CLONING HUMAN BEINGS

Views of Scientific Societies and Professional Associations on Human Nuclear Transfer Cloning Research

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CONTENTS

PREFACE

In response to the news of the cloning of Dolly, a Scottish mountain sheep, President Clinton asked the National Bioethics Advisory Commission (NBAC) to report to him on the legal and ethical issues that cloning raises in regard to its potential use in human beings. To obtain the views of the scientific community, the NBAC asked a number of scientific societies and professional associations for their opinions on the use of nuclear transfer cloning using embryonic or adult human donor nuclei for three general areas of research: (1) basic developmental biology conducted in vitro on embryos up to day 14; (2) in vitro cell differentiation to generate specific human cell types for potential cell based therapies; and (3) the generation of cloned offspring for the treatment of infertility or related reproductive reasons.

This report summarizes the responses of the scientific organizations to the NBAC questions about human nuclear transfer research, as well as their general comments about the risks and benefits, possible restrictions, and the ethical and religious issues connected with human cloning research. It was prepared by RAND's Critical Technologies Institute (CTI) in response to a request from the Ad-hoc Cloning Science Working Group of the NBAC, and is intended for inclusion in the NBAC's report to the President on legal and ethical issues involved in the cloning of human beings. The author is an American Association for the Advancement of Science Fellow at CTI.

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SUMMARY

The cloning of Dolly, a Scottish mountain sheep, has brought into sharp focus the possibility of cloning human beings along with all its inherent moral, ethical and legal implications. On February 24, 1997, President Clinton asked the National Bioethics Advisory Commission (NBAC) to deliver a report to him within 90 days on the legal and ethical issues involved in the cloning of human beings and "possible federal actions to prevent its abuse." On March 4, 1997, President Clinton imposed a ban on the use of federal money for cloning human beings and asked for a voluntary moratorium by researchers working with private money until he receives the report from the NBAC.

As an aid to its deliberations, the NBAC requested that a number of scientific societies and professional associations provide their views about the use of nuclear transfer cloning, using either embryonic or adult human donor nuclei, for three general areas of research: (1) basic developmental biology conducted in vitro on embryos up to day 14; (2) in vitro cell differentiation to generate specific human cell types for potential cell-based therapies; and (3) the generation of cloned offspring for the treatment of infertility or related reproductive reasons. Thirty-two societies and associations responded to the Commission's request,[1] providing comments not only on the science of human nuclear transfer cloning, but on the associated risks and benefits, and ethical and policy issues as well.

The societies and associations made a clear distinction between the use of human nuclear transfer cloning for the purposes of research and for the cloning of an entire human being. The majority of respondents did not support cloning to produce a new individual. Although the societies and associations were asked to comment on the use of either embryonic or adult donor nuclei, the majority of respondents made no distinction between these two sources of donor nuclei.

The majority of societies and associations stated that research on basic developmental biology or new cell-based therapies should be allowed to proceed freely with proper peer review to ensure that established scientific and ethical principles are not violated. The overwhelming view was that the potential benefits of cell-based therapies far outweighed the risks of the research, and that the many possible contributions to science and medicine warranted this type of research. Prohibition or excessive regulation of this technology could limit our knowledge of the genetic

basis of diseases, such as certain birth defects, inherited disorders, and cancer, and impede the development of new therapies with the potential to help many people.

In contrast to their views on the use of nuclear transfer cloning for basic developmental biology and cell-based therapies, the majority of the societies and associations agreed that the generation of cloned offspring should be prohibited entirely at this time. Most of the objections centered on (1) ethical issues of personal and social well being, such as family relationships, identity, individuality, psychological impact, and expectations of sameness; and (2) scientific issues such as the low efficiency of nuclear transfer cloning and the high likelihood of abnormal offspring. The concerns of several respondents were nicely captured in statements made by the American Medical Association (AMA). The AMA, founded on the principle that physicians practice medicine within set standards of professional conduct and are bound by a code of ethics, stated, "Cloning as an approach to medical infertility has ethical hazards in the areas of confidentiality, consent, and discrimination. This and risks to personal and social well being would prevent professional endorsement at the present time." The AMA also stated, "Cloning as an approach to terminal illness or population enhancement is not acceptable medical practice." Finally, the AMA indicated that even if animal cloning technology ever met standards sufficient to permit clinical trials, it would still be necessary to establish that cloning offered an equal or better approach than existing therapy.

Several respondents were concerned that an ambiguous definition of "cloning" might interfere with valuable medical research. To avoid inadvertently prohibiting important genetic research, they argued that there needs to be a clear distinction between human cloning to produce a new human being, and cloning as a tool in biomedical research that in and of itself would not result in a new human being. Although most respondents indicated that cloning to produce a new human being was practically and morally unacceptable, they did not advocate legislation to prohibit research in this area. Instead, a voluntary moratorium was proposed. Because the prospect of cloning an entire human being is so preliminary at this stage, a voluntary moratorium would allow additional time to consider the scientific, ethical, social, and legal bases of such research. In contrast, most of the societies and associations indicated that there should be no new restrictions on nuclear transfer cloning for biomedical research beyond those already in place for similar types of research, which include (1) the obligation of researchers and physicians to observe self-restraint consistent with scientific, medical, and ethical codes of conduct; (2) oversight by the scientific community through such means as peer review and Institutional Review Boards; and (3) federal oversight, such as by a national bioethics authority, or regulation by the federal policy for the protection of human research subjects. Several respondents also stated that nuclear transfer cloning experiments should first be perfected in animal models, after which confirmatory experiments with human cells could be performed to address species variations.

It was notable that none of the societies or associations called for the enactment of federal or state legislation banning either the cloning of an entire human being, or cloning research to study basic developmental biology or to develop cell-based therapies. Several respondents specifically indicated that they opposed such legislation due to concerns that overly broad

regulations may inhibit or deter critical biomedical research. Many medicines, diagnostics, and vaccines to treat diseases such as heart attacks, cancer, diabetes, hemophilia, and hepatitis were developed with knowledge gained from the cloning of genes and cells. In addition, a legislative ban would have a force of permanence that may not be presently scientifically or ethically justified. The difference between a moratorium and legislation is that a moratorium can either be lifted in the future or made permanent when more information is available to assess the feasibility, desirability, and public acceptability of the cloning of human beings.

This summary of opinions came from a subset of the scientific and medical communities. However, it is by no means a complete account of all the scientific societies and professional associations that may have opinions on this complex issue. A more thorough investigation of the issues may provide many more important points of view and information critical to a decision on the allowability of human nuclear transfer cloning research.

