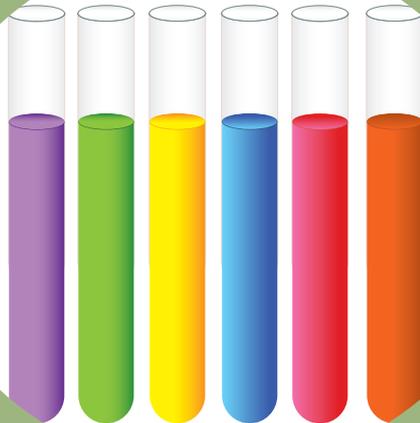
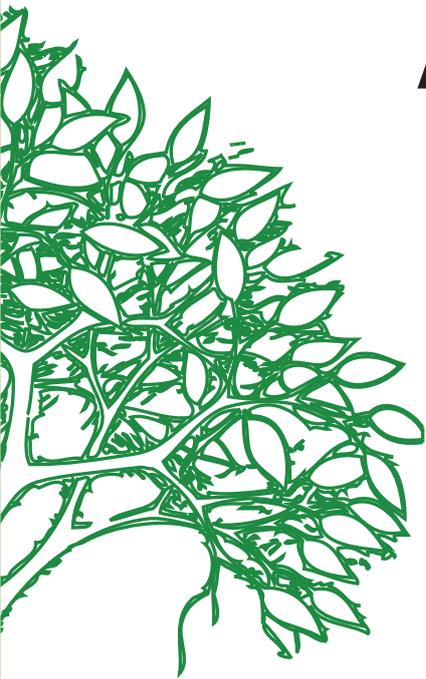




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ACRONYMS

AEBC: Agriculture and Environment Biotechnology Commission
BBRC: Biotechnology and Biological Research Council
BIOTEC: Thailand's National Centre for Genetic Engineering and Biotechnology
CHRB: Convention on Human Rights and Biomedicine
CIOMS: Council for International Organizations of Medical Sciences
COMEST: World Commission on the Ethics of Science and Technology
CSR: Corporate Social Responsibility
GM: Genetically Modified
ELSI: Ethical, Legal and Social Impact
GMOs: Genetically Modified Organisms
GTCCC: Gene Technology Community Consultative Committee
GTEC: Gene Technology Ethics Committee
GTMC: Gene Technology Ministerial Council
HES: Human Embryonic Stem
HUGO: Human Genome Organization Ethics Committee
IBC: UNESCO International Bioethics Committee
IDHDG: Internal Declaration on Human Genetic Data
IVF: In Vito Fertilization
LMOs: Living Modified Organisms
NGOs: Non-Governmental Organizations
NHMRC: National Health and Medical Research Council (Australia)
OECD: Organization for Economic Cooperation and Development
OGTR: Office of the Gene Technology Regulator
PAH: Polycyclic Aromatic Hydrocarbons
PCB: Pentachlorobenzenes
PCP: Pentachlorophenyl
PRV: Papaya Ringspot Virus
RUSHSAP: Regional Unit for Social and Human Sciences in Asia and the Pacific
SFU: Shareholder Focused Utilitarianism
TNT: Trinitrotoluene
UNESCO : United Nations Educational, Scientific and Cultural Organization
US-APHIS: US Animal and Plant Health Inspection Service
US-EPA: US Environmental Protection Agency
US-FDA: US-Food and Drug Administration
VBEAC: Victorian Biotechnology Ethics Advisory Committee

PREFACE

Biotechnology has been with humankind since the beginning of our existence as we modify the environment around us for shelter, food and tools. Modern biotechnology has been a stimulus for discussion of many bioethical issues, and continues to be so as evident in the papers assembled in this volume. While ensuring the right of scientific investigation, there is also a necessity to ensure that scientific progress is ethically acceptable. Reflecting this concern, UNESCO (United Nations Educational, Scientific and Cultural Organization) has made ethics of science and technology one of its five priority areas. This volume offers perspectives from persons in a range of countries across Asia and the Pacific on some ethical issues related to biotechnology, many of whom are actively involved as members of the UNESCO Asia-Pacific School of Ethics.

UNESCO's programme in this area aims to strengthen the ethical link between scientific advancement and the cultural, legal, philosophical and religious context in which it occurs. UNESCO's strategy in bioethics has been to act as a standard-setter on emerging ethical issues, to disseminate information and knowledge and to help Member States build their human and institutional capacities. The standards include the Universal Declaration on the Human Genome and Human Rights, adopted by UNESCO's General Conference in 1997 and subsequently endorsed by the United Nations General Assembly in 1998. This was followed by the International Declaration on Human Genetic Data, adopted in 2003; and the Universal Declaration on Bioethics and Human Rights, adopted by UNESCO's 33rd General Conference in 2005.

This collection of papers is second in a series of books from RUSHSAP, UNESCO Bangkok offering perspectives on ethics in Asia and the Pacific region, with each focusing on a specific theme. These papers were originally presented during conferences on ethics in science and technology which UNESCO's Regional Unit for Social and Human Sciences (RUSHSAP) has been convening since 2005. Since intercultural communication and information sharing are essential components of these deliberations on ethics of science and technology, the books also provide theme-related discourse from the conferences.

