Church of Scotland
Church and Society Council

Report of the Working Group on

Embryo Research, Human Stem Cells and Cloned Embryos

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Chapter 1

Introduction and Background

This is the report on Embryo Research, Human Stem Cells and Cloned Embryos of an ecumenical expert working group of the Church of Scotland Church and Society Council. A summary of this report with proposed deliverances is to be presented to the 2006 General Assembly as Appendix 3 of the Report of the Church and Society Council.

Introduction

1. The General Assembly of the Church of Scotland has considered in detail many matters to do with human reproduction, the embryo, embryo research and stem cells, as well as a range of wider issues to do with the family. Study groups of the Board of Social Responsibility reported on human fertilisation and embryology in 1985, human genetics and genetic selection in 1995, and on embryology, in vitro fertilisation (IVF) and embryo research in 1996. In 1997 the Society, Religion and Technology Project (SRT) reported on animal and human cloning. Both groups reported on stem cells and “therapeutic” cloning in 2001, and further stem cell reports were made from 2002-4. Sex selection issues were considered in 2002 and 2003. Appendix B lists the relevant deliverances.

2. SRT prepared a supplementary report for the 2004 General Assembly on Cloned Human Embryos in response to a series of scientific and regulatory developments in early 2004. These included the now discredited claim for the first cloned human embryos in Korea and the imminent assessment by the Human Fertilisation and Embryology Authority whether to issue UK licenses for similar research. The 2004 Assembly decided

“to remit for further study, within the Church and Society Network, the issue of human embryology and stem cells in the light of recent scientific and medical developments and for a Report to be made to the General Assembly of 2005.”

3. An ecumenical working group was set up by the SRT Project and the Social Interests Committee of the Board of Social Responsibility, whose members are listed in Appendix A, and reported to the Church and Society Council. We now present the results of this study. It has been delayed by the church restructuring, but the additional time has enabled some important further developments to be taken into account. Of particular priority was to re-examine the theological understanding of the embryo and what aspects of embryonic stem cell research, if any, should be acceptable including the uses or creation of surplus IVF embryos, cloned and parthenogenetic embryos, in the light of recent scientific developments.

4. This report is especially timely because the Government announced a consultation on ethical, regulatory and legal issues in reproductive research with a view to replacing the 1990 Human Fertilisation and Embryology Act with new legislation. During the preparation of our report, a working group was set up to prepare a response, which was submitted by the Church and Society Council in December 2005. Parts of that submission have been helpful in drafting this report. That submission and our discussions have also identified a range of additional issues which we may wish to address in future, including pre-implantation genetic diagnosis and genetic selection, gamete donation and surrogacy, genetic information and consent procedures.
5. In Chapter 1, we introduce the task of the report in the light of previous Assembly reports, which are summarised. Chapter 2 explains what stem cells are, their different sources and the main ways they are being used in scientific and medical research. It also summarised how this research is regulated in the UK and its wider European and global context. Chapter 3 provides four case studies to illustrate how the use of stem cells is envisaged in the research and potential treatment of particular degenerative and other diseases. Chapter 4 re-examines the theological and ethical arguments concerning the moral status of the human embryo, and the theological significance to various stages of biological development. The conclusions drawn are then applied to a range of particular issues relating to stem cell research in Chapter 5, leading to the recommendation of deliverances to the Assembly.

**Previous Assembly Reports**

6. The 1996 report, later published as *Preconceived Ideas: A Christian Perspective of IVF and Embryology*, was a landmark study in making a careful survey of biological and theological perspectives and in being especially sensitive to the different views that exist within the Church on the highly controversial issue of the status of the embryo.

7. In considering what it called the central question, it first made a commentary on the three classic ethical positions with respect to the embryo – respectively, that is has no moral status, some status, or is sacrosanct.\(^8\) It laid out the first two positions and critiqued various arguments cited in support of them, and then asserted its endorsement of the third position, whose positive features it stated without further analysis. The report then elaborated on this theologically in asserting that genetic completion at conception is when human life begins, and maintains that this is the biblical position, with reference to Psalm 139, Jeremiah 1 and the conception of Jesus Christ by Mary.\(^9\)

8. The 1996 Study Group report affirmed unanimously “the sanctity of the human embryo from the moment of its conception”, and firmly stated “the human embryo must be regarded as an actual person … at all stages of development from the moment of conception” and that as a result “all research on human embryos is morally wrong”. The report explicitly disagreed with the second position, as articulated in the Warnock report,\(^10\) that although the embryo “deserves greater respect than that accorded to other human tissue”, it “should not, particularly in the earlier stages, be given the respect that is given to actual persons”. The report also recognised that some Christian people do accept the view which now underpins the Human Fertilisation and Embryology Act (1990),\(^11\) that prior to implantation and early development of the primitive streak, the embryo does not have the same moral or legal status as a more fully formed foetus.

9. That Study Group also examined in some detail the argument of the brain scientist and philosopher of science Donald MacKay\(^12\) that only the small minority of conceptions that lead to a baby should be regarded either biblically or logically as human persons. The report’s response suggested that we treat all embryos in the light of what we know about some, namely those which become babies. This does not seem to answer MacKay’s point that it is meaningless to treat fertilised ova that never developed “any of the minimal structures for recognisably personal life” as human persons.

10. Having taken a normative stance, the report then identifies a tension in the section entitled *A Conflict of Obligations* between affirming the sanctity of human life and applying it “to the exigencies of human need and circumstance” in a fallen world where God’s divine ideal relates to imperfect reality. Theologically and pastorally it recognised a tension between ethical norms and
human need. For some of the group the desire to uphold the sanctity of life led to maintaining the normative view that all embryo research is wrong. Other members felt “the need of childless couples and the potential benefits of embryo research … outweighed the obligation felt for the embryo”. The report believed that “it is not right to make dogmatic pronouncements, nor yet burden further the already taxed consciences of those working in the field of Christian couples who feel it is right to receive infertility treatment”.

11. The aim of this report to hold together these diverse viewpoints is notable. Its success has been called into question because it left a theological inconsistency, in that those who felt that obligations to the embryo could be overridden by the benefits of embryo research have de facto retreated somewhat from a true normative position of the status of the embryo, or else they would be condoning what amounted to murder. The report does not resolve this point. The 1996 General Assembly deliverances reflect this equivocal situation in referring to the sanctity of the embryo, but recognising the differences of view over IVF and embryo research, and welcoming the limitation of research to 14 days.13

Subsequent Assembly Reports and Other Papers

12. The next development in the field was the announcement of the cloning of Dolly the sheep from non-reproductive cells in February 1997. Based on its knowledge of the issues through its engagement with the Roslin Institute scientists who had created Dolly, the SRT Project was able to present a supplementary report on animal and human cloning to the 1997 Assembly.14 This laid down the principle that, while animal cloning might be permitted under some limited circumstances, reproductive human cloning was fundamentally unacceptable. “On principle, to replicate any human technologically is a violation of the basic dignity and uniqueness of each human being made in God's image, of what God has given to that individual to no one else. … The nature of cloning is that of an instrumental use of both the clone and the one cloned as means to an end, for someone else's benefit.”

13. The report noted that further ethical consideration was needed for possible medical applications of cloning. This was brought into focus by the first isolation of human embryonic stem cells in November 1998. SRT report briefly on this in 1999, pointing out the dilemma of creating cloned human embryos to reprogramme them to produce human cells to replace damaged tissue in serious medical conditions.15 To clone embryos and redirect them from totipotency to use as spare part cells would, de facto, remove the special status of the embryo, and reduce it to a mere means towards an end. This was followed by a substantial joint submission to the Government’s Donaldson Committee consultation in October 1999, on stem cells and therapeutic uses of cloning, from SRT and a new Board of Social Responsibility study group.16

14. Two reports on stem cells and related issues came to the assembly in 2001, from the Board of Social Responsibility and from SRT.17 18 These are discussed further in paragraphs 13-18 and 29-34 of Chapter 5. That Assembly endorsed adult stem cell research. It accepted the use of surplus embryos from IVF treatment to be used for IVF research but rejected their use for stem cell research. The Assembly accepted the creation of cloned human embryos to produce stem cells and for therapies, but reaffirmed its rejection of creating cloned embryos for reproduction. A brief SRT report in 2002 and its supplementary report in 2004 drew the Assembly’s attention to questions raised about its rejection of the use of spare embryos for stem cell research but its support for cloned embryos for this purpose. The 2004 Assembly decided to remit these matters for further study, and it is in response to this instruction that we present this report.
15. In presenting this report, the working group and the Church and Society Council are very aware of the sensitivity of these issues, and that profound and sincere differences of views exist among our own members, and in the Church of Scotland as a whole. On many issues we were able to come to a mind, but, as we expected, unanimity was not possible in the working group over embryo research in general and its application to stem cells. In recommending particular positions to the Assembly, we indicate those where members hold opposing views. As brothers and sisters in Christ, we wish to record the deep respect which all members held for those whose views differed from their own, and the sincerity in which they hold them. As we search together for the mind of Christ on these complex matters, we commend our imperfect reflections to your thoughtful and prayerful consideration at this Assembly, and in the following months and years, in your churches and fellowships.
Chapter 2

The Scientific Context for Stem Cells

What are Stem cells?

1. Stem cells are a type of “ancestor” cell in humans and animals, which have two special properties. They are able to renew themselves to produce many more stem cells in perpetuity. They can also differentiate into specialised cells which then serve particular, specific functions in body tissues (bone, muscle, nerve etc.). Stem cells are present in the early embryo which differentiate to make all the cells of the eventual body. Stem cells are also found in some tissues of the adult human or animal, in the foetus, and in placental cord blood. These normally develop only into the cells associated with the particular organ or system of the body. In the adult, stem cells serve the function of maintaining healthy tissues or repairing damage inflicted by disease or injury. Perturbation of these renewal processes can lead to the death of the cells (and eventually of the organism). Their uncontrolled growth can, on the other hand, lead to cancer.

2. The first isolation of human embryonic stem cells (ES cells) in the USA in 1998 was widely seen in scientific and medical circles as a landmark event. It opened up the possibility of a potentially unlimited source of cells which could be used to replace cells lost in serious, and largely incurable, degenerative human diseases and other conditions. A matter of concern is the rhetoric sometimes accompanying both these claims and those made for adult and placental cord stem cells. These have often raised expectations which go far beyond what can presently be justified by the state of a science which is still in its early stages. While there is indeed exciting potential, a degree of caution is therefore needed. As we discuss in subsequent sections of this report, many of these developments and possibilities raise important ethical and theological questions.

Potential Uses of Stem Cells

3. If ways can be found to derive the relevant cell types from stem cells in sufficient quantities, and overcome the many technical hurdles, and if laboratory results can be translated into safe and effective clinical practice, then the potential range of conditions for which they may offer treatment is very wide. Examples include:
   - neurodegenerative disorders such as Parkinson’s disease, requiring neuronal cell types (Case Study 1),
   - diseases of the blood and immune systems using haematopoietic stem cells in bone marrow (Case Study 2),
   - diabetes, requiring insulin secreting cells (Case Study 3),
   - acute liver failure, requiring hepatocytes, the predominant mature cell types in the liver,
   - damage to heart tissue, requiring cardiomyocytes, the predominant mature cell types in the heart.

4. Cell-based therapies also offer prospects to recover severed nerves in spinal cord injuries, to repair bone or cartilage and to treat severe burns. The challenges and benefits of these potential interventions vary from condition to condition. Thus the prospects may range from life saving (for example in a case of acute liver failure), a complete cure, substantial recovery of function,
arresting further degeneration, to ameliorating the conditions and quality of life of the patient. The therapeutic use of stem cells, known as regenerative medicine, is expected to be a more widely applicable alternative to organ transplantation and safer than proposals to use animal organs (xenotransplantation). It should be stressed that these are hopes. It is not possible to guess today how much of this potential will be fulfilled and what will not. Established treatments derived from stem cells will mostly be a very long way away.

5. There are various other uses of stem cells, some of which may prove equally significant. One is to obtain cells to study the emergence and progression of diseases for which it is currently difficult or impossible to extract the actual cells from a patient (Case Study 4). Such cells could also be used to help develop and screen potential drugs to treat the diseases, as mentioned in Case Study 1, and perhaps also reduce the use of animals for this purpose. While most of the therapeutic aims are a long way from application, this latter use is of emerging commercial interest to pharmaceutical companies. Embryonic stem cells provide specific opportunities for research into developmental and reproductive processes in humans. Finally, a long term research aim with stem cells is to develop the knowledge that might one day enable the accurate manipulation of the body’s own stem cells to prompt tissue regeneration when required, or to control the deregulated growth that occurs in cancers.

**Adult Sources of Stem Cells**

6. Human stem cells can be obtained in the laboratory from foetal and adult tissues. The latter include the liver and nervous system, cord blood, intestinal crypts, skin, liver, and bone marrow. As noted above, these stem cells seem to have only a restricted potential to form different cell types *in vivo* (in the body). This is in keeping with the functional requirements of the organs and tissues in which they are found. Thus, stem cells isolated from bone marrow can give rise to all of the different cells in the blood and immune systems, but would not normally produce skin cells. Accordingly, bone marrow transplantation has been used for decades to regenerate these cell types where they are lost, for example as a result of intensive chemo- and radiotherapy for cancer treatment (see Case Study 2), but not for other tissues.

7. Recently, however, research groups have found evidence that stem cells from fetal, neonatal and adult tissues can sometimes be induced to form cell types *in vitro* (in the laboratory) that they would apparently not normally yield in the body. This is seen by many to suggest the exciting prospect that adult cells could have a much wider therapeutic use. But it would be an exaggeration at this early stage to see these as necessarily capable of all the applications currently anticipated from embryonic sources. There are questions about the accuracy and reproducibility of the evidence, the interpretation of experimental results and whether these cells are able to function normally. A major difficulty with adult-derived cells is also their limited potential to replicate in culture in the laboratory. So far this is a serious limitation in producing sufficient cells to be useful in therapies. This is discussed further in Chapter 5, paras 52-56.

8. A number of clinical studies are ongoing to investigate the potential value of, for example, bone marrow-derived stem cells in cardiac repair after heart attack and stem cells from the covering of the eye (the cornea) to repair damage or ulceration to the cornea which can lead to blindness. Although some of the initial findings look promising, it is still far too early to say whether these approaches will lead to clinically useful therapeutic approaches or not.
Embryonic Stem Cells (ES Cells)

9. Embryonic stem cells may be obtained from embryos that have become surplus in IVF treatments or more rarely those discarded in embryo selection procedures using pre-implantation genetic diagnosis (PGD). ES cells are normally isolated from the embryo when it consists of 50-100 cells. They are taken from the inner cell mass that goes on to develop into the foetus. Stem cells derived from embryos differ from those obtained from other sources by their capacity both to multiply indefinitely in the laboratory, and to differentiate into the full range of different cell types found in the body. In principle, they offer the ability to obtain large numbers of any desired cell type of the body. The evidence from animal research also suggests that embryo-derived stem cells currently offer better scientific prospects for the therapeutic treatment of degenerative conditions, taken as a whole, than cells from other sources. Transplantation studies with mouse embryo stem cells or their derivatives have demonstrated benefits in rodents in treating spinal cord injury, Parkinson’s disease and diabetes, see Case Studies 1 and 3.

10. The science of obtaining and transforming embryonic stem cells is new and much has still to be understood. As the case studies indicate, significant challenges must be overcome in producing transplantable cells in the laboratory, even before considering the major challenges of translating these into viable therapies. First, these systems must produce sufficient quantities of functionally normal cells that are tolerable to the immune system of the recipient, or can be made tolerable. Secondly, cells produced by these systems must be free of contaminants that could harm the patient, or be transmitted to the general population by the patient. While some of this experience exists for adult tissue and bone marrow transplantation (Case Study 2), quality assured practice for human embryonic stem cell production has yet to be defined anywhere in the world.

11. One major disadvantage of cells derived from IVF or PGD embryos, compared with adult cell sources, is that these will not be of the same genetic type as the patient. The cells added to the patient may therefore risk rejection by the body’s immune system. This should not happen with adult cells if these were derived from the patient’s own tissue, or had come from a sample of placental cord blood taken when the patient was born and then frozen in storage. The prospects of establishing this as an approach for every child that is born are low on economic grounds, and obviously will not help most of the current population. Various strategies are proposed to overcome this for embryonic stem cells. The most prominent is to set up a bank of embryonic stem cell lines of different genetic and immunological types to provide at least the best match possible for a particular patient. Estimates vary widely as to how many cell lines would be needed and to what extent immune suppression and/or cell modification would still be necessary.