ACKNOWLEDGMENTS

The author would like to thank the scientific societies and professional associations for their timely and informative response to the NBAC's request for input on the issue of human nuclear transfer cloning. The guidance, input, and review by Carol Greider, David Cox, Steven Holtzman, and Diane Scott-Jones from the NBAC Ad-hoc Cloning Science Working Group were invaluable for the preparation of this document. The author would also like to thank Rachel Levinson from the Office of Science and Technology Policy for the opportunity to work with the NBAC on this project. She would also like to thank the NBAC Staff—Henrietta Hyatt-Knorr, Patricia Norris, and Robin Dorsey—for their help in soliciting and compiling the society and association responses. The author is also very grateful to her colleagues at RAND—Richard A. Rettig, Katherine Webb, and David Adamson—for their quick and thorough review of this document.

LIST OF ABBREVIATIONS

CTI	Critical Technologies Institute
FDA	Food and Drug Administration
IRB	Institutional Review Board
NBAC	National Bioethics Advisory Commission
NIH	National Institutes of Health
RAC	Recombinant DNA Advisory Committee
Ref #	Reference number

INTRODUCTION

The first and only mammal to be cloned from an adult cell, the sheep named Dolly has brought into sharp focus the possibility of cloning human beings along with all its inherent moral, ethical, and legal implications. On February 24, 1997, President Clinton asked the National Bioethics Advisory Commission (NBAC) to deliver a report to him within 90 days on the legal and ethical

issues involved in the cloning of human beings and "possible federal actions to prevent its abuse." On March 4, 1997, President Clinton imposed a ban on the use of federal money for cloning human beings and asked for a voluntary moratorium by researchers working with private money until he receives the report from the NBAC.

The nuclear transfer technique that was used to clone Dolly from the udder of an adult sheep is not new technology. This technology has been used since the early 1960s to answer the question of whether the genetic material of differentiated cells from adult animals is irreversibly modified. Nuclear transfer experiments, first performed in amphibians in the 1960s, in mice in the 1970s, in sheep in the 1980s, and in monkeys in the 1990s have provided evidence that fully differentiated somatic cells retain all the genetic material of the early embryo, and that differentiation is almost entirely achieved by reversible changes in gene expression (Rossant 1997, Wilmut et al. 1997).

The nuclear transfer technology that produced Dolly is not new to Ian Wilmut and his group in Scotland, either. They have been studying the control of cell development for over ten years, and just last year published a report of the first mammal to be cloned from an established cell line (Campbell et al. 1996). Their major contributions to this area of research are (1) the complete genetic material from an adult mammalian cell has been used in the development of a new individual for the first time; and (2) donor cells, induced to exit the growth phase and become quiescent before being used for nuclear transfer, are more susceptible to reprogramming by the recipient egg cell and result in the normal development and birth of cloned offspring (Campbell et al. 1996, Wilmut et al. 1997).

In order to fully evaluate the issues that nuclear transfer cloning raises, the NBAC requested input from a wide cross-section of the scientific community. Various scientific societies and professional associations (hereafter "societies") were asked for their views on the use of nuclear transfer cloning, using embryonic or adult human donor nuclei, for three general areas of research: (1) basic developmental biology conducted in vitro on embryos up to day 14; (2) in vitro cell differentiation to generate specific human cell types for potential cell-based therapies; and (3) the generation of cloned offspring for the treatment of infertility or related reproductive reasons.

This report summarizes the responses of the scientific organizations to the NBAC questions about human nuclear transfer research, and describes their general comments about the risks and benefits, possible restrictions, and the ethical and religious issues connected with human cloning research. The strategy for soliciting input from the societies on human nuclear transfer is also presented.

STRATEGY FOR SOLICITING INPUT FROM SOCIETIES ON HUMAN NUCLEAR TRANSFER CLONING

In an effort to form recommendations that best represent the scientific community, the NBAC sought input from scientific societies and professional associations on the human nuclear transfer

cloning issue. Because of time constraints, it was not possible to mount a systematic survey of the members of the societies. Instead, the NBAC requested help from society and association leaders to obtain an informal assessment of the views held by their members, with the knowledge that the responses may only reflect the views of the leadership, or may even be the personal opinion of the respondent. The societies were asked to provide feedback regarding the appropriateness of pursuing six types of research (Questions 1–6):

1. Nuclear transfer cloning using *adult* human donor nuclei for basic developmental biological research on early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.

2. Nuclear transfer cloning using *embryonic* human donor nuclei for basic developmental biological research using early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.

3. Nuclear transfer cloning using *adult* human donor nuclei for research purposes on in vitro cell-differentiation to generate specific human cell types for potential cell-based therapies.

4. Nuclear transfer cloning using *embryonic* human donor nuclei for research purposes on in vitro cell-differentiation to generate specific human cell types for potential cell-based therapies.

5. Nuclear transfer cloning using *embryonic* human nuclei for research toward generating cloned offspring in the treatment of infertility or related reproductive reasons.

6. Nuclear transfer cloning using *adult* human nuclei for research toward generating cloned offspring in the treatment of infertility or related reproductive reasons.

The societies and associations were asked to indicate whether each kind of research should be (1) prohibited entirely, (2) allowed in some limited circumstances, or (3) allowed freely. They were also asked for the reasoning behind their answers, what types of limited circumstances they envisioned, and their views on why nuclear transfer cloning experiments using either embryonic or adult donor cells should be allowed or prohibited.

SOCIETY RESPONSES TO QUESTIONS ABOUT THE USES OF NUCLEAR TRANSFER CLONING

Thirty-two societies responded to the NBAC's request.[2] Table 1 lists the societies that responded, the corresponding reference number (Ref #) used in this report, and notes whether the response provided was in an official or personal capacity. In addition, four societies stated that they could not respond in the time allotted. Twenty-five of the 32 responses presented the official views of the society, while 7 represented the personal views of the respondent. Some of the societies that responded in an official capacity qualified their responses: eight stated that their responses

represented the leadership and not necessarily that of the entire membership; one submitted the consensus view of the society's Public Policy Committee; and one gave an impression of the views of the society's members. Six respondents provided general comments about their views on cloning, but did not directly address the six research areas (Questions 1–6) defined by the NBAC. Seven societies had no official position on human cloning or on the six proposed research areas. Nineteen respondents specifically addressed Questions 1–6.

Table 2 summarizes the responses of the scientific societies and professional associations on the six areas of human nuclear transfer research described in Questions 1–6. It is interesting to note that even though the societies were asked to comment on the use of either embryonic or adult donor nuclei, the majority of respondents did not differentiate between these two sources of donor nuclei. Three respondents specifically stated that they drew no distinction between the use of adult or embryonic nuclei, when used for in vitro purposes, on the assumption that such use be subject to usual ethical approval constraints (13, 32, 34).

