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STEM CELL RESEARCH IN NORWAY VIS-À-VIS THE UNITED STATES OF AMERICA AND IRAN

Nashmil Ghafur Saleh

Lasse Svenkerud Aasgaard

Ane Sofie Viset Fremstedal

Silje Mathisen

Kjersti Normann

Dominic Sagoe

PREFACE

This is a project report presented for the course TBT4850 Experts in Team, spring 2011 at NTNU. The Experts in Team village was “Stem Cells Studies” and the leader of the village Oleksandr Dykyy. Teaching assistants were Nora Helen Lund Lyngra and Henrik Fliflet.

Silje Mathisen Lasse Svenkerud Aasgaard Kjersti R. Normann

Ane Sofie Fremstedal Dominic Sagoe Nashmil Ghafur Saleh

Date: Place:

ABSTRACT

This report investigates the state of stem cell research (SCR) in Norway alongside the state of SCR in the United States of America and Iran thus providing a wider perspective of Norway's position in the international SCR arena. Extensive literature on the subject was reviewed; a survey was conducted on the attitudes of Norwegian students towards SCR and Norwegian experts involved in SCR interviewed. It was found that the main reasons why SCR has not reached an internationally-competitive level in Norway is due to the lack of political will and the huge financial resources required for SCR. The main reasons for the lack of political will are some degree of anti-academic attitude identified amongst the Norwegian population especially in the districts, the Norwegian State Church's vigorous opposition to SCR, as well as the immense human and material resources the oil industry claims. To advance SCR in Norway, it is important that financial resources are invested into it. Additionally, the attitudes of Norwegians towards SCR especially that of the students and youth who constitute the future generation must be improved. In pursuit of this goal, Trivial Pursuit: Stem Cells Edition, a game has been invented to enhance the knowledge and attitudes of Norwegian youth and the general Norwegian population towards SCR. Furthermore, it is crucial that the five year SCR program started in 2008 is given adequate funding after the program is ended in 2012.

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CHAPTER ONE

INTRODUCTION

For several centuries, scientists have known that humans and certain animals can regenerate some parts of their bodies. However, the identity of the powerful cells that allow humans to regenerate some tissues was first revealed when experiments with bone marrow in the 1950s established the existence of stem cells in the human body. For the first time in history, it became feasible for physicians to regenerate a damaged tissue with a new supply of healthy cells by drawing on the unique ability of stem cells to create many of the body's specialized cell types.

Scientists were able to extract embryonic stem cells from mice in the 1980s, but it wasn't until 1998 that a team of scientists from the University of Wisconsin–Madison became the first group to isolate human embryonic stem cells and keep them alive in the laboratory (The National Academies, 2005). Researchers are currently striving to produce therapies that rebuild or replace damaged cells with tissues grown from stem cells. This presents hope to people suffering from spinal-cord injuries, cancer, cardiovascular diseases, diabetes, and many other disorders. Both adult and embryonic stem cells may also provide a route for scientists to develop valuable new methods of drug discovery and testing. They are also powerful tools for doing the research that leads to a better understanding of the basic biology of the human body (The National Academies, 2005).

This report examines the state of stem cell research (SCR) in Norway as compared to the United States of America and Iran. Additionally, it discusses some lessons Norway can learn from these countries which are comparatively more advanced in SCR. Furthermore, it discusses how SCR in Norway can be advanced.

1.1 Properties and types of stem cells

Stem cells have the capacity to give rise to lineages of differentiated cells, and they are self-renewing. If stem cells are classified according to their descent and developmental potential, four levels of stem cells can be recognized: totipotent, pluripotent, multipotent and unipotent (Goldsby et al., 2007). *Totipotent cells* can give rise to an entire organism. A fertilized egg, the zygote, is a totipotent cell. *Pluripotent cells* also known as embryonic stem cells, or simply ES cells arise from totipotent cells and can give rise to most, but not all of the cell types necessary for fetal development. For example, human pluripotent stem cells can give rise to all of the cells in the body, but cannot generate a placenta. Further differentiation of

pluripotent stem cells leads to the formation of multipotent and unipotent stem cells. *Multipotent cells* can give rise to only a limited number of cell types. An example of a multipotent cell is hematopoietic cells which can give rise to all the blood cell types including myeloid and lymphoid lineages. *Unipotent cells* on the other hand can generate only the same cell type as themselves (Goldsby et al., 2007).

1.2 Current trends in SCR

Currently, there are two main ways of utilizing stem cells. One way is to cultivate embryonic stem cells which are pluripotent and try to differentiate them into the kind of cells which are needed. The other way is to reprogram or induce pluripotency in differentiated cells (Mummery et al., 2010). A number of well-characterized human embryonic stem cell lines are currently available and research groups in several countries have been deriving new cell lines under conditions compatible with clinical use. Much research effort has however been focused on finding the factors and conditions that can guide differentiation of human embryonic stem cells in a particular direction so that they could be used for cell replacement therapy (Mummery et al., 2010).

In countries where embryonic SCR is banned or very limited, research into other sources of stem cells has benefited since government support for those types of research has often been expanded as compensation. In these contexts, adult stem cells like multipotent stem cells have been used for research. However, how promising the potential of human embryonic stem cells for therapy might seem, ethical reservations associated with the use of embryos has launched the search after alternative sources of pluripotent cells (Mummery et al., 2010). Currently stem cell researchers have been trying to find alternative methods to reprogram adult cells to pluripotent stem cells, eliminating the need for retroviruses or other methods causing integration of foreign DNA into the genome of the cell because these methods have many disadvantages (Mummery et al., 2010).

1.3 SCR in Norway

1.3.1 History and legislation

In 1987, a law was passed in Norway that prohibited research on fertilized human eggs (Nordforsk, 2007). Since then, SCR in Norway has been controlled by the biotechnology law, and the biotechnology committee set up in 1991. This committee is charged with the responsibility of discussing the principal and general aspects concerning use of biotechnology, including the social and ethical questions that are associated with this branch of science (Bioteknologinemda, 2000).

The ban from 1987 was kept when the biotechnology act concerning the medical use of biotechnology on humans was passed in 1994. In 2000, the biotechnology committee issued a consultative statement concerning a report regarding the use of stem cells from surplus fertilized eggs and aborted fetuses to the Social and Health Department of Norway (Bioteknologinemda, 2000). The majority of the committee supported the contents of the report expressing that it could be ethically justifiable under certain specified circumstances to use surplus fertilized eggs and aborted fetuses in establishing pluripotent stem cell lineages that could be utilized in medical research. A minority within the committee did not support the contents of the report. They argued that knowledge amongst the general public on this subject might over time influence people's attitude towards abortion and act as an extenuating factor in the choice of induced/provoked abortion, and that this also might influence the choice of the method used to induce abortion. Another segment within the minority emphasized recent literature at the time, regarding research on multi- and pluripotent stem cells derived from somatic cells showing promising results.

The results of this hearing was that in 2003, a total ban on research on embryonic stem cell lines developed from fertilized eggs was adopted. This legislative amendment also included a ban prohibiting research on hybrid organisms and therapeutic cloning, for which there was unanimous support of within the committee. In January 2008, this amendment was mitigated, opening the door for the possibility to do research on surplus fertilized eggs. This revision followed a hearing where the majority of the biotechnology committee once again supported the use of surplus fertilized eggs in research arguing that the eggs would otherwise be destroyed, and that the research could contribute to future treatment of severe human diseases. They also emphasized that clear ethical guidelines should be set in place deciding what research could be done (Bioteknologinemda, 2006).

As the Norwegian biotechnology law stands today, use of redundant fertilized eggs for SCR is allowed when the purpose of the research is to "achieve new knowledge that takes aim at future treatment of serious human diseases". Research is allowed until fourteen days after the egg is fertilized. Before such research is allowed it must be approved by the Regional Committee for Medical and Health Research (Warberg, 1996).

1.3.2 Politics and public opinion

The Norwegian state church influences politics through a political party called Kristelig Folkeparti (KrF), which translates into Christian Peoples Party. KrF has been active in the political debate concerning SCR. Their opinion is that a child should not be a means towards

achieving a goal, but a goal in itself.

According to Bioteknologinemda (2001), a conference concerning SCR was held in Norway in 2001. In this conference a panel of 15 people with no strong prior connection to the field was selected from a group of 110 people who volunteered. These people where presented to the subject of stem cells through two weekend seminars, self study and dialog with experts. The goal of the conference was to give advice to the political authority. Participants concluded that they were open for the use of both aborted fetuses and fertilized eggs left over from IVF in research, and the use of stem cells derived from this research in clinical therapy and medical treatment. They reasoned that these cells would otherwise be destroyed. The group also agreed that using fetuses for the sole purpose of research, therapeutic cloning, and reproductive cloning should not be allowed. Their reason was that this would not be compatible with their ethical views.