12. A second problem with ES cell therapy is the potential risk of causing cancer as a side-effect because of the special properties of these cells. Teratomas (tumour cells) often develop when ES cells have been put into animals under experimental conditions. For any therapies, it would have to be shown that the risk of tumour formation is negligible, although one might be willing to accept a small risk of tumour formation for an immediate life-threatening condition. For this reason only specific differentiated cell types could be administered to the patient, and the risks of also accidentally transplanting some undifferentiated stem cells have to be eliminated. This is thought to be practicable, with known methods to eliminate ES cells from a culture of differentiated cells. Adult stem cells are not expected to be as problematical in this way, but, with any cells to be transplanted into a patient, much care and rigorous quality control is required to ensure that they remain fresh and have not developed abnormal properties.
Alternative Routes for generating Human Embryonic Stem Cells

13. The embryos used for stem cell research are almost entirely the surplus embryos from IVF for infertility, or occasionally from PGD to select out embryos with a severe genetic defect. UK law also allows for embryos to be created for the purposes of research, either conventionally by in vitro fertilisation or unconventionally by procedures that mimic the contributions made separately by eggs and sperm. These include parthenogenesis and cloning by cell nuclear transfer. Parthenogenesis involves chemically inducing an egg that has been released from the ovaries to activate embryo development without fertilisation by sperm. An embryo would be produced but with the entire genetic content supplied by the mother instead of half from the father and half from the mother. Such embryos are not believed to be viable because they lack the expression of essential genes from the father, which will eventually lead to failure of the placenta. Based on work in mice, it is thought that human parthenogenetic embryos could be created and allowed to develop sufficiently to a point where embryonic stem cells could be extracted. Some have suggested these might be an ethical alternative to stem cells taken from normally viable embryos. This ethical claim is critiqued in paras 41-42 in Chapter 5.

14. Nuclear transfer cloning is the process used in 1996 at the Roslin Institute to create Dolly the sheep, and many other mammals since then. It involves removing the nucleus of an egg of the animal, containing most of its genetic information, and replacing this by an ordinary body cell donated from another individual. The two are fused either chemically or by an electric current, which has the effect of stimulating the egg to develop into an embryo, but with the genetic composition of the donated body cell. Dolly was not the first cloned sheep. What was dramatic was that a non-reproductive cell had been, as it were, turned back into an embryo, which was hitherto thought impossible in mammals.

15. There has been a general objection to using the nuclear transfer cloning process to produce human babies (reproductive cloning), which is now enshrined in UK law and sundry international conventions and declarations. But there was considerable initial enthusiasm by the Government and scientists for therapeutic uses of human cloned embryos, especially if these could be produced and then used to extract their embryonic stem cells. This was especially seen leading up to the Parliamentary vote in 2000-1. It was hoped at that time, that this would be a way to make replacement cells which were genetically matched to the patient, overcoming the expected rejection problems mentioned above for surplus IVF embryos. It should be noted that this might not work for conditions whose underlying cause was the patient’s own genetic constitution. For example, treating a patient’s diabetes by injecting insulin-secreting cells from her own cloned embryo would only perpetuate her condition if her disease was primarily genetic in origin.

16. A second problem is that for each therapy at least one, and possibly several, human eggs would be needed to create the cloned embryo. The scarcity of human egg donation is a long standing problem for various areas of reproductive research. For some this presents a very serious barrier to the widespread use of “therapeutic cloning”. Korean claims, reported at the 2004 General Assembly, to have made the first cloned human embryos, genetically matched cell lines and with a small number of eggs, are now shown to be false. While some UK research continues in this area, the prospects are now very uncertain again.
17. At the moment a more important use of cells derived from cloned embryos may be in research, as outlined in para 5 above. One application is to understand the fundamental processes of cell differentiation. A very distant and somewhat radical goal is to identify the factors which could enable adult cells to be turned back into a pluripotent state, perhaps eventually enabling scientists to make any desired type of human cell without the use of embryos. A second application is to obtain disease state cells to study serious inheritable disease conditions whose genetic basis is unknown, as described in Case Study 4. The ethical aspects of cloned embryos are discussed in Chapter 5, paras 29-24.

**Eggs and the Creation of Embryo Stem Cells**

18. To create embryos for research requires a source of human eggs. This is true whether the embryo is created by IVF methods, or unconventionally by parthenogenesis or nuclear transfer cloning. Eggs can be obtained by voluntary donation following hormonal stimulation, in the same way as would be the case during assisted reproduction. This can only be done under licence from the Human Fertilisation Embryology Authority (HFEA), which precludes offering financial inducements to the woman. Eggs can also be obtained in various situations where the donated eggs are clinically unusable. These include eggs collected for infertility treatment but which are not fertilisable at the time, or which fail to fertilise due to male-factor deficiencies. These eggs could be fertilised later in culture using donated sperm from another source. It is important that the acquisition of eggs to create embryos for stem cells should not compete with any fundamental interest on the part of the donor to reproduce.

19. Eggs may also be obtained from female cadavers (dead bodies) or from women who undergo an elective surgical procedure which provides ovarian access. These both depend critically on the age and health of the donor and the timing of their reproductive cycle. These eggs would still need to be cultured to mature them to a state where they are able to develop.

20. More radical alternative sources of eggs might be to generate them *in vitro* from existing stem cell lines, or to use eggs obtained from animals. Embryonic stem cells seem to have the potential to form sperm and egg-like cells, but their normalcy and developmental potential remains untested. More recently, controversial research in mice has also suggested that adult bone marrow and stem cells derived from peripheral blood have the potential *in vivo* to regenerate eggs in artificially depleted ovaries. The prospects seem to be distant at best. These routes have been optimistically cited as a solution to the lack of eggs for therapeutic cloning, but as discussed in Chapter 5, they may also pose significant risks as well as ethical problems.

21. Animal eggs cannot be fertilised by human sperm. But nuclear transfer cloning has occasionally been attempted to create an animal-human hybrid embryo by removing the nucleus of an animal egg and inserting a human body cell. Some speculate that human stem cells could be so obtained, but this is not known. A Chinese group has claimed hybrid rabbit-human embryos but this has yet to be reproduced by others. Ethically, this is highly controversial, as discussed in Chapter 5, paras 43-46.

**The Regulatory Framework**

22. In the UK all reproductive medical research, fertility treatment and embryo research is governed by the Human Fertilisation and Embryology Act (1990). It covers the treatment or research involving the creation, keeping or use of human embryos outside the body, the storage or dona-
tion of human eggs, sperm or embryos. These activities are subject to a system of licensing and inspection by an independent statutory regulator, the Human Fertilisation and Embryology Authority (HFEA). The HFE Act contains several absolute prohibitions, to which criminal penalties apply, including placing a human embryo in an animal, placing in a woman any non-human sperm, eggs or embryos, and keeping or using an embryo after 14 days development. In addition, the Human Reproductive Cloning Act (2001) prohibits placing in a woman a human embryo created otherwise than by fertilisation.

23. Research to create or use embryos outside the body requires a licence granted by the HFEA. The original purposes for which embryo research can be licensed were:

- promoting advances in infertility treatment
- increasing knowledge about the causes of congenital disease
- increasing knowledge about the causes of miscarriages
- developing more effective techniques of contraception
- developing methods for detecting the presence of gene or chromosome abnormalities in embryos before implantation.

24. The list was extended by Parliament in 2001 to include:

- increasing knowledge about the development of embryos
- increasing knowledge about serious disease
- enabling any such knowledge to be applied in developing treatments for serious disease.

25. These changes enabled embryonic stem cell research to be conducted in the UK using embryos created by IVF methods or by nuclear transfer cloning. The vast majority of licenses for embryo research have been on embryos surplus to IVF treatments, including most licenses for embryo stem cell research. A few licences have been granted in which IVF embryos have been created for research. Controversially, three licenses have been granted for creating cloned embryos and two for parthenogenetic embryos. In 2003, the SRT Project was invited by HFEA to comment on its performance as a regulator and in relation to public consultation. SRT’s report is referenced. In August 2005 the UK Government announced a long-awaited review of the HFE Act and invited comment on 74 questions. A working group of the Church and Society Council prepared a report, drawing on the work and reports of the SRT Project and the Board of Social Responsibility, and some insights of this present study.

26. The Commission is advised by the European Group on Ethics in Science and New Technologies, which has given widely respected opinion on stem cell research. But given the diversity of traditions and values on this issue, the ethical questions of embryo research remain firmly the responsibility of member states. Several member states have no legislation covering stem cells, but most countries that have passed laws either forbid embryo research or permit it only using surplus IVF embryos. The UK, Belgium and Sweden permit the creation of embryos for research, including cloned embryos, for which the UK has attracted severe criticism via several European Parliament votes but these have no legal force on the matter. In March 2004, the European Parliament and the Council of the European Union passed the Human Tissues and Cells Directive 2004/23/EC on setting standards of quality and safety for the donation, procurement, testing, processing, preservation, storage and distribution of human tissues and cells. This will lead to some amendments to UK legislation in 2006.
27. The Convention on Human Rights and Biomedicine of the Council of Europe was signed in 1997 but has not been ratified by the UK.\textsuperscript{31} It contains articles excluding the creation of embryos for research and a protocol forbidding human reproductive cloning.

28. At the United Nations, a resolution banning reproductive cloning was opposed by a counter-proposal, supported by the United States and some other nations to ban all forms of cloning, including for reproduction, therapy and research. Whereas almost universal consensus existed on reproductive cloning, agreement was impossible on this wider motion. The UN General Assembly only made a non-binding recommendation in 2005 to ban all forms of cloning.\textsuperscript{32}

29. We now consider four case studies which illustrate both the potential and the problems for the use of stem cells in clinical treatments.
Chapter 3

Case Studies

1. Cell Based Therapies for Neurodegenerative Diseases
2. Bone Marrow Transplants as Adult Stem Cell Therapy
3. The Potential Role of Stem Cells in Diabetes Care
4. Cloning Human Embryos to Study Motor Neuron Disease

Case Study 1.

Cell-based Therapies for Neurodegenerative Diseases

Parkinson’s and Huntington’s Diseases

1. The potential of cell therapies is well illustrated by a group of diseases that result in the loss of neurons (neurodegenerative diseases). Two examples are Parkinson’s and Huntington’s diseases. Both involve a progressive loss of certain neurons involved in specialised brain functions and are characterised by involuntary movements. In the case of Parkinson’s, a tremor progresses to problems with balance and the ability to make voluntary movements, and it often leads to dementia. Huntington’s disease causes uncontrollable muscular movements, problems with balance, concentration and short-term memory, as well as depression, changes of mood and sometimes aggressive or anti-social behaviour. A particularly distressing feature of this inherited disease is that affected individuals will pass the mutated gene to approximately half of their offspring, and if the mutation is present, the offspring will inevitably develop Huntington’s at some time in their life.

2. Parkinson’s disease is relatively common, particularly among the older population. In 1990, worldwide an estimated 4 million people were suffering from the condition. In Europe, its overall prevalence is reckoned to be 16 per 1000 persons over 65 years of age. Huntington’s is some 50 times less frequent. Both diseases appear later in life. Usually, Huntington’s appears after age 40 and Parkinson’s after age 50, but in both cases it can sometimes appear much earlier. Because the world population trend is to live longer, the importance of both diseases to public health is expected to increase.

3. Huntington’s disease is known to be due to a genetic defect which causes the abnormal functioning of a protein called Huntingtin. Individuals with the condition carry mutations that enlarge the protein, causing it to become unstable. The unstable protein forms large aggregates that are thought to be toxic to neurons. In Huntington’s disease, the age of onset is related to the size of the mutated Huntingtin protein. Individuals with larger proteins are more likely to develop the disease than those with smaller ones, and in rare cases it can appear in children and teenagers.
Current treatments

Chemical Therapies

4. The triggers for Parkinson’s disease are unknown, but the synthetic drug L-dopa can be used to control the symptoms in the first stages of the disease. Usually, however, the body becomes less sensitive in the long term and so the drug treatments ultimately do not provide a cure. For Huntington’s, a diagnostic test is available, but at-risk individuals related to a Huntington’s patient often choose not to take the test - because of its implications for their future, the complete lack of any cure, and the small degree of progress with drug-based control of the disease.

The Potential for Cell Therapies

5. As the distinctive characteristics of each disease suggest, only a small and very specific set of neurons is affected in each condition. These neurons are highly localised within the brain. The localised and specialised functions of affected neurons make the diseases attractive targets for cell-based therapies. In both cases, the lost neurons synthesise chemicals known as neurotransmitters that stimulate nerve impulses. In the case of Parkinson’s, the neurons produce L-dopamine. The drug L-dopa is a synthetic form of this chemical, but it cannot substitute for cells which produce the substance in a regulated fashion in the correct location. In the case of Huntington’s several types of neuron are lost, predominantly at a localised site called the striatum. The hypothesis for cell therapies for both diseases is as follows. If these neurons could be replaced in situ in regulated amounts at the place where they are required, in each case the progression of the disease could at least be arrested, and potentially, a complete cure might even be effected.

Cells from Foetal Tissue Transplants

6. Several clinical trials have been carried out by transplanting cells from aborted foetuses. In both cases, small populations of the appropriate developing brain sub-region were taken from the foetuses, and grafted into the affected region of Parkinson’s or Huntington’s patients. For instance, some Parkinson’s patients have reported benefits over a 10-year period, and were even able to cease L-dopa treatments over a period of several years without a recurrence of the symptoms. Others have reported no beneficial effect, however. Some have had adverse effects, called dyskinesias (involuntary muscular movements and aberrant postures). It is likely that some of these problems can be overcome by developing better methods to ensure the survival of the cells, and also by treating patients in early stages of the disease, since they are most likely to benefit from the implants.

7. For Huntington’s disease, clinical trials have also reported mixed findings. One small-scale clinical trial showed recovery of muscle and brain function, with no further deterioration of the patients’ condition over a period of years, associated with survival of the graft. This has prompted large-scale clinical trials using a similar protocol which are still under way. Other trials have not been as positive, with little clinical benefit. Once again, the less encouraging results are probably due to differences in protocol and the stage of the disease in the patient.

8. Thus in this early stage of cell therapy development, there are some very promising indications of long-term benefit, although there is still much to be learned before a cure can be guaranteed for sufferers of either condition.
Embryonic Stem Cell Based Therapies

9. It is not ideal to use foetal tissue as donor for either condition, on two counts. One is the ethical problem of using tissue from a relatively well-developed foetus. Secondly, not enough foetal tissue is available to supply all the patients requiring the treatment. One treatment typically uses tissue from between one and six foetuses. An approach based on stem cells would seem preferable from both ethical and practical standpoints.

10. Using embryonic stem cells as a starting point, progress has been made towards obtaining pure populations of the appropriate neurons. In one promising study, embryonic stem cells have been stimulated to specialise in a cell culture to generate a type of neural stem cell that can be cultured over long periods, and which can divide to give rise to large numbers of neural cells. The cell types lost in both Huntington’s and Parkinson’s have been produced in cultures initially derived from embryonic cells. However, the present challenge is to control the process so that it produces the right balance of cell types at a stage of differentiation that allows them to survive and integrate correctly in the patients’ brains.

Alternatives to embryonic stem cell-mediated therapy

11. Early indications in rodents that transplanting adult tissue stem cells (e.g. haematopoietic stem cells) might eventually provide some clinical benefit in humans have more recently lost credence. This is because it seems that, although the transplanted cells may incorporate in the brain, this is too rare an occurrence to hope for a cure from these cells, and little evidence is available on whether the cells function appropriately. A possible exception to these rather disappointing results may be found in other cells that can be isolated from the bone marrow, called Multipotential Adult Progenitor Cells (MAPC)\textsuperscript{14}. Unlike most other adult cells which have been proposed for use in cell therapy, these can be grown in culture over long periods. They can give rise to a number of different cell types, including neurons. In practice, however, culture of these cells is not simple and only a very few labs have successfully grown them. So far, there are no reported studies on their potential to repair neurodegenerative disease in animals. Therefore, although a promising avenue of research, it is uncertain whether these cells would ever bypass the need for embryonic stem cells.

12. In parallel, work is in progress to try to stimulate adult stem cells within the patient’s own brain to divide and regenerate the lost neurons. The process of making new neurons is so far only known to occur at localized sites in rodents, most notably in the area that is involved with detection of smell. It is not clear whether stem cells for the parts of the brain affected in Parkinson’s and Huntington’s diseases that are found in a foetus still exist into adulthood. If they do, it is not known whether they can be stimulated to regenerate lost neurons. Parkinson’s sufferers might eventually benefit from this approach, but research is in a very early stage. However, for Huntington’s disease, this approach seems unworkable in principle, because any cells produced within the patient will also carry mutant Huntingtin and therefore eventually degenerate.

Using Stem Cells to Test Drugs for Parkinson’s and Huntington’s Diseases

13. While much attention has focused on cell therapies, a more immediate clinical benefit may probably be found in using neural cells derived from embryonic stem cells as a means to test drugs that could be used in treating these diseases. The neural cells could be used to screen dif-
ferent pharmaceutical products to assess their ability to protect neurons from degeneration, suppress cell death, or stimulate the division of fresh neural precursor cells.

14. To do this would require the creation of ES cell lines that were susceptible to the damage incurred in the two conditions. In the case of Huntington’s, this would mean isolating ES cell lines carrying the mutant form of Huntingtin. A convenient source of such cells would be embryos from a couple, one of whom was a carrier of the gene, who had opted for pre-implantation genetic diagnosis to avoid passing it to their children. Embryos which have tested positive for the mutation, which would otherwise be discarded, would be suitable to create an ES cell line. In addition to the drug screening application, this would provide a supply of cells susceptible to the disease that would facilitate research into the causes of Huntington’s disease.
Case Study 2

Bone Marrow Transplants as Adult Stem Cell Therapy

1. This is the primary example of the use of adult stem cells in therapy for treating disease. Although the therapeutic potential of various adult cell types is being examined, bone marrow transplantation is the only method of stem cell transplant of any kind which is currently in clinical application. They are used in various clinical indications, namely cancers in the blood system (acute leukaemia, chronic myeloid leukaemia, Hodgkin’s disease, non-Hodgkins lymphoma), solid tumours (breast cancer), severe aplastic anaemia (a form of complete bone marrow failure) and systemic autoimmune disease (diseases such as severe Rheumatoid Arthritis or Systemic Lupus Erythematosus (SLE). It provides a very effective way of rescuing or replacing the bone marrow following high-dose ablative chemo-radiotherapy. The success of the overall treatment strategy in “curing” the underlying disease varies, depending on the nature of the clinical condition. It is fairly effective in chronic myeloid leukaemia, but less so in the more aggressive acute leukaemias.