Of the 19 respondents commenting on Questions 1–6, four represented the personal views of the respondent, and 15 represented the official views of the society. The majority of respondents stated that nuclear transfer cloning should be allowed freely for in vitro research on basic developmental biology (Questions 1 and 2) or for the in vitro generation of specific cell types for potential cell-based therapies (Questions 3 and 4). In contrast, the majority of respondents stated that the use of nuclear transfer cloning for the generation of cloned offspring in the treatment of infertility or related reproductive reasons (Questions 5 and 6) should be prohibited entirely.

A few respondents recommended that nuclear transfer cloning should be allowed only in some limited circumstances for in vitro research (Questions 1–4) or for generating cloned offspring (Questions 5 and 6). The types of limitations cited included the requirements that nuclear transfer cloning experiments be conducted under strict regulations and safeguards, and first be perfected in animal models. Although the majority of societies distinguished the cloning of human beings from the use of cloning for the purposes of research, three respondents stated that all research with nuclear transfer cloning, including creating entire human beings, should be allowed freely (10, 15, 24). In contrast, two respondents stated that all research with nuclear transfer cloning, including research not intended for implantation, gestation, and birth, should be prohibited entirely by enforcing a moratorium (12, 21).

Table 1. Respondents to the NBAC's Request for Input on the Issue of Nuclear Transfer Cloning

Society/Association	Ref #	Official/Personal	Comments
Norman Abeles Department of Psychology Michigan State University	1	personal	
American Association for the Advancement of Science (AAAS)	2	official	
American Association of Colleges of Pharmacy	3	official	
American Association of State Colleges and Universities	4	official	
American Board of Medical Genetics	5	official	
American College of Medical Genetics	6	official	leaders
American College of Obstetricians & Gynecologists	7	n/a	could not respond in time
American Federation for Clinical Research	8	n/a	could not respond in time
American Medical Association	9	official	
American Psychological Association	10	official	leaders
American Psychological Association Norman, Abeles, President	10a	official	
American Public Health Association	11	n/a	could not respond in time
American Society for Cell Biology	12	official	consensus
American Society for Human Genetics	13	official	
American Society for Reproductive Medicne	14	official	leaders
American Society of Parasitologists	15	official	leaders
Association of American Universities	16	official	
O. W. Barnett North Carolina State University, College of Agriculture and Life Sciences	17	personal	
Biotechnology Industry Organization (BIO)	18	official	
Council of Scientific Society Presidents	19	official	
Entomological Society of America	20	personal	
Federation of American Societies for Experimental Biology (FASEB)	21	personal	colleagues

Table 1. Respondents to the NBAC's Request for Input on the Issue of Nuclear Transfer Cloning (cont.)

Society/Association	Ref #	Official/Personal	Comments
Genetics Society of America	22	official	Board of Directors
Tony E. Hugli, Ph.D. Scripps Research Institute	23	personal	
Brian W. J. Mahy, Ph.D. National Center for Infectious Diseases, Centers for Disease Control and Prevention	24	personal	
National Academy of Sciences	25	personal	
National Advisory Board on Ethics in Reproduction (NABER)	26	official	leaders
National Health Lawyers Association	27	official	
Pharmaceutical Research & Manufacturers of America (PHARMA)	28	official	
Public Responsibility in Medicine and Research (PRIM&R/ARENA)	29	official	impression
Society for Assisted Reproductive Technology	30	official	leaders
Society for Clinical Trials	31	official	impression
Society for Developmental Biology	32	official	leaders
Society for Neuroscience	33	official	
Society of Integrative and Comparative Biology	34	official	
Society of Research Administrators	35	official	
Society of Research in Child Development	36	n/a	could not respond in time

Key

n/a = not applicable
no position = respondent has no official position on the issue
Board of Directors = circulated to the Board of Directors
colleagues = prevailing opinions of colleagues at recent professional meetings
consensus = consensus view of Society=s Public Policy Committee
impression = represents responders impression of the views of Society members
leaders = view of society/association leadership and not necessarily entire membership

Table 2. Summary of Scientific Societies' and Professional Associations' Views on the Issue of Human Nuclear Transfer Cloning

	Response of Scientific Societies/Professional Associations (number responding)			
Questions	**Prohibited entirely**	**Allowed in some limited circumstances**	**Allowed freely**	**No Position**
(1) Nuclear transfer cloning using *adult* human donor nuclei for basic developmental biological research on early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.	3	2	14	7
(2) Nuclear transfer cloning using *embryonic* human donor nuclei for basic developmental biological research using early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.	3	2	14	7
(3) Nuclear transfer cloning using *adult* human donor nuclei for research purposes on in vitro cell differentiation to generate specific human cell types for potential cell-based therapies.	2	5	12	7
(4) Nuclear transfer cloning using *embryonic* human donor nuclei for research purposes on in vitro cell differentiation to generate specific human cell types for potential cell based therapies.	3	5	11	7
(5) Nuclear transfer cloning *embryonic* human nuclei for research toward generating cloned offspring in the treatment of infertility or related reproductive reasons.	13	1	4	8
(6) Nuclear transfer cloning using adult human nuclei for research toward generating cloned offspring in the treatment of infertility or related reproductive reasons.	14	1	3	8

* 4/19 responses to questions 1–6 were personal views
* 5 additional societies officially replied
* 15/19 responses to questions 1–6 were official views but did not directly answer questions 1–6
* all responses of no position were official views

Specific Comments on Questions 1 and 2

Question 1: *Nuclear transfer cloning using adult human nuclei for basic developmental biological research on early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.*

Question 2: *Nuclear transfer cloning using embryonic human nuclei for basic developmental biological research on early embryos up to 14 days post fertilization, but not for ultimate implantation, gestation, and birth.*

The majority of respondents stated that using either embryonic or adult human donor nuclei for nuclear transfer cloning for in vitro research to study basic developmental biology should be allowed freely (6, 9, 10, 13, 14, 15, 18, 19, 24, 25, 26, 28, 31, 34). Several respondents indicated that this research should be allowed to proceed since it is promising, may prove extremely beneficial to medicine, does no harm, and is intended to benefit people (13, 14, 19, 26, 31, 34). This type of research may be necessary for understanding the scientific basis of cellular differentiation (10). It may also provide new and needed information about the morphology, biochemical and biophysical properties, genetic expression, and similar biological characteristics of pre-gastrulation-stage human embryos (14). Such research could also help improve the understanding of the origin of certain birth defects, increase the knowledge about cancer and metastasis, and explore ways to circumvent disease and inherited disorders of defects (14). The needed advancement within this important field of biological science warrants the use of early-stage embryos (14). It was pointed out that the NBAC's questions raise ethical issues surrounding research on embryos, whether or not they will be implanted (18). It was also noted that the Human Embryo Research Panel in 1994 addressed this issue and declared that early developmental research on embryos was acceptable for federal funding until the primitive streak appeared on the embryo, at approximately 14 days (18, 28). Therefore, NIH has already concluded that basic developmental research on embryos that will not be implanted is acceptable.