In 2010, Perduco carried out a comprehensive study concerning the biotechnology law in Norway (Perduco, 2010). In this survey 1,013 respondents from the general public answered an online questionnaire concerning the biotechnology law. While it was found from this study that there is a relative large agreement amongst Norwegians that SCR has the potential to lead to a positive development, Norwegians also agree that there are considerable ethical issues connected to this research. A total of 85% of Norwegians surveyed agreed completely or partially that SCR should be subject to strict rules. Respondents were however suspicious of the government setting the right ethical limits on SCR.

The European Commission for Public Opinion biennially conducts a survey known as the Eurobarometer. Norway has on and off been included in these surveys, depending on its relationship to the European Union. In the period 1999 to 2002, these surveys show Norwegians who were previously skeptical, becoming more and more optimistic towards SCR. There is then a period where Norway is not included in the surveys, but in 2010 it shows that Norwegians are among the most optimistic about SCR in the European Union (The European Commission, 2010).

1.3.3 Current research

Research on stem cells in Norway is not much advanced compared to the leading nations, and also compared to its neighbors in Scandinavia (Nordforsk, 2007). There has however been considerable work done on cancer stem cells with the aim of producing new therapeutic

approaches to treat human cancer at the Cancer Stem Cell Innovation Center (CAST) in Oslo. One area where Norway has especially been active is within the field of blood stem cells where much work has been done at Rikshospitalet and Radiumhospitalet in Oslo. In 2008, the Norwegian Research Council started a five year program for SCR which led to the establishment of a Norwegian Center for SCR (NCS). The programs had a budget of 47.3 million NOK in 2009 (Forskningsrådet, 2009). Its prioritized goals are to better the understanding of the basic processes associated with growth and differentiation of stem cells, to create cell lines that can be used therapeutically, to develop protocols for repair of damaged tissue and organs, and the use of stem cells in the development and testing of new medicine and toxicological screening. The center is part of Oslo University Hospital and works in close cooperation with CAST. Within basic and preclinical research, their main areas of focus are mesenchymal stem cells (multipotent stem cells derived embryonic connective tissue), ocular stem cells, neural stem cells and tumor stem cells (Forskningsrådet, 2009). Several clinical trials are currently in progress. Two current promising trials include one on stem cells for replacement of hyaline cartilage (a collaboration between Jan Brinchmann and Lars Engebretsen) and one on stem cells for corneal replacement (a collaboration between Morten Moe, Liv Drolsum and Bjørn Nicolaissen) (Forskningsrådet, 2009).

Recently, several organizations have been established that finance a number of projects related to SCR. NordForsk with their mobility program within SCR is an example of such an organization which finances some Norwegian researchers. Nordforsk works within the entire Nordic region. The largest source of research funds is the European Union's frame financing for research. Norway can apply for this funding, even though it is not part of the EU. Due to the Vatican’s strong influence, and its opposition to embryonic SCR (Nordforsk, 2007), small amounts of funding is allocated to embryonic SCR. Financing of ESHRE's work in establishing a bank for well characterized stem cells is most noteworthy amongst EU's contributions.

1.4 SCR in the United States of America

1.4.1 History, public opinion and legislation

In the United States, the history of stem cells has been closely tied to the abortion debate (Wertz, 2002). Starting in 1973, shortly after the Supreme Court’s Roe versus Wade decision, which legalized abortions, the US government banned the use of federal funds for research on embryos, fetuses, and embryonic or fetal tissue because Congress feared this would

encourage women to have abortions (Fletcher, 2000). However, on 9th August, 2001 President George W. Bush permitted National Institutes of Health (NIH) funding for SCR, setting a historical precedent that made bioethics a national priority (Wertz, 2002). However, embryos left over after in vitro fertilisation (IVF) were to be the sole source of cells for research. While many criticized President Bush's policy as too restrictive (Rewerski, 2007), it was a significant step forward as it marked the first time any U.S. federal funds were ever spent on SCR (Hall, 2009).

On March 9, 2009, President Obama revoked this presidential limit, announcing that the Department of Health and Human Services (DHHS), through the NIH, *"may support and conduct responsible, scientifically worthy human SCR, including human embryonic SCR, to the extent permitted by law"* (Executive Order 13505, 2009). Notwithstanding this progress, federal support of SCR in the United States is not necessarily as progressive as it may first appear.

First, SCR operates within a highly decentralized setting with a mix of public and private regulation. These regulations allow federal funding only on stem cells that are derived from human embryos created for reproductive purposes, no longer needed for that purpose, and donated for research (National Research Council, 2005). Additionally, the guidelines impose rigorous eligibility standards requiring stringent informed consent mechanisms for embryo donors (Charo, 2009). While this system is a significant improvement, the strict eligibility standards may rule out research on stem cell lines approved even under the Bush administration (Wertz, 2002).

Second, the United States has a number of independent non-profit organizations made up primarily of medical professionals that conduct research, advance knowledge, and promulgate guidelines for physicians' practice in areas involving reproductive medicine (American Society for Reproductive Medicine, 2010). However, these bodies are purely self-regulated, affecting only physicians and researchers that wish to be members or follow their guidelines (Simpson et al., 2006). Thus, their influence is restricted "due to the groups' limited ability to monitor and enforce compliance rules" (Rewerski, 2007).

Furthermore, states are free to create their own legislation and regulation for state funding (Rewerski, 2007) within the limited confines of the patchwork federal rules (Johnson, 2004). State legislation and regulations vary considerably, ranging from Louisiana's strict ban on intentional use and destruction of embryos under any circumstances (Newhart, 2004) to

South Dakota's prohibition on all "nontherapeutic research that destroys a human embryo" (Rewerski, 2007).

1.4.2 Current research

In 2010, two U.S companies broke new ground by winning regulatory approval to start the first experiments using embryonic stem cells on humans suffering from spinal cord injury and blindness. The potent but hotly debated cells can transform into nearly any cell in the human body, opening a path toward eliminating such ills as Parkinson's disease, paralysis, diabetes, heart disease, and maybe even the ravages of aging. Advanced Cell Technology was also cleared in November 2010 by the US Food and Drug Administration to begin testing a therapy derived from embryonic stem cells to treat a rare form of blindness that strikes in childhood, known as Stargardt's disease. In addition, a Harvard University scientist, Derrick Rossi, discovered a way to avoid risky genetic modification and instead use RNA molecules to reprogram adult human cells into pluripotent cells without altering the DNA. Apart from these efforts, transplants of adult stem cells have become a standard lifesaving therapy for perhaps hundreds of thousands of people with leukemia, lymphoma and other blood diseases in the U.S (Ritter, 2010). In multiple sclerosis, Dr. Jeffrey Cohen of the Cleveland Clinic is trying a different and less-researched approach using a different kind of stem cell from patients' marrow that he hopes can slow nervous system damage but also promote repair. In type 1 diabetes, studies at about a dozen medical centres in the U.S are testing whether an off-the-shelf preparation of marrow stem cells can calm the immune system of diabetics. Even as scientists hope adult stem cells will produce new treatments, they are concerned about clinics that make claims about unproven stem cell therapy (Ritter, 2010).

1.5 SCR in Iran

1.5.1 History, public opinion, and legislation

Science in Iran was strengthened in the early 1970's under support from the Shah. However, political unrest surrounding the nation around the time of the revolution of 1979 caused Iran to suffer a significant "brain drain". After decades of neglecting science, Iran is now starting to invest heavily into it. Specifically, there have been some major improvements in areas regarding SCR. Unfortunately, continuing political unrest between Iran and the western world is a source of difficulty and hinders Iran from making significant progress in the world of science. Among Islamic countries, Iran has recently emerged as a leader in SCR (Morrison & Khademhosseini, 2006). Iran is one of the leading countries in SCR and is currently ranked 10th in the world. Iran believes that investing in science is an Islamic duty. The Royan

Institute, named after the Persian word for embryo, is Iran's leading SCR centre and one of its best infertility clinics. In 1998 the Ministry of Health approved the Royan Institute as a cell-based research centre. The Royan Institute's Department of Stem Cells was established in 2002 with the goal of establishing embryonic stem cell lines and developing techniques to differentiate these lines into various mature cell types, including cardiomyocytes, *B* cells and neural cells. Since then, much research has been conducted in many different areas such as registration of one human embryonic stem cell line in the International Society of SCR. Additionally, there has been the establishment of 6 lines of human ESCs and 8 lines of mouse ESCs. Furthermore, Iran has reported human embryonic stem cells' proteomics for the first time in the world (Morrison & Khademhosseini, 2006).

Iran as an Islamic republic is founded principally in Islamic law. According to the Iran's Shia religious authorities (the Grand Ayatollahs), SCR is permissible only in the pre-ensoulment stages of fetal development. The Quran states that there is a distinction between the different stages of human development and Muslim jurists have stated, based on the opinions of the Sunni and Shia Muslim scholars, ensoulment occurs four months (120 days) after conception (Morrison & Khademhosseini, 2006).