Haematopoietic Stem Cells

2. More accurately these are transplants of haematopoietic stem cells found in bone marrow which produce the different blood cell types e.g. red blood cells, platelets, white blood cells and cells of the immune system. 99% of the cells found in the bone marrow are precursor cells in the early stages of the “lineage” of development into one or other of these different cell types, but each is already completely committed to its one lineage. The remaining 1% are mostly progenitor cells which are capable of a little further division to make more progenitors but are also essentially committed to a specific lineage. A very small proportion of these progenitor cells (a further 1%) are true haematopoietic stem cells that can self-renew and generate all the specialized blood cell types.

3. In other words, these stem cells are quite rare. For this reason, haematopoietic stem cell transplants used to involve removing one litre of bone marrow from the pelvis of a donor. This requires multiple punctures. It is painful for the donor and requires a general anaesthetic. 99% of these bone marrow cells are not wanted.

4. Progenitor cells have also been found in circulating blood, but they are normally so rare in the bloodstream that it has not been practical to try to collect them. However, when a growth factor called GCSF was given to a donor, it was found to increase the proportion of progenitor cells in the peripheral blood to 1-2%. These can then be removed from circulating blood relatively easily by a centrifugation process. The process of collecting these cells takes about 3-4 hours and is better for both the donor and patient.

5. The transplant recipient has to undergo a conditioning regime where very high dosage radiotherapy and intense chemotherapy are administered. This is to eliminate any residual diseased cells and create space in the marrow for incoming cells. Recipients also have to be heavily immune-suppressed in order to accept the donor cells. They are given an intravenous infusion of haematopoietic stem cells which will find their own way into the bone marrow and then re-ensgraft. No surgery is required. The source of the progenitor cells is important. For example, when sourced from bone marrow, re-engraftment takes place in around three weeks. When the
source is peripheral blood, re-engraftment takes only two weeks, which is better for the recipient.

6. Some transplants use allogeneic cells (from a donor) others autologous cells (one’s own cells). In some conditions a patient’s own stem cells can be used to rescue the patient after administering high-dosage radiation (e.g. Hodgkin’s disease). In other cases the stem cells themselves are defective and therefore donor cells are required (e.g. myeloid leukaemia). For allogeneic transplants an exact tissue type match is required in order to avoid an immune reaction between the patient and the grafted cells (graft versus host disease), which is likely even if the donor is a close relative. There is about 30% mortality from the procedure alone.

7. In Scotland around 100 autologous transplants and 50 allogeneic transplants are carried out in a year. 75-88% allogeneic transplants are derived from peripheral blood. Matching the HLA type is very important. The Human Leukocyte Antigen system (HLA) is the molecular mechanism by which the immune system differentiates between cells of self from cells of non-self. HLA types are remarkably diverse. With siblings, one in four individuals would be expected to provide an exact HLA match on average. Taking into account typical family size, about 30% of people in the UK are likely to have an HLA-matched sibling. The diversity of HLA types has led to the development of registries which collect identified volunteers willing to be stem cell donors if needed. There are about 80 registries worldwide, with about 8 million people HLA typed. These represent 400,000 HLA phenotypes (around 1% of those possible). 15% are unique phenotypes represented by just one person. Caucasians have a 60-70% chance of finding what is known as a “6/6 match” donor, which is the best match at 3 sites of common genetic differences among individuals known as polymorphisms. Even with tissue-typed siblings, 40% of people will still experience immunological rejection because these polymorphisms are not the only ones that exist even within this population. Only an identical twin donating to their twin can be sure to mount no immunological reaction against the grafted cells.
Case Study 3.

The Potential Role of Stem Cells in Diabetes Care

Diabetes Background

1. *Diabetes mellitus* is a condition in which glucose metabolism becomes disordered, resulting in elevated concentrations of glucose in the blood. This can make a patient acutely unwell, and can also put them at long-term risk of complications, which may include visual loss, numb and/or painful feet with ulceration and amputation, kidney failure, heart attack or stroke.

2. Diabetes is present in about 3.5% of the population in the UK, at least double this in the USA, and is increasing in prevalence, expected to double worldwide over the next 10-15 years. Type-1 accounts for about 10% of all diabetes in the UK, but the onset is usually in teenagers and young adults, making it socio-economically very important. It occurs when the body’s immune system attacks the islet cells in the pancreas gland which normally produce insulin, the main hormone controlling blood glucose concentrations. The resulting loss of insulin results in elevated glucose levels. Type-2 diabetes usually starts later on in adult life. It is more complicated, usually a combination of poor quality insulin secretion from the islet cells and resistance to its effects in the liver, muscle and elsewhere. The increase in type-2 diabetes mainly relates to increasing obesity and reduced physical activity in people already genetically predisposed to develop diabetes. The reason for the increase in type-1 diabetes is less clear.

3. Current treatments for diabetes involve “managing” the condition. Despite recent advances with new types of insulin and improved methods of delivery diabetes control remains difficult. An exciting prospect for type-1 diabetes is in the use of continuous blood glucose monitoring devices under the skin which would signal to switch programmable insulin pumps on or off. The possibility of “curing” diabetes remains the ultimate aim.

Organ Transplantation

4. Patients with kidney failure due to diabetes have received renal transplants for many years. Patients need to be matched immunologically with donors who are in short supply. Donors may be living or cadaveric (recently died). Patients receiving transplanted kidneys require long-term immuno-suppression, which involves a lot of monitoring and potential side-effects, such as infections. More recently, pancreas transplantation has been introduced, but it is technically more difficult, donors are scarce and so it is mainly restricted to the minority of patients who already have kidney failure. Xenotransplantation of organs from pigs has been considered, but there are many problems with this including feasibility, immunological cross-reactions, the potential for animal borne infections, and ethical issues. In summary pancreatic organ transplantation is available only to a few patients, and involves a major operation, usually at the time of renal transplantation.

Islet Cell Transplants

5. Islet cell transplantation offers the possibility of a cure for patients with type-1 diabetes, pioneered in Canada and first used successfully in the UK last year. Its role in the more common type-2 diabetes remains more complicated. The procedure requires no major surgery. The islet
cells are injected into the portal vein and bed into the liver (not the pancreas as you might expect), where they become functional by secreting insulin. The failure rate is high as optimal conditions of both islet cells and recipient are essential. If unsuccessful, the procedure is much more repeatable than transplant surgery, but availability is a serious drawback. Since humans only have one pancreas, nearly all islet cells require the post-mortem donation of several pancreas’s, 3-6 per recipient, but in Europe only 10-20 organ donors are available per million per year. There is no prospect of enough samples from cadavers. The result of these factors is that there is a potential requirement for large numbers of islet cells. Pig cells are potential alternative sources, but with risks similar to those of whole organ xenotransplants.

**Stem Cell Research**

6. This leaves the options of tissue stem cells or embryonic stem cells (ES cells) as potential sources of insulin producing cells for human transplantation. Insulin producing cells have been isolated from mouse ES cells and have been shown to reverse diabetes introduced in rodents under restricted laboratory conditions. To translate this initial rodent result into the creation of a viable human therapy is a daunting task. Human ES cells have been manipulated to produce insulin in certain culture conditions, but, just as in the Parkinson’s and Huntington’s case study above, there are difficulties in controlling the process of differentiation from these stem cells so that it produces the right balance of cell types, in this case insulin secreting cells. It is thought that to generate islet cells, new human ES cell lines need developing to achieve a sufficient spread of HLA types and to satisfy medical standards.

7. Cells derived from “adult” tissue have been explored in rodents. Infusions of bone marrow have been shown to develop into pancreatic endothelial cells in the rodent pancreas, which then promoted the production of new islet cells. Apparently stem cells in the added bone marrow somehow promote the proliferation of native islet cells. However, recovery from diabetes depends on stopping the ongoing autoimmune destruction of islet cells, either using immunosuppressive drugs, or other laboratory techniques. Cells from the spleen and pancreas have also shown some capacity for islet renewal in rodents. The main lessons from this work are that the autoimmune destruction would need to be reversed for the stem cell transplants to have any significant clinical impact.

8. Liver stem cells from both rodents and cells from human foetuses have also been differentiated into insulin secreting cells. Recent work has demonstrated that adult human pancreatic cells have divided and produced insulin secreting cells in some circumstances, but the clinical usefulness of this is unclear. There are no models of these reversing diabetes or lowering blood glucose to a clinically significant degree in humans.

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<tr>
<th>Options by which type-1 diabetes patients might achieve independence from needing injected insulin</th>
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<td>• Human Pancreas Transplantation</td>
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<td>• (Pig Pancreas Transplantation – xenotransplant)</td>
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<td>• Islet Cell Transplants – from human cadavers</td>
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<td>• Islet Cell Transplants – from tissue stem cell (“adult” stem cells)</td>
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<tr>
<td>• Islet Cell Transplants – from embryonic stem cells</td>
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9. It is not clear at this very early stage whether embryonic or adult stem cells are likely to provide the better route. Much further research is required before either could become a viable clinical option, and also to improve the survival of islet cells after transplantation.

Conclusions

10. Diabetes will be a major global health-care problem in the 21st century. The scientific community see stem cells as a potentially very important way of being able to supply sufficient islet cells for transplantation, which could “cure” many cases of diabetes, preventing much illness and premature death. There are many scientific obstacles to overcome before stem cells are likely to be usable in clinical practice, providing an opportunity to establish an ethical framework.
Case Study 4.

Cloning Human Embryos to Study Motor Neuron Disease

1. Motor Neurone Disease

1. Motor neurone disease (MND) is an adult onset, fatal, neurodegenerative disease in which the motor neurones in the brain and spinal cord degenerate and the muscles they control become weak and wasted. Patients progressively lose the ability to walk, talk, eat, feed or bathe themselves, which can engender feelings of helplessness and despair. MND symptoms emerge typically in people aged 50 to 70. About half the patients die within 3 years; about 90% in ten years. Treatments are mostly only available to alleviate the symptoms. It affects up to 6 people in 100,000 but the genetic basis of the majority of inherited cases of MND is unknown. MND is inherited in 10% of patients. Mutations in a known gene, the superoxide dismutase gene (SOD1), are detectable in 20% of such families.

2. The development of degeneration in motor neurones has been induced by genetically modifying mice, but these laboratory in vitro “models” generally poorly mimic the pathology of the diseases. New in vitro models to explore the disease mechanisms, initiate drug screening programmes and explore the potential of stem cell therapies would be very desirable.

2. Approaches to Study the Disease

3. The study of a human cellular disease in the laboratory requires a capacity to produce and maintain a population of the affected cells in culture. Ideally, these cells should be produced by the same pathways of differentiation that occur in the body, and should have a normal life span. Further, the affected cells should be obtained without too intrusive an intervention for the patient. Most importantly they should have the same genotype as individuals affected with the disease. In principle, four approaches have the potential to meet these requirements. Each approach requires further technical development and has strengths and weakness. The four approaches would use:

- cells taken from adult tissue of MND patients that are able to differentiate into a range of different cell types (multipotent), or
- cells derived from human embryo stem cells made by nuclear transfer (cloning) of adult tissue from the MND patient, or
- cells genetically modified to replicate MND, taken from either existing adult stem cells or human embryo stem cell lines, or
- cells derived from stem cells taken from embryos discarded from possible pre-implantation genetic testing for MND susceptible embryos.

i). Multipotent Adult Cells

4. The aim is that stem cells would be isolated from an adult tissue sample taken from an MND patient, and that a means would be found to differentiate these adult stem cells into the relevant neural cells. Advantages are that they would be of the specific genotype and would not require the use or creation of embryos. However, the different necessary procedures have not yet been described for any species. It is not certain that their differentiation would mimic that during
normal development. Based on the available evidence it also remains to be confirmed that the cells can be fully functional. Finally, at present derivation of most if not all adult stem cell types, such as for example those present in bone marrow, requires comparatively intrusive sampling procedures. This prospect may be many years into the future.

**ii). Cell Nuclear Transfer to derive Embryo Stem Cell Lines of Specific Genotype**

5. Human embryonic stem cells seem to offer better prospects because theoretically they have the ability to differentiate to form all of the tissues of an adult. Culture conditions have been established that encourage the development of neural cells from embryonic stem cell lines. The usual sources of ES cells from spare IVF embryos would be of no use, unless by chance an embryo was found which carried a defective gene known to cause MND (although in future PGD embryo selection might offer this possibility, see iv). Nuclear transfer cloning, however, offers a unique route to a supply of cells containing both the known defective gene and potentially as yet unknown MND-related genes.  

6. Skin or blood cells would be taken from people who have an inherited form of MND whose genetic cause is unknown. These would be fused with a human egg whose nucleus had been removed to create a cloned embryo that was the same genetic type as the patient. The embryonic stem cells would then be removed to create a stem cell line, from which cells could be chemically induced to become motor neurones. The individual steps proposed for this type of project have been completed in the mouse. The next stage is to try to develop these procedures to generate human motor neurones.

7. Two key limitations have to be met. There must be an adequate supply of human eggs at the appropriate stage of their development. A variety of sources were discussed in Chapter 2 (paras 18-21), for example by voluntary donation of mature eggs by women undergoing hormonal stimulation, or of immature eggs by women undergoing elective surgery which provided access to the ovaries.

8. Secondly, the cloning procedure in humans needs to be established unequivocally and optimised. The recent controversy regarding the veracity of claims for cloned human embryo stem cells suggest that this technical capacity may not currently exist. Researchers would also need to be sure that neither the cloning process nor the prolonged culturing had perturbed mechanisms controlling the expression of genes. If once established, however, stem cell lines derived from cloned embryos would be expected to furnish cells for study over very long periods.

**iii). Genetic modification in Existing Cell Lines**

9. Mutations known to be associated with MND could be introduced into existing embryo stem cells by genetic modification. These would be differentiated to produce the relevant neurones, to allow scientists to analyse the effect of the introduced mutations on how the cells function in the development of the disease. Genetic complexities mean that there are significant technical challenges, but this approach offers the only means of analysing the effect of several specific genetic changes in one genetic background. There are no implications for donors because the cell lines are already available.

**iv). Embryo Stem Cells from Pre-implantation Genetic Testing (PGD)**

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10. If in future an appropriate pre-implantation genetic selection test were ever developed for known forms of MND, a couple who wished to undergo embryo selection to avoid passing the relevant MND gene to their children, might give permission that any embryos found to carry this defective gene could be used for stem cell research.

3. Conclusion

11. All of the approaches require technical development before cells for research could become available and each has advantages and limitations. Experience suggests that it may take some years before the expertise to isolate, expand and manipulate these cells became routine. While the cells required for this research project might one day be produced from multipotent cells from adult human tissues, the researchers argue that far more is known of embryo stem cells, and that the nuclear transfer cloning route offers a more likely route to cells currently unobtainable in any other way.
Chapter 4
Theological Context

1. Basic Perspectives

1. We start from the premise that all humans are equally creations of the triune God, uniquely made in God’s image, regardless of gender, age, race, health, wealth, rationality, genetic “impairments” or any other functional framing of the human condition. Human beings are not “no more than” products of time and chance in a random evolutionary process. The various levels of scientific description, valuable as they may be, are inadequate to be seen as the sole account of human being and its origins. God is the Author of all creation and as such human offspring are a blessing given by God (Gen. 1:28; 9:1 and 7). One of the marvels of God’s creation of the world and his continuing sustaining of life is that human reproduction is not just a biological bringing into existence of an entity. It involves a divine action in which God pours out his love to the new existence. Creation of personal existence is an expression of God’s love. God’s act of creating existence is in a mysterious way intrinsically related to the act of God’s loving.

2. The creation of human beings “in the image of God” implies, amongst other principles, the dignity of every human life (Gen. 1:26). Each individual is loved by God and is of inestimable value, exactly as he or she is. We understand the human person in the light of the incarnation, life, death and resurrection of Jesus Christ, who, while being in the form of God, was born of a woman’s womb as a baby like any other, and became a man (Phil. 2:6), living and dying for all humanity, imputing a special value to all human life.

3. Humans are also made relational and communal. This gives important insights into questions too often assessed from the perspective of the single individual. God created people relational (Gen.1:26-27, 2:18 and 24) and in population groups. No individual can be viewed wholly independently of their community and relational context (for example Gen.12:2; Deut.26:5, 1 Cor. 12:12,13,27). We value uniquely the union between man and woman and have regarded with concern developments in reproductive technologies that loosen the ties of that bond. For believers, the ultimate fulfillment of human life lies in its relationship with God and the life beyond death in resurrection in union with Jesus Christ.

4. Following in the footsteps of Jesus Christ many Christians are deeply committed to works of healing, medical care and research, and have been pioneers in many areas of medicine. We welcome many of the scientific developments which have enabled diseases to be understood and treated and suffering greatly reduced. We also recognise the finitude and falleness of all human life before God and the inherent limits of medicine and medical research. The powerful gospel mandate to heal the sick does not of itself override other moral considerations, but needs to be taken in conjunction with them in ways that are often complex and sometimes involve heart-searching dilemmas.