The First UNESCO Bangkok Bioethics Roundtable was held between 11-15 September, 2005 - the first event in Bangkok to celebrate UNESCO's 60th anniversary. The UNESCO Bangkok office is the largest UNESCO branch office in the Asia-Pacific region, encompassing 46 member countries. RUSHSAP is designated as the regional office for coordinating implementation of UNESCO programmes in the social and human sciences sector in Asia and the Pacific region, which includes programmes on ethics of science with the Division of Ethics of Science and Technology in Paris.

I would like to thank the active discussion and participation of all those who attended the UNESCO Bangkok meetings. A special thank you is due to Heather McClellan, Silvie Poeth and Daniel Calderbank for help in editing the papers, and to Frankie Keller for transcribing the discussion. The cover design is thanks to Alessandro Blasi and the book text layout was prepared by Celia Thorheim. We look forward to increased discourse on these papers not to be seen as the final word on these topics, but rather as ways to catalyze a greater regional discussion of the ethics of science and technology.



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Is there a need or space for gene technology ethics: An Australian perspective*

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Biotechnology and Ethical Principles

Biotechnology is a classical example of a knowledge-value industry that is widely supported by the OECD (Organization for Economic Cooperation and Development) as a basis for future employment and wealth for advanced nations. Australia has drawn up its own Biotechnology: National Strategy, in which it states that it shall be “consistent in safeguarding human health and ensuring environmental protection, that Australia capture the benefits of biotechnology for the community, industry and environment”. The National Strategy was developed with regard to international standards. Equally, the National Strategy acknowledges the emergence and development of environmental ethics. The environmental ethical principles that have emerged are expressed in both familiar and new terms, such as care and protection of the environment, respect for biodiversity, the precautionary approach (see Article 15, Convention on Biological Diversity), and sustainability and natural ecosystems (Graham, 2004).

Gene Technology Act 2000: Australian regulation of GMOs

The Gene Technology Act 2000. This Act established the regulatory framework for the licensing of dealings with genetically modified organisms (GMOs) in Australia. Reflecting the sentiments of the National Strategy, the Act aims “To protect the health and safety of people, and to protect the environment, by identifying risks posed by, or as a result of, gene technology and by managing those risks through regulating certain dealings with GMOs”.

The aims of the Act are to achieve:

- national consistency in regulation within the federal system;
- transparency and accountability in GMO dealings;
- responsiveness to stakeholder's views;
- scientifically-based risk assessment;
- independent decision making;
- avoidance of duplication in regulation;
- improvement in the coordination of agencies.

The Act established the Office of the Gene Technology Regulator (OGTR)¹, which regulates dealings with GMOs, including exempt dealings, accreditation of facilities and organizations, and licensing of intentional releases of GMOs into the environment (see: www.ogtr.gov.au). The Act sets down a comprehensive and rigorous system of the scientific assessment of risks involved in dealings with GMOs. The Gene Technology Regulator is required to develop a Risk Assessment and Management Plan to address any identified risks. The Regulator principally examines the scientific risks involved, and is not required to consider issues of:

- cost/benefit economic considerations;

¹ See www.ogtr.gov.au

* Paper first presented at the First UNESCO Bangkok Bioethics Roundtable, September 2005.

- comparisons with alternative technologies;
- marketing and trade impacts of any granted licence

The Act does include comprehensive consultation processes that are required by the Regulator for the issue of a licence. At the end of September 2005, the Regulator had approved 35 field trial licences, approved 303 contained dealings licences, and received notification of 1,809 low-risk dealings. One commercial licence has been issued for a carnation (blue colour) and a cholera vaccine (cholera toxin removed), three were issued for cottons (herbicide tolerant and/or insecticidal), and two for canolas (hybrid and /or herbicide tolerant).²

Gene Technology Ethics Committee (GTEC)

The Gene Technology Regulator has three advisory committees under the terms of this Act. The Gene Technology Technical Advisory Committee advises on the scientific and technical aspects of applications for licences. The Act also recognizes that, as well as strict compliance with the legal requirements of the Act, there may be ethical and social issues that require consideration. These ethical and social issues surrounding genetically modified organisms (GMOs) were recognized by the creation of the Gene Technology Ethics Committee (GTEC) and the Gene Technology Community Consultative Committee (GTCCC).

The Gene Technology Ethics Committee (GTEC) was established to provide advice to the Regulator or the Ministerial Council on:

- ethical issues relating to gene technology;
- the need for, and content of, codes of practice in relation to ethics in respect of conducting dealings with GMOs;
- the need for, and content of, policy principles in relation to dealings with GMOs, which should be conducted for ethical reasons (section 112).

The Gene Technology Ministerial Council may issue policy principles in relation to: ethical issues; recognizing non-GM or GM zones designated under State law for marketing purposes; and matters dealings with GMOs prescribed by the Gene Technology Regulations of 2001.

The GTEC is a multi-disciplinary committee with members with skills or experience in areas such as environmental ethics, law, religious practices, agricultural practices, and animal health and welfare (section 111, (5)).

Are environmental ethics needed?