The rapid progress of SCR in Iran forced the Ministry of Health and Tehran University of Medical Sciences to make some guidelines concerning research on gametes and embryos in 2005. They permitted the use of human embryos for SCR under certain circumstances. Ethical committees in universities and research centers in Iran oversee and evaluate SCR and therapeutic cloning in accordance with these guidelines, but these guidelines are still open for public examination and debate and are not parliamentary legislation (Saniei & De, 2008).

1.5.2 Current research

SCR in Iran is growing rapidly. Among Islamic countries, Iran has recently emerged as a leader in hES cell research. Iran was the 10th country in the world to produce, culture and freeze human embryonic stem cells (Miremadi, 2010). SCR is on the cutting edge of scientific discovery and Iran's inclusion in such an exclusive group of countries stands as another tremendous example to the quality of research that is being achieved in the country. In 2004, the first PGD child was born in Iran and researchers at Royan Institute used adult stem cells in the treatment of myocardial infarction during coronary artery bypass grafting. They also produced the Insulin Producing Cell from embryonic stem cell and used limbal stem cells in the treatment of corneal injuries. In addition, the transplantation of stem cells to

the animal model of diseases in hepatic cirrhosis, spinal cord injuries, bone defects and cartilage damages have all been conducted. Other areas of research include diabetes embryonic stem cells, induced pluripotent stem cells, germ line stem cells, adult stem cells, cancer stem cells, and the establishment of the first cord blood bank.

Moreover, on 2nd August 2006, researchers at the Royan Institute witnessed the birth of the first cloned sheep in the Middle East. After many unsuccessful attempts, researchers were able to artificially fertilize the female sheep, which gave birth approximately one week early. Although the newborn lamb died minutes after birth as a result of respiratory problems, nonetheless, this is a tremendous example of the progress of Iranian science. Following 3 years of research, Iran again became the first Middle Eastern country in producing a transgenic animal. On 9th January, 2010 the scientists at Royan Institute succeeded in producing two transgenic goats containing coagulation factor IX in their milk which is an important drug used in the treatment of haemophilic patients (Morrison & Khademhosseini, 2006).

1.6 Ethical aspects of SCR

SCR raises many ethical dilemmas. Most hotly disputed is the conflict between the ethical value of the embryo's human life on the one side, and the possibilities of medical progress which can save lives on the other (Baune *et al.*, 2007). Opponents of embryonic SCR argue that it is like killing little human seeds in order to save other humans, and refer to Kant's "*Du skal aldri behandle et annet menneske bare som et middel, men alltid også som et mål i seg selv"* (Immanuel Kant as quoted in Rognum & Ottesen, 2007: 54). When the goal is good, as it so obviously is in SCR, is it then ok that a human becomes a means?

As Rognum and Ottesen point out, few people would argue against the moral principle that all humans are equal, but when this principle is challenged, it is difficult to take a clear stance (Rognum & Ottesen, 2007). Is it ok to give birth to a child first and foremost in order to save another? Is it ok to destroy human seeds in order to cure other humans suffering serious illness, or does this go against human dignity? Kant argues that the goal can never justify the means but the greater this goal is, the harder it is to uphold this principle, especially for those who find themselves in a difficult situation. A question raised is, at what point does a fertilized egg become a human being? What is a human life, when does it begin; when the egg is fertilized, when it is implanted in the uterus, at a certain stage of the development of the foetus? Is being conscious a requirement? Is a potential life the same as life itself?

Professor emeritus Ernle Young, founder of the Stanford Centre for Biomedical ethics describes the discussion as a distinction of being human and being a person (Haug, 2005). By making this distinction most people would argue that a blastocyst, the basis for embryonic SCR, is not a person, and one would by this definition allow embryonic research. If however this distinction is not made, the embryo is often perceived as a person, which would evoke scepticism towards embryonic SCR. One could however argue that using the concept of person as criteria is problematic because perceptions of what a person is related to physical and psychological qualities, and at what point in time these qualities develop, differs severely (Baune et al., 2007). Therefore the concept is vague and cannot be said to clarify the discussion.

Ethics professor Jan Helge Solbakken disputes that stem cell researchers are not creating humans or life, but use the cells to combine them in a specific manner (Rognum, 2001). However some argue that the mere potential for an embryo to develop into a human with a moral status, grants it the right to life (Baune *et al.*, 2007). Similar to the problems of defining a person, this concept of potentiality is criticised for being vague. As Vassnes argues the role of the mother and of the uterus is underestimated; the development of the embryo is not only dependent upon its genetic potential, but also of other factors such as the insertion into the uterus, the care and nurture the mother and the heath worker provides for instance (Vassnes, 2005). It has no possibility for developing into an individual without needed signals, nutrition and the protection of the mother. The fertilized egg is no more a human being than a recipe is a cake, he argues. Nevertheless, SCR is in itself based on the thought of potentiality. Stem cells are important precisely because of their potential to develop into any type of cell within out body therefore one cannot disregard the potentiality argument (Baune *et al.*, 2007).

We want a society which includes all; those who are healthy and those with disabilities. This is underlined in the Norwegian law of biotechnology (Rognum & Ottesen, 2007). Rognum and Ottesen (2007) however question whether this will become nothing more than empathy words if we allow human seeds to be destroyed because they are likely to develop a disability or a serious illness. It is perhaps thought provoking that among those who fear the consequences of SCR, we find those who struggle with disabilities.

Before the government even passed a law on stem cells research, elsewhere in the world scientists were making progress one could only think of as science fiction but a few years ago (Steen, 2005). The parliamentary debate on ethics will always be a few steps behind research and capital interests. The whole of humanity will benefit from this research it is claimed. But is there really any indication that modern science and the neo liberal global economy within which the pharmaceutical industry operates have aspirations of doing good for the majority of the world's population? Those researchers working to find new solutions to illness are most likely driven by a sincere wish to help as many people as humanly possible, but the pharmaceutical industry is ruled by the market, and the market is ruled by capital (Ibid). The outcome is a focus on diseases commonly found in the global north, (heart and lung diseases for instance) where the richest 20% of the world's population is situated (the minority world), managing 83 % of the world economy (Benjaminsen & Svarstad, 2006). In the global south, where the majority of the world's population reside (the majority world), people are dying of diseases we found a cure for 50 years ago (Steen, 2005). A cure for tuberculosis was for instance found as early as in 1920 (Hånes, 2010), however today more people than ever are infected by the disease. As the gap between the rich and the poor grows wider, so does the gap between those who have access to medicine and those who do not (Steen, 2005). While HIV and AIDS medicine can ensure a long life, these medicines are not necessarily available to those who need it the most. The pharmaceutical industry in the US amongst others, have said no at lowering the price of medicine in the poorer countries of the world (Ibid). They have also denied the pharmaceutical industry in Brazil the right to produce the same medicines cheaper. It is highly likely that this gap between the health of the rich and the poor of the world will increase even more as stem cells research evolves.

In his book *Det fornybare mennesket, stamceller og jakten på evig liv* Vassnes paints the picture of eternal life. He points to scientists who have proclaimed that in just 15-20 years it will be possible to drastically prolong the human life (Vassnes, 2005). Experiments have already been carried out with animals, and the roundworm *Caenorhabdis elegans* lived 5 times the normal length of life. Opponents say that this is to play God, but as Vassnes points out, in this notion all medicine could be regarded as playing God (Ibid). Stem cells do not represent anything principally new; rather it makes use of the body's ability to heal itself. These mechanisms grow less efficient as the body ages, and when they do, stem cells can assists this process. But the question is who will be able to access this research? This development runs the risk of increasing the gap between rich and poor both between

countries as well as within countries. Those who have enough money will be able to by themselves almost eternal life, while the man in the street die young, and millions in the majority world suffer an early death from lack of clean drinking water. In addition to this a prolonged life expectancy in the minority world ultimately puts additional pressure on the resources of the world, which again are not equally distributed (Benjaminsen & Svarstad, 2006). This will therefore further increase the gap between the global north and the global south.

1.7 Aims of the study

This report aimed at finding out the current state of SCR in Norway side by side the state of this field of scientific research in the United States of America and Iran. Furthermore, this report sought to investigate the attitude of Norwegian university students towards SCR and how SCR can be advanced in Norway.

1.8 Research questions

1. What is the state of SCR in Norway in comparison with the United States of America and Iran?
2. What is the attitude of Norwegian students at NTNU towards SCR?
3. What lessons can Norway learn from the United States of America and Iran in order to promote and improve SCR in Norway?