5. In approaching these issues we are acutely aware of the magnitude of their theological import, their social implications, and the difficult human situations of human suffering to which many of them relate, in childlessness, chronic or terminal disease and many other conditions. We acknowledge the dilemma of the individual and social dimensions of ethics in these fields. It is not easy, faced with individual cases of pain and disease, sometimes to stand back and take a
wider perspective. Our Christian tradition calls us to do this with compassion and an appreciation of humanity on a broader scale as well as the individual.

6. The particular Presbyterian tradition of the Church of Scotland means that we approach ethics with the understanding that differences of judgement are to be expected among God’s people, as we seek together to understand the mind of God on novel and often highly technical challenges to moral reasoning. On matters to do with the embryo we are especially aware of deeply held and sincere differences of view within our membership. These span the range from so-called “absolute” to “gradual” positions of the developing embryo, and from complete rejection to conditional acceptance of embryo stem cell research. Few, if any, would regard embryonic human life as possessing no moral status, however.

7. In so doing, we recognise the importance of the dialogue between our biology and our theology, each informing the other. Through theology we may seek to understand ultimate realities of God, humanity and creation, but the practice of science can also be said to reflect God’s creative image as men and women seek to unearth the truths of what God has embedded in creation. All real truth is ultimately God’s truth, for which God provides us guidance in scripture, supported by the accumulated understanding of God’s people. The deepening of our understanding God’s creation is intended to promote the flourishing of creation and people, deepening relationships within and between both. In this sense science can relate to God’s image in humans given responsibility to care for creation on God’s behalf and to offer back creation to God.

8. Scientific knowledge may also be liable to misuse, but the Church has no reason to be afraid of science as science. “If we are keen to know the truth, then, we should not be afraid of what truth is discovered, in whatever field.” We therefore profoundly need to seek God’s wisdom with the help of the Holy Spirit to discern where to act and where to withhold - out of obedience to God, respect for the rest of creation, care for others and especially the powerless, and in recognition of sin both in ourselves and the “powers” of this world. As persons in community who belong to one another in Christ we are called to strive together in our moral reasoning – mindful of the finitude of our present understanding and of solidarity in sin, but also thankful for the possibilities that scientific knowledge of God’s creation brings. In the present context of stem cell and embryo science, while we understand many new things, we recognise the many uncertainties in the relatively early stages of current research. New discoveries may change our perspectives, and there are some things which we may perhaps never know.

2. When does a human life begin?

i). General Considerations

9. This theological question needs to be addressed first as a foundation for any discussion of stem cell research. If the embryo is respected as a person from the very first instant of existence, then the only procedures permitted on it should be for its own benefit and for no other purpose. Alternatively, if the process of fertilisation is regarded as just one of a series of morally significant developments in the early embryo’s life, then different conclusions may be drawn about embryonic stem cell research. People may agree about the biology but their interpretation differs. For one, biological facts about the early embryo suggest that it should be regarded in the same way as any other human being. For another, they do not. People may also disagree about interpretation to be placed on certain biblical passages and the weight to be put on various theological arguments, both past and present. We first examine some relevant biblical passages.
ii). Biblical Passages and their Interpretation

10. At a time when modern liberal concepts of individual autonomy and private choice are failing to provide an adequate ethic of technology to meet present-day needs, we believe firmly that scripture is still sufficient to guide, shape and direct the Church in matters of both doctrine and morals. “All scripture is inspired by God and is useful for teaching, reproof, for correction, and for training in righteousness, so that everyone who belongs to God may be proficient, equipped for every good service” (2 Tim. 3:16-17). This does not mean, however, that we shall be supplied with “literal” or ready-made answers straight from the text, without regard for the context of each passage and its place in broader theological doctrines. The form of questions now being asked were not posed as such in Biblical times. The processes of fertilisation and embryo development which science has so far revealed were largely unknown. To search the Bible for guidance on these points is a complex task, needing great care.

11. Biblical teaching is unclear or agnostic about when life begins. Christian tradition lacks unanimity about it. Various passages are cited to establish the claim that God knows, calls and loves each person before birth just as much as after (Ps. 139:13-16; Jer. 1:5; Is. 49:1; Gal. 1:15, etc.). Jesus and John the Baptist are announced before their conception (Matt. 1:18; Lk. 1:13, 31). Isaiah, Jeremiah and Paul admit to being called to particular tasks before or during their time in the womb. The book of Hebrews refers to Levi the priest being, at one time, “still in the loins of his ancestor”, referring to his great-grandfather Abraham. (Heb. 7:10). All this suggests that God’s knowledge of people is not limited to a timeslot after birth but extends back “beyond the foundation of the world” (Eph. 1:4).

12. However, we feel it important not to go beyond what may reasonably be concluded. For example, it may be said that from the standpoint of eternity God foreknew Jeremiah, before conception, but Jeremiah did not exist until a particular point in time. The Hebrew word golem, translated “unformed substance” (Revised Standard Version) in Ps.139:16, is vague. Significantly, Jewish scholarship has not drawn the conclusion from such texts that a human person is unequivocally present from fertilisation, but much later. These passages do not explicitly answer questions such as at what point did that foreknowledge become a relationship, or when it may be said that human personhood began, nor how to assess our obligations to medical research. Hence the need to set our questions within the broader theological reflection on human existence in the light of the gospel of Christ.

13. In so far as human beginnings are referred to in scripture, the focus is naturally on people who have become born. Passages cited to indicate the continuity of human life from conception onwards like Psalm 139 and Jeremiah 1 refer to God’s knowledge or foreknowledge of adult persons who now exist. These passages and the whole Bible are silent, however, about the great majority of conceptions that do not give rise to babies. Inferences are made, one way or another, but they remain inferences about passages whose primary contexts were about quite different questions than “when life begins”. A general comment is to note that where scripture is silent or its meaning is unclear, Christians should recognise that their own views are interpretations, that others may interpret differently, and that these other interpretations should therefore be treated with respect within the church.
iii). Biological Development and Theological Interpretation

14. We are therefore challenged to examine also what biological science currently teaches us, in the light of scripture and theology. We do so in order to try and discern among the new technical possibilities which ones are useful and good. This necessarily involves interpretation and making decisions about what matters in our arguments, what grounds we rely upon, and so on. The old question: “Does it honour God?” is still relevant as one important criterion by which decisions may be made.

15. As observed above, we understand the human person first and foremost in the light of the incarnation, life, death and resurrection of Jesus Christ. The 1996 report states “Each person is of supreme value to God, is created in his image, and is being called into his likeness in Jesus Christ.” His incarnation in earliest embryonic form means that all human life must be reckoned as having extraordinary worth. But, as Christian clinical geneticist Caroline Berry put it, when should the embryo or foetus be regarded as a brother or sister for whom Christ died? 43 If, in a Christian perspective, life is a multi-faceted whole and not merely a biological event, is its beginning adequately defined just by genetic completion at conception? In this light, a new life might have several senses of beginning. Conception is a beginning, but so is individuation (when an embryo is established as a single individual), implantation (the beginning of relational life), differentiation into the organs which allow us to recognise our creator, and birth, the event at which we take our first breath and begin separate (though dependent) life. Although the later stages need the earlier stages for them to be able to occur, early stages will not achieve their purpose without the later ones.

16. The 1996 report considered that “attempts to determine whether or not the embryo at any given stage in its development is a person or manifests God’s image in order that we might know how to behave towards it can only end in sterile argument” (p.60). The majority of the group would not agree that the debate is necessarily sterile without duly considering the moral implications of key stages in embryonic and foetal development, which we now do.

iv) Creation of the Embryo : Fertilisation and Genetic Completeness

17. In what is often referred to as the “absolute” view, the human embryo is regarded as having the moral status of person from the first instant of existence. In normal reproduction, this point is seen as the completion of the process of fertilisation of the egg by the sperm, which is also commonly called conception. The 1996 report took the view that “despite natural wastage … from a biblical point of view human life begins at conception, at which point the human embryo is genetically complete” (p.61). It interpreted the psalmist tracing his identity back to his conception. But it particularly emphasised the significance of Christ’s incarnation. It saw his conception as the point at which the Word became flesh, and concluded that this therefore “affirms, confirms and sanctifies every other conception in the same way that his Incarnation affirms, confirms and sanctifies our humanity” (p.62). It concluded that “…every other human being from the moment of conception is a person in Christ, called into personal relationship with Christ, and must be so regarded and treated with sanctity”.

18. The key factor in this position is that fertilisation is taken as the beginning of a life. Before this point no one could speak of an entity that was a human being. A life has now been created. Creation may be defined as "to make out of nothing or bestow existence upon". 44 Creating entails bringing forth something that did not previously exist in time and space. As we have observed already, in a Christian understanding, this is not mere biological human existence. In the
absolute position, from this point of fertilisation onwards there is a being made in the image of God, called to relationship with Christ, even though this being may not yet be (or ever be) in a position to respond to this love on earth. No one but God may ever be aware of the existence and life of this being, but in this view, the embryo already has the same human dignity as a person that has been born. Human dignity inheres in the very existence of the embryo, not in any property it possesses at this point, except in that it now has the full genetic complement of a human being, which neither egg nor sperm possessed separately. That dignity is based in the love of God for the person which has come into existence. The moral status of the embryo is the same as that of a child or an adult with no discontinuity.

19. This view equates the sacredness of human life as a gift given by God at fertilisation. In the words of Orthodox theologian John Breck sacredness “originates with God and is accorded purely as an expression of his love. As such, it is wholly derivative … the gift of God’s own life and holiness, bestowed upon us independently of any merit, value or achievement of our own.”

He emphasises how, from the outset, a person is created as a whole, complete both in a body and with a soul, deeply united into the concept of the person “as an embodied soul and a besouled body”.

20. A consideration of the beginning of human existence in the light of the conjunction of the soul and body was offered by Gregory of Nyssa (ca. 335 - 394 AD). He argued that since a human's being is one, consisting of soul and body, the beginning of its existence must be one as well. In other words, soul and body come into being at the same moment on the occasion of creation. In line with other leading Church Fathers, Gregory of Nyssa held that each soul is created by God along with the body and grows together with the body from the moment of its creation. There is no room in this perspective for a dualistic approach in which the body would be created first and the soul and its associated dignity would, somehow, be implanted at a later stage.

21. This line of teaching is developed by T.F. Torrance who indicated that it is this kind of “holistic, non-dualistic, conception of the body and soul which …we must allow to govern our understanding of the unborn child in the oneness of its body and soul, as an embodied soul and a besouled body. This means that we must regard the human embryo as already a human life … not just a potential human being, but as a distinct, viable human being in which body and soul develop together within the womb of the mother.”

22. Implicit in this view, where the focus is on the creation of a new human life, the single most theologically significant moment of biological development is fertilisation. This is when the unique genotype of that human embryo is established, fusing into one the half complement of genes of egg and sperm into a genetically complete, unique entity.

23. The 1996 report expresses a variation of this position in describing the embryo as a “potential person” (p.60), but declares that development of the embryo “is not to be seen as growth into that which it was not before but rather the fulfillment of that which it already is” (p.56). Another way of putting it is that it is not the length of time for which pre-natal or post-natal persons exist that matters. It is the fact that they exist at all, even just for a few micro-seconds, and are complete and whole. Thus the issue of whether or not an embryo is viable to be able to produce a baby is not morally important, as long as it exists and is alive.

24. The very beginning of life also portrays a life at its most vulnerable. God’s especial valuing of the weak and defenceless who have no one else to speak for them resounds throughout the
Bible, underlined by the incarnation of Jesus Christ. Arguably, we are obliged to protect all embryos as an expression of this truth.

25. The implication of this position is that, if God brings a new human being into existence through the process of fertilisation, and if there is no other point at which anyone can be as certain in its affirmation that an individual human life has begun, then the only manipulation that may be permitted on this embryo is for its own treatment. This is similar to the official position of the Catholic Church. John Paul II indicated in Evangelium Vitae "What is at stake is so important that, from the standpoint of moral obligation the mere probability that a human person is involved would suffice to justify an absolutely clear prohibition of any intervention aimed at killing a human embryo." In other words, because a fully personal human life may be present, there is a moral imperative to resolve any doubts on the side of protecting life.

26. In this view, embryonic stem cell research of the kind already happening in the UK should be regarded as inherently immoral and condemned as such by the Church. To use the embryo as a source of stem cells for research or therapeutic purposes (for a human life other than that of the embryo in question) would be to sacrifice the weak to make life better for the strong – which runs directly counter to the Christian ethic. Embryonic stem cells may be useful in medical treatment but the end does not justify the means.

27. This view also considers that a human being is equally created in unusual natural events such as when the embryo itself divides to form twins, and in the deliberate creation of cloned human embryos at the point when the nucleus of a somatic cell is fused with an enucleated human egg.

v). Issues Raised by Genetic Completeness

28. We have already noted that the diversity of conviction amongst Christian people with respect to the moral status of the embryo is considerable. The so-called gradual positions consider that there are not sufficient theological or scientific reasons for claiming that the early human embryo should be accorded the moral status of personhood. The creation of a new life as a gift from God and loved by God is a shared belief of both absolute and gradual positions. But not all consider that this should unequivocally be seen as the point of fertilisation for the reasons which we will now discuss. It is at least arguable that different interests and duties are owed to the embryo at successive stages of development.

29. For example, engagement with scripture, Christian tradition, and modern scientific advances produces a different result for Caroline Berry. She warns against attaching undue importance to the uniqueness of embryo’s genotype and disregarding relevant factors about the kind of developmental individuality found in the early embryo. “The Christian has to ask ‘does this printout [of our three thousand million genetic base pairs] bear the image of God?’ Is it my brother or sister for whom Christ died, or is it the ‘dust of the earth’, which became a living being only as God breathed into it when he formed humans (Gen. 2:7)? If we impute too great a value to our molecular make-up, we find that the person becomes simply the sum of his/her genes.” Too high a status should not, therefore, be given to the establishment of genetic completion.

30. The new embryo’s genotype is unique in the sense that, statistically, it will most likely never occur again, but the moral status attached to genetic uniqueness can be questioned. Associating personhood too closely with DNA risks the error of genetic reductionism. Our understanding of genes, proteins and their environment increasingly reveals a highly complex dynamic interactive
pattern not a simple static blueprint. For example, in the life time of an individual not all of their genes will be switched on; unique features of genetic make up may never be expressed. Environmental factors have a major impact on gene expression. In the womb, the maternal diet and intake of stimulants may significantly affect which foetal genes are switched on or off, with consequent effects on the physiology of the individual after birth, including body weight and susceptibility to heart disease and diabetes. While it is very important, genetics does not exhaust theological truth about human creation and identity. For example, some genes contain defects which medicine may seek to repair by manipulating the genes, but this would not normally be seen as tantamount to changing the person. The argument that genetic uniqueness has inherent value in itself is problematic in so far as it has unquestionably harmful possibilities, such as the serious genetic mutations which afflict some babies.

31. To bring this further into focus, from a biological point of view, fertilisation is only the very first step in the demanding and complex developmental process which most of the initial conceptions fail to fulfil. In order to achieve each success, a considerable and inevitable level of failure seems to be inherent in the process of animal and particularly human sexual reproduction. Winston cites that four fifths of all human embryos are lost in the first few days after conception, before implantation in the womb. Statistically, it is only the exceptional combination of embryos and environmental conditions that are able to go to term and become babies. The remainder are spontaneously discharged by the woman’s body. If the focus is on conception as the determinative moment, and if all failed conceptions are deemed to be human persons, this also has theological implications. In this view, God’s providence allows that the considerable majority of human persons who are created never see the light of day, most not even going beyond a very primitive stage of development.

32. Within the absolute position, the loss of so many embryos has no impact on their moral status, because their loss is seen as no different from the loss of many infants from disease, since all are human persons. The 1996 report indicated that “Large numbers of people lose their lives as a result of natural occurrences like floods, drought, and earthquakes, but such loss does not tell us anything about the nature of the individuals lost” (p. 55). From a gradual viewpoint, the two situations are not entirely comparable, however. Most embryo loss seems to occur because the embryos themselves, or the conditions needed for their implantation, made them biologically non-viable. The large majority of infants who die in infancy, on the other hand, die not because they were not viable biologically but because of malnourishment, infections, disasters or pollution, most of which could in principle be avoided by human provision. The point at issue is not whether a person is there at birth, but whether a person is yet there at the early embryo stage.

33. A third objection to treating fertilisation as the absolute beginning point of personhood, is that it implies priority over other factors in the development of the embryo and foetus that might have at least as much moral and theological significance. It could also be argued that, as an embryo progressively acquires the characteristics of an individual, so the acquisition of personhood is a process, rather than a point in time. All that was said above about the beginning of a human life would be affirmed, but from a later stage. The solidarity of Christ’s incarnation with each human beginning depends on when that beginning is deemed to have happened. Genetic uniqueness is a property of most humans, but is it the determinative feature in their development?

vi). Individuation and Differentiation of Embryonic Cells

34. Two significant early stages are the individuation of the embryo and the differentiation of the cells. Early in development, the embryo divides to give rise to cells that are each equally potent.
to become a single individual. Indeed, sometimes during these early divisions the embryo divides to become two or more embryos, each of which will go on to have a separate individual life as “identical” (or monozygotic) twins, triplets, etc. Not only this, in studies in other mammals, single cells from different embryos at this stage can be combined together experimentally and form a single individual. It is argued that at the early division stages individual personhood cannot be considered a property of single embryos, since a single entity can produce no, one, two or more people.