In the area of research involving humans, the basic regulatory framework depends on well-established codes of ethical practice, such as the key international reference point of the Declaration of Helsinki (WMA, 1996), or, within Australia, the National Statement of Ethical Conduct in Research Involving Humans (NHMRC, 1999), or the CIOMS Guidelines (1997). In the case of research involving animals, there are established ethical and legal standards (for example, BBRC, UK, 2000) that provide a statutory framework within State and Territory Animal Welfare Acts. The statutory framework has been supplemented gradually by Codes of Practice and ethical principles developed by the National Health and Medical Research Council (NHMRC), in particular the 7th edition of the 2004 Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (NHMRC, 2004).

There are no gene technology or environmental equivalents of the Human Research Ethics Committees or Animal Welfare Committees. Similarly, while codes of medical research ethics contain statements of broadly agreed and consistent principles, there are no equivalent international statements in relation

² Updates in Quarterly Report of the Gene Technology Regulator

to agreed environmental ethical principles. At this stage, environmental ethics are significantly less developed and formalized (Smith, 1997; Sylvan, 1994).

The GTEC is developing a National Framework Statement on environmental ethics, and on the ethics of gene technology. Other countries (for example, New Zealand (2004) and the Vatican (2002) have also examined the ethical aspects of genetic manipulation. GTEC notes the excellent work done by the two states of Queensland (Queensland, 2001) and Victoria in developing their ethical statements in this area. The GTEC, in developing the draft National Framework Statement, took the following matters into account:

- relevant provisions/objects of the Act;
- relevant International Conventions (UNESCO 1 and 2);
- concerns about GMO technology (AEBC, 2003ab; Nuffield Council, 2003);
- development of environmental ethics as a distinct branch of ethics;
- codes of ethics dealing with human and animal research;
- social responsibility of scientists to act ethically/with integrity;
- scientific endeavours and the pursuit of knowledge

GTEC has identified the following set of 10 core principles that apply to the environment in general, and to gene technology, GMOs, and GM products:

- (1) Integrity is the guiding value for researchers and all others involved in gene technology and GMOs in their search for knowledge. It is crucial in their commitment to the obligations and spirit of the national regulatory system;
- (2) Researchers and all others involved in gene technology and dealings with GMOs have the legal and ethical responsibility to ensure that activities within their control do not cause damage to the Australian environment or in areas beyond the limits of national jurisdiction. In so doing, there must be a thorough assessment of the extended side effects of practical applications in gene technology and dealings with GMOs;
- (3) Gene technology and dealings with GMOs should be conducted with consideration of the environmental and health needs of present and future generations;
- (4) Gene technology and dealings with GMOs should be conducted in a manner that integrates environmental and health protection into the research and development process;
- (5) Researchers and all others involved in gene technology and dealings with GMOs should demonstrate respect for persons in all acts, including obtaining appropriate consent. Respect for persons is expressed as regard for the welfare, rights, beliefs, perceptions, customs, and cultural heritage (both individual and collective) of persons likely to be affected by the gene technology and GMO dealings;
- (6) Researchers and all others involved in gene technology and dealings with GMOs should demonstrate respect for all living things and the environment on which they depend in every act when dealing with gene technology;
- (7) Researchers and all others involved in gene technology and dealings with GMOs should minimise risks of harm or discomfort to the persons (or living things) affected by the dealing;
- (8) Researchers and all others involved in gene technology and dealings with GMOs should act with compassion, reciprocity, and solidarity with others and with future generations;
- (9) There is a challenge to promote an equitable distribution of benefits from the biotechnology revolution to developing nations. This may include promoting equal access to scientific developments, sharing knowledge, and recognising the value of benefit sharing.

(10) Researchers and all others involved in gene technology and dealings with GMOs should carry through the values and principles set out in this framework in a practical, informed way, without sacrificing one value while attempting to realise another value.

These core principles aim to assist scientists and the community to identify and follow the correct conduct in relation to the environment in general, and gene technology, GMOs, and GM products in particular. The GTEC considered that these principles were grounded in certain core values identifiable in the Australian community (knowledge; reason and wisdom; trust; integrity and courage; respect for life and equity; freedom of choice; and respect for the environment). These principles are for guidance and, at this stage, are not intended to be prescriptive. These principles may form the basis upon which codes of practice or policy principles (under the relevant provisions of the Gene Technology Act 2000 and the corresponding state and territory acts) may be developed at a later stage.

Concluding remarks

Public trust in science and biotechnology is a major issue. The Novartis Foundation, for example, has noted that deficits of trust are and were a general rule, rather than advances of trust. This was similarly recognized by the U.K. House of Lords Select Committee, which said there was a “new mood for dialogue where scientists were beginning to understand the impact of [their] work in society and public opinion”. This trend is towards greater public scrutiny through legislation, which places the responsibility for the scrutiny of biotechnology squarely within parliamentary responsibility. But, of course, this is not to deny the importance of the social responsibilities of the scientists themselves.

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Governance of biotechnology in the state of Victoria, Australia*

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Introduction

In April of 2004, the Government of Victoria asked the Victorian Biotechnology Ethics Advisory Committee (VBEAC) to convene a meeting of community and industry stakeholders to consider the need for a “Code of Ethical Practice for Biotechnology” to guide the behaviours, actions, and decision-making of individuals using biotechnology in the State of Victoria.