CHAPTER TWO

METHODOLOGY

As previously mentioned the main objective of this report is to examine the state of SCR in Norway side by side the current state of SCR in the United States of America and Iran. In order to do this, we applied a combination of qualitative and quantitative research methods. This combination has provided us with a holistic approach to the theme and given us a wide specter of information. By conducting a questionnaire-based survey, we were able to capture the general attitude of Norwegian students at the Norwegian University of Science and Technology (NTNU) regarding SCR, while interviews with specialists in the field gave us in-depth information on the theme. With the survey and interviews as a backdrop, we have analyzed our collected data in relation to extensive literature on SCR in Norway, and some literature on the United States of America and Iran.

2.1 Procedure

Three main procedures were employed in the study. These are, first, the review of current literature on SCR in Norway, the United States of America, and Iran. Additionally, a survey was conducted among Norwegian students at. Finally, some interviews were conducted with Norwegian experts engaged in SCR in Norway.

2.1.1 Literature review

We conducted an extensive review of past and current literature on SCR. Our literature sources included books, journal articles, reports, internet entries, dissertations, and conference proceedings. This diverse nature of literature sources has provided us with a rich array of information regarding our topic.

2.1.2 The survey

The aim of our survey was to investigate the attitudes of Norwegian students at NTNU towards SCR. The rationale for investigating the attitudes of Norwegian students towards SCR is that as the future generation, they will soon possess enormous power in directing Norway's scientific and research policy in their diverse capacities as politicians, health personnel, professors, religious leaders etc. Thus, the attitude of Norwegian students towards SCR is likely to influence the future direction of this field of research in Norway. This study replicated a study conducted by the Norwegian Biotechnology Advisory Board (Perduco, 2010) to examine the general Norwegian population's attitudes towards biotechnology in general, with some aspects of this study centered on Norwegians' attitudes towards SCR. As indicated above, our study was directed at students using the same instrument employed by

the Norwegian Biotechnology Advisory Board (Perduco, 2010). To ensure that we got a representative sample of students, we decided to include a balanced number of female and male respondents pursuing academic programs in all faculties at NTNU. Our results are discussed alongside the results of the survey conducted by the Norwegian Biotechnology Advisory Board referred to above.

2.1.2.1 Participants and Procedure

Sixty-four 64 students (29 male, 35 female) pursuing academic programs in all faculties at NTNU were randomly surveyed. The ages of respondents ranged from 18 to 55 years. Group members individually administered questionnaires to respondents. Clear and adequate instructions and ample time was given to respondents for the completion of the questionnaires. Respondents returned the questionnaires individually to group members after completing them.

2.1.2.2 Measure

The SCR subsection of a questionnaire used by the Norwegian Biotechnology Advisory Board (Perduco, 2010) was adopted for this study (Appendix A). Apart from the demographic variables, the questionnaire had 6 questions which assessed the attitudes of Norwegian students towards SCR.

2.1.3 The interviews

Some internationally renowned Norwegian experts engaged in SCR were interviewed to seek their views on SCR in Norway. These are Ole Myklebost who is Assistant Director at the Cancer Stem Cell Innovation Center (CAST), Rikshospitalet in Oslo. Jan Helge Solbakk who is leader at the Section for Medical Ethics at the University of Oslo and a member of the international Human Embryonic Research Guidelines Task Force was also interviewed. Finally, Arne Sunde who doubles as leader of the Fertility Section of St. Olav's Hospital, Trondheim and chairman of the European Society for Human Reproduction and Embryology (ESHRE) was interviewed. The interviews with Ole Myklebost and Jan Helge Solbakk were conducted through telephone and Skype while Arne Sunde was personally interviewed by us.

We made use of a semi-structured interview guide. This enabled us to ask crucial follow-up questions while providing informants the luxury of bringing other issues of relevance into focus during the interview (Longhurst, 2010). Additionally, the semi-structured interview guide made it possible for us to compare the responses and divide the interviews into different segments related to themes during the analyses of the interviews. As Kitchin and

Tate (2000) note, the qualitative interview allows the researcher to produce rich and varied data and to capture experiences, feelings or opinions.

CHAPTER THREE

RESULTS

The questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS). Results of the survey are delineated below according to the items of the questionnaire.

1. Do you think we should use fertilized eggs for stem cell research?

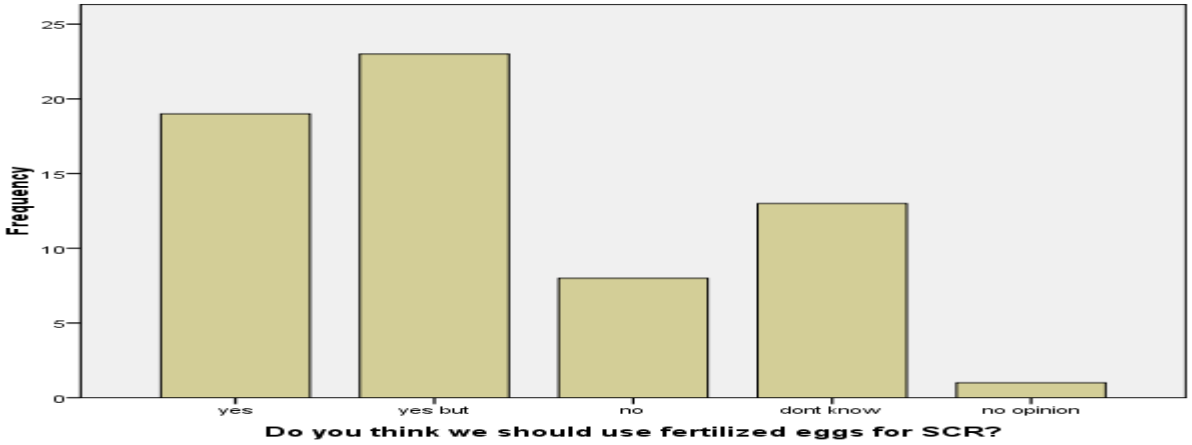

Fig. 1: Frequency of answers to the question: Do you think we should use fertilized eggs for stem cell research?

From Figure 1, 23 (35.9%) respondents were of the view that fertilized eggs should be used for SCR only with the consent of the donors. 19 (29.7%) of the respondents were also of the view that fertilized eggs should be used for SCR. However, 13 (20.3%) did not know whether fertilized eggs should be used for SCR, 8 (12.5%) were of the view that fertilized eggs should not be used for SCR, while 1 (1.6%) had no opinion.

2. Do you think we should use aborted fetuses for stem cell research?

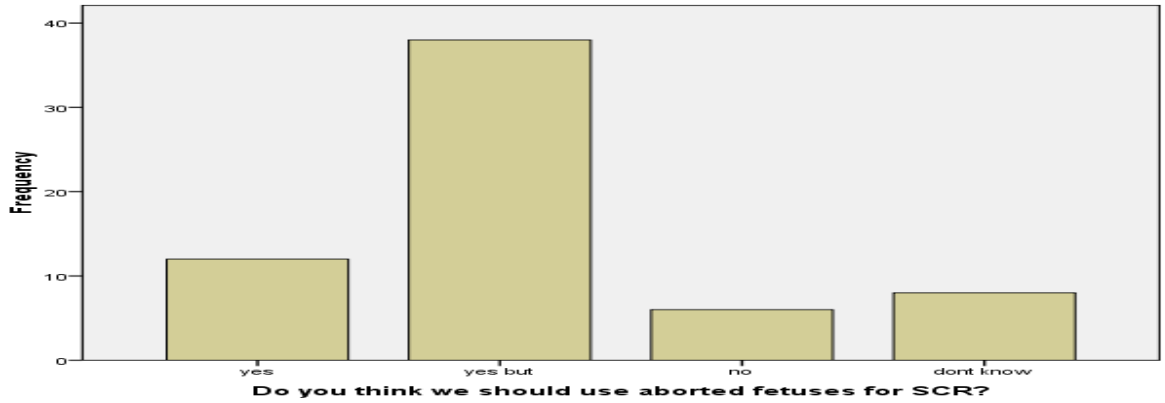

Fig. 2: Frequency of answers to the question: Do you think we should use aborted fetuses for stem cell research?

From Figure 2, 38 (59.4%) respondents were of the opinion that aborted fetuses should be used for SCR but only if the woman who had the abortion has given her consent while 12 (18.8%) of the respondents were of the view that aborted fetuses should be used for SCR. In addition, 8 (12.5%) did not know whether aborted fetuses should be used for SCR while 6 (9.4%) were of the view that aborted fetuses should not be used for SCR.