Those who replied that in vitro research using human nuclear transfer cloning to study basic developmental biology should be allowed only in limited circumstances thought that this research should only be conducted under strict regulations and safeguards (30, 32). Another respondent indicated that most of the basic research in this area should take place in experimental animals, but that some limited confirmatory experiments will have to take place with human cells, since species differences may occur (32).

Three respondents thought that in vitro research using human nuclear transfer cloning to study basic developmental biology should be prohibited entirely (12, 20, 21). One respondent holds a "pro-life world view" and believes that any scientific research with human embryonic tissues is immoral and unethical since it involves the ultimate death of a potentially completely unique human being (20). The other respondents called for a moratorium on all six areas of human nuclear transfer research described in Questions 1–6 to allow time for appropriate consideration of the technology's scientific and ethical implications (12, 21).

Specific Comments on Questions 3 and 4

Question 3: *Nuclear transfer cloning using adult human nuclei for research purposes on in vitro cell differentiation to generate specific human cell types for potential cell-based therapies.*

Question 4: *Nuclear transfer cloning using embryonic human nuclei for research purposes on in vitro cell-differentiation to generate specific human cell types for potential cell-based therapies.*

The majority of respondents stated that using either embryonic or adult human donor nuclei for nuclear transfer cloning research for the purpose of developing potential cell-based therapies should be allowed freely (9, 10, 15, 18, 19, 24, 25, 26, 28, 32, 34). One respondent indicated that the use of adult donor nuclei should be allowed freely (Question 3), while the use of embryonic donor nuclei should only be allowed in limited circumstances (Question 4) (14).

Several respondents indicated that research for the purpose of developing potential cell-based therapies should be allowed freely, since this research holds therapeutic promise, does no harm, the payoffs far outweigh the risks, and is intended to benefit people (10, 14, 19, 26, 34). In addition, nuclear transfer cloning of adult or embryonic nuclei to generate specific human cell types for potential cell-based therapies is a technology fundamental to developing new, more effective medicines (28, 34). Prohibition or excessive regulation of this technology could profoundly limit our knowledge of the genetic bases of disease and significantly impede or preclude the development of new, breakthrough drugs with the potential to help many people (28). This area of research holds the most future potential when combined with other approaches to cell-based therapies, such as promoting the growth of stem cells from adult tissues and generating embryonic stem cell lines (28, 32). It may also circumvent the current problems of graft rejection and scarcity of donor material (32). An example of the utility of this type of research is the possibility to develop healthy nervous system tissue and brain cells for transplantation in degenerative diseases such as Alzheimer's disease (30). It was suggested that guidelines for research using human cells in the development of cellular and tissue-based products could be coordinated with the new regulations being developed by the Food and Drug Administration (FDA), which are dependent on the origin of the cellular material as well as the intended use (18).

Some respondents thought that research using either embryonic or adult human donor nuclei for the purpose of developing potential cell-based therapies should be allowed in limited circumstances (6, 13, 30, 31). One reason for granting limited approval was that the cell-based therapies were not specified, and while some might be acceptable, others would not (31). In addition, it was suggested that there should be strict supervision with guidelines on appropriate consent by couples donating embryos (30), and that the processes and controls currently used in human gene therapy may be appropriate starting points for evaluating such experiments (6).

Two respondents indicated that there should be more limitations on the use of embryonic donor nuclei than on adult donor nuclei for research aimed at developing potential cell-based

therapies (14, 20). The view of one respondent was that the use of adult tissue for this type of research does not involve the ultimate death of a potentially complete, unique human being (20). Since the goal of this type of research is to better understand a variety of health and developmentally related subjects, the use of adult human donor nuclei was allowable with limitations, but the use of embryonic human donor nuclei should be prohibited entirely (20). The other respondent indicated that the use of adult donor nuclei for the development of cell-based therapies should be allowed freely, but research using embryonic donor nuclei could not exceed the 14-day stage of development (14). It was felt that the potential therapeutic benefits of directing cell differentiation warrant the use of early-stage embryos that are not grown beyond the 14-day limit; however, research exceeding the 14-day stage would be problematic (13, 14). In addition, before this research takes place with human cells, animal models should be used to determine whether it is feasible, possible, and/or beneficial (14, 30).

Two of the respondents indicated that research using adult human donor nuclei for the purpose of developing potential cell-based therapies should be prohibited entirely (12, 21), while three respondents stated that the use of embryonic human donor nuclei should be prohibited for this type of research (12, 20, 21). One respondent held a "pro-life world view" and believed that any scientific research with human embryonic tissues is immoral and unethical since it involves the ultimate death of a potentially completely unique human being (20). The other respondents called for a moratorium on all six areas of human nuclear transfer research described in Questions 1–6 to allow time for appropriate consideration of the technology's scientific and ethical implications (12, 21).

Specific Comments on Questions 5 and 6

Question 5: *Nuclear transfer cloning using embryonic human nuclei for research purposes towards generating cloned offspring in the treatment of infertility or related reproductive reasons.*

Question 6: *Nuclear transfer cloning using adult human nuclei for research purposes towards generating cloned offspring in the treatment of infertility or related reproductive reasons.*

The majority of respondents stated that using either embryonic or adult human donor nuclei for nuclear transfer cloning research toward generating cloned offspring in the treatment of infertility or related reproductive reasons should be prohibited entirely (6, 9, 12, 13, 14, 18, 20, 21, 26, 30, 31, 32, 34). One respondent indicated that using embryonic donor nuclei should be allowed in limited circumstances, but the use of adult donor nuclei should be prohibited entirely because there is no therapeutic benefit in cloning an existing or previously existing person (14).

The reasons given for entirely prohibiting research aimed at generating cloned offspring in the treatment of infertility or related reproductive reasons were similar for the use of either embryonic or adult human donor nuclei. The objections to this type of research included the observation that it would be years before the scientific data existed to determine if such

experiments were even feasible (6, 25). It was also pointed out that the efficiency of nuclear transfer is so low and the chance of abnormal offspring so high that experimentation of this sort in humans is currently unthinkable (13, 18, 19, 25, 32). It was suggested that an imposed moratorium would allow time for the appropriate consideration of the technology's scientific and ethical implications (12, 13, 18).