The VBEAC is an independent committee established by the government to provide advice on ethical issues in relation to biotechnology in Victoria. Its members are appointed in their own right for having relevant expertise in areas such as: biomedical research; applications of biotechnology in agriculture; religion and ethics; consumer advocacy; animal welfare; law; and environmental advocacy. In addition, the VBEAC has lay representatives drawn from the community, who have no affiliation with the biotechnology industry.

The meeting attendees were largely individuals who use biotechnology in the continuum from research to commercialisation. Representatives from civil society and the lay community also participated. After considering existing and proposed models for biotechnology governance, the meeting recommended that the government develop a voluntary document to provide guidance, rather than enact an enforceable code.

Subsequently, the Statement of Ethical Principles for Biotechnology in Victoria (the Statement) was developed by VBEAC and received the state government’s endorsement. As a government-endorsed document, the Statement allows individuals and institutions to adopt it and customize its use in their related activities.

The Statement is intended to be reviewed and updated on a regular basis, and information about its usefulness and relevance to the users of biotechnology will be gathered to inform this process.

Code versus statement of principle

The field and applications of biotechnology are broad. Numerous statutory and non-statutory instruments currently in place were identified as providing guidance and setting standards for the ethical behaviour of scientists and others using biotechnology.

VBEAC’s interest in identifying gaps in the current scheme required a parallel process to develop a map of existing instruments that provide ethical guidance and governance. The map was tabled with the Statement and is the basis for stakeholder meetings to develop strategies to address any gaps.

An enforceable Code of Ethical Practice was not the preferred approach of stakeholders. They expressed fears that the resulting duplication in coverage between state and national-governance instruments could potentially cause confusion and inconsistency in practice for users of biotechnology. Because Australia has a central national licensing system for gene technology yet no administrative structures in place to enforce additional legislation in this area, it was viewed that enforcement of a Code of Ethical Practice would have required significant input of resources without any notable advance in the

* Paper first presented at the First UNESCO Bangkok Bioethics Roundtable, September 2005.

protection of public health and safety or the environment.

The industry and, in particular, research institutions also highlighted the already substantial administrative burden of compliance with existing governance and regulatory schemes.

Finally, it was suggested that the development of a statement of ethical principles for biotechnology would have an additional benefit in its usefulness as an educative tool for the wider community — the ethical principles applicable in science and technology activities are not easily available or accessible for individuals outside of the science community.

Process for development of the Statement

The VBEAC's development of the Statement and the mapping exercise was carried out in a systematic and consultative manner.

Similar examples of codes of conduct and practice were reviewed. For example, ideas were sourced from both the UNESCO Preliminary Draft Declaration on Universal Norms on Bioethics as well as Australian legislation and guidance documents relating to the ethical review of research involving humans.

Given that the Statement is directed towards business practice as well as scientific conduct, the VBEAC included principles drawn from the fields of business ethics and governance within the public sector.

Two rounds of publicly advertised comment were sought — initially interested parties were asked what elements were important to include in such a statement, and an initial draft of the Statement and the mapping document were circulated for comment. A total of 78 submissions were received and reviewed by the VBEAC before the document was finalized and presented to the Government.

In addition, the VBEAC convened a secondary school student forum, in which 30 schools participated. The student forum was organized by a group of students from senior years 10 to 12. Students constructed a questionnaire looking at the applications of the draft ethical principles, which was then discussed in small breakout groups and again in a plenary forum. The students also considered how adherence to the Statement could be monitored, and they suggested strategies for its dissemination.

The statement of ethical principles for biotechnology in Victoria

The Statement of Ethical Principles for Biotechnology in Victoria is contained within a seven-page document that defines “ethical principles”, “biotechnology”, and the environment in which the Statement operates.

The map of existing ethical guidance and controls accompanies the Statement but is formatted as a ready reference poster.

The Statement puts forward the following eight ethical principles as fundamental to all activities using biotechnology:

Respect for Persons: The recognition that persons have an inherent dignity and the welfare, rights, beliefs, perceptions, customs, and cultural heritage of individuals should be taken into account;

Respect for Animals: The recognition that animals have a value both in their being and in relation to human culture; the welfare and humane treatment of animals should be taken into account;

Respect for the Natural Environment: The recognition that the natural environment is our common heritage and sustains all life and human culture. The natural environment is more than a means to satisfy human ends. The safeguarding of biodiversity, ecosystems, and the beauty of the natural environment should be taken into account now and in the interests of future generations;

Respect for the Public Good: The recognition that individual activities take place in a context

of social and institutional relationships. The “public good” is a collective good to be taken into account along with individual interests. Our understanding of the “public good” shapes the society in which we live;

Benefit and Harm: The recognition that human activities have an impact and should promote good and avoid harm. The use of risk assessments, as a tool to ensure health and well-being, should be considered;

Justice and Equity: The recognition that the benefits and burdens from biotechnology activities should be distributed equitably through society such that no particular group is inequitably advantaged or disadvantaged now or in future generations;

Probity: The recognition that activities should be conducted honestly, truthfully, lawfully, impartially, competently and with considered regard for transparency of process;

Accountability: The recognition that persons and institutions are inherently responsible both for their actions and the justification, the purpose and the consequence of their actions.