3. Stem cell research has vast potential to lead to a positive development.

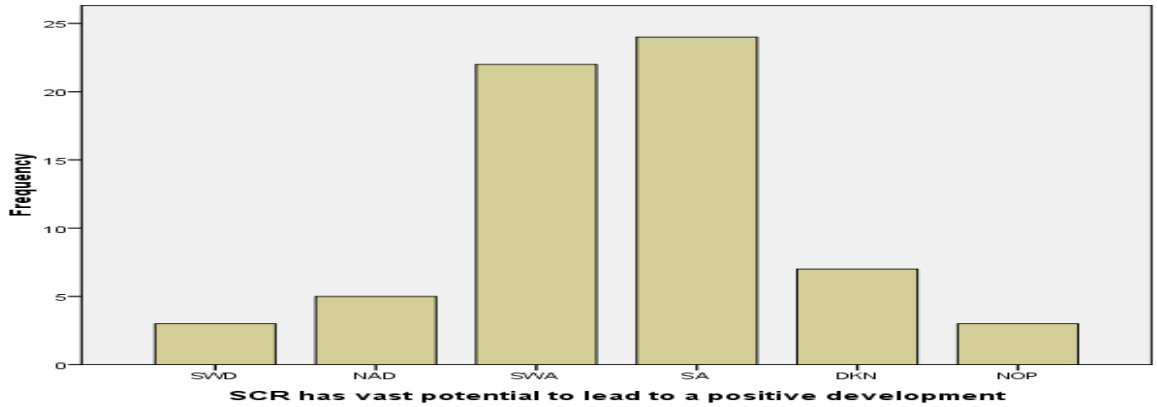

Fig. 3: Frequency of answers to the question: Stem cell research has vast potential to lead to a positive development.

From Figure 3, 24 (37.5%) respondents strongly agreed with the opinion that SCR has vast potential to lead to a positive development while 22 (34.4%) respondents somewhat agreed to this view. However, 7 (10.9%) did not know whether SCR has vast potential to lead to a

positive development. In addition, 5 (7.8%) neither agreed nor disagreed, 3 (4.6%) somewhat disagreed with this view, while 3 (4.6%) also had no opinion on this issue.

4. There are significant ethical issues with stem cell research.

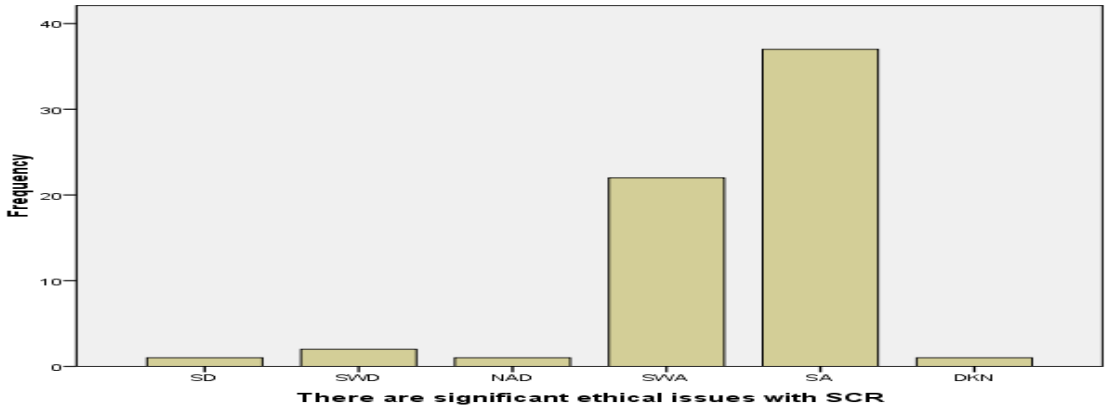

Fig. 4: Frequency of answers to the question: There are significant ethical issues with stem cell research.

From Figure 4, 37 (57.8%) respondents strongly agreed with the view that there are significant ethical issues with SCR, and 22 (34.4%) somewhat agreed to this view. Furthermore, 2 (3.1%) somewhat disagreed with this opinion, 1 (1.6%) did not know whether there are significant ethical issues with SCR, 1 (1.6%) neither agreed nor disagreed, while 1 (1.6%) also had no opinion on this issue.

5. Stem cell research should be subject to strict rules.

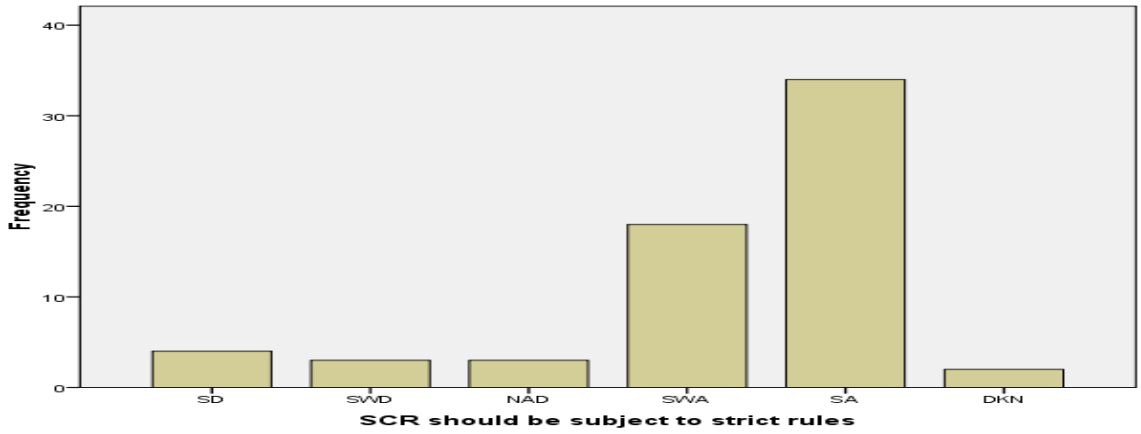

Fig. 5: Frequency of answers to the question: Stem cell research should be subject to strict rules.

From Figure 5, 34 (53.1%) respondents strongly agreed with the view that SCR should be subject to strict rules while 18 (28.1%) somewhat agreed to this view. However, 4 (6.2%) strongly disagreed with this view, 3 (4.7%) neither agreed nor disagreed, and 3 (4.7%) also somewhat disagreed with this issue. Furthermore, 2 (3.1%) did not know whether SCR should be subject to strict rules.

6. I trust the government to set the proper ethical boundaries for stem cell research.

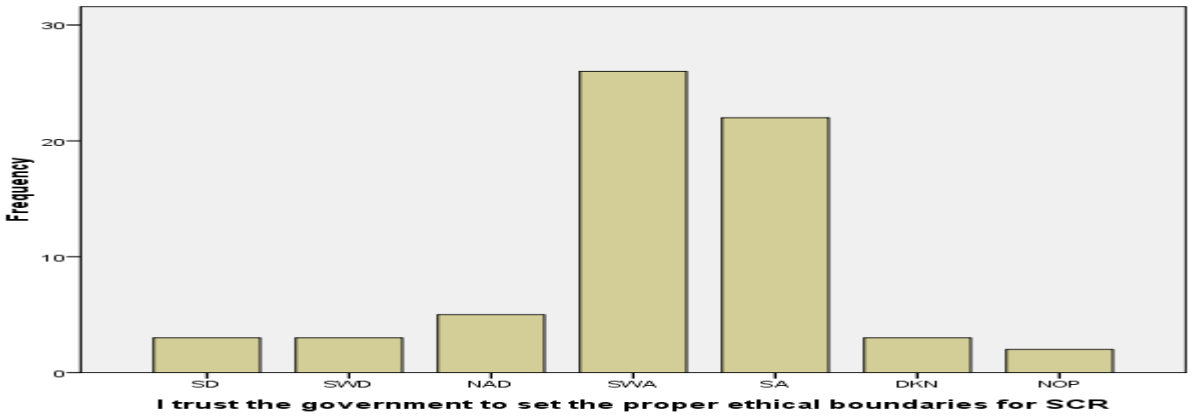

Fig. 6: Frequency of answers to the question: I trust the government to set the proper ethical boundaries for stem cell research.

From Figure 6, 26 (40.6%) of the respondents somewhat agreed with the view that government should set the proper ethical boundaries for SCR, 22 (34.4%) strongly agreed to this view. However, 5 (7.8%) neither agreed nor disagreed with this view, and 3 (4.7%) did not know whether the government should set the proper ethical boundaries for SCR. Finally, 3 (4.7%) somewhat disagreed, 3 (4.7%) equally strongly disagreed, while 2 (3.1%) also had no opinion on this issue.

3.1 Limitations

As mentioned earlier we, culled the SCR aspect of the questionnaire employed by the Norwegian Biotechnology Advisory Board for this study. It is important to note that the introduction text to this questionnaire paints a rather positive picture of SCR, and avoids elucidating specific important ethical issues related to SCR by simply stating that there are ethical issues. This might have influenced the participant's answers, as most people asked did not have much knowledge of SCR beforehand. In addition, the survey only included 64 participants. With these two factors in mind, the results of our survey might not be said to be representative of the entire NTNU student mass. However, they can be said to give an indication regarding the attitudes of Norwegian students towards SCR.

CHAPTER FOUR

DISCUSSION

The survey we conducted with Norwegian Students at NTNU agrees well with the survey conducted by Perduco, and also with the results presented by the Eurobarometer (The European Commission, 2010). The items in the questionnaire were based on the ones used by Perduco (2010), to allow for a comparison of the results. The results typically differ with 2-6% which can probably be explained by the increased degree of stochastic effects due to our relatively small sample size. We will mainly discuss differences that show a substantial deviation such as 10% or more.

