

**REVIEW ARTICLE**

# Multifaceted Aspects of Human Cloning

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## Introduction

Curious human brain has led to numerous discoveries. Human cloning, which was a topic of science fiction for hundreds of years, turned real with arrival of Dolly, a cloned sheep in 1997. Cloning since its inception has led to seemingly unending and controversial debate worldwide on a number of medico legal, ethical and social issues (1,2). The present review discusses all these aspects of human cloning.

## What is cloning ?

Clone means one or a group of genetically identical cells, organisms or plants derived by vegetative reproduction from a single parent; also, a DNA population, derived from a single hybrid DNA molecule by replication in a eukaryotic or bacterial host cell (3). The word "clone" is derived from a Greek word for taking a cutting from a plant. Scientists traditionally used the term "cloning" to describe different processes for duplicating biological material. In simple terms, human cloning is a process of producing genetically identical human beings. In general biological terms, human cloning is defined as "the asexual replication of an existing genome or individual, or a replica of a DNA sequence, such as a gene, produced by genetic engineering".

## Historical Milestones

First report of successful cloning of lambs (4) that went unnoticed was soon followed by arrival of "Dolly" in 1997 (5). Ian Wilmut and colleagues at Roslin Institute and PPL therapeutics near Edinburgh produced the clone, Dolly the lamb. Dolly was created by taking cells from the udder of an ewe and "reprogramming" them to create a new embryo by a process known as nuclear transfer, and implanting the embryo in another ewe. Doubts related to Dolly's origin that if she was really a clone was put to rest by Forensic DNA testing methods, which confirmed Dolly to be the direct descendent of

an Udder cell (6,7). Soon there were reports of cloned mice and large farm animals. Genetically altered fibroblasts were used to clone large farm animals, sheep (8) and cow (9) by nuclear transfer. Cloning of human embryos has already been achieved but successful cloning of humans has not been proven yet despite of some claims regarding the same. The South Korean scientists announced the cloning of a human embryo first in February 2004. They grew the embryo for seven days before destroying it. Recently, South Korean scientists have created the world's first cloned dog Snuppy (10).

## Reproductive and Therapeutic Cloning Technologies

1. Reproductive Cloning Technology includes a process called "somatic cell nuclear transfer" (SCNT). The genetic material from the nucleus of a donor adult cell is transferred to an egg whose nucleus, and thus its genetic material has been removed. The reconstructed egg containing the DNA from a donor cell is treated with chemicals or electric current in order to stimulate cell division. Once the cloned embryo reaches a suitable stage, it is transferred to the uterus of a female host where it continues to develop until birth. Thus, reproductive cloning is a process of nuclear transplantation and embryo splitting. Dolly was created by reproductive cloning technology.
2. Therapeutic Cloning Technology also known as, "embryo cloning," is the production of human embryos for use in research with the goal of harvesting stem cells that can be used to study human development and treat diseases. Stem cells are extracted from the egg at blastocyst stage and can be used to generate any type of specialized cell in the human body.

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### Applications (11,12)

1. Cloning is most likely to serve as a new unusual but perhaps efficacious treatment for infertility or sought by couples, who because of a high risk of genetic disease or other factors cannot or do not wish to conceive a child.
2. Researchers believe that stem cells have a potential to serve as replacement cells in treatment of degenerative diseases such as Alzheimer's disease, Parkinson's disease, spinal cord damage, diabetes, cardiovascular disorders, cancer research and therapy etc.
3. Cloning technology can also be used to generate tissues and organs for transplants. The cloned tissue or organ is a genetic match to the recipient thus risk of tissue rejection would be eliminated.
4. This technology might be helpful in preservation and repopulation of the endangered species and genetic improvements etc.
5. It may become possible to clone a dead or dying person.
6. Researchers also hope to use cloning to help with basic research into human diseases.

### Arguments Against Cloning (13)

#### Religious Perspectives

Most prominent arguments for an outright ban on human cloning include that human beings have a right to be "born in a human way and not in the laboratory" and that life is meant to come from God through the blessed relationship of a man and a woman. Other arguments include that "We all have the right to be born of love". When embryos are made in a test tube or a petrie dish "they can be frozen, poured down the sink and treated as objects rather than subjects of infinite human value." Catholic teaching opposes cloning, whether therapeutic or reproductive, as the process is the same in either case; only the purpose is different. The official opinion of the Roman Catholic Church is that "every possible act of cloning humans is intrinsically evil" and can never be justified. Hinduism and Islamic views with relation to human cloning are not unanimous.

#### Ethical Issues

Direct objections are that cloning is unnatural; it affects human dignity and violates the individual's right to genetic uniqueness, whereas consequential objections concern unjustified health and psychosocial risks for the

progeny. Cloning is an "invasion of personality" and a "Pandora's box with unpredictable consequences (14)".

**Cloning and human dignity :** The notion of "human dignity" is commonly used ethical justification for cloning laws on the basis that reproductive human cloning necessarily infringes with the notions of human dignity (15). UNESCO's Universal Declaration on the Human Genome and Human Rights, recommends a ban on "practices which are contrary to human dignity, such as reproductive cloning" (16) and the World Health Organization, 1998 reaffirmation that "cloning for the replication of human individuals is ethically unacceptable and contrary to human dignity and integrity (17) are known illustrations of the same.

The reasons behind claims that cloning infringes with the human dignity are that :

1. Dignity closely relates to "autonomy" and human "uniqueness," the concern is that a clone's autonomy will be compromised and the uniqueness lost because of identical genome (18).
2. The act of cloning can be implicated as an intention to "violate the rights of the clone in the future", because the person cloned would not be created for their own benefit but someone else's. This is an instrumental way of using another human, as a means to someone else's ends; which is unacceptable human control.
3. The most fundamental ethical case against human cloning is that no human being should have his or her complete genetic make up pre-determined by another human.
4. Cloning is "replication" and not "reproduction". The asexual nature of the process is "unnatural," and found only in the lowest forms of life. Thus, cloning degrades human dignity.