Interpreting the ethical principles

In addition to the stated ethical principles, the VBEAC document includes a set of questions to assist individuals integrating the ethical principles into institutional and individual practice and governance systems.

In Relation to Respect for Persons:

- Have persons likely to be affected by decisions been informed and consulted about the proposed biotechnology activity?;
- Has this biotechnology activity been undertaken with regard to the safety, welfare, rights and beliefs of research staff, research participants and those impacted by the activity?;
- Has individual autonomy been respected through the provision of accurate information presenting both the benefits and the risks likely to occur from undertaking the activity that will allow individuals to make informed decisions?;
- Has the privacy of personal information been protected?;
- Will genetic information arising from biotechnological activity potentially be used in a manner that may lead to discrimination?;
- Does this biotechnology activity contribute to an identified need by improving human health or otherwise enhancing the quality of human life?;
- Has a properly constituted Human Research Ethics Committee approved any biotechnology research proposal involving humans?

In Relation to Respect for Animals:

- Have alternatives to the use of animals in biotechnology research been sought wherever possible?
- Have the minimum possible number of research animals needed to produce valid results been used and a justification provided for the determined number?
- Has biotechnology research been designed with regard to the biological characteristics of research animals, including their behaviour, species, genetic attributes, and their nutritional and general health status, so that potential pain and distress to the research animals is avoided or minimized?
- Has a properly constituted Animal Ethics Committee approved the biotechnology research proposal involving animals?
- Where the biotechnology activity may result in the creation of a transgenic or genetically modified animal, has regard been given to minimize any suffering of the animal, including the

deprivation of its natural expressions?

In Relation to Respect for the Natural Environment:

- Will the benefits from the application of biotechnology be achieved at the expense of damaging the natural environment for future generations?;
- Has humanity's stewardship of the splendour and inherent value of the natural environment been taken into account via the neutral impact of the biotechnology activities?;
- Does the biotechnology activity support environmental sustainability?;
- Does the biotechnology activity preserve and foster biodiversity and avoid serious side effects to species present in the surrounding environment?;
- Have suitably qualified persons undertaken an environmental impact assessment wherever there is uncertainty or lack of information regarding the effects of proposed biotechnology activities?;
- Is environmental degradation reduced or avoided as a result of the biotechnology activity?

In Relation to Respect for the Public Good:

- Has balanced information been made available to the public so as to foster informed public discussion of biotechnology-related issues and to allow for the expression of any public concerns about a particular development?;
- Does the biotechnology activity lead to an overall benefit for the public, with consideration given to the social and environmental benefits as well as expected economic benefits?;
- Is the biotechnology activity consistent with the accepted ethical standards of professional practice?;
- Is the proposed biotechnology research activity of sufficient scientific merit that it does not produce results of questionable validity or duplicate other research unnecessarily?;
- Have the results of biotechnology research been published within a reasonable time frame (given consideration of any commercial-in-confidence restrictions)?;
- Has this biotechnology activity been carried out in a manner that recognizes and protects the cultural heritage and rights of indigenous populations?;
- Is the biotechnology activity adequately secured so that it will not be used or applied to destructive ends, such as in biotechnological weaponry?;
- Have research staff and research ethics committees undertaken training in ethics and research governance to ensure that biotechnology activities are conducted according to accepted ethical standards?;
- Where appropriate, has a social impact study been undertaken for this biotechnology activity?

In Relation to Benefit and Harm:

- Is the biotechnology research carried out by individuals who have the relevant technical knowledge and skills for such activities?;
- Do risk assessments of the biotechnology activity identify the possible long-term effects so these may be taken into account in risk management strategies?;
- Is the biotechnology activity undertaken in a way that causes harm to, or puts at risk the safety of, persons, animals, or the natural environment, where such harm or risk is disproportional to the expected benefits?;
- Are there systems in place to ensure the recall or ceased production of any biotechnology activity or GM product that exhibits negative effects on human health, safety, or the environment?

In Relation to Justice and Equity:

- Have the interests been taken into account of those most likely to be affected by this biotechnology activity?;
- Have groups been identified who are potentially disadvantaged by the biotechnology activity?;
- Have steps been taken to ensure that the biotechnology activity does not expose any particular group to

- a risk or burden disproportionate to the benefit that may be expected to flow to them?;
- Will the biotechnology activity result in obtaining benefits for the present generation to the detriment of future generations?;
- Will this biotechnology activity adversely impact efforts to foster a society where risks, burdens, and benefits are distributed equitably?

In Relation to Probity:

- Are biotechnology activities undertaken with intellectual honesty and in accordance with professional standards?;
- Have processes been put in place to identify and resolve actual or perceived users' conflicts of interest relating to biotechnology product development?;
- Are public statements made by biotechnology users or organizations tested to ensure that they do not misrepresent the biotechnology product or the process of its development?;
- Do biotechnology research results undergo peer review before being published?;
- Are responses to information requests from the community met promptly and accurately, subject to specific privacy or commercial-in-confidence restrictions?;
- Have biotechnology users and organizations put in place processes to monitor their adherence to and compliance with the Statement of Ethical Principles?;
- Are there mechanisms in place for dealing with conflicts of interest as well as conflicting interests, especially for persons responsible for public statements?