The concerns of several of the societies were nicely captured by one respondent: "Cloning as an approach to medical infertility has ethical hazards in the areas of confidentiality, consent, and discrimination. This and risks to personal and social well-being would prevent professional endorsement at the present time" (9). The respondent also stated, "Cloning as an approach to terminal illness or population enhancement is not acceptable medical practice" (9). Finally, the respondent indicated that even if animal cloning technology ever met sufficient standards that clinical trials might be permissible, it would still be necessary to establish that cloning offered an equal or better approach than existing therapy (9).

Most of the objections to the generation of cloned offspring centered on ethical issues. Further discussion and consideration of the ethics of generating cloned offspring would be desirable due to the potential implications for society in general (31, 34). It was asserted that "the deliberate generation of human clones impinges on the dignity and integrity of the human as an individual," and even though the therapeutic objectives of such studies might be to help infertile couples, it would be achieved at great cost to the offspring (32). "Humans cherish their uniqueness and an attempt to deliberately clone another human being involves an inescapable element of coercion, since the perpetrator has chosen to transcend the normal means of reproduction in order to produce a genetic copy of himself" (32). Although most of the respondents indicated that research in this area was practically and/or morally unacceptable, they were reluctant to advocate legislative prohibition of research in this area. Instead, a voluntary moratorium was proposed on such research (12, 13, 18, 21, 32).

A few respondents stated that nuclear transfer cloning using embryonic (10, 15, 19, 24) or adult (10, 15, 24) human donor nuclei for research toward generating cloned offspring in the treatment of infertility or for related reproductive reasons should be allowed freely. It was felt that the payoff far outweighed the risks and that this research did no harm and was intended to benefit people (19).

One respondent stated that nuclear transfer cloning using embryonic human donor nuclei for research toward generating cloned offspring in the treatment of infertility or related reproductive reasons should be allowed with limitations (14). The use of embryonic nuclear transfer technology might be a viable option for an infertile couple as long as all other types of treatment had been exhausted (14). For example, age-related infertility may be treated by transferring the nuclei of a couple's early embryo, produced in vitro, into a younger woman's enucleated egg to overcome problems encountered by older women (e.g., the outer layer of an older woman's egg, the zona pellucida, can be tough and not allow for cell division to occur freely; the cytoplasm and mitochondria of an older woman's oocyte are more likely to be

dysfunctional; and an older woman is more likely to produce a small number of embryos appropriate for transfer, and through nuclear transfer cloning, the number of embryos for transfer could be increased, thereby improving the likelihood of successful implantation and delivery) (14). However, if this type of infertility treatment were allowed, careful limits would need to be set as to the number of nuclei that can be used from the early embryo and the timing of the transfer of cloned embryos (14). In addition, if any resulting cloned embryos are cryopreserved, they should only be used in the event of a prior unsuccessful pregnancy attempt (14).

Another respondent stated that because nuclear transfer cloning using adult human donor nuclei for research toward generating cloned offspring raises both scientific and emotional issues of concern, it should be allowed with limitations (19). Specifically, it would be necessary to perform animal experiments before any human experiments were done since it is not known if clones of adult cells will produce harmed offspring (19). In addition, there are several emotional issues connected with this technology, including religious and other beliefs that married sex should produce all offspring, and the fear that creating a clone will diminish the donor in some fashion (19). The respondent stated that this research should be not be subject to legislation, but to oversight by the leaders of the relevant parts of the scientific community, perhaps as formal as the Recombinant DNA Advisory Committee (RAC), but certainly with a sunset for such an oversight (19).

GENERAL COMMENTS ABOUT HUMAN NUCLEAR TRANSFER CLONING

The general comments made by the scientific societies and professional associations fall into six categories: (1) definition of cloning; (2) knowledge gained and potential uses; (3) potential risks and scientific constraints; (4) restrictions, regulations, or legislation; (5) ethical and religious issues; and (6) general comments.

Definition of Cloning

To avoid inadvertently prohibiting important genetic research, there needs to be a clear distinction between human cloning to produce a new human being and cloning as tool in biomedical research that in and of itself would not result in a new human being (9, 12, 13, 18, 22, 25, 28, 30). According to these respondents, it would be unfortunate if an ambiguous definition of “cloning” interfered with valuable medical research.

“Cloning” is the copying of biological material to produce identical genetic copies from a single entity, such as genes, cells, or organisms. Scientists use the word “cloning” in many different ways. The term “human cloning” is routinely used to describe accepted and approved research such as (1) “clones” of human genes placed into various cell types to study their function; (2) human genes “cloned” into bacteria to produce proteins for therapeutic purposes (e.g., the production of Factor VIII to treat hemophilia, and the production of interferon- for the treatment of cancer); and (3) “cloning” of human cells for the study of cancer or genetic diseases.

These types of cloning are integral tools in biotechnology, and have been used to produce breakthrough medicines, diagnostics, and vaccines to treat heart attacks, cancer, kidney disease, diabetes, hepatitis, multiple sclerosis, cystic fibrosis, and other diseases (18).

Knowledge Gained and Potential Uses

Human nuclear transfer research could possibly revolutionize and certainly advance our understanding of basic developmental biology by (1) addressing how cells become different from each other during the development of an organism from egg to adult (32); (2) confirming that the genetic material of adult cells is intact and potentially "totipotent" (i.e., totally capable of recreating an adult organism) (32); and (3) advancing our knowledge of fundamental processes such as how genes control human development and how an oocyte can reprogram the adult nucleus (12, 18, 32). A full understanding of how the oocyte can reprogram the adult nucleus holds great hope for research of cell-based therapies for human genetic and degenerative diseases, and for developing novel strategies for the repair and regeneration of human tissues (32). In the decades ahead, these fundamental insights will provide the basis for even greater biomedical advances in the service of humanity (18).

Any decision to clone or permit cloning of humans has enormous potential for impacting our basic understanding about human development, capabilities, relationships, and rights (10a). In addition, human nuclear transfer research may provide new insights into reproductive biology, create improved animal models for human disease, and generate farm animals for the production of rare and currently expensive protein therapeutics (12).

Potential Risks and Scientific Constraints

Human nuclear transfer cloning using either embryonic or adult human donor nuclei to produce a new human being poses several potential risks, which were cited as reasons to limit or prohibit this activity. The most commonly stated risk was that the efficiency of nuclear transfer is so low and the chance of abnormal offspring so high that experimentation of this sort in humans is premature and, therefore, currently unthinkable (13, 18, 19, 23, 25, 32).