#### Physical Risks

It took 277 attempts and 29 implantations to produce one healthy Dolly and because cloning humans is more complicated, "even more deaths and lethal birth defects can be expected during experimentation". Many attempts at animal cloning produced disfigured monsters with severe congenital abnormalities. Cloned animals tend to have immuno-compromised status, higher rates of infection, tumour growth and other complications, or other developmental abnormalities not appearing till after birth. Some of the defects may not be revealed until a clone is mature. Dolly, the most famous sheep in history,



suffered from arthritis at an unexpectedly early age and was euthanised on February 14, 2003 at the age of 6 after being diagnosed with an incurable lung disorder-probably linked to the cloning process. Dolly's death, while not definitively traceable to the cloning process again highlighted the possible health risks associated with reproductive cloning (19). The big worry besides congenital and developmental abnormalities is impact of cloning on mental development and early ageing cannot be predicted by existing technology (20).

### **Psychological Risks**

Children may suffer from a diminished sense of individuality and personal autonomy as the feeling that he or she is different from others and a copy of someone else, may creep in. A cloned child may feel that their future is constrained by the life path of their gene donor. Besides ill-defined relationship, unbearable emotional pressures in trying to establish his or her identity may shatter the clone's personality. The mental development and reaction of the clone to such stresses, as it grows up cannot be predicted in advance and thus it would be unethical to inflict that risk knowingly (21).

### **Social Issues**

Main risk of human cloning is that it would allow third parties to impose biological predetermination. Widespread practice of human reproductive cloning will encourage a form of eugenics as people arbitrarily decide which traits are desirable that may possibly lead to Degradation of the Quality of Parenting and Family Life and Objectification of Children. Parents having complete control over the genome of their children might begin to view children as objects i.e. it might lead to the objectification of children. Objects derive their worth from how well they serve the needs of others. Parents may value their children according to how well they meet expectations and larger society may not recognize them as individuals. Thus, reproductive cloning would have an adverse impact on the social definition of family:

### **Legal Issues**

People that support further research into human cloning argue that respect for personal autonomy, freedom of reproductive choice, and freedom of scientific inquiry should prohibit lawmakers from making human cloning illegal. Opponents believe that the government has the authority to override these rights for larger interests of the society. Laws governing human cloning should reflect ethical positions and not based on religious

beliefs. Perhaps the most urgent ethical, legal and social issues about cloning arise in the context with the known and unknown risks following human experiments making it potentially dangerous and ethically irresponsible.

### **Legislations Relating Cloning**

Although a global comprehensive treaty, relating cloning technologies is lacking, different countries have laws to cope with emerging medico legal problem. 1997 Council of Europe Convention on Human Rights prohibited cloning for reproductive and research purposes in most of Europe. In 1998, the Commission of the European Convention in Paris ratified a Protocol prohibiting all those methods that can create identical human beings but some countries did not sign it. UK has enacted Human Reproductive Cloning Act of 2001, which prohibits the placing in a woman of a human embryo, which has been created otherwise than by fertilization (22). In 2001, an amendment to the "Human Fertilization and Embryology Act" was made to allow research on therapeutic cloning (23). Similarly, USA has enacted Human Cloning Prohibition Act of 2001 (HCPA 2001) to regulate use of cloning technology (24). Among the Asian countries, Japan enacted a law that bans human reproductive cloning but allows stem cell research. Other Asian countries, such as India, China, Singapore, and South Korea, also allow experimentation with stem cell research. In Bangladesh, at present cloning prohibition law is absent. Scientists could misuse this legal disparity and therefore a universally accepted law is required. The regulation of human cloning continues to be a significant national and international policy issue. The United Nations postponed indefinitely a vote on proposed worldwide ban on human cloning in November 2004 after 22 nations including India and Britain opposed the motion.

### **Status of Cloning in India**

India allows experimentation with stem cell research. In India medical termination of pregnancy is permitted under the MTP Act of 1971 (25). The resulting fetal tissues that are freely available from the MTP Clinics and hospitals can be utilized for research purposes. Termination of pregnancy for obtaining fetus for stem cell research or for transplantation is not permitted. The main source of embryonic cells will be from the ART/ IVF clinics dealing with the infertility treatment where spare or supernumery embryos will be available for the purposes. However, no embryos can be created for the sole purpose of obtaining stem cells.



Institutional ethics committee should keep in view the ethical, legal and social issues and should adhere to the "Ethical Guidelines for biomedical research on human subjects" issued by the Indian Council of Medical Research (ICMR) in October 2000 (26). In India, only the research programmes and not the therapeutic transplantations are permitted at present.

### Conclusions

It is difficult to find a solution to various issues related to cloning technologies or to reach a consensus on universal policy. The central objections to human reproductive cloning are not objections relating to dignity but objections relating to risk, especially those imposed on children born in the course of early human experimentation. There is consensus that the reproductive cloning is unjustified now, because of the health risks involved and should be restricted. However restriction on cloning as such can impede important research and progress in animal biotechnology and medicine. Thus the benefits sought using the technology against any potential harm to the offspring should be weighed. Instead of seeking prohibition of human cloning, focus of attention should be towards the development of more effective cloning procedures, guidelines and regulations. This will allow us to obtain its benefits while minimizing the risks involved. Research related to reproductive cloning should be universally banned but therapeutic cloning related research should be conducted under restriction and strict supervision of the society. Gradually in times to come, human cloning should shift from being "totally unacceptable" to cloning under controlled conditions.

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