In Relation to Accountability:

- Is the biotechnology activity carried out in a transparent and open way with public scrutiny as far as is possible given the constraints of commercial-in-confidence requirements?;
- Are the outcomes of publicly funded biotechnology research and development publicly reported?;
- Will biotechnology users and organizations adopting the Statement of Ethical Principles put in place transparent processes that report on compliance with the Statement?;
- Where a biotechnology activity has inadvertently resulted in harm or loss to a third party, will the biotechnology user or organization act to remediate the loss or harm?;
- Has a properly constituted Institutional Biosafety Committee reviewed the biotechnology activity and established a monitoring process relative to the level of risk?

External bodies such as Human Research Ethics Committees, Institutional Biosafety Committees and Animal Ethics Committees have defined roles within the Australian ethical governance system. Further information on their roles and function are noted in the map.

Conclusions

The State Government endorsed the Statement of Ethical Principles for Biotechnology in Victoria. The VBEAC held further stakeholder meetings to identify gaps in the existing system of ethical guidance and controls and suggest ways in which these gaps may be addressed. Further documentation providing individuals and institutions with a framework for recognizing ethical issues associated with the use of biotechnology has subsequently been distributed as well as the statement and map. The VBEAC also provided the Statement to other government jurisdictions with an aim to support the development of a national Australian Statement, and to mitigate potential inconsistency in practice across jurisdictions.

Further information on the Statement and VBEAC activities may be found at <http://www.health.vic.gov.au/biotechnology>

Information on the Victorian Government's Strategic Development Plan for Biotechnology (2005) may be found at <http://www.biotechnology.vic.gov.au>

The Transgenic Thai Papaya story: A Milestone Towards Thailand Becoming a Biotech Crop Country*

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Transgenic papaya resistant to Papaya Ringspot Virus

Papaya ringspot virus (PRSV) is one of the limiting factors in growing papaya in many regions of the world, including Thailand. PRSV stunts the infected plant and reduces the size of its fruits, sugar content, and yield. After the plants become infected by the virus, curative measures are not available. Some control measures are aimed at removing virus sources, providing certified virus-free plant materials, reducing the spread of the virus, breeding for virus resistance, and cultural practice. Although conventional breeding has developed a number of virus-tolerant papaya varieties (DOA, 1997), these tolerant papayas may serve as reservoirs of the virus and may be attributable to subsequent epidemics of the ringspot disease. Currently, no natural virus-resistant genes against PRSV have been identified or are readily available for conventional breeding. Thus, genetically engineered virus resistance became a primary interest of researchers.

A virus-resistant transgenic papaya was the first genetically modified fruit crop launched on the market (Gonsalves, 1998). The first transgenic papaya resistant to PRSV was produced in a laboratory in a joint experiment between Cornell University and the University of Hawaii (Fitch et al., 1992). The pathogen-derived resistance mechanism in transgenic papaya has been reported as an RNA-mediated mechanism (Souza, 1999). On May 1st, 1998, after the completion of research, testing, deregulation, and commercialization procedures, the transgenic papaya seeds became available to the farmers of Hawaii (Gonsalves, 1998). Development of the virus-resistant transgenic papaya line 55-1 has been reviewed in detail by Gonsalves (1998). The success of transgenic papaya has been well evidenced and served as a model for technology transfer for many countries, such as Jamaica, Brazil, Venezuela, Bangladesh, and Thailand. Since then, farmers in Hawaii have been able to reclaim their land for papaya production. (Gonsalves et al., 2004).

Papaya Ringspot Virus in papaya in Thailand

Destruction of papaya plantations by PRSV has been reported worldwide (Gonsalves, 1998; Kiritani and Su, 1999; Wolfenbarger and Walker, 1974). Papaya ringspot virus (PRSV) is a flexuous rod-shaped single-stranded positive sense RNA virus belonging to the Potyviridae strain. Its host range is limited to Caricaceae, Cucurbitaceae, and Chenopodiaceae (Purcifull et al., 1996). Conventional control methods of the virus, including sanitation, cultural practices, cross protection, and control of aphid vectors, have not been very successful (Gonsalves, 1998; Kiritani and Su, 1999).

PRSV can kill young susceptible papaya seedlings. It causes mottled patterns of the leaves, reduction of the laminar area, and water-soaked ringspot lesions on stems and fruits (Wolfenbarger and Walker, 1974). When severely infected with PRSV, the palm-like papaya tree is reduced to only a stem (Kiritani and Su, 1999; Tennant et al., 1994). In addition, yields of the infected plants are mostly unmarketable. PRSV causes one of the most destructive diseases in papaya (*Carica papaya* L.). It is a major limiting factor to papaya production in many tropical and subtropical countries, including the United States (Hawaii and Florida), tropical Africa, Australia, and South and Southeast Asia (Ali and Lazan, 1998; Gonsalves, 1998; Kiritani and Su, 1999).

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In Thailand, the first report of PRSV was in 1975. Measures used to combat the infestation of PRSV included instigating quarantine controls, burning all infected plants, and using virus-tolerant varieties and pesticides. Nevertheless, all these measures just seemed to delay the real destruction. In 2002, up to 80% of papaya production was severely damaged by the infestation of PRSV (Sangruksawong, 2004). From a report by the Thailand Department of Agriculture, the production of papaya between the years 1997 and 2002 was 461,179 metric tons, or approximately 17.437 metric tons/hectare/year, which is considered very low. When virus-resistant transgenic papayas were deployed in a disease management programme, the 2002 production of papaya in Hawaii was approximately 29.037 metric tons/hectare. (Gonsalves et al., 2004).