35. The Catholic ethicist Mark Johnson argues that once cells in the embryo have started to divide, the embryo is a single entity carrying on life-functions and should therefore be considered as individuated human life. Some speculate that, given that the process of twinning is not entirely understood, it might be seen as a budding of one new individual out of cells from the first – A produces A and B – such that the original individual continues to exist. The more normal biological understanding of twinning is, however, that an embryo A generally splits in two, forming two new individuals, B and C, such that the original single embryo A ceases to exist.

36. Differentiation is the slow process by which these early embryo cells progressively lose the property of being able to give rise to all cell types, called totipotency (L. totus - all). This begins in divisions following the 8 cell stage, while the embryo is still free-floating in the oviduct and uterus. Cells on the outer surface of the embryo produce a cell type whose role is to interact with the mother’s uterus at implantation and which eventually produces the placenta. Meanwhile the inside cells retain the capacity to give rise to all the cells in the body of the embryo itself, called pluripotency (L. pluralis – of many but not of all).

37. During these stages, before and around implantation, the cells of the embryo are characterised by extreme plasticity as evidenced by their ability (described above) to compensate for events such as splitting the embryo, or recombining two embryos together. In embryos at these stages, cells can be removed or added without disturbing the eventual organisation of the foetus. A basic biological characteristic of a human body is a subordination of the parts (the individual cells) to the whole (the body), so that cells do not function independently of each other. At these early stages the cells of the embryo have the ability to function independently of each other, and can each give rise to any part of the body or even a whole embryo. After the formation of the “primitive streak” at around 14 days, the cells lose this capacity for independent existence and thereafter can only function dependent on each other. At this time, the definitive body-plan is laid down, defining the head and tail, back and front, left and right, outside and inside of the embryo.

38. This stage is also associated with loss of pluripotency, so that each cell takes on specialised functions and can no longer be regenerated when removed. Cells from one part of the body cannot substitute for another. Occasionally, during primitive streak formation, two individuals are produced, resulting in the formation of conjoined (“Siamese”) twins. Although sometimes sharing parts of their bodies, these are normally regarded as distinct individuals. Up to the formation of the primitive streak, therefore, there is still the possibility of producing multiple individuals from a single fertilised egg.

39. In the light of these considerations, it is argued within the gradual position that fertilisation cannot be considered in biological terms as absolutely equivalent to individual personhood. One can only say that in retrospect about a particular life, but one cannot say it prospectively about all early embryos.
vii). Implantation and Relational Arguments

40. As Christians we see the relational aspect of our humanity in God’s image as centrally important in our understanding of the human person. For many this makes implantation, the beginning of physical relationship with the mother, the most significant point at which we can speak of the embryo as a human person. The process of implantation occurs over a period from about 6-14 days, and is ethically significant because of the bonding with the mother that has begun. Chemical signalling between mother and embryo had begun earlier, but the physical link is established only at this stage.

41. The 1996 report stressed relationship with God as the most basic relationship. “It is in that calling to be a person, in relationship to, and in likeness to, Jesus Christ, that each person is different from any other person and from all other forms of creation. … True humanity is understood not only in self-reference, or in relation to others, but supremely in relationship to Jesus Christ ..” (p.61). From the moment of conception every person is “called into personal relationship with Christ.” This may be true in the sense that the embryo is a human embryo and not that of some other mammal which is not in God’s image. The image of God has a relational dimension, because God in Trinity is relational. We may ask at what point and in what sense does God relate to the human person during the development of the embryo? Does God relate to conceptions that will spontaneously abort in the first few days and if so does he relate in the same way, as to a person, or in some different sense? Ultimately we do not know; only God knows.

42. God loves all of creation and knows all he has created. This applies to the air, the seas, the rocks, bacteria, fungi, plants and other animals. On the basis of how we interact with God it is reasonable to conclude that God relates to the different elements of creation in different ways. It may also be that God relates to an egg which is never fertilised and to the majority of embryos which do not develop into new born babies, in a different way from the way relationships develop with those who develop a wider consciousness. There is no way we can be sure, but some speculate that at least some level of differentiation in the embryo is necessary for us to be able to speak of knowing God, on our part. God knows us from eternity, but our awareness of that love and our response to it is inevitably a significant element in the beginning of a particular human life.

43. For some Christians, a level of development of the embryo after conception is necessary before we can speak meaningfully of a human person in relationship, both with the mother, and, more profoundly, with God.

viii). Subsequent Stages in Development

44. In its consultations, the 1985 Warnock committee sought opinions from various professional medical bodies on what should be the criteria in embryo development that would set a limit to keeping embryos alive in the laboratory. This led to the current UK legislative limit of 14 days, just before the formation of the primitive streak. The primary criterion was seen as functional development, marking “the beginning of individual development of the embryo” and just before early neural development (17 days). It was also considered “consonant with” the completion of implantation in the womb, though somewhat later than the beginning of implantation which was favoured by some groups.
45. Later significant points include the beginning of the neural network in the development of the brain at about 3-4 weeks, when electrical discharges begin, and which is taken as brain birth. Some have asked if there is an ethical significance to the symmetry between brain birth and brain death? Other more traditional indicators of the beginning of life might come from the beginning of blood circulation (drawing from the Old Testament notion of blood associated with the life of an animal or human, Gen.9 and the Levitical sacrificial laws), “quickening” (when the mother first feels the movement of the baby in her womb), or even when the baby takes its first breath, associated with God breathing his Spirit into the dust or dry bones to form a living being (Genesis 2:7, Ezekiel 37).

46. The American Jewish bioethicist Laurie Zoloth comments that Jewish tradition has a developmental view of the moral status of the embryo and foetus. Many passages in the Talmud refer to human being being established only after 40 days, before which it is me’a b’alma “mere fluid”. Full personhood is established at birth. Islamic scholarship puts the point of human being at 40 or 120 days, based on the Hadith (sayings of the prophet Mohammed) in which the developing embryo is likened for each of 40 days, respectively, to a drop, a clot and a piece of flesh, before God sends an angel to blow the spirit into him. Prior to this the embryo has sanctity but not that of a full human being. Both ethical traditions emphasise an especial imperative for saving life through medicine.

3. Drawing Conclusions about the Beginning of a Human Life

47. So how do we describe the ethical significance of the embryo? What are these cells? A tiny person or human cells with as yet unfulfilled potential? Do we compromise the intrinsic worth of the embryo if we treat it as instrumentally important for some purpose other than reproduction? We set out three different conclusions in the following sections.

i). Absolute Moral Status

48. The “absolute” position is primarily predicated on the embryo at the point of fertilisation being the earliest beginning stage. Before this point there was not a human life. From this point onwards there is a human life, created in God’s image and called into relationship with Christ. The implication of this view is that the embryo is to be accorded the moral status of a human being.

49. In doing so, de facto this imputes a theological priority to fertilisation and the establishing of the genotype over all other stages of development. Whilst this is indeed a view of some within the church, many of the working group were not clear that it is valid to say that establishing the genotype de facto matters more than forming bodily functions, consciousness, sentience or human relationship. Some were concerned lest we become somewhat reductionist in seeking to determine theological categories and boundaries to what is biologically a continuum of development which does not have them.

ii). Giving the Embryo the Benefit of the Doubt

51. The 1996 report considered “The use of various criteria to define personhood and establish the point at which an embryo or foetus becomes a person is arbitrary and subjective.” (p. 56) It is argued that the very number of stages at which an embryo might be considered as having the same moral status as an adult inevitably means a subjective judgement. In other words, the process of human development is a continuous one in which any demarcation would be arbitrary
and merely conventional. Within the development process it is indeed impossible to indicate a non-arbitrary point of transition from human non-person to human person. While science can throw light on such matters, it will not resolve the theological and ethical judgement of when full human moral status should be conferred.

52. Faced with this uncertainty, an alternative version of the “absolute” position is to give the earliest embryo the benefit of the doubt, and to offer from conception the protection which we would expect to give a fully formed child or adult. Many in the church, including some in the working group, would hold this view.

53. A variation on this view is that personhood does not necessarily begin at fertilisation, but that the important thing is that the embryo has the potential to develop into a human being. In this view, failed human conceptions are therefore not necessarily human persons, for example. The objection to research on an embryo that leads to its destruction is that it is not for humans to decide which ones are or are not to develop into a full grown human being. The question is more one of agency than status, as such.

54. There are however some problems with this. Whoever takes this view is by definition unsure that fertilisation is the point of beginning of the human person. The implications of this precautionary stance are that potentially valuable medical research is not undertaken, on the grounds of what may or may not prove to be a misunderstanding. A judgement is thereby made about relative priorities in this particular aspect of Christian ethics.

55. Nonetheless, for many the embryo is either unequivocally a human person or a potential human being. Whilst accepting that many embryos never develop into human babies, they contend that it is not for any human person to make a decision that prevents its development or actively leads to its destruction.

iii). Gradual Development of Human Status

56. A variety of problems with the “absolute” and “potential” positions were discussed above. One is that the embryo at conception cannot yet be equated to a particular human being in relationship with God. Until the stage of the primitive streak, it could be one, several or no individuals. That is seen only in retrospect. We note that the 1996 report asked “if we are not sure whether one or more persons is present, does that justify us in treating what is before us as if there were no persons present?” (p.56) This does not altogether follow, since the issue at stake is whether one can truly speak of there being persons present, until the individuation of any particular person is finally established at around 14 days.

57. There are also theological questions about the nature of God’s creative and redemptive purposes, if all the failed conceptions are seen as full human persons for whom Christ died. Does it square with our wider understanding of scripture, if the large majority of the race of human beings primarily comprises not those who have been born but those who never reached beyond a certain stage in embryonic and foetal development, and many not beyond a few hundreds of cells? For some, these are decisive objections to the “absolute” or “potential” positions.

58. The development from fertilisation to birth is a continuum, but Mackay has pointed out it is illogical to treat both ends of a continuum of development as the same thing. Common sense might suggest that, since a 1-cell embryo is not the same as a baby, it does not make sense to treat it as though it is. Christian psychologist Malcolm Jeeves contends that because there is
complete continuity in biological development does not rule out a decisive stage before which there is nobody there and after which there is a “she” or “he” there.\(^{57}\)

59. The 1996 report argued that if our humanity is understood in what we \textit{are} and are called to be, in the light of being created in the image of God, the argument falls that human personhood has to do with capacities and functions. (p.56) The majority of the group would argue, however, that it at least involves \textit{both} ontology and some level of development, if a crucial factor in human personhood is one of relationship, as observed above. The 1996 report presumed that personhood was equated to conception, for all embryos, regardless of their subsequent fate. The majority of the working group considered that a level of development of the embryo after conception is necessary before we can speak meaningfully of a human person in relationship. God gives a significance to the human embryo in the act of creating, but it is not clear that this is yet the significance of a human person.

60. God knows, for example, that an 8-cell embryo exists, and all about it. God holds it together with all things in creation. But this is not necessarily the same thing as the mutuality implied by the notion of relationship. We might ask what place within divine providence does an embryo hold that gets no further than 8 cells and then dies - the same as to a person, or to something not truly a person?

61. Against this view, Meilaender and George have cautioned against making human dignity dependent on attaining specific capacities.\(^{58}\) They regard it as dangerous to propose that a living human embryo could not be a member of the community of persons unless and until it had acquired certain capacities without offering any serious discussion of what this means. Other commentators, especially those holding to an “absolute” position, are critical that the gradual position is vague and based on somewhat arbitrary judgements. We have discussed above what this might mean, and the various difficulties we find with the alternative view of human personhood from fertilisation.

62. The majority of the working group take a “gradualist” view of the human embryo. That is to say that only at some functional stage may we talk meaningfully of a human person and of mutual relationship with God. It is also not enough to speak only of the potential being there. Before this point we do not have a human person. Nonetheless the embryo is not simply to be seen as a mere ball of cells, with no moral status, open to any human intervention without limit.

63. Following this argument through, most of the group considers that the current UK law makes a valid judgement in seeing 14 days as representing the crucial period when a number of things begin, and before which human personhood is not clearly established. In contrast to the 1996 report, most of the present working group have some sympathy with the insight of the Warnock Committee that while the human embryo deserves greater respect than that generally accorded to human tissues, it should not necessarily be given the respect that is given to actual persons until about this time. Some of us would draw a line at a point earlier than 14 days, congruent with the beginning, rather than the end of implantation. Research on embryos might therefore be permitted up to this stage, but only for a very good reason, because had we not chosen an embryo for research and implanted it instead, it would have had a chance of becoming a baby.

64. Others may accept a distinction that draws from MacKay’s ethical analysis of that biological fact that most embryos that are conceived never become human persons. Only those which become babies are human persons to whom God can say, as to the psalmist in Psalm 139 “I knew you even in the womb”. These God knew all along and such embryos are worthy of full respect
from conception. Those that never reached some significant stage of development were never human persons in any meaningful sense. In this view also, some embryos could be used and destroyed in research up to 14 days. The difference is that humans are choosing which will not become human persons in this sense.

65. The question of when the embryo or foetus should be regarded as a brother or sister for whom Christ died does not lend itself to precise answer. Only God knows. We must walk as responsibly as we can, praying for the guidance of the Holy Spirit in our uncertainty.

4. “A Conflict of Obligations” Revisited

The Tension between the Mandate to Heal and Absolute Views of the Embryo

66. We agree that human embryos are special because they are human life, but we disagree whether this is an absolute specialness that nothing can gainsay, or whether we recognise that there are other specialnesses which need to be taken into account. Is the embryo so special that no other considerations matter – even the potential to save life? As we noted above (paras 8-9), the 1996 report identified an important tension at this point in its section entitled “A Conflict of Obligations”. Having concluded the absolute position of the sanctity of the embryo from conception in its theological evaluation, it asks whether this should be applied regardless of human need and circumstance, especially in addressing childlessness and research into genetic diseases. This question is even more acute now that the prospects for embryo research include the whole area of regenerative medicine, as illustrated in our case studies. “In coming to an assessment of their obligations and responsibilities, Christians differ. Some will out of principle apply the norm without compromise.” (p.64)

67. In his book “The Soul of the Embryo” Catholic scholar David Albert Jones does not deny that diseases such as cystic fibrosis, Tay-Sachs disease, thalassaemia, sickle cell disease and Duchenne muscular dystrophy, can be dreadful and often place huge demands on individuals and families. In his view however, the cost of pursuing strategies of prevention and treatment that involve the taking of human life, albeit very early human life, is too high. Indeed, that is too calculating a way of expressing the matter. Boundaries that should not be crossed would be disregarded. Christians should not be party to acts tantamount to murder. No matter that natural wastage means many embryos fail to implant or grow beyond a small sphere of cells. The destiny of each person is hidden in God and, if Christ shared this life-form, it is worthy of the highest respect.

68. But others, who would assent to all that has been said about the absolute status of the embryo seems right, feel that other, equally right, principles are even more compelling. This leads them to conclude that IVF treatment and human embryo research may be acceptable in specific circumstances. The 1996 report reflected this, noting “Those who seek to reconcile both the ideals of the norm and the practical situation will inevitably live with tension, wondering whether they have allowed principle to be eroded by compassion.” (p.64)

69. Case studies 1 and 3 on the use of embryonic stem cells in research aiming to treat degenerative diseases such as Parkinson’s and diabetes, respectively, are examples of such an ethical tension. The Bible provides instances where Jesus made difficult choices which may provide guidance on this aspect of the stem cell debate. Keeping the Sabbath is listed alongside prohibiting murder and adultery in the Ten Commandments, but healing is not mentioned. Yet all four gos-
pels make significant mention of occasions when Jesus heals on the Sabbath. In Matthew’s account of the restoring of a withered hand the key issue was that it is lawful to do good on the Sabbath. (Matt.12:9-14). Healing was always a high priority for Jesus. Here he demonstrated that he gave the need to heal a higher priority than obedience of one of the Ten Commandments. This followed an earlier discussion of the appropriateness of picking grain for food on the Sabbath (Matt 12:1-8).

70. We would not conclude that this gives a mandate that the needs of healing always overrule the commandments. But Jesus clearly demonstrated that the moral high positions taken by the religious authorities of his day, whilst well-grounded in Old Testament theology and honed by centuries of hard debate about its applications in daily life, needed to be modified by the “law of love” when dealing with individual cases like lepers, prostitutes, tax-collectors, adulterers, and the sick.

71. Many who hold the “absolute” position do indeed maintain that to derive ES cells for research or therapy cannot be overruled by medical needs, because it would be a case of murder in respect of the embryo that was destroyed in the process. But for some Christians, the opportunity to find therapies for a range of incurable, degenerative diseases is sufficient to question the strength of principle in the absolute status of the embryo. If, however, one draws the conclusion that healing is even more important, to the extent of sacrificing some embryos for research, can one continue to hold the view that all conceptions are human persons? To allow embryo research would seem knowingly to be sanctioning taking the innocent life of someone one regards as a human person, and who cannot speak for themselves. It remains something of a paradox that the 1996 report maintained unanimity on the sanctity of the embryo yet some of its members sanctioned embryo research.

72. A second conclusion, might be a “lesser of evils” pragmatic position. This recognises that surplus human embryos exist in large numbers from IVF and PGD treatments, which will be destroyed, and so to use them for research into potential healing purposes before destruction is better than simply “binning” them.

73. For the majority of the working group, however, a more gradual view of the moral status of the embryo allows some embryo research. This now leads us to consider the acceptability or otherwise of a range of different applications of embryo stem cell research in the Chapter 5 (paras 5-37), together with the merits of alternative routes (38-56), the continuing need for firm regulation (57-61), and a postscript which reflects briefly on the global context (62-66).

