living beings. Nonetheless, testing here should be viewed in the broader context of sorting and selecting for the purpose of passing

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- genetic material on to future generations. In a world of limited resources, the process of sorting is a form of genetic engineering.
23. See J. David Bleich, "The Obligation to Heal in the Judaic Tradition," in J. David Bleich and Fred Rosner eds., *Jewish Bioethics* (Hebrew Publishing Company, NY, 1979).
 24. See for example *Shulhan Arukh, Orach Hayyim*, 328 and comments of *Magen Avraham*, 328:6. The observation of R. Yaakov Emden, *Mor u-Ketsi'a* 328, is worth noting: "A person is obligated to be treated . . . only when the doctor is using a well established medically effective cure which has been proven reliable. When it has, a person in danger may be treated against his will."
 25. The exact point at which no one can claim that a specific medical treatment is mandatory is a matter in dispute, and the same is true with regard to how risky a medical treatment has to be before it is prohibited. Consider the case of a dying person who has a course of treatment which can restore long term health, unless the treatment kills the patient more quickly, which is the more likely result. May the patient use the treatment? Must the patient use the treatment? Is the treatment prohibited? R. Hayim Ozer Grodzinsky in *Abi'ezer, Yoreh De'a* 16 rules that a patient may (but need not) undertake such a treatment. R. Moses Feinstein in *Iggerot Moshe, Yoreh De'a* 3:36, quotes *Mishnat Hakhamim* as prohibiting such treatment. Indeed, R. Feinstein's view is itself unclear, as in *Iggerot Moshe, Yoreh De'a* 2:58 he formulates a rule different from the one he formulates in *Yoreh De'a* 3:36.
 26. Consider for example human growth hormone. While undoubtedly there will be abuses of such a substance, few would claim that we ought not ever allow such a substance to be developed and used to address the consequences of children lacking in enough growth hormone. This example is particularly important, as one is hard-pressed to call being short a "health hazard" but yet, human growth hormone is a drug that is given to children to assist them in becoming more "normal" and thus permitted according to Jewish law.
 27. See "The Foetus and Foeticide," from David M. Feldman, *Birth Control in Jewish Law* (Third edition, New York, 1995), and "Abortion in Halakhic Literature," in J. David Bleich, *Contemporary Halakhic Problems*, vol. 1, pp. 325-371.
 28. Maxwell J. Mailman, "The Law of Above Averages: Leveling the New Genetic Enhancement Playing Field," *Iowa Law Review* 85:517 (2000).
 29. See George J. Annals, "The Man on the Moon, Immortality and Other Millennial Myths: The Prospects and Perils of Human Genetic Engineering," *Emory Law Journal* 49:753 (2000) who states:

On the national level, I (and others) called for a moratorium on human gene transfer experiments, what are more commonly (and incorrectly) referred to as "gene therapy" in early 2000. Many experiments were halted, but others continued, as does the debate about whether we know enough at this time to use them on humans. Formal moratorium or not, we must have a national (and international) debate on the goals of the research, and whether the lines between somatic cell and germ line research, or between treatment

- and enhancement research are meaningful. My own view is that the boundary line that really matters is set by the nature of the species itself, and that species-altering experiments should be outlawed.
30. See Seale Harris, *Bunting's Miracle: The Story of the Discovery of Insulin* (Lippincott, 1946).
 31. For a fine volume on this topic, see *The Orthodox Forum Proceedings VI: Jewish Responsibilities to Society*, (D. Shatz & C. Waxman eds., 1997).
 32. It has been reported to this writer that such is the position of Meir Lau, the former chief rabbi of Israel, although I have been unable to verify these reports. News reports state that "Israeli Chief Rabbi Meir Lau said . . . the use of genetic engineering to create life is totally prohibited," the rabbi said during a conference at Tel Aviv's Bar-Ilan University." See *AFP-Extel News Limited*, *AFX News* March 5, 1997. However, subsequent reports indicate that the "Chief Rabbinate doesn't reject genetic engineering in principle, but limits must be set, Chief Rabbis Eliahu Bakshi-Doron and Yisrael Lau told the Knesset Science and Technology Committee at Hechal Shlomo on Monday;" *Jerusalem Post*, April 2, 1997, p. 3, "News in Brief."
 33. A recent article reported ("Cloning," *Pittsburgh Post Gazette*, March 1, 1997 at A):

Rabbi Moshe Tendler, professor of medical ethics, Talmudic law and biology at Yeshiva University in New York, sees other potential good use for human cloning. In theory, the Orthodox scholar might permit cloned children when a husband cannot produce sperm. But he believes that the danger of abusing the science is too great to allow its use. As a Jew, he lives in the historical shadow of the Nazi eugenics program, in which people with "undesirable" traits were weeded out of society, forbidden to have children and ultimately killed. . . . "The Talmud says that man has to learn to sometimes say to the bee, 'Neither your honey nor your sting.' Are we good enough to handle this good technology? Of course we are, if we can set limits on it. And when we can train a generation of children not to murder or steal, we can prepare them not to use this technology to the detriment of mankind."

34. Robert Langreth, "Cloning Has Fascinating, Disturbing Potential" (*Wall Street Journal*, Monday, February 24, 1997), states that:

In producing the first clone of an adult mammal, researchers plied a seemingly simple technique to achieve what many thought to be impossible. Here's how it worked:

— Researchers took mammary-gland cells culled from an adult sheep, put them into a test tube and forced the cells into an inactive state by limiting their intake of nutrients.

— Next, they took unfertilized eggs from female sheep and mechanically removed the DNA-containing nucleus from each egg.