The most striking finding was that 92.2% of the students agreed or strongly agreed that there are considerable ethical issues connected to SCR, compared to only 61% in the general public. The views on regulation were similar between the two surveys. This is quite surprising as it would be expected that the increased portion of students who meant there where considerable ethical issues connected to the field would also be reflected in the opinions regarding the legislation. A possible explanation might be that more students are aware that strong regulation would most likely hinder the development of the field. The students also seem to trust the government more in issuing the correct level of legislation. Maybe as young people, fewer feel they have been let down by their government in the past. There is also an indication that the students are more open towards the use of aborted fetuses in research, and a weak trend showing that the students are less concerned with whether consent is necessary. This might be because the student population is typically younger, and therefore are less likely to have been in a position where they have had an abortion or had fertilized eggs created in vitro. As a consequence, they do not identify strongly on an emotional level with this issue.

We also found that the law that was in place between 2003 and 2008 banning research on cell lines developed from embryonic stem cells did not have a significant negative effect on the development of SCR in Norway. This is the view of the experts that we interviewed (Ole Myklebost & Arne Sunde, Personal communication 17.02.2011 and 10.03.2011). In Arne Sunde's opinion, there was not enough political will present in this period. The reason for this lack of will was probably in a large part due to the ethical issues surrounding SCR. As a consequence none of the political parties wanted to invest political capital in this sensitive subject. This would be especially relevant in the years 2001 till 2005 when the Christian

Party (KrF) had significant influence on Norwegian politics as part of a collision government. The leader of this party at the time, Kjell Mangne Bondevik, also held the position of Norwegian prime minister. Dagfinn Høybråten a politician within KrF, allegedly stopped SCR on blood stem cells that had been approved by the ethical committee (Ola Myklebost Personal communication 17.02.2011). This was while he held the position as Norway's health minister. Although Norway's strategy in this period seemed to include increased funding towards adult SCR (Nordforsk, 2007), there is little evidence of large scientific contributions as a result of this. An exception might be cancer research that indirectly touched upon some of the aspects of adult stem cell biology. The Norwegian policy seemed to be to wait until the ethically difficult parts of the research had been worked out, and then adopt new treatments as they emerged. Even though the legislation in the United States has been strict in the past, the country has a strong pharmaceutical industry which invests large amounts of money in SCR.

The main reason why Norway is not among the leading nations in the field of SCR appears to be financial. Arne Sunde describes this field of research as a "big science" requiring enormous financial resources. Arne Sunde indicates that tens of billions of Norwegian Kroner (NOK) are necessary to develop SCR to an internationally competitive level in Norway. For instance, Iran's budget for SCR in the period 2008 to 2012 was 2.8 billion U.S dollars (Washington Times, 2009), in comparison with Norway's 47.3 million NOK in 2009 (Forskingradet, 2009). Norway can therefore not hope to compete with the leading world powers such as USA and Iran unless Norway is prepared to divest billions of NOK from the oil industry into SCR. Although Norway is among the wealthiest countries in the world when measured through gross domestic product per citizen, it is a small country in an international perspective. This does not mean that Norway cannot play a role, but that this role will have to be within focused areas of research. In this way, Norway can still make a considerable contribution to the international effort to realize the predicted potential of stem cells. Jan Helge Solbakk suggests that Norway could also contribute by making redundant fertilized eggs from Norway available to other nations that have the resources available to do research on them. According to Arne Sunde, almost no redundant fertilized eggs are used for SCR in Norway. He adds that not a single egg has been donated to SCR from the fertility clinic at St. Olav's Hospital. The reason for this is probably due to the huge amount of work required in the characterization of new stem cell lines, Norway has therefore instead imported characterized stem cell lines from abroad.

The large amount of funding needed for SCR also brings into the discussion whether it is right that 90 percent of the world's resources are focused towards helping 10 percent of the world's population? Jan Helge Solbakk referred to this as the 10/90 gap. It can be argued that the huge amounts of funding going towards SCR could be put to better use in other ways that would help more people. In this discussion, it is important to ask what will lead to the greatest degree of sustainable development. The human population is in a phase of exponential growth, and we are approaching the limit of what the earth is able to sustain (Dèry & Anderson, 2007). To solve the challenges this will bring forth, we are dependent on knowledge gained through basic research. It is impossible to predict what scientific discoveries SCR will lead to, or what spin off technologies might arise as a consequence. Even though stem cells cannot hope to solve all of the world's problems, their predicted potential makes this a very promising area of research. It could therefore be argued that SCR is worth the investment, and that Norway should also contribute.

The Norwegian Research Council's five year plan for SCR and the recent establishment of the Norwegian Stem Cell Center (NCS) suggests that Norway views SCR as an important area of research. The appointment of Joeal Glober, a prominent researcher from abroad, as the head of NCS gives this center international credibility. This also effectively increases the network of experts this center can draw knowledge from. Ole Myklebost and Arne Sunde emphasized that short term plans in research often do not work as they are intended because it generally requires much more time to develop a sustainable research community. It is therefore important that this initiative is given adequate support after 2012. Otherwise, this substantial investment might go waste.

Another factor that probably influences research funding is Norway's position as one of the world's leading nations within offshore oil production. Even though this industry produces huge amounts of revenue, it also draws many of Norway's best and brightest towards the private oil industry. Much research in Norway is also directed towards offshore drilling, search for oil, and oil production. This is no doubt necessary to maintain Norway's position, but it also drains considerable amounts of resources from a relatively small country such as Norway. Most of the profits from the oil industry are invested in the Norwegian oil fund. The financial security provided by oil might hinder the development of new industry, simply because we are not forced to look for different alternatives.

The Norwegian State Church has played an important role in the opposition of the use of embryonic stem cells for research. So has the Christian People's Party (KrF) which has the opinion that we should focus on research towards adult stem cells (Kristelig Folkeparti, 2011). In this sense KrF is more conservative than the comparable political parties in the rest of Scandinavia. In Islam and Judaism, there exist religious councils that are charged with interpreting the contents of their holy documents in light of our current modern society, and new scientific discoveries which bring forth new theological discussions. This might be one of the reasons that the Middle East is emerging as an important player in the field of SCR. Within Christianity, no such council exists, and Christians must therefore follow their holy texts as best they can. Because these texts hold the human life as holy from the moment of conception, the Vatican is in strong opposition to embryonic SCR (Doerflinger, 1999). According to Arne Sunde, the Vatican's strong position in the EU effectively blocks most of the funding towards embryonic SCR. In Islam, it is a religious duty to carry out research with the aim of developing new medicines and technologies that can benefit humanity. Because of this and the fact that Islam does not oppose the use of fertilized eggs in research, Iran stands at a considerable advantage when compared to the European Union and the USA.

Two other factors that influence the level of SCR in Norway are public opinion and politics. It can be argued that in a complex field such as SCR, very few amongst the public and politicians have enough knowledge on the subject to make calculated and objective decisions. This is clearly illustrated by the Mehmet case which played a key role in the development that led to the changes in the biotechnology law in 2008. In this case, one sick child caused a total change in the opinions of the Norwegian people and politicians. This led to the Norwegian government's approval of a highly experimental procedure involving preimplantation diagnostics and choice of tissue type to save Mehmet. In the aftermath of this case, the entire political climate surrounding the issue of SCR had changed, making it much easier to gain support for a change in legislation, allowing SCR on cell lines derived from surplus fertilized eggs. Thus, the changes in the biotechnology law can be seen as a direct result of this one case. Although this led to a positive development for SCR, the pitfalls of such an ad hoc decision became apparent when the mother lost the child due to the poor follow up of the case. According to Arne Sunde, there are still no good enough support measures in place around this type of treatment. This case raises the question of how it can be ensured that changes made in policy are well thought through, and not impulsively based on

feelings. It should be possible to relate to patients that could potentially be cured by treatments developed from SCR, without relying on the tabloid looking holes in to reality.

An interesting aspect of the subject of public opinion in Norway is what some call a conservative and anti-academic attitude within the Norwegian population. According to some social anthropologists, this goes as far back as the time when Norway was a colony under Denmark (Arne Sunde, Personal communication 10.03.2011). The reason for this negative attitude towards academia is supposedly because anyone seeking higher education during this period had to travel to Denmark. Therefore, those who returned with higher education from Denmark were viewed as traitors by the common man on the street. The author Sandemoen (1933) captures many of these aspects in ten unofficial rules (Sandemose, 2005). According to many, this anti elite, anti academic attitude still exists today, especially in the districts. Although young people in modern society see less and less to it, it still sits deep within the older population. This might help explain why Norway is so far behind its neighbors within the research industry and also within SCR. In comparison, the culture in America is very different. America is referred to as "the land of opportunity". In America, people who come from nothing and go against all odds to make it in life are held in high regard. This attitude encourages people to make it in life and those who succeed are held in high regard, regardless of which area they contribute to. In Norway, the only people who are truly admired for their achievements are the athletes. This is reflected in the fact that Norway with its modest population, competes with the largest countries in the world when it comes to the number of gold medals in the Olympics and world championships within winter sports. This raises the question of why we are not able to compete at the intellectual level. In sharp contrast to Norway, public opinion in Iran does not have strong influence on these types of issues. The state oversees all aspects of life and obstructs the public in expressing their opinion. Therefore, the general public has little influence on the decisions made by the politicians.