Several respondents agreed that nuclear transfer cloning experiments must be perfected first in animal models, and that it would be inappropriate to "waste" human tissues, cells, and even embryos in attempts to perfect techniques that could first be perfected in other species (6, 13, 14, 18, 19, 23, 25, 32). It was also suggested that it may be possible to adequately investigate, advance, and perfect the technology—as it may apply to man—using non-human primates, which should not prevent, inhibit, or delay the research in cloning technology (13, 23). Risks associated with the technology that might be tolerated in the case of farm animals would never be tolerated were the technology to be applied to human beings (18).

Even if this technology is perfected in animals, there will eventually be a need for human experiments (6, 32). The human species will provide more than a few surprises, and techniques

that work wonderfully in animals may fail dismally in human experiments (6, 32). Since the embryology of each species is different and very little basic research in human embryology has been performed, much more preliminary data is necessary before appropriate scientific protocols could be developed (18). Even after all of the procedures were verified and optimized, there is a high probability that many human eggs, as well as surrogate mothers, would be necessary to establish this technique as a reliable method of developing new human beings (18). Therefore, the use of nuclear transfer technology for the generation of entire human beings is neither feasible nor ethically acceptable at this time (6, 13, 18, 23, 25, 32).

Restrictions, Regulations, or Legislation

The types of restrictions proposed for the cloning of an entire human being included oversight by leaders of the scientific community, such as an Institutional Review Board (IRB), federal oversight by a national bioethics authority, and a voluntary moratorium. However, none of the societies or associations called for federal or state legislation banning the cloning of an entire human being. As for cloning research using human donor nuclei to study basic developmental biology or to develop cell-based therapies, most of the societies indicated that there should be no new restrictions on nuclear transfer cloning for biomedical research beyond those already in place for similar types of research, which include (1) the obligation of researchers and physicians to observe self-restraint because of scientific, medical, and ethical codes of conduct; (2) oversight by the scientific community, such as through peer review and by IRBs; and (3) federal oversight, such as by a national bioethics authority, or regulation by the federal policy for the protection of human research subjects. There were also a few proposals for a voluntary moratorium. Again, no one called for legislation banning cloning research. Although most of the respondents drew no distinction between the use of adult or embryonic human donor nuclei, one thought that there should be more restrictions with adult nuclei than with embryonic ones (15).

One statement seemed to capture the general feelings of most of the respondents on the issue of restrictions, regulations, and legislation:

> "Ian Wilmut's group has clarified what a number of scientific questions should be [about embryology, development, biology and developmental genetics], and that is a very great service. It would be a shame if those questions, and others, were not to be addressed because of restrictions (6)."

Self-Restraint. The scientific and medical communities subscribe to ethical codes of conduct (9, 18). Physicians have an obligation to "do no harm" to patients under the Hippocratic oath (18). Furthermore, the medical profession has taken care to uphold standards, articulated in the Helsinki Declaration and the Belmont Report, that are "consistent with medical obligations to patients and the public's health" (9). In addition, universities and companies have ethical codes of conduct for their employees (18). Scientists and physicians could jeopardize their professional standings and careers by performing ethically questionable research (18).

Oversight. Several societies and associations stipulated a need for oversight, guidelines, and strict research protocols of the highest standards when dealing with this unique field of human subjects research (1, 10, 12, 13, 14, 18, 19, 29). The importance of informed consent was also emphasized (1, 13, 30). However, it was clear that all the respondents calling for restrictions agreed that this area of research should not be subject to legislation. A suggestion was made for oversight by the leaders of the relevant parts of the scientific community, perhaps as formal as the RAC, but with a sunset provision for such oversight of some minimum necessary number of years (19). Alternatively, it was suggested that all human cloning research should obtain approval of an IRB, which could ensure that subjects are not abused, and research results are not a danger to the community (14, 29). Another suggestion was that the NBAC could become, or could appoint, a standing body to monitor and periodically report on the progress of research in this field as well as other innovative advances in reproductive biology (12, 18). Finally, it was proposed that the highest level of national oversight would be achieved if federal funding of human cloning research were allowed (14).

Voluntary Moratorium. Several societies and associations supported the President's call for a voluntary moratorium on the cloning of human beings until the NBAC reviewed the scientific, legal, and ethical implications of the recent scientific advances brought to light by the birth of Dolly (2, 6, 12, 18, 22, 28). Furthermore, three respondents proposed a continuation of this voluntary moratorium on the cloning of an entire human being beyond the 90-day review period (13, 18, 32). One recommendation was that the moratorium on research on implanted embryos derived by nuclear transfer last for three years to permit time for the consideration of the scientific, ethical, social, and legal bases for such research (13). At the end of the three-year period, all research subjected to the moratorium should again be reconsidered by the NBAC or another responsible agency (13). Two respondents called for a moratorium on all human cloning research until there has been enough time to allow for appropriate consideration of the scientific and ethical implications of the technology (12, 21). One suggestion for enforcing the moratorium was to have the NBAC appoint an international panel of eminent scientists to reinforce the call for a moratorium and to develop global research guidelines relating to nuclear transfer cloning (12). The advantage of a moratorium over legislation is that it can either be lifted in the future or made permanent, when more information is available to assess the feasibility, desirability, and public acceptability of these procedures (32).

Legislation. At least ten bills dealing with the cloning of a human being have been filed at the state level and at least three at the federal level (18). Representative Ehlers has two bills before Congress, H.R. 922 and H.R. 923, that refer simply to "human cloning" (22). Poor communication between scientists and legislators may produce an ambiguous definition of what is to be prohibited, which could result in interference with valuable life-saving and life-enhancing medical research or even practice (22). The point was made that the enactment of any state law on the subject of human cloning should be opposed because issues raised by the cloning of entire human beings should be addressed nationally and comprehensively, not on a state-by-state basis (18). A continuation of the moratorium on cloning human beings may obviate the need for any state or federal legislative action (18).

There is a fear that hastily drafted rules or legislation could inadvertently result in a much broader ban on research than intended or needed to address the ethical concerns (12, 18, 22, 29, 32). Overly broad legislation may inhibit or deter critical biomedical research that uses the cloning of genes and cells to develop future drugs for many currently incurable diseases and conditions (18). Hasty responses to profound developments or new capabilities do not always promote sound policy (29). Instead, guidelines about the use of highly controversial technologies should only follow deep and lengthy dialogue among stakeholders and advisors (29).