— They then used standard lab techniques to insert 277 of the adult DNA cells into 277 eggs.

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— Of these fused egg cells, only 29 survived for a few days and were surgically implanted into the wombs of 13 ewes.

— One of the 13 sheep became pregnant and gave birth to a lamb that was an exact genetic replica of the adult donor, carrying none of the mother's genes.

35. See *Sanhedrin* 38a and *Berakhot* 58a. R. Loew also indicates that genetic diversity is part of the divine plan; see his *Derekh Hayyim* 4, p. 204, and sources cited in note 6.
36. Menachem Elon, *Jewish Law: History, Sources Principles* (Philadelphia, 1996), pp. 1103-1204.
37. See "Compelling Tissue Donations," J. David Bleich, *Tradition* 27:4, pp. 59-89 (1993). The rationale for this being that such donations (which are not really donations according to Jewish law, as they can be compelled) are neither statistically harmful nor particularly painful, and thus one who engages in this activity fulfills the biblical obligation not to stand by while their neighbor's blood is shed. This activity is compulsory activity in the same way one must jump into the water to save one who is drowning, if one knows how to swim and such activity poses no danger.
38. See *Yevamot* 64a; *Shulhan Arukh, Even ha-Ezer* 154:6-7; and Yehiel Michel Epstein, *Arukh ha-Shulhan, Even ha-Ezer* 154:52-53.
39. The birth of the child itself is a fulfillment of the *mitsva* to be fruitful and multiply, and the donation by the child of bone marrow or blood or other replenishable body serums that can save the life of another—particularly of a parent—is a second good deed.
40. See note 19.
41. "Halakhic Approaches to the Resolution of Disputes Concerning the Disposition of Preembryos," Yitzchok A. Breitowitz, *Tradition* 31:1, 64-91 (1996).
42. Consider the classic hypothetical discussed in the PGD literature about whether deaf parents can intentionally create deaf children through PGD, when they think that such is best for their child (as such is what they are). Such is undoubtedly true even about such mundane matters as the balance between schizophrenia and artistic tendencies or the intentional creation of an idiot savant with a particular strong set of skills but also dramatically diseased.
43. See Michael Broyde, "Child Custody and Jewish Law: A Review," *Journal of Halacha and Contemporary Society* 36, pp. 21-46 (1999).
44. For further discussion on this topic see "Experimental Procedures and Pikuach Nefesh: The Concept of Refu'ah Bedukah," J. David Bleich, *Tradition* 25:1, pp. 50-58 (1989).
45. That the notion of cost plays a role in the Jewish tradition's understanding of public policy is worthy of note. Treatment can be phenomenally expensive; such treatments do not become a *refuah beduka*, simply due to their functional unavailability as a matter of cost. Thus so long as PGD remains beyond the economic range of normal people (i.e., is not covered by health insurance), it cannot be an established cure in Jewish law.

In addition, PGD is in no way shape or form a *mitsva* when it is used merely to enhance one's genotype whether it be as a matter of height or intelligence or beauty as opposed to curing an illness. The enhancement of

- one's physical attributes is not always mandatory in Jewish law and indeed in this writer's opinion perhaps does not even rise to the level of permitting the discharge even of pre-embryos other than in severe cases. Thus, this writer thinks that pre-implantation genetics diagnosis as a form of enhancement of one's ability is much more complicated as a matter of Jewish law than as a treatment for an illness or a disease or to save the life of one's sibling in need of a blood or bone marrow transplant.
46. It is more effective than sperm sorting, a common technique used in these circumstances medically, but yet a less effective technique.
 47. Consider the cases of *Moavi* and *halal* where, for status reasons, parents might choose to specify the gender of a future child. The prohibition in Deuteronomy 23:4 for a *Moavi* (Moabite) to enter (i.e., marry into) the congregation is limited to men. Thus a *Moavi* couple who converts to Judaism might choose to have a daughter to facilitate her marriage to a Jew. Similarly, a *Kohen halal* who has desecrated his kohen status with a prohibited relationship might sex-select a son, as a daughter's status would preclude her from marrying a *kohen*.
 48. A related question is whether sex selection may be permitted in cases where PGD is already being done for another reason—parents have sought to examine for another illness and only afterward is sex selection brought up. This would seem easier to justify.
 49. See note 39.
 50. Gina Kolata, "Human Embryos Created Through Cloning," *New York Times*, February 12, 2004.
 51. See Michael Broyde, "Cloning People: A Jewish View," *Connecticut Law Review* 30:2, pp. 503-535 (1997).
 52. This technology has proponents in the homosexual community and is growing in popularity among same-sex couples who wish to have offspring that resembles both of them genetically, but who recognize the need for the contribution of genetic material from a member of the opposite sex. Indeed, this author has already faced a query from a lesbian couple, one of whom was Jewish, who used the sperm of a gay man for in vitro fertilization, then proceeded to combine the genetic material from two IVF eggs before implanting the resulting fetus in the womb. This situation is referred in the lesbian community's colloquial slang as an "omelet," as one needs to break two eggs to create this fetus.
 53. Human-mouse hybrid experiments have been considered—see Nicholas Wade, "Stem Cell Mixing May Form a Human-Mouse Hybrid," *New York Times*, November 27, 2002; as have human-cow hybrids—see Nicholas Wade, "Human-Cow Hybrid Cells Are Topic of Ethics Panel," *New York Times*, November 18, 1988.
 54. *Niddah* 3:2.
 55. Rashi *Bekhorot* 8a, s.v. *benai yama*.
 56. *Kil'ayim* 8:5.