74. In this context, a further question with significant theological implications arises. If one accepts some use of embryos in research, should embryos actually be created just for research? Would the degree of instrumentality towards the embryo be seen as breaching moral limits? The nub of the question is whether there is an ethical difference between creating and using embryos. It is widely accepted among Christians that human life is a gift of God, and that we are “begotten” not merely “made”.61 The making (and subsequent destruction) of embryos for research might be seen as careless of this truth, and therefore to be rejected, however worthy the human purposes for which the research was intended. Some would argue that accepting the use of embryos in research is already an acceptance of some instrumentality towards them; to create embryos for the purpose would not be radically different. This is a matter on which the working group was divided. We discuss this further below in paras 22-34 of Chapter 5.
Chapter 5
Applications of Stem Cell Research

1. Summary of the questions considered so far

1. We have considered the science of stem cells and some case studies of potential applications. We then examined the central theological question about the human embryo. At what stage should we ascribe the moral and theological status of human personhood to the developing human embryo and foetus - the beginning or at some later point? We have looked at various criteria against which we might make such a judgement, reviewing biblical, theological and biological evidence. Amongst these we have explored genetic completion, individuation, a certain level of functional development (described in various ways), and the establishment of relationship with the mother at implantation. We have reflected on when we might think our relationship with God and the image of God in humans have their beginning. We have also considered such issues as whether the many human embryos which fail in the first few days after conception have the same status as those few which go on to become babies.

2. We have recognised the diversity of view which exists in the working group on these matters, and which reflects similar differences in the wider church. We also examined the dilemma for some who take the absolute principled position about the embryo, of what to conclude about the imperative to heal. They feel a conflict of obligations over doing good, in whether to allow research which according to this view should be forbidden.

3. A minority of the group takes the absolute position which considers that the human embryo should be treated as a full human person from conception onwards and that in consequence, no research should be undertaken on human embryos which would not be to their immediate benefit or which would lead to their destruction. This leads to a strong objection to the provisions of the existing HFE Act which allows such research. Some would regard the use and subsequent destruction of embryos to extract stem cells as tantamount to sanctioning the murder of one human person in the hopes of saving the life of another, which therefore ought to be absolutely impermissible as a medical strategy. For those who take this position the only option open is to rely on research using stem cells derived from adult tissues or placental cord blood, and to accept any limitations that there might be from this restriction. All of the applications of embryo stem cell research considered below would be unacceptable.

4. A majority view of the working group consider that the moral status of the human embryo is not established until some time into its biological development after conception, variously represented by individuation, the primitive streak or implantation. They would not object in principle to allowing some research, and possibly some eventual therapy, which involves the destructive use of human embryos up to a maximum of 14 days. From the 1996 report we are also aware that some in the church who might wish to take the absolute view of the embryo may consider that the obligation to heal holds prior importance. The following discussion of the applications of embryo research in paragraphs 6-35, adult cell alternatives (paras 51-55) and regulation (paras 51-60) should therefore be taken to reflect the majority, but not all, of the working group. The section (paras 36-50) dealing with the parthenogenetic, animal-human hybrid and “disabled” embryos is broadly shared by the whole group.
2. Stem Cell and Related Issues considered in this section

5. Within this viewpoint, we now examine a series of questions about particular applications within the field of embryo stem cell research, as follows:

- For which medical purposes might embryo research be permitted?
- If research is permitted, what are acceptable sources of these embryos?
- May surplus embryos from IVF or PGD treatments be allowed for stem cell research?
- Should embryos be created by IVF methods just for use in stem cell research?
- Should embryos be created for use in stem cell therapies in future?
- Should embryos be created by cloning methods just for use in stem cell and other medical research?
- Should various ways to create non-viable human embryos be permissible as a source of stem cells for research, including parthenogenesis and animal-human hybrid cells?
- Should 8-cell embryos be used for stem cell research?
- Should research into adult and cord blood stem cells be pursued instead of embryo stem cell research, or as a parallel route?

6. We note in passing two potential applications which nuclear transfer cloning has potentially made more possible. These are genetic modification of the human germline and the transfer of the cytoplasm between fertilized human eggs to seek to avoid mitochondrial diseases. The working group has not so far had time to discuss the considerable ethical implications of these cases sufficiently to bring to the Assembly at this time. They were, however, addressed briefly in a submission from the Church and Society Council to the Government’s review of the legislation on reproductive technologies.  

7. We examine these issues in the light of the present state of knowledge in a relatively young area of research which is in a phase of rapid change and much uncertainty. Much is likely to change. Some of our ethical judgements are provisional according to what is known today. But others are less susceptible to change in the light of more knowledge.

3. Purposes for which Embryo Research may be Allowed

8. We are especially concerned that the Warnock Committee’s concept of the “special status” of the embryo is not lost with the growing pressure to increase embryo use from communities engaged in stem cell, nuclear transfer and related areas of research. We believe this concept remains as valid today as it was in the 1980’s, an expression of the moral dilemma felt by many that, while some research using embryos may be permitted for certain crucial medical reasons, we are still dealing with an entity which either already is or, under the right circumstances could become, a human person. We note that a Medical Research Council study revealed a greater reluctance to submit embryos for research among some people who have gone through IVF treatment. This is a valid indicator, from a group of people in a special position to be aware of the issues, that we are not just dealing with a mere “ball of cells”.

9. The purposes for which research using embryos may and may not legitimately be undertaken should, therefore, continue to be defined in law. Research should only be allowed by specific licence from the national regulatory body. The justification for embryo research should be on a “No research unless …” basis, not “Yes, provided …”. That is to say, say licenses for embryo research should be allowed, under specific, limited and peer-reviewed purposes.

- only on a case-by-case basis, and
only when the realistic benefit is of such significance that the destruction of embryos for the purpose might be considered a justified moral cost, and

that no realistic or practical near-term alternative to using human embryos exists, and that the potential for such alternatives has in every case been explored by the license applicant, and

that the desired research outcome is of great medical importance for the relief of human suffering, is realistic in its aims and timescale, and would be freely available, not just for wealthy individuals or societies, and

that consent procedures should be followed extremely carefully, with appropriate counselling, especially where, for example in some stem cell research, truly informed consent is difficult to give because the outcomes are inherently uncertain.

10. We fear that, particularly with stem cell research, human embryos could become regarded as mere research objects in a catalogue on which it is “open season” for scientists to research, provided that their objective falls within one of the allowed categories. We therefore stress that the fact that a license application is for a listed purpose is not itself an automatic justification. Each application should be justified as to why that particular experiment needs to be done.

4. Sources of Embryos

11. In its important review of the stem cell ethical issues in 2001, the EC Expert Group on Ethics in Science and the New Technologies (EGE) recognised important moral distinctions among the three sources of embryos, namely

- those surplus from IVF treatments,
- embryos created by IVF methods explicitly for stem cell research, and
- embryos created by nuclear transfer cloning methods explicitly for stem cell research.

12. These distinctions are reflected in differences among the legislations of EU countries. Most countries which have passed national legislation in this area allow either no research at all on embryos or only the use of surplus embryos in stem cell research. Most forbid the creation of embryos for such research. A few allow the creation of IVF embryos for research and two, the UK and Belgium, allow the creation of both IVF and cloned embryos for stem cell research, but have received strong criticism from the European Parliament for doing so.

i). Using Surplus Embryos

13. The normal source of embryo stem cells in laboratories across the world where research is being performed is from “surplus” embryos which are unwanted after IVF treatments. These are readily available in large quantities.

14. A practical disadvantage for possible therapies is that inevitably the cells derived from surplus embryos would by definition be of a different genetic type to the patient. This may lead to a risk of rejection by the patient’s body. To address this problem the currently favoured proposal is to set up a “bank” of stem cells from surplus IVF embryos of a wide range of genetic and tissue types. It is hoped this would give a good enough match to be able to treat most patients, possibly aided by some genetic modification of the cells to minimise rejection.

15. The EGE and most other authorities consider it is less ethically contentious to use surplus IVF embryos for research and for possible therapies, since these embryos are not now destined to produce children but to be destroyed. Most of the working group would agree with this as-
essment. Some Christians who would otherwise object to embryo research see this is an example of the ethical doctrine of “double effect” by which an act which they would consider wrong if done in itself – in this case creating an IVF embryo which would be destroyed in research - might be justified if it occurs as a by-product of another, well-intentioned act, namely creating an IVF embryo to try to have a baby.

16. This situation presents a problem for the combination of positions taken by the 2001 General Assembly. That Assembly opposed the use of spare IVF embryos for research or treatment other than that concerned with human reproduction. On the other hand, it considered that it may be acceptable to create and use cloned human embryos in medical research or treatment. For reasons discussed below in paras 29-34, it is now very uncertain whether cloned embryos would provide a reliable route for stem cell therapies in general use for the wide range of diseases for which they raised hopes, whereas spare IVF embryos are likely to remain the primary route for embryonic stem cell research and for eventual therapies. The 2001 Assembly’s position means in practice that the Church of Scotland in effect rules out support for most or possibly all likely future therapies involving embryonic stem cells.

17. The rationale of the Board of Social Responsibility’s 2001 report in rejecting the specific use of spare IVF embryos for stem cell research was that they were created and intended for reproduction. “If God intends human embryos as a means of human reproduction, we certainly go beyond God's intention if we use them for other purposes. The Board takes the stronger view that we go against God’s intention if we so use them …” On the other hand, it was considered acceptable to use cloned embryos because they were created expressly for stem cell research, and not for reproduction, i.e. to develop into human babies.

18. This has met with several major objections. It has been argued that it is presumptuous to state that we necessarily know God’s purpose for any particular embryo, especially since most fail to achieve their reproductive aim. Secondly, the 1996 report recognised the importance, for those who would permit embryo research, of research into genetically transmitted diseases and not just research into reproductive problems in infertility (p.64). Thirdly, in the case of surplus IVF embryos, the reproductive intention will be thwarted in any case, because they will certainly be destroyed even if they are not used for research. If what is deemed the original reproductive intention for these surplus IVF embryos is prevented, it would seem illogical, and perhaps uncharitable, to maintain that they cannot be used for stem cell research on the grounds that this is a purpose other than human reproduction. The majority of the working group therefore propose that the Assembly accepts that “surplus” embryos derived from IVF treatments may be used in stem cell research.

**ii). Embryos from Pre-implantation Genetic Diagnosis (PGD)**

19. A proposal has recently been made to use surplus embryos from Pre-implantation Genetic Diagnosis. A couple with a family history of serious genetic disease and who carry the relevant “defective” gene may wish to avoid having children with the disease. One option is to use IVF methods and then to have the embryos tested for the gene. Only embryos which do not carry the defective gene would be selected for implantation. The remainder would normally be destroyed. This is ethically controversial, because it involves the couple producing some embryos which they would intend to have destroyed. It is beyond the scope of this brief report to discuss the complex ethics of the PGD procedure, but it was felt appropriate to consider, in cases where PGD is used, whether the unwanted embryos should be allowed for used in stem cell research.
20. The primary reason for using unwanted PGD embryos is the suggestion by some scientists that they are generally of a higher quality than IVF embryos for producing stem cells. Stem cells are difficult to obtain and good embryo quality has been suggested as an important factor where successful stem cell “lines” have been established. Although a couple opting for PGD carry a serious genetic disease, the physiological quality of their embryos would generally be fairly normal. In contrast, IVF couples generally have difficulties in conceiving, some of which may be due to physiological problems in the embryos they produce. If one accepts the use of spare embryos from IVF treatment, it would seem logical also to accept the use of unwanted PGD embryos. In a therapeutic context, patients might be reluctant to accept cells ultimately produced from embryos which were known to have a serious genetic defect, even if this did not relate to their condition. The embryos most appropriate for therapeutic stem cell use would be those that were not defective but which were more than the couple wanted to have implanted.

21. There need to be very strict regimes to separate the professional staff involved with the PGD procedure from the research group that would use the embryos. The importance of this has been underlined by the recent malpractice of a Korean cloning research group which sourced donor eggs from its own researchers. It is especially vital to ensure that the number of embryos being produced are no more than that reasonably required for the PGD selection.

iii). Creation of Embryos and the Special Status of the Embryo

22. UK legislation permits the creation of embryos solely for research either by IVF methods or by nuclear transfer cloning. This was a matter on which the Warnock Committee were deeply divided. Its 1984 report rehearsed the conflicting arguments in some detail.63 Seven out of the sixteen members objected to making it legal to create embryos for research in two minority reports.64 It was also a matter of considerable objection by some MPs that they were not permitted to make this distinction in the free vote on amending the law to allow embryo stem cell research in 2000. As noted in para 12 above, many European legislations prohibit the creation of embryos for research.

23. If it is not just a cluster of cells, nor is it a full human being, the human embryo has a status all of its own. This unique status means it is not clear exactly what might be allowed to be done with embryos. Judgements have to be made, weighing the interventions and their intended purposes in the wider context of balancing the uncertainty of the possibility of destroying what could be a human life with the chance of saving real human lives. There are three relevant arguments.

24. One view sees it as wrong under any circumstances to cause to come into existence something with the potential to become a human person and then deliberately destroy it. Thus to create any human embryo solely for research is wrong, regardless of the purpose.

25. A second considers whether the type of manipulation done to the embryo is acceptable. This is exemplified in a submission made in October 1999 by the SRT Project and the Human Genetics working group of the Board of Social Responsibility to the Donaldson Committee.65 This drew an ethical distinction between types of uses of embryos in research. Up to that point, the purposes for which embryo research was allowed - like embryo development, the causes of infertility and genetic diseases - treated the embryo as a reproductive entity. Stem cell research for serious diseases, however, marked a new type of use in which de facto the embryo is regarded simply as a cellular resource from which to extract particular cells. This was seen as too instrumental towards an entity to which a special status had been assigned, as the philosophical basis
of the present UK legislation. While a measure of instrumentality was already admitted in embryo research, the submission argued that the proposed new use was significantly more instrumental. It called into question whether an embryo created simply to be a resource for cells could meaningfully be described as being accorded a special status.

26. The response to this point in the Donaldson Committee report expresses a third category of argument, namely that “specialness” could be seen in the uses to which the embryo was being put in stem cell research. The wider the range of people and disorders, the more the research may be ethically justified. Some argue that to produce cells to treat otherwise untreatable degenerative diseases is more justified than any previously allowed purpose. This view may be criticised because it frames specialness purely in terms of utilitarian value, which does not satisfy the question, if the means used were seen as an abuse of the ontology of the embryo.

27. A few of our working group embryos consider should never be created for stem cell research for the first or second reasons. It may be argued, however, that to reject the creation of embryos for stem cell research because it is too instrumental is not an absolute so much as a judgement of degree, weighing where the line of acceptability is crossed. For others in the group, therefore, a question arises whether this assessment of instrumentality is open to any variation in the light of particular exceptional purposes of research. Some of these felt reluctant to say “never”, being only too aware of the provisionality of our present knowledge about such a rapidly moving field of science and medicine. This is another example of the dilemma expressed earlier in this report about conflicts of obligations.

28. A small majority of the group consider that in very exceptional circumstances embryos might be created for research. By this we mean that in general creating embryos should not be allowed, but rare examples might be found where the consequences of absolute prohibition would be to fail to address a very particular example of human need. It is not sufficient merely to cite a good idea for pursuing interesting basic research. Some possible examples arise in the following section on cloned embryos.

iv). Cloned embryos

29. Cloned embryos were originally proposed as a way of potentially producing genetically matched replacement cells by creating a cloned embryo and thence stem cells from, say, a blood sample from the patient. This concept is known as “therapeutic” cloning to distinguish it from illegal “reproductive” cloning in which the embryo would be implanted to produce a baby. This whole area is now greatly uncertain after the exposure as fraud of the claims of Korean scientists to have made cloned embryos, and stem cell lines from them. These were said to present the proof of principle of creating genetically matched replacement cells, but this is not now the case.

30. Some of the working group would reject any use of cloned embryos in research for the same reason as the previous section, namely that it would involve creating embryos explicitly for research. This is, however, in contradiction to the position taken in the 2001 Assembly which justified their creation because there was no intention to use the embryos for reproduction. We do not agree with this position, which makes an implicit distinction between God’s intention for a cloned embryo compared with an embryo created by sperm and egg. This has no biological basis. Dolly the cloned sheep was a real sheep produced from a true embryo. The route of production does not change its ontological status as an embryo. The argument also found little support in bioethical circles, since most authorities consider that there is no basis to distinguish the mor-
al status of cloned embryos from those produced by sperm and egg on the basis of the intent to implant or not to implant.

31. Some of us agree with the House of Lords’ committee which concluded that it should only be an exceptional reason that justified the use of cloned embryos for stem cell research.\textsuperscript{67} We do not consider that research using cloned embryos should be licensed on the current premise of the claims for “therapeutic cloning” (genetically-matched cell replacement using cloned embryos as the source of the stem cell line). A number of leading experts in the field have expressed the opinion that it would never be practicable to apply therapeutic cloning to the wide range of diseases which it is claimed it could treat. This is because the number of potential UK patients alone runs into hundreds of thousands, each of whom would require several donated human eggs in an individual procedure geared to their own genetic type. This is unrealistic because it would depend on obtaining extremely large numbers (perhaps millions) of human eggs, using an invasive and sometimes painful procedure which is not free of risk. Altruistic donation of intimate tissues on this scale would be unprecedented. This and the large financial cost point to the likelihood that any such therapy would be available, at most, to a few fortunate patients suffering from a particular disease who can afford to pay. Yet the rhetoric used to justify this aspect of cloned embryo research has been on the basis that it would enable widespread therapies.