The future of SCR in Norway not only depends on politics and money but it also lies in the hands of future generations. If Norway is to increase the number of scientists in the future, we will have to increase knowledge and interest among the young people in the population. As a means to meet this requirement, we have developed an idea for a board game which is to be used at high schools. The board game is called "Trivial Pursuit (TP) Stem Cells Edition" and is based on the same rules as regular Trivial Pursuit, but with some minor changes to make the game more stem cell orientated. The use of games in education has proven to increase learning interest (Oxford Learning, 2007) and therefore this type of game will raise interest

and knowledge among students, and may influence them to study stem cells in the future. This is important because Norway requires more competent researchers within this area to develop SCR further in the future. To develop this idea further, the game may be broadened to include other scientific topics within the field of biotechnology. Now that the anti academic shroud is starting to lift from Norway, it is important that we make the younger population understand that making ground breaking research is more of a sustainable accomplishment than jumping far on skis. This will be increasingly important in preparation for a time when there is no more oil left.

4.1 Conclusion

This report has examined the state of SCR in Norway side by side the state of SCR in two of the world's leading nations within SCR, the United States of America and Iran, to try to gain a wider perspective, and to examine if Norway can hope to compete with these nations in the future. We found that the main reason why SCR has not reached an internationally-competitive level in Norway is due to the lack of political will. We identified three main factors that account for this situation. Anthropologically, some degree of anti-academic attitude identified amongst the Norwegian population especially in the districts is a plausible explanation. Religiously, the Norwegian State Church's vigorous opposition against SCR as reflected in the Christian People's Party has also played a role. Furthermore, economically, the security Norway experiences as a large oil-exporting country, as well as the immense human and material resources the oil industry claims has also played a role. The possibility of Norway competing against the leading nations within the field of SCR is doubtful unless the huge amounts of financial resources necessary for advancing this field is invested into it. Additionally, it is important that the attitude of Norwegians towards SCR, especially that of the youth who constitute the future generation, is improved. Furthermore, for the advancement of SCR in Norway to an internationally competent level, it is crucial that the five year program started in 2008 is given adequate funding after the program is ended in 2012.

Now that trends in Norway points to increasing optimism amongst the public towards SCR, and legislation is opened for research on cell lines developed from embryonic cells, it may seem that SCR in Norway has the possibility of a promising internationally-competitive future. This future however depends on increasing the level of awareness and the degree of knowledge amongst the public, and there is no doubt that there is much Norway can learn

from the United States of America and Iran in terms of their attitude towards SCR. To show some initiative and contribute with a first input in this direction, we have invented Trivial Pursuit: Stem Cells Edition, a board game to enhance the knowledge and attitudes of Norwegian youth and the general Norwegian population towards SCR (Please find accompanying this report). The questions in this game are based on the material presented in the theory part of this report. This initiative, it is hoped, will help raise awareness and enhance the knowledge and attitudes of Norwegian youth and the general Norwegian population towards SCR.

REFERENCES

American Society for Reproductive Medicine, (2010). *Vision of ASRM.* Retrieved 13th March 2011 from: http://www.asrm.org/detail.aspx?id=35

Baune, Ø., Borgen, O. J., Funderud, S., Føllesdal, D., Heiene, G. & Østnor, L. (2007). *Stamceller fra embryoer til forskning og terapi? Uttalelse fra en norsk prosjektgruppe,* Oslo: Unipub Forlag.

Benjaminsen, T. A. & Svarstad, H. (2003). *Samfunnsperspektiver på miljø og utvikling.* Oslo: Tano-Aschehoug.

Bioteknologinemda. (2010). *Tidslinje.* Retrieved 9th April, 2011 from http://www.bion.no/temaer/tidslinje/.

Bioteknologinemda. (2000). *Uttalelse til sosial- og helsedepartementet om bruk av stamceller fra overtallig befruktede egg og aborterte foster.* Retrieved 13th March, 2011 from http://www.bion.no/filarkiv/2010/07/2000.09.01-stamceller.pdf.

Bioteknologinemda. (2001). *Lekfolkskonferanse om stamceller.* Retrieved 13th March, 2011 from http://www.bion.no/filarkiv/2010/07/2003_01_27_sluttrapport_lekfolkskonf.pdf.

Bioteknologinemda. (2002). *Høringssvar: Forbud mot terapeutisk kloning m.m.* Retrieved 9th April, 2011 from http://www.bion.no/filarkiv/2010/07/2002.04.10-hoering_terapeutisk_kloning.pdf.

Bioteknologinemda. (2006). *Høring: Endring i bioteknologiloven – forskning på overtallige befruktede egg og begrenset bruk av preimplantasjonsdiagnostikk.* Retrieved 13th March, 2011 from http://www.bion.no/filarkiv/2010/07/2006_07_06_revbiolov_befruktede_egg_pgd.pdf

Charo, R. A. (2009). Stem cell compromise. *New York Times Editorial, April 22, 2009.*

Dèry, P. & Anderson, B. (2007). *Peak phosphorus*. Energy Bulletin. Retrieved 9th April, 2011 from. http://www.greb.ca/GREB/Publications_files/Peakphosphorus.pdf.

Doerflinger, R. M. (1999). The ethics of funding embryonic stem cell research: A Catholic viewpoint. *Kennedy Institute of Ethics Journal, 20*(4), 137-150.

Executive Order No. 13505. (2009). *Removing barriers to responsible scientific research involving human stem cells.* Retrieved 9th April, 2011 from http://www.whitehouse.gov/the_press_office/Removing-Barriers-to-Responsible-Scientific-Research-Involving-Human-Stem-cells/.

Fletcher J. C. (2000). Deliberating incrementally on human pluripotential stem cell Research. *Ethical Issues in Human Stem Cell Research,* Vol. II. Commissioned Papers. National Bioethics Advisory Commission, US Government Printing Office: Rockville, MD, E1-E50.

Forskningsrådet. (2009). *Årsrapport 2009 stamceller (2008-2012)*. Retrieved 9th April, 2011 http://www.forskningsradet.no/servlet/Satellitec=Page&cid=1234854152612&pagename=stamceller%2FHovedsidemal.

Goldsby, R. A., Kindt, T. J., & Osborne, B. A. (2007). *Immunology (6th Ed.)*. New York: W. H. Freeman and Company.

Hall, Z. W. (2009). Stem cell research in California: The intersection of science, politics, culture, and law. *Minnesota Journal of Law, Science & Technology, 10*(1), 1-17.

Huge,C. (2005). *Det er ingen skam å snu.* Tidsskrift for Den Norske Legeforening Downloaded the 23th of February 2011 http://www.tidsskriftet.no/index.php?vp_SEKS_ID=1144176

Hånes, H. (2010). *Tuberkulose – Faktaark* Folkehelseinstituttet. Downloaded the 2th of March 2011. http://www.fhi.no/eway/default.aspx?pid=233&trg=MainLeft_5648&MainArea_5661=5648:0:15,2917:1:0:0:::0:0&MainLeft_5648=5544:50435::1:5647:39:::0:0

Johnson, J. A., & Williams, E. (2004). *Stem cell research 13*. Congressional Research Service Report For Congress No. Rl31015.

Kitchin, R. & Tate, N. J. (2000) *Conducting research into human geography*. Harlow: Pearson Education Ltd.

Kristelig Folkeparti. (2011). *Hva mener KrF om Bio-og genteknologi.* Retrieved 13th March, 2011 from http://www.krf.no/ikbViewer/page/krf/artikkel/hva-mener-krf?p_document_id=3572.

Miremadi, T. (2010). Stem cell research and technology in Iran—Window of opportunity in the midst of international tension. *Review of Policy Research, 27*(6), 699–719.

Morrison, D. W. G., & Khademhosseini, A. (2006). *Stem cell science in Iran.* Retrieved from http://www.isgmit.org/projects-storage/StemCell/stem_cell_iran.pdf.

Mummery, C., Wilmut, I., Van De Stolpe, A. & Roelen, B. (2010). *Stem cells. Scientific facts and fiction* (1st Ed.). Elsevier.

National Research Council (2005). *Guidelines for human embryonic stem cell research.* Retrieved 9th April, 2011 from http://www.nap.edu/openbook.php?record_id=11278&page=R1.