Development of the virus-resistant transgenic Thai papaya

Due to an urgent need for effective control measures against PRSV, several governmental agencies have been working to alleviate a common problem: the epidemics of ringspot disease in papaya. These agencies include Mahidol University, Kasetsart University, and the Department of Agriculture. Researchers at Mahidol University study molecular resistance mechanisms. Those at Kasetsart University are working on resistance against PRSV and delayed-ripening traits. The Department of Agriculture had established collaboration with researchers at Cornell University, USA, to develop virus-resistant Thai papayas. Here we will cover the works related to the Department of Agriculture only.

In 1995, the Department of Agriculture sent Thai researchers to produce virus-resistant Thai papayas with a group led by Professor Dennis Gonsalves at Cornell University, where the first virus-resistant transgenic papaya was developed. In 1997, the first Thai papayas were transformed by Thai researchers with technical assistance provided at Cornell University and brought back to Thailand. As a result of this technology transfer, two lines of transgenic Thai papayas, namely Khak Dam and Khak Nuan varieties, were rendered. These transgenic papayas were transformed with constructs of non-translatable versions of a coat protein gene of a PRSV isolate from Thailand. Thus, similar to the transgenic papayas in Hawaii, these transgenic Thai papayas do not express a viral coat protein. The resistance mechanism is RNA-mediated, commonly known as a process called post-transcriptional gene silencing.

Thailand's Department of Agriculture set up the Khon Kaen Horticultural Station with the aim of making Thailand a centre of excellence in the study of transgenic papayas. These papayas were subjected to a test for their resistance against Thai strains of PRSV and for biosafety, both nutritional and environmental. The testing was divided into three levels, i.e., in laboratory or under greenhouse conditions, in a confined field site of the Department of Agriculture, and in a field site under real orchard conditions.

Several tests have been conducted to clarify biosafety concerns (Sangruksawong, 2004). The tests under laboratory and greenhouse conditions showed that both lines of the transgenic Thai papayas exhibited 97-100% resistance against PRSV infection compared to the non-transgenic papayas. Under confined field conditions, the average yield of transgenic Thai papayas was over 293 metric tons/hectare. In co-cultivation experiments, transgenic Thai papayas were grown in close proximity with several locally-grown plant species and weeds, such as ground nuts, maize, lettuce, string bean and water morning glory. In this experiment, all plants exhibited normal growth and development. Also, the number of microorganism species in the soil and compost of transgenic Thai papayas was not significantly different from the number of microorganism species in those of non-transgenic papayas. Those species included *Rhizobium*. and mycorrhiza. In addition, the development and growth of bees and mice were not affected by consumption of transgenic Thai papaya, compared to those fed with non-transgenic papayas.

Risk assessment and deregulation of genetically-modified crops

Genetically engineered plants and products derived from genetically engineered plants have reached markets in several countries, including the United States, Canada, China, and Australia. However, a common apprehension is that transgenic plants can be harmful to human consumption and the environment. Since nutritional aspects and allergenicity are major concerns to human consumption, guidelines to determine the allergenicity of food products derived from genetically engineered

plants are available (FAO/WHO, 2001; Wal, 1997). For instance, comparisons of amino acid sequences and protein structures of known allergens are made with the food products derived from genetically engineered plants to determine their similarity. Reactions of antibodies to known food antigens are tested. In addition, animal testing and digestion assays can determine relative digestibility of the genetically engineered protein in mammalian gastrointestinal tracts.

The environmental concerns over virus-resistant plants are mainly ecological. These include transcapsidation, synergism, transgene flow or introgression, and recombination (Tepfer, 2002). Nonetheless, we need to delineate actual risks from perceived risks. It is difficult to generalize whether transgenic plants are likely to pose ecological risks because each transgenic plant may be transformed with different genes and derived from different techniques. Each component provides idiosyncrasy to a transgenic plant. Many of the concerns are not only specific to the gene and the host plant, but also to the environment in which the plant is released. Thus, it is important to consider the concerns on a case-by-case basis.

In the USA, deregulation of transgenic papayas was conducted by the US Animal and Plant Health Inspection Service (US-APHIS), the US-Food and Drug Administration (US-FDA), and the US Environmental Protection Agency (US-EPA) before releasing transgenic papaya into the environment. US-APHIS, with its mission to monitor and safeguard resources and the environment, was concerned with the potential ecological risks of the transgenic papaya. APHIS deregulated transgenic papaya line 55-1 in Hawaii and its derivatives in 1996 (USDA/APHIS, 2002). A petition to the US-EPA for an exemption from tolerance levels of the coat protein produced in the transgenic papaya was submitted in 1997 (EPA, 2002). The mission of the US-EPA is to protect human health and to safeguard the natural environment. The Hawaiian transgenic papaya line 55-1 and its derivatives, including 'SunUp' and 'Rainbow' varieties, were granted an exemption by US-EPA in 1997. US-FDA, which regulates food safety of transgenic products, approved the papaya line 55-1 and its derivatives in 1997 (FDA/CFR, 2002). Data showed that line 55-1 is not materially different in composition from non-transgenic 'Sunset' (Gonsalves, 1998). 'SunUp' and 'Rainbow' were commercialized in May 1998.