32. This is an example where a speculative area of embryo research is not justified because the claimed therapeutic intention is unrealistic. We would also caution against making judgements about today’s research into therapeutic cloning which presume upon the future availability of proposed alternative methods for obtaining human eggs from stem cells. These speculative methods are of uncertain feasibility and would themselves raise significant risks and some ethical concerns.

33. The creation of cloned embryos as a source of cells for studying terminal diseases for which no other source is envisaged (Case Study 4) might prove an allowable exception for some Christians. Were there to be other routes to the same cells, the justification would fall. It would be allowable not because it is the “best” method, but because it would be the only method. The same argument applies to research aimed at discovering the factors that might enable scientists to reverse adult cells routinely back to a totipotent state and eliminate the need for embryos to be used to make stem cells.

34. The possibility of creating human embryos raises one additional issue. To do research to create cloned embryos for some medical reason would also make it easier for someone irresponsible enough to attempt to implant a cloned embryo, to create a pregnancy, despite the enormous risks of creating deformed babies and the profound ethical objections. We do not see this in itself as a reason to oppose therapeutic uses of cloning, but it underlines the continuing importance of the 1997 Assembly’s call for a United Nations ban on reproductive human cloning. As noted in Chapter 2, a proposal in 2001 which had a very wide acceptance was nonetheless overruled because the USA and other countries wanted to extend the ban to include therapeutic and research uses. There was no prospect of this being agreed, so all that was passed was a non-binding recommendation to oppose all forms of human cloning, which has no legal force.

5. Creation of embryos for stem cells to treat serious diseases

35. Hitherto the discussion has concerned only using embryos to perform research. If research is successful and clinical treatments emerge utilizing ES cells, the question would arise whether embryos should be created specially for use in such treatments. While some might argue that the
point of allowing embryo stem cell research is frustrated if the final realisation in stem cell based therapies were not to be allowed, others contend that it would instrumentalise embryos too far if we were now to allow them to be created routinely for treatment. Again, to agree to this would have lost the sense of Warnock’s “special status” and de facto would imply that embryos are just balls of cells of no more moral worth than research mice in a catalogue.

36. The 2003 General Assembly said that a principal aim of both embryo and adult stem cell research should be to enable therapeutic routes which do not require embryos to be used. While it did not expressly decide against any therapeutic routes using embryos, it indicated that we should not prematurely embark on that route, until it has been established that no alternative route is reasonably likely using adult or placental stem cells or some other therapeutic method.

37. At this time it would, therefore, be quite premature to include in any new Act an article which expressly allowed for embryos to be created for the treatment of serious diseases. We suggest instead that provision should be made for this possibility to be addressed by a regulatory change, after extensive public consultation, to be decided one way or the other by a free Parliamentary vote.

6. Alternatives to Embryos to Derive Stem Cells

38. In response to the ethical objections and the current restrictions on federally funded embryo stem cell research, various US research groups have sought technical methods which they claim could overcome the basic ethical objection. Three of them would make embryos incapable of developing into a full pregnancy - by disabling the ability of an embryo to implant, by creating non-viable animal-human hybrid embryos, or by parthenogenesis. The fourth seeks to extract cells at a much earlier stage than normal, without harming the early embryo.

39. We suggest that the aim is somewhat misguided because technical fixes like these do not often solve ethical dilemmas. To be effective it is not sufficient for the scientists to think they have avoided the dilemma. The solutions have to satisfy those who strongly object to embryo research. For many of these, the viability of the embryo is not the only crucial issue. Fundamental principles of being are involved, as we have discussed in the previous chapter. It would seem highly unlikely that many of those who see the embryo as a human person would consider these options to solve the basic ethical problem.

i). Implantation-Disabled Embryos

40. In the first alternative, the Whitehead Institute for Biomedical Research has adapted the nuclear transfer cloning technique used in Dolly the sheep to create mouse embryos that cannot implant into the womb, and from which they extract embryonic stem cells. The scientists have genetically modified mouse cells to switch off a genetic signal which controls implantation and fused these cells with a mouse egg to create a non-viable embryo. If the embryo was never viable, it is suggested, here is a source of stem cells obtained without destroying a future life. Objectors to embryo research argue that it is unethical to genetically modify human cells to make an embryo non-viable because it involves engineering a disability into it which denies its potential to develop.

ii). Parthenogenesis
41. Parthenogenesis involves chemically inducing an egg that has been released from the ovaries to be “fertilised”. An early stage embryonic entity would be produced but with the entire genetic content supplied by the mother instead of half from the father and half from the mother. For reasons of biological development this could not be viable. The cells would die after a few divisions, but there may still be time to extract stem cells. This does not pose an ethical solution for several reasons. It is not clear in a parthenogenetic embryo if a person would ever have existed or whether it could also be considered as a sort of “tumour”. Those who take the absolute view would cite the precautionary principle to consider these embryos as human persons until further biological information is forthcoming. Secondly, as with the previous case, it would be unethical deliberately to create embryos whose very manner of creation inevitably made them too severely damaged to be viable.

42. On such a sensitive issue, it is of much concern that the HFEA has recently granted several licenses for research using parthenogenetic embryos without any form of public consultation or setting the matter before Parliament. The current legislation is anomalous in that, while animal-human hybrids are absolutely prohibited by law, parthenogenetic embryos are simply a matter for the HFEA to decide.

iii). Human-animal hybrid or chimera embryos for research

43. Similar objections apply to obtaining stem cells from other deliberately non-viable embryos by animal-human hybrids, but this also raises other issues. SRT’s report to the 2001 General Assembly explored this question along with various other issues at the human-animal interface involving genetic modification and xenotransplantation. The ethics of the admixture of the human and the animal at a fundamental cellular level are complex. SRT has argued that misgivings in this area are more than just a matter of unfamiliarity or the so-called “yuk reaction”, but are underlain by profound ethical issues.

44. Humans and animals, though holding many deep similarities, are nonetheless different in more than just the biological differences among species. In the Christian tradition (drawing on Hebrew scriptures) humans are believed to be uniquely created in God’s image and set apart from all other creatures spiritually, as the 1996 report also asserts, with a unique moral responsibility which animals do not share. While humans are given the task of caring for the animal kingdom as fellow creatures of God, animals are not seen as of equal status to humans. Inter-course between animals and humans is also expressly condemned. The admixture of the human and the animal at a fundamental cellular and developmental level would breach this distinction in a much more problematic way than xenotransplants, and should not be allowed.

45. We agree with the 2001 Assembly, which expressly opposed the creation of human-animal hybrid or chimeric embryos. We note that the 2000 Donaldson Committee also came to a similar conclusion and that the Government’s response at that time indicated its intention to bring forward primary legislation to ban it. We were surprised that the Commons Select Committee report on reproductive technologies should attempt to assert that because less human material would be involved there would be less ethical concerns than using human embryos. This is ethically simplistic, because it is not a matter of the degree of human atoms and molecules but of more basic ethical issues.

46. We therefore reject the suggestion that hybrid embryos, parthenotes and embryos that have been modified to make them non-viable would be an ethical solution to deriving stem cells from human embryos. Whatever the status of such creations, it would seem at least as unethical to use
methods that would create an “embryo” so deformed that it could not be viable and which therefore inherently denies its potential to develop.

iv). Stem Cells from 8-cell Embryos

47. The US company Advanced Cell Technologies claims to have derived embryonic stem cells from a single cell removed from an 8-cell mouse embryo. They have implanted the remaining seven cells in a female mouse womb and produced apparently normal pregnancies in about half the cases. Hitherto, stem cells have been taken from later stage embryos in a way which destroys their potential to develop any further. If the new method could be achieved with human early embryos, the researchers suggest that this provides a way to obtain embryo stem cells without destroying the embryo.

48. Some might object that it would still be too instrumental towards a future human baby to remove an eighth of its substance, not for its own sake, but for use as a medical resource for research or making cells for therapy. They might consider that the inherent human dignity of a real future human being was violated.

49. It also presents an almost insuperable practical problem. For this ethical argument to be valid, the researchers would be morally obliged on every occasion they did this procedure to implant the remaining seven cell embryo to make a baby. It is hard to imagine the circumstances under which this would happen. It seems unlikely that a fertile couple, instead of having normal intercourse, would choose to go through an IVF procedure to create a healthy embryo, because additionally they want to provide cells for some future therapy. They would know there is a substantial risk of losing their embryo if the procedure did not go well or if the seven cells did not re-implant successfully. The risks of the procedure itself are low, but not zero. It would also challenge the strict separation of research from treatment, which would not normally allow an embryo about to be implanted to create a pregnancy also to be used for research, or for a research embryo to be implanted.

50. An infertile couple seeking IVF would probably not want to risk their chance of having a baby, by adding an extra procedure to an IVF technique whose success rate is still low. The new procedure would use a method of cell extraction which also forms the basis for embryo selection by pre-implantation genetic diagnosis (PGD). However, the ethical claim of creating embryo stem cells without destroying embryos means the method could not be used in conjunction with any real PGD treatment, because by definition this method accepts the principle of destroying embryos that are regarded as defective.

51. It also raises some awkward questions about informed consent. What would an eighteen year-old think who discovered that while she was still an embryo, one of her cells was removed to create an “immortal” cell line for scientists to use in research or medical therapies?

v). Adult and Placental Cord Blood Stem Cells

52. For those for whom the use of any embryos to produce stem cells is ethically impermissible, the only sources of stem cells are from adult tissues or placental cord blood. These have the advantage over embryo stem cells that they could be of the same genetic type as the patient, and be
less liable to immune rejection. For some genetic diseases the presence of the defective gene in the replacement cells might present problems. The main disadvantages are that stem cells in adult tissues are quite rare, they cannot be multiplied in the laboratory, and their purpose is to regenerate only cells relevant to that particular part of the body.

53. As we discussed in chapters 2 and 3, some recent research suggests that certain cells from adult tissue may sometimes be induced to produce a much wider range of cells types than had been previously assumed. Some opponents of embryo research have put great stress on this and have claimed that it is not necessary to do embryo research because of the “facts emerging” about adult stem cells.

54. As with embryo stem cell research, however, the science is too new to make firm predictions about adult or cord blood stem cells. As we indicated in the case studies, it would be premature to claim that the full range of desired cell types for all degenerative diseases could be produced from adult or cord blood cells in sufficient numbers and quality. A priori, the case for adult cells would seem weaker than for embryonic stem cells. The latter must be capable of producing all cell types of the human body, by definition, whereas adult stem cells are not designed to do this. It is currently not clear if embryonic stem cells isolated in the laboratory are also capable of the producing the complete range of some 200 body cells. It is even less sure that adult or placental cord blood cells could be induced to do this. If it turned out that some cell types could only be produced using embryo stem cells, restricting research to adult or cord blood would mean that these diseases would presumably remain untreatable. Those opposed to the use of embryos would accept this limitation, maintaining that it is not acceptable to destroy some human lives in order to save other ones.

55. Adult cells are often difficult to obtain from a person. Placental cord blood is much easier to obtain. It would need to be removed at the time of birth and put into storage as a matter of routine, against the future possibility of being useful for the baby at some time in the distant future.

56. It is important ethically not to make exaggerated claims for the potential of any stem cell method or to raise premature expectations. On present evidence, many in the research community consider that important data are expected to come from both routes, and that different diseases may require different routes for producing the relevant replacement cells. Many researchers hope that adult cells may eventually be the preferred route to therapies, but consider that some of the knowledge necessary to achieve this could only become available from doing research on embryos or stem cells derived from them. If true, this would suggest the need to research all avenues in parallel until the situation was clarified.

7. Regulation of Embryo Research

57. We welcome the Government’s intention to re-examine legislation in this field. The Act is much respected and was ground-breaking legislation, but has remained controversial on issues such as embryo research, sex selection and stem cells. We have been concerned that the time was ripe to consider whether the 1990 HFE Act reflected public opinion and the considerable recent developments of thinking on ethical and societal issues on biotechnology.

58. We strongly agree that human reproductive technologies should remain within a firm and all-encompassing regulatory regime, which should be no less tight in both force and scope than has been the case since 1990. It should remain under the licensing authority of a strong independent regulatory authority, embracing both clinical and research practice, as is at present per-
formed by the HFEA. We are aware that pressures are being brought to bear on the Government to reduce the licensing powers, to deregulate research in these fields, or to liberalise the range of allowed practices. We have long been concerned at the situation in the USA where private sector embryo research and IVF clinics are essentially unregulated, and where individual states may adopt markedly different practices. Through SRT’s work in the international arena we have also had opportunity to see the high regard in which the HFE Act and its regulatory body are held internationally. While other countries may not agree with certain aspects that are allowed by the Act, many see the model itself as an excellent one and some have adapted it as a basis for their own legislations. There does not seem to be any widespread public sympathy for a relaxation of the HFE Act and its regulations.

59. We strongly urge that where the use of human embryos for research is allowed, it should only be done under very closely defined circumstances and subject to strict control of the regulatory authority. This should include stipulating that all eggs undergoing processes, or made subject to processes which could result in the creation of an embryo, should be subject to regulation, regardless of whether that embryo is capable of progressing to a viable pregnancy.

60. Parliament should have the capacity to examine new scientific developments without having to address the entire Act, but this power should be framed in such a way that it must consider first whether the procedure was ethical, as a pre-condition to assessing safety or clinical aspects.

61. We would be concerned if giving flexible powers to Parliament implied that the primary considerations were seen to be safety and clinical efficacy, which could be debated by Parliament if these were once assured, and not equally matters of ethics. Parliament’s powers must be such that ethical issues must be examined alongside safety and that both have to be acceptable.

8. Postscript : Stem Cells in a Global Context

62. In this report our main focus has been to present a Christian evaluation of the science, ethics and theology of stem cells. It is one of the most dramatic areas of development in biology and medicine and poses some of the most controversial issues in ethics. Successive Assemblies have acknowledged that Christians differ fundamentally about the status to be ascribed to the human embryo, and our working group is no different. In seeking to bring recommendations to this Assembly we are very aware that not all in our group agree with the position and some of the divergences. We all recognise as a group that differences would have been the outcome whatever positions we had adopted. Nonetheless, there are also issues on which we agree.

63. One of these is a wider question posed by current World Council of Churches discussions on bioethics. Why are we pursuing what to some looks like luxury research for the rich of industrial and developing countries, when so many more pressing medical problems exist? Diabetes in particular is becoming a disease of excess, linked to obesity. A less consumptive life style, better diet and more exercise may be more to the point than stem cell treatments. In other cases, genes and cell degeneration are no respecters of persons or privilege. The rich sick are just as sick as the poor sick, but the poor have less access to resources and less chances of treatments.

64. The group has focused primarily on the particular issues of the UK context on which far-reaching decisions are being made, month by month. The perspective of the kingdom of God and the ethics inspired by the incarnate, suffering and resurrected Christ need to be brought to the
questions of embryo research, as changes to the law are being considered and research trajectories are developed. It is important for the church to be present in the market place.

65. But we recognise that a priority of the gospel is the poor and those whom the way the world works leaves behind as the “have not’s”. This leaves us dissatisfied about the balance of funding priorities. This is of concern because as yet, the drive for stem cell research is primarily coming from the public sector, from Government and the scientific and medical communities. The gospel would prompt us to ask why there is not comparable enthusiasm in Government and EC funding and research council priorities for perhaps less glamorous but equally difficult scientific problems of malaria and HIV/AIDS as there is for stem cell research?

66. The commercial agendas of large companies are not a major factor because the science is still at a very uncertain stage, but these are likely to become influential at some stage. The reality is that to take a discovery through to clinical availability generally needs the sort of investment only the private sector can afford. We are not against commerce as such, but we are aware that the claimed benefits of GM food to “feed the world” were not matched by the reality in which the applications and research priorities were almost entirely aimed at western supermarkets. At some point in future, the ethical priorities for stem cell development will become an important question. We are also aware that other questions of ageing research, life extension, genetically tailored drugs are high on the Northern agenda, because there is money to be won, while most basic healthcare needs, which so many of the world’s population would welcome having, remain unmet because the research does not pay. The benefits of whatever treatments eventually emerge from stem cell research must be evaluated against this much bigger picture. In God’s economy, different issues make up the bottom line.
Proposed Deliverances for the
2006 Church of Scotland General Assembly
in the Report of the Church and Society Council

Stem Cell Research

The General Assembly:

17. Recognise the differences of view which exist within the Church on the moral status of the embryo and the acceptability of embryo research on stem cells, serious genetic diseases and infertility.

18. Strongly urge HMG not to weaken the provisions of the UK legislative framework on embryology, and to ensure that in any future legislation the concept of the special status of the human embryo be maintained and protected.

19. Urge HMG to ensure in any future legislation that embryo research is allowed only under a specific licence from a regulatory authority, on a strict case-by-case basis, only where there are significant expectations of the relief of human suffering, and for which no realistic research alternative exists.

20. Recognise that surplus human embryos arising from in vitro fertilisation or pre-implantation genetic diagnosis may be used in medical research with a view to eventual treatments involving stem cells, subject to the 14-day limit.

21. Oppose the deliberate creation of human embryos for research by IVF methods or nuclear transfer cloning methods, except into serious diseases and only under exceptional circumstances.