Newhart, A. (2004). The intersection of law and medicine: The case for providing federal funding for embryonic stem cell research. *Villanova Law Review, 49*(2), 329-61.

Nordforsk (2007). *Stem cell research in the Nordic Countries: Science, ethics, public debate and law.* Retrieved February 3, 2011 from http://www.nordforsk.org/_img/nordforsk_pb2_web.pdf

Office of the Press Secretary. (2009). *Remarks on the signing of Stem Cell Executive Order and Scientific Integrity Presidential Memorandum*. Retrieved 9th April, 2011 from http://www.whitehouse.gov/the_press_office/Remarks-of-the-President-As-Prepared-for Delivery-Signingof-Stem-Cell-Executive-Order-and-Scientific-Integrity-Presidential Memorandum/).

Oxford Learning. (2007). *Board games and learning.* Retrieved 13th March, 2011 from http://www.oxfordlearning.com/letstalk/2007/10/18/board-games/.

Perduco. (2010). *Bioteknologiloven undersøkelse om holdninger til etiske problemstillinger.* Retrieved 9th April, 2011 from http://www.helsedirektoratet.no/vp/multimedia/archive/00302/Bioteknologiloven_-_302019a.pdf.

Rewerski, P. (2007). The need for a new U.S. Stem cell research policy: A comparative look at international stem cell research laws. *Journal of Law, Technology & Policy, 7*, 415-431.

Rognum,T.O. (2001) *Terapautisk Kloning – Fremtidens medisin eller en etisk blindgate?* Tidsskrift for Den Norske Legeforening. Downloaded the 23th of February 2011. http://www.tidsskriftet.no/?seks_id=382515

Rognum, T. O. & Ottesen, E. (2007). *Bioteknologi på liv og død. En enkel bok om stamceller og donorsøsken, bioetikk og menneskeverd*. Oslo: Lunde Forlag.

Sandemose, A. (2005). *En flyktning krysser sitt spor.* Oslo: Aschehoug.

Saniei, M. & De Vries, R. (2008). Embryonic stem cell research in Iran: Status and ethics. *Indian Journal of Medical Ethics, 5,* 181-4.

Schechter, J. (2010). Promoting human embryonic stem cell research: A comparison of policies in the United States and the United Kingdom and factors encouraging advancement. *Texas International Law Journal, 45,* 603-629.

Simpson, J. L., Rebar, R. W., & Carson, S. A. (2006). Professional self-regulation for preimplantation genetic diagnosis: Experience of the American Society for Reproductive Medicine and other professional societies. *Fertility and Sterility, 85,* 1653-1660.

Steen, T. (2004). Om å være den du er. i Borge, O. J. & Tennøe, T. (eds). (2004). *Stamceller og kloning.* Bioteknologinemnda og Teknologirådet.

The European Commission. (2010). *Eurobarometer Special Surveys.* Retrieved 9th April, 2011 from http://ec.europa.eu/public_opinion/archives/eb_special_020_000_en.htm.

Vassnes, B. (2005). *Det fornybare mennesket. Stamceller og jakten på evig liv*. Oslo: J. W. Cappelens Forlag.

Warberg, L. A. (1996). Norway - Biotechnology, law and ethics - The new Norwegian act on medical use of biotechnology (Act No. 56 of 5th August, 1994). *European Journal of Health and Law, 3*(2), 189-95.

Washington Times. (2009). Iran at forefront of stem cell research. Retrieved 9th April, 2011 from http://www.washingtontimes.com/news/2009/apr/15/iran-at-forefront-of-stem-cell-research/.

Wertz, D. C. (2002). Embryo and stem cell research in the United States: History and politics. *Gene Therapy, 9,* 674–678.

APPENDICES

APPENDIX I: STEM CELL RESEARCH QUESTIONNAIRE

This is a survey I am conducting for my Expert in Teamwork class. It will ask you a little about your background and then your views on the issue of stem cell research. The purpose of this is to get an idea of how Norwegian students feel about stem cell research and why. I will greatly appreciate it if you take a little time to answer these few simple questions. Please note that you will remain anonymous and will not have to provide any information other than what is asked for in the survey.

What is your gender? ( ) Male ( ) Female

In which of the following age groups do you belong?

( ) Below 18 years ( ) 18 – 26 years

( ) 27- 35 years ( ) 36 – 55 years

What is your political ideology?

( ) Conservative ( ) Moderate ( ) Liberal ( ) No opinion

How would you describe yourself religiously? (

( ) Catholic ( ) Protestant ( ) Islamic ( ) Jewish ( ) No religion

( ) Other. Please specify.....

Which faculty/study program are you in.....

Below are some questions about stem cell research. Before you answer the questions, please read the text below.

In a healthy body, thousands of cells die every second; these are replaced by new cells produced by the body's stem cells. Stem cells thereby give rise to specialized body cells such as blood, muscle, skin and nerve cells. If researchers succeed, stem cell research can contribute to more effective treatments for diseases like cancer and heart disease, as well as providing the opportunity to treat conditions for which there are currently no available treatments. Stem cells can be collected from several sources including fertilized eggs, embryos, fetuses and umbilical cords that can be collected from people. Many believe it is problematic to use embryos and fetuses for research. Stem cell research, therefore, is much discussed. An egg that has been fertilized outside the body can become a fetus in the womb of the mother. This is done by assisted fertilization. Fertilized eggs can also be used by scientists as a source of stem cells.

Do you think we should use fertilized eggs for stem cell research?

( ) Yes ( ) No ( ) I do not know ( ) I have no opinion on this

( ) Yes, but only if the woman and man, whose egg and sperm cells are being used, have given their consent.

It is possible to use aborted foetuses as a source of stem cells for use in research. Do you think we should use aborted foetuses for stem cell research?

( ) Yes ( ) Yes, but only if the woman who had the abortion has given her consent

( ) No ( ) I do not know ( ) I have no opinion on this

To what extent do you agree or disagree with the statements below?

Stem cell research has vast potential to lead to a positive development.

( ) Strongly disagree ( ) Somewhat disagree ( ) Neither agree nor disagree

( ) Somewhat agree ( ) Strongly agree ( ) Do not know ( ) Have no opinion on this

There are significant ethical issues with stem cell research

( ) Strongly disagree ( ) Somewhat disagree ( ) Neither agree nor disagree

( ) Somewhat agree ( ) Strongly agree ( ) Do not know ( ) Have no opinion on this

Stem cell research should be subject to strict rules

( ) Strongly disagree ( ) Somewhat disagree ( ) Neither agree nor disagree

( ) Somewhat agree ( ) Strongly agree ( ) Do not know ( ) Have no opinion on this

The government should set the proper ethical boundaries for stem cell research

( ) Strongly disagree ( ) Somewhat disagree ( ) Neither agree nor disagree

( ) Somewhat agree ( ) Strongly agree ( ) Do not know ( ) Have no opinion on this

APPENDIX II: INTERVIEW QUESTIONS

Spørsmål til Norke stamcelle forskere

- Hvor utbredt er stamcelleforskning i norge?
    - Hva gjøres i norge (type forsknning, celle-typer som brukes)
        - Hvor i Norge gjøres det forskning?
    - Hvordan ligger vi ann i forhold til andre land?
    - Hvilke(t) land er ledende innen stamcelleforskning?

- Hvor langt har de lendende landene kommet innen stamcelleforskning/ hvor langt forran er de? Hvorfor tror du det er slik?

- Kan du beskriv prosessen man må gjennom for å starte forskning med stam celler i norge?
    - Om dette er en treg prosess, hvorfor tror du det er slik?
    - Har du noen tanker om forbedringer/effektivisering med denne prosessen?
    - Hvordan ville effektiviteten påvirket stamcelle forskningen i norge?

- På hvilken måte begrenser/hjelper bioteknologiloven forskningen på stamceller slik den er i dag ?
    - Tror du det blir noen endringer i nærmeste fremtid?
    - Hva slags endringer?

- Ligger Norge langt bak andre land?
- Med alle de muligheter stamceller har for fremtidig behandling av en rekke sykdommer, hvorfor tror du norge ligger såpass bak andre land?
    - (utdanning, religion, politikk / finansiell støtte, etikk... etc.)
    - Tror du Ola Nordmann sitt syn og kunnskap om stamcelleforsknning påvirker hva som gjøres? I hvilken grad/ hvordan? Vet nordmenn for lite?

- Mener du norge satser for lite på stamcelleforskning?

- Hva betyr det for norge at vi driver med stamcelle forskning?

- Hvorfor kan vi ikke bare ”hvile” på andre lands forskning og teknologi?

Andre kommentarer/ viktig info om stamcellefoirskning i norge?

APPENDIX III: TRIVIAL PURSUIT: STEM CELL EDITION

Please find accompanying this report the Trivial Pursuit: Stem Cells Edition game.