In other countries such as Japan, the development and application of living modified organisms (LMOs) are regulated under specific laws. Japan has "The Law Concerning the Conservation and Sustainable Use of Biological Diversity Procedures". They are classified into two types: Type One is for the use of LMOs where no preventative measures are required against their dispersal into the environment; Type Two is for the use of LMOs with preventive measures. During the period of development, the Ministry of Education, Culture, Science, Sports, and Technology is responsible for the risk assessment of LMOs.

For Thailand, specific laws and regulations concerning the release of LMOs are still to be established. Currently, the Department of Agriculture has been following the Quarantine Regulations that have been used to quarantine and handle any importation of plants and living materials since 1964. Thus far, there has been no distribution of transgenic materials to the public. Besides, the Department of Agriculture has been conducting the test on biosafety with the highest security level. For instance, the confined field sites have been double fenced and guarded 24 hours a day. The non-transgenic papaya production facility is located approximately 150 metres away from the confined field experiment location. These measurements have been employed to minimize the risk of cross-contamination from the fields of transgenic papayas to other crops.

At the time of printing this paper no commercialization or distribution of transgenic Thai papaya seeds is allowed (Sangruksawong, 2004). Any importation of genetically modified organisms can only be done for research purposes. Therefore, any procedures involving transgenic papayas must be conducted with great care. Detailed biosafety laws have been undergoing drafting for years by the Ministry of Natural Resources and Environment, in conjunction with an expert panel from Thailand's National Centre for Genetic Engineering and Biotechnology (BIOTEC), the researchers must conduct experiments by taking precautionary measures for biosafety concerns.

Because of a need for a legal framework to deal with transboundary movement of LMOs, the Cartagena

Protocol on genetically modified crops or other LMOs has been ratified by 147 countries as of May 2008.¹ Initially, the Cartagena Protocol was drafted to protect biodiversity resources against any deliberate release of LMOs. Currently, it is also used to provide consistent and unbiased guidelines to a country that, for whatever reason, might need to deal with the importation and release of LMOs (Watanabe et al., 2004). Thailand signed up to the Cartagena Protocol soon after BBRT¹, acceding to it in February 2006.

Summary

The devastation caused by PRSV on papaya production has been documented extensively. The impacts could be both economical and sociological to both farmers and local communities. In Thailand, the farmers either rotate their crop species or move to another area where the virus infestation has not arrived, and some markets have started to import papayas to substitute production losses. These temporary solutions have not only had negative impacts on the local economy but also affected the minds and dignity of the local people, because they need to import a staple food that was once grown in their own backyards. These are definitely not good solutions to the problem. The urgency of measures to alleviate the ringspot disease on papaya is apparent in Thailand. While several governmental agencies are taking efforts to deregulate the virus-resistant transgenic Thai papayas, stakeholders should work towards a practical and sound resolution based on scientific evidence in a timely manner.

The transgenic papayas in Hawaii provide an excellent example to objectively determine how a transgenic product may affect the farmers and local community. The project was started on a humanitarian basis, without investments from large multinational companies. The genetically engineered papaya cultivars have successfully demonstrated resistance to PRSV in laboratory, greenhouse, and long-term field trials. They have been in the open field for almost a decade now and there is no single report of any catastrophic event from the release of the transgenic papayas in Hawaii. However, for Thailand, it appears that the deregulation process will take more time than it did in Hawaii. This seems to be due to the controversies over generalization of transgenic technology.

Concerns over biosafety issues should attest to justified assessment experiments for the actual risks, and on a case-by-case basis. At this point in time, Thailand has no biotech crop that is grown by local farmers. To bring Thailand towards being a biotech crop country, it is essential for the scientists and those who know and understand this technology to speak up and educate the uninformed. After joining the Cartagena Protocol, the interim regulatory agencies are working on agreements on the deregulation process of LMOs. A high demand for virus-resistant transgenic papayas from local farmers, and the established regulations of the government may propel the speed of deregulation. Then, with the regulatory approval to the virus-resistant transgenic Thai papayas, Thailand will set its milestone towards becoming a biotech crop country. The transgenic Thai papaya will pave a path and become the practical pilot case for other fruits of biotechnology to follow.

Disclaimer

This article only reflects the opinions of the authors. It does not provide any implication or any relation to the Thailand Department of Agriculture or any other mentioned agencies. Should further clarification be required, please contact the corresponding author.

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¹ <http://www.cbd.int/biosafety/signinglist.shtml>

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Benefits and ethical limits of biotechnology*

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Introduction

Consideration of the ethics of science, technology and the environment require a multidisciplinary perspective.

Biotechnology is the most controversial scientific discovery of recent times and hit the headlines of newspapers throughout the world because of potential positive and negative effects on the ethical and social aspects of present day civilized society. There are innumerable biotechnical, agricultural, industrial and medical applications in the biotechnological approach. In the field of medical and chemical biotechnology, biotechnologists have triumphed in producing some special chemicals such as amino acids, vitamins and