An example cited of policy adopted in the absence of thorough exploration of the issues is the federal ban on fetal research and the accompanying state regulations that followed (29). Massachusetts expanded the federal ban on fetal research to include neonatal research. As a result, truly critical information on normal values and measurements in neonates was not obtainable in Massachusetts. As a result, neonatologists left to work elsewhere and the care of sick neonates declined. An example of an appropriate, measured response to new technology was the development of guidelines for performing recombinant DNA technology, which resulted in a useful, reasonable, and effective national policy for regulating such research (29). Relocation of research is a common response to overly rigid controls (29). Although relocation to other academic centers has local implications, relocation of banned research to the "underground" or to foreign countries where no ethical guidelines may be observed may be a dangerous and tragic result of superficial consideration of the implications of such measures (29).

Ethical and Religious Issues

Several respondents made remarks about the potential impact of nuclear transfer cloning using adult donor nuclei to generate new individuals on issues of personal and social well-being such as family relationships, identity and individuality, religious beliefs, and expectations of sameness (6, 9, 10, 18, 19, 30). Some of respondents made very poignant remarks about these issues, which are reflected in the following comments from various society and association responses.

Family Relationships. Some respondents thought that nuclear transfer cloning using adult donor nuclei to generate an entire human being would have negative impacts on family relationships, while others believed that it would not. Some of the comments follow.

> "These new prospects [of cloning human beings from the genetic material of an adult cell] challenge some of the most fundamental concepts we hold about ourselves as social and spiritual beings. These concepts include what it means to be a parent, a brother or sister, a family" (18).

> "Unprecedented relational circumstances would or could arise. For instance, birth cousins may be genetic siblings, and marital prohibitions might be called into question" (9).

> "An additional argument against cloning is its supposed destruction of the family unit. This argument has been made with every new development in the area of reproductive medicine. I do not believe cloning will have any negative impact on the concept of family" (30).

Identity and Individuality. It was also pointed out that is not just people's genetic background, but their unique experiences, that play an essential role in determining who they are (10, 18, 30). Therefore, predictions of armies of identical individuals are not realistic (10). Other responses included the following.

> "We are quite familiar with identical twins in our everyday lives. We know, for example, that such twins have very distinct personalities despite sharing the same genetic makeup.... While we may encounter identical twins of the same age today, we have never experienced identical twins substantially different in age; indeed, perhaps alive during entirely different periods in history" (18).

> "One can make the argument that cloned children may be psychologically harmed by their lack of individual identity. However, this does not appear to be the case with identical twins and triplets" (30).

Religious Beliefs. Citizens of all religious and moral persuasions must be allowed to contribute to the discussion of cloning entire human beings (6). Three major ethics systems under which society functions—which could be used to determine how society would deal with the issue of human nuclear transfer cloning—are (1) the greatest good for the greatest number; (2) sets of rules (e.g., thou shalt not commit murder); and (3) golden rules (do unto others [Jesus] or do not unto others [Hillel]) (19). It would be inappropriate for scientists to assert that one system of ethics is better than another for this issue (19).

Expectations of Sameness. Cloning of an existing or previously existing person may be attractive as an approach to overcome terminal illness, a way to replace a deceased loved one, or simply for reasons of vanity. However, this implies that the resulting child will be identical, in all ways, to the person being cloned. In addition, there may be preconceived notions about the child's character, level of intelligence, and talents.

> "The possibility of having one's life over again, or having the life of a dying child over again might be attractive to people facing death and dying. However, this reasoning does not withstand examination.... Because the cloned individual is—because of the different environment in which he or she creates his or her life story—not the same person; then the dying individual does indeed still die and a 'second chance' is not achieved. Cloning, therefore, does not appear to be a reasonable medical approach to terminal illness" (9).

> "The idea that cloning will lead to creation of cloned children for reasons of pure vanity needs to be viewed from the perspective of the reasons why children are created by any method. There is a wide spectrum of motivations for wanting a child. Sometimes it is for pure vanity even when non-cloning (natural) methods are used. Banning reproductive use of cloning will not assure that children are produced for the right reasons. And dictating the "proper reasons" for producing a child is not an activity a government ought to be involved in" (30).

> "In our everyday lives we may decide to procreate a child and wait in wonder and awe to see the unique individual he or she will turn out to be. We do not, on the other hand, have experience creating a child where part of that decision may include an evaluation of the life, health, character, and accomplishments of an adult from whom we will take the genetic material that will become the child's entire genetic makeup" (18).

Additional Comments

"Research has always had a history of upsetting the status quo and by its very nature will always be a provocative change agent. Biotechnology now saves lives and makes for a better future. Heart transplants and gene therapy were shocking in their time; they have both become routine. In vitro fertilization, now an industry, was considered adultery only two decades ago. Our society adjusts after it has time to learn and understand the benefits [of new technologies]" (19). This remark reflects the general attitude of several of the respondents. The public reaction to the cloning of Dolly parallels the fears evoked during the early days of recombinant DNA research, plant transformation, organ transplantation, in vitro fertilization, and protocols involving genetics and gene therapy (6, 17, 19, 23, 29). Once fear was replaced by a body of evidence that demonstrated the concerns for safety were greatly exaggerated, a rational policy was developed (6, 17, 23).

Several respondents expressed their concern that 90 days is not enough time to make this type of critical decision, and that by forcing this decision to be made in such a short time frame, there may be a rush to judgment and unanticipated issues may be overlooked (6, 13, 19, 21, 22, 23, 25, 30). It was clear that the many of the respondents felt that this matter deserves a much less rushed and more thorough study and review (6, 13, 19, 21, 22, 23, 25, 30).

Correspondingly, the need to educate and inform the public, legislators, and the scientific and medical communities was thought to be vital to the understanding of these very complex issues (2, 6, 17, 19, 23, 28, 29). A place to start would be to establish a basic understanding of the special language, technologies, and issues that typify molecular biology, cell biology, and cloning protocols (29). As the public and scientists learn more about what types of cloning experiments are proposed, they will be more accepting of the technology and will become aware of the good that can result and not so afraid of the potential negative side (17).

The need for a rational, well-informed, national debate was also identified (6, 22, 23). "After the public and legislators have been better informed, and have had time to digest the implications and debate the issues pertaining to human cloning, a more enlightened policy should emerge for regulating future human experimentation" (23).

Some respondents commented that the guiding principle in the NBAC's recommendations should be the optimization of human health within moral bounds (12). Human research should be allowed freely in all circumstances that offer the promise of increased knowledge and/or potential therapeutic benefits, providing that the research does not place the subjects at a risk that outweighs the potential benefits or violate established ethical principles, that the research is properly reviewed prior to initiation, and that appropriate informed consent is obtained (13).