22. Oppose the creation and use of human embryos as a source of cells in the treatment of diseases, and urge HMG, in any revision of the Human Fertilisation and Embryology Act, not to include a legislative provision which would allow this.

23. Urge HMG to encourage research into stem cells derived from adult tissues and placental cord blood, and to work to find therapeutic solutions which avoid embryo use.

24. Oppose the creation for research or therapy of parthenogenetic human embryos, animal-human hybrid or chimeric embryos, or human embryos that have been deliberately made non-viable.

25. Call upon the stem cell research community to ensure a more rigorous peer review of stem cell research, and greater honesty in presenting the significance of its discoveries, aware of the harms caused among vulnerable patients by publicising premature or false expectations.

26. Commend this report to churches for study, encourage its wide distribution, and encourage the Society, Religion and Technology Project to continue its examination of contemporary issues in human genetics and embryology, and to bring a report to a future General Assembly.
References

8. Pre-conceived ideas, op cit., pp.54-60
9. Pre-conceived ideas, op cit., pp.60-62
13. See Appendix B.
21. The first UK human embryonic stem cell line was from a PGD embryo which carried a cystic fibrosis gene.
28. Church and Society Council (2005), op cit.
34. Useful websites for the diseases include:
30 We are mindful of some problems associated with the use of the term ‘absolute’ in this context and have considered alternatives such as “conservative”. We continue with its use in the absence of a better alternative and because it draws attention to the completeness of human beginning at fertilisation, compared with more gradual interpretations.


32 This is argued by the evangelical scholars John Bryant and John Searle, Life in Our Hands: A Christian Perspective on Genetics and Cloning (London: IVP, 2004).

33 Traditionally, the Church has recognised “tropological or moral readings” of the Bible as distinct from “literal” readings. The tropological or moral sense of Holy Scripture, says John Cassian, is “the moral explanation which has to do with improvement of life and practical teaching. John Cassian, Conferences http://www.newadvent.org/fathers/350814.htm Bk 14, Ch. VIII. For an authoritative account of biblical exegesis in the Patristic and Medieval Church, see Henri de Lubac, Medieval Exegesis. Vol. 1, The Four Senses of Scripture, transl.by Mark Sebanc (Edinburgh : T&T Clark, 1998).


39 Gregory of Nyssa, De anima et resurrectione, MPG 46, 125-8; De opificio hominis, 28-9.

40 Gregory of Nazianzus, Oraciones, 37.15: Cyril of Jerusalem, Catechises, 4.18f; Epiphanius, Anchoratus, 55; Cyril of Alexandria, In Johannem, 1.9.

41 Torrance, T.F. (1999), op. cit.


51 Preconceived Ideas, op. cit., pp.63-65

52 Jones (2004), op. cit.


54 Church and Society Council (2005), op. cit.


56 Department of Health (1984), op. cit, Expressions of Dissent B and C, pp.90-94

57 SRT Project and Board of Social Responsibility (1999), op. cit.

58 Department of Health (2000a), Stem Cell Research: Medical Progress with Responsibility, Re-port of the Chief Medical Officer’s Expert Group reviewing the potential of developments in stem cell research and cell nuclear replacement to benefit human health, Department of Health.

59 House of Lords (2002), Report of the Select Committee on Stem Cell Research
Appendix A

Membership of the Working Group
Rev Dr David Graham (Convenor; Minister of Dirleton)
Dr Donald Bruce (Secretary; Director, SRT Project)
Rev. Professor David Atkinson (Curate Aberdeen Episcopal Cathedral, Former Vice-Principal, Scottish Agricultural College)
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Appendix B

Relevant Agreed Deliverances
of previous Church of Scotland General Assemblies

Deliverances

General Assembly 2004 : Board of National Mission, Supplementary Report, Society, Religion and Technology Project
1. Remit the issue of human embryology and stem cells to further study with the Church and Society Network, in the light of recent scientific and medical developments and for a report to be made to the General Assembly of 2005.

2. Urge HM Government to encourage research into stem cells derived from adult tissues and placental cord blood in parallel with embryonic stem cell research, and to work to find therapeutic solutions which as far as possible avoid embryo use.

General Assembly 2002 : Board of National Mission, Society, Religion and Technology Project
3. Call upon HMG to ensure that animal-human hybrid nuclear transfer is explicitly forbidden in law.
General Assembly 2002 : Board of Social Responsibility
5. Urge HM Government that sex selection by sperm sorting:
   a). be brought under the regulatory control of the Human Fertilisation and Embryology Authority, and
   b). be made illegal except where serious hereditary gender-related disease is to be avoided, in accordance with the European Convention on Human Rights and Biomedicine, article 14

General Assembly 2001 : Board of Social Responsibility
1. Agree the Board’s approach to Human Genetics as follows:
   (i). Endorse stem-cell research in general, and medical treatment using stem cells derived from the patient concerned or from a consenting donor.
   (ii). Affirm that IVF treatment may be appropriate treatment for some couples.
   (iii). Recognise that since God intended human embryos as a means to the end of human reproduction, it may, therefore, be right to use a human embryo in IVF research.
   (iv). Given that the law allows research on human embryos, welcome the limitation of research to 14 days, and oppose any extension of that limit.
   (v). Oppose the use of embryos created from human sperm and ova in medical research or treatment, other than that concerned with human reproduction.
   (vi). Recognise that human embryos created by cell nuclear transfer may be used in medical research and therapy, subject to the 14-day limit.
   (vii). Recognise that while it may be acceptable to pursue therapeutic cloning, we affirm opposition to human reproductive cloning.
   (viii). Should any babies in future be born from human cell nuclear transfer embryos, we affirm they will be fully human, made in the image of God, answerable to God according to their abilities, and our "neighbours" whom God commands us to love.
   (ix) Welcome research into alternatives to the use of human embryos in medical research or treatment.

General Assembly 2001 : Board of National Mission, Society, Religion and Technology Project
8. Oppose the use of nuclear transfer to create hybrid human-animal embryos.

General Assembly 1999 : Board of National Mission, Society, Religion and Technology Project
39. Commend SRT's prominent work in the media and national and international debate in response to human and animal cloning issues, and urge HM Government to exercise caution on the cloning of animals, while welfare and related uncertainties are addressed.

General Assembly 1997 : Board of National Mission Supplementary Report, Society, Religion and Technology Project
1. Commend the principle of the production of proteins of therapeutic value in the milk of genetically modified sheep and other farm animals, but oppose, and urge Her Majesty's Government to take necessary steps to prevent, the application of animal cloning as a routine procedure in meat and milk production, as an unacceptable commodification of animals.
2. Reaffirm their belief in the basic dignity and uniqueness of each human being under God. Express the strongest possible opposition to the cloning of human beings and urge Her Majesty's Government to press for a comprehensive international treaty to ban it worldwide.

General Assembly 1996 : Board of Social Responsibility
9.1 Congratulate the Board on the production of the Report on Human Fertilisation and Embryology and commend it to the Church for study, and encourage its wide distribution, in particular to Scottish Health Boards, their ethical Committees, Local Health Councils, and all our Medical Schools;

9.2 Affirm that the justification of the profession of medicine is the promotion of physical, mental, social and spiritual wellbeing;

9.3 Note in particular the complexity of the subject matter and the continuing monitoring of developments in the field of infertility;

9.4 Affirm the sanctity of the embryo from conception, and urge that its special nature be recognised in law;

9.5 Given that the law allows research on human embryos, welcome the limitation of research to fourteen days, and oppose any extension of that limit;

9.6 Recognise the differences of view which exist on the ethical acceptability of in vitro fertilisation (IVF) and embryo research;

9.7 Recognise that the IVF treatment may be right for married couples and, while not equating cohabitation with marriage, for unmarried couples in faithful, stable, lasting relationships, where gametes used are those of the partners;

9.8 Oppose donor insemination and IVF treatment where either the sperm or the egg are donated;

9.9 Oppose the offer of infertility treatment to those in same sex relationships;

9.10 Oppose surrogacy;

9.11 Oppose sex selection, except to prevent sex linked genetic disease;

9.12 Encourage the Church to provide counselling services for childless couples to compliment that provided by infertility clinics.

**General Assembly 1985 : Board of Social Responsibility**

23. Receive with interest the comments of the Board on the Report of the Committee of Inquiry into Human Fertilisation and Embryology (the Warnock report) regretting the failure of the report to give adequate consideration to the moral questions raised by the various medical solutions offered to couples facing the problems of infertility and childlessness.

24. Note the Board’s acceptance of AIH (artificial insemination by husband) and in vitro fertilisation (IVF) and support the Board’s rejection of AID (artificial insemination by anonymous donor), egg donation, embryo donation and surrogacy, which are incompatible with the Christian concept of marriage.

25. Welcome the recommendation that counseling should be available to all infertile couples and third parties at any stage of treatment for infertility.

26. Reject all non-therapeutic embryo experimentation as being contrary to the Christian belief in the sanctity of life.

27. Commend to the Church the continuing study of moral issues raised by the directions currently being taken by medical science in the area of human reproduction.

**Relevant General Assembly Reports**


Appendix C

Church of Scotland Engagement on Stem Cells & Cloning

In addition to the various reports to the General Assembly, the Church of Scotland has played a leading role in the wider debate on cloning, stem cells and related areas of research. SRT in particular has made a unique contribution on behalf of the Church through its engagement with scientists at the Roslin Institute and major centres of research, with the ethical and social science community, regulators, Government and international bodies. This has included important work with the Bioethics Working Group of the Conference of European Churches. It has been invited to make presentations on stem cell and cloning issues to Westminster MPs, the European Commission’s Ethical Group on Technology and the New Sciences, to various EC conferences on stem cells, the Human Genetics group of the European Parliament, and to United Nations delegates. It has several times been an official observer to meetings of the Bioethics Committee of the Council of Europe (CDBI) and the International Bioethics Committee of UNESCO. It has been prominent in the media with numerous broadcasts and articles, including appearances on BBC’s Newsnight programme on cloning issues. SRT’s website is widely cited as a source of informed opinion. SRT recently wrote the ethical section of a public booklet on stem cells for the Biotechnology Research Council.

The Board of Social Responsibility was also active in a series of publications based on its Assembly reports and special conferences on human genetics and related issues with prominent experts in genetics, law, ethics and theology. Its responsibilities in this area were transferred to the Church and Society Council from 2005.

Appendix D

Glossary of terms
Sources
A: Barfoot, Jan; Mauelshagen, Craig; Bruce, Donald; Henderson, Catherine and Bownes, Mary (eds.) (2005), *Stem Cells. Science and ethics*. 2nd Ed., Biotechnology and Biological Sciences Research Council and Scottish Institute for Biotechnology Education, Edinburgh.
B: Pre-conceived Ideas, op cit.
Some of the remaining definitions have been adapted from Wikipedia, http://en.wikipedia.org

**Allograft**
A transplant from one individual to another (but not an identical twin).

**Allogenic**
With a different set of genes.

**Autosomal**
Any chromosome other than sex chromosomes.

**Aplastic Anaemia**
Bone marrow failure resulting in bone marrow not producing blood cells.

**Autoimmune**
When the body forms antigens to its own antibodies, causing the immune system to attack the body's own tissues, as for example in type1 diabetes and multiple sclerosis

**Autologous**
Patient donating his or her own blood for use later.

**Blastocyst**
A ball of around 250 cells formed about five days after fertilisation. (A)

**Cardiomyocytes**
Precursors to heart muscle cells.

**Clones**
A group of genetically identical cells or organisms derived from a common ancestor. (B)

**Cell nuclear replacement (CNR)**
The nucleus of an egg cell is removed and replaced with the nucleus of another cell, which can be a germ cell or a somatic cell. (A)

**Chromosome**
Within cells the DNA is packaged into chromosomes. (A)

**Cytoplasm**
The material inside a cell, surrounding the nucleus

**Differentiation**
The process through which cells become specialised to perform certain tasks. (A)

**DNA**
Abbreviation for deoxyribonucleic acid, which makes up genes. (A)

**Dyskinesia**
Abnormality of movement.

**Embryo**
An embryo is an organism in its early stages of development prior to birth. In humans, the embryo is the developing child from conception to the end of the second month of pregnancy.

**Embryonic stem cells (ES cells)**
Stem cells from the inner cell mass of the blastocyst which will go on to produce every cell in the adult human body. (A)

**Endothelial cells**
The endothelium is the layer of thin, flat cells that lines the interior surface of blood vessels, forming an interface between circulating blood in the lumen and the rest of the vessel wall. Endothelial cells line the entire circulatory system, from the heart to the smallest capillary.

**Engraft**
Causes the organs from different people (or sources) to grow together.

**Foetus**
An unborn human offspring from the end of the eighth week of pregnancy (when the major structures have formed) until birth.

**Gene**
A functional unit of heredity, which is a segment of DNA, located at a specific site on a chromosome. A gene often directs the formation of an enzyme or other proteins. (A)

**Haematopoietic cells**
Tissue stem cells from blood or bone marrow which can proliferate and differentiate into all blood cell types. (A)

**Hepatocytes**
Precursors to liver cells.

**HLA**
Human Leukocyte Antigen system. A group of genes that encode proteins on the outer part of the body’s cells that are effectively unique to that person. The immune system uses the HLA types to differentiate self from non-self. Any cell displaying that person’s HLA type belongs to that person (i.e. is not an invader). Any cell displaying some other HLA type is “non-self” and is an invader. HLA types are inherited.

**Implantation**
When the embryo gets embedded in the mother’s uterus.

**In vitro**
In the laboratory.

**In vivo**
In the live body.

**In vitro fertilisation (IVF)**
The sperm fertilises the egg in a laboratory to create embryos, one or more of which are then placed into the womb, hopefully to develop into a normal pregnancy. (A)

**Multipotent cells**
Stem cells able to give rise to a subset of fully differentiated cells. (A)

**Mutation**
In biology, mutations are changes to the genetic material. Mutations can be caused by copying errors in the genetic material during cell division and by exposure to radiation, chemicals or viruses.

**Neurons**
Cells of the nervous system. Neurons come in many different shapes and sizes and are found in the brain, spinal cord and peripheral nervous system.

**Neurotransmitter**
Chemicals that are used to relay electrical signals between a neuron and another cell.

**Nucleus**
The inner part of a part of a cell which contains most of its genetic material. Nuclei have two primary functions: to control chemical reactions within the cytoplasm and to store information needed for cellular division.

**Parthenogenesis**
The activation of an egg, using only the female genetic component, without the involvement of sperm, to start development.

**Plasticity**
A measure of the extent to which a stem cell can form different types of differentiated cells. (A)

**Pluripotent cells**
Capable of giving rise to all the cell types of a mature organism, but not able to support development into an embryo. (A)

**Polymorphism**
In genetics, this is a gene that can exist in several different forms, which may be reflected in physical differences. An example would be the ABO blood group in humans.

**Pre-implantation genetic diagnosis (PGD)**
The genetic testing of embryos produced by IVF to select embryos which possess a certain genetic make up. This is usually done where either or both of the potential father or mother carry a disease-causing gene or genes. By electing to implant only appropriate embryos, the couple wish to avoid producing a baby which carries that gene. (Adapted from A)

**Progenitor cell**
A cell derived from a stem cell, that has already started to differentiate into a specific cell type but has not yet fully-differentiated. Unlike stem cells, progenitor cells cannot renew themselves.

**Primitive Streak**
The first change in appearance of the embryo from simply being a round ball. The streak will develop into the central nervous system. (C)

**Somatic cell**
Cells of the body other than the germ line (e.g. sperm and egg) cells. (A)

**Stem cells**
Unspecialised cells which can divide to give exact copies of themselves and can also give rise to one or more specialised cell types.

**Striatum**
A part of the brain.

**Superoxide dismutase**
An antioxidant enzyme.

**Totipotent cells**
Cells which possess the ability to develop into an embryo which can then develop into a complete organism (including generation of a placenta). (A)

**Zygote**
A cell created when an egg and sperm fuse. (A)

**Xenotransplant**
Animal to human transplant.

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**Appendix E**

**Selected Bibliography**
Barfoot, Jan; Mauelshagen, Craig; Bruce, Donald; Henderson, Catherine and Bownes, Mary (eds.) (2005), *Stem Cells. Science and ethics. 2nd Ed.*, Biotechnology and Biological Sciences Research Council and Scottish Institute for Biotechnology Education, Edinburgh.


**Other Useful Sources of Christian Reflection on these issues**

**Christian Medical Fellowship**
CMF ethics publications, include several reviews of human embryology and linked research :
- Artificial reproduction (1999)
- What is a person? (2000)
- Therapeutic cloning and stem cells (2000)
- Reproductive cloning (2002)
- Sex selection (2003)
- Neo-natal ethics (2004)
- Saviour siblings (2005)

[http://www.cmf.org.uk](http://www.cmf.org.uk)

**Conference of European Churches’ Church and Society Commission**
The CEC working group on Bioethics and Biotechnology has produced a series of papers on human and non-human biotechnology including :
- Cloning animals and humans (1998)
- Therapeutic uses of cloning and embryonic stem cells (2000)

[http://www.cec-kek.org/English/cs.htm](http://www.cec-kek.org/English/cs.htm)

**Society Religion and Technology Project, Church of Scotland**
The SRT Project website has numerous articles on cloning, stem cells, human and non-human genetics, and related issues. This website also contains the text of most of the General Assembly reports referenced in this report.

http://www.srtp.org.uk