CONCLUSION

Thirty-two scientific societies and professional associations responded to the NBAC's request for their views on the use of nuclear transfer cloning using embryonic or adult donor nuclei for three general areas of research: (1) basic developmental biology conducted in vitro on embryos up to day 14; (2) in vitro cell differentiation to generate specific human cell types for potential cell-based therapies; and (3) the generation of cloned offspring for the treatment of infertility or related reproductive reasons.

The majority of societies agreed that research aimed at gaining knowledge in basic developmental biology or developing new cell-based therapies (areas 1 and 2 described above) should be allowed to proceed freely. It was their view that the benefits of these types of research far outweighed the risks, and the many possible contributions to science and medicine warranted this type of research.

In contrast, the majority of societies agreed that the generation of cloned human offspring, even if only used for the treatment of infertility or related reproductive reasons, should be prohibited entirely at this time. Most of the objections centered on the ethical issues of personal and social well-being. Other objections focused on scientific issues, such as the low efficiency of nuclear transfer cloning and the high likelihood of abnormal offspring.

The general comments made by the responding scientific organizations focused on five main issues:

1. the need for a clear definition of cloning to avoid inadvertently prohibiting important genetic research

2. the knowledge that was gained and potential uses of this technology

3. the potential risks and scientific constraints of this technology

4. the need for certain restrictions and regulations in the form of either self-regulation by the scientific community itself, national oversight, or voluntary moratorium, but not in the form of legislation

5. the ethical and religious issues that are brought to light by the potential to clone an existing or previously existing person.

This report summarizes the views of a cross-section of the scientific and medical communities. However, it is by no means a complete account of all the scientific societies and professional associations that may have important input into this complex issue. A more extensive investigation may provide other points of view and information critical to a decision on the allowability of human nuclear transfer cloning research.

APPENDIX: ALPHABETICAL LISTING OF SCIENTIFIC SOCIETIES AND PROFESSIONAL ASSOCIATIONS

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2. American Association for the Advancement of Science
   1200 New York Avenue, NW
   Washington, DC 20005
   Phone: (202) 326-6600
   Fax: (202) 289-4950

3. American Association of Colleges of Pharmacy
   1426 Prince St.
   Alexandria, VA 22314
   Phone: (703) 739-2330 (ext. 127)
   Fax: (703) 836-8982

4. American Association of State Colleges and Universities
   One Dupont Circle
   Washington, DC 20036
   Phone: (202) 293-7070
   Fax: (202) 296-5819

5. American Board of Medical Genetics
   9650 Rockville Pike
   Bethesda, MD 20814
   Phone: (301) 571-1825
   Fax: (301) 571-1895

6. American College of Medical Genetics
   9650 Rockville Pike
   Bethesda, MD 20814
   Phone: (301) 571-1825
   Fax: (301) 530-7079

7. American College of Obstetricians and Gynecologists
409 12th Street, SW
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Phone: (202) 638-5577
Fax: (202) 484-5107

8. American Federation for Clinical Research
311 Massachusetts Ave., NW
Washington, DC 20002
Phone: (202) 543-7450
Fax: (202) 543-5327

9. American Medical Association
1101 Vermont Ave, NW
Washington, DC 20005
Phone: (202) 789-7413
Fax: (202) 789-4581

10. American Psychological Association
750 First Street, NE
Washington, DC 20002-4242
Phone: (202) 336-6080
Fax: (202) 336-6069

11. American Public Health Association
1015 15th St., NW
Washington, DC 20005
Phone: (202) 789-5600
Fax: (202) 789-5661

12. American Society for Cell Biology
9650 Rockville Pike
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Fax: (301) 530-7139

13. American Society for Human Genetics
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14. American Society for Reproductive Medicine
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Fax: (205) 978-5005

15. American Society of Parasitologists
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16. Association of American Universities
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Fax: (202) 408-8184

17. O.W. Barnett
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18. Biotechnology Industry Organization (BIO)
1625 K Street, N.W., Suite 1100
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Phone: (202) 857-0244
Fax: (202) 857-0237

19. Council of Scientific Society Presidents
1155 16th Street, NW
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Phone: (202) 872-4452
Fax: (202) 872-4079

20. Entomological Society of America
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21. Federation of American Societies for Experimental Biology
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22. Genetics Society of America
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25. National Academy of Sciences
2101 Constitution Avenue, NW
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Phone: (202) 334-2446
Fax: (202) 334-2153

26. National Advisory Board on Ethics in Reproduction (NABER)
409 12th Street, SW
Washington, DC 20024-2118
Phone: (202) 863-4997
Fax: (202) 554-0453

27. National Health Lawyers Association
1620 Eye Street, NW
Washington, DC
Phone: (202) 833-1100
Fax: (202) 833-1105

28. Pharmaceutical Research & Manufacturers of America
1100 15th Street, NW
Washington, DC 20005
Phone: (202) 835-3420
Fax: (202) 835-3429

29. Public Responsibility in Medicine and Research
132 Boylston Street
Boston, MA 02116
Phone: (617) 423-4112
Fax: (617) 423-1185

30. Society for Assisted Reproductive Technology
Physician Pavilion West
6569 Charles Street, Suite 406
Baltimore, Maryland 21204
Fax: (410) 828-3067

31. Society for Clinical Trials
600 Wyndhurst Avenue
Baltimore, MD 21210
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Fax: (410) 435-8631

32. Society for Developmental Biology
9650 Rockville Pike
Bethesda, MD 20814-3998
Phone: (301) 571-0647
Fax: (301) 571-5704

33. Society for Neuroscience
11 Dupont Circle, NW, #500
Washington, DC 20036
Phone: (202) 462-6688

34. Society of Integrative and Comparative Biology
401 N. Michigan Avenue
Chicago, IL 60611-4267
Phone: (312) 527-6697 or (800) 955-1236
Fax: (312) 245-1085

35. Society of Research Administrators
1200 18th Street, NW, #300
Washington, DC 20036-2401
Phone: (202) 857-1141
Fax: (202) 223-4579

36. Society of Research in Child Development
University of Michigan
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Notes

[1]This was an informal request, not a formal survey. Most of the societies and associations did not have time to poll their members in a systematic manner. Therefore, most of the views that were expressed by the societies and associations were not necessarily representative of their entire membership.

[2]The statements in this document are the views of the societies and associations that responded to the NBAC's request, and are not those of the author, RAND Critical Technologies Institute, or the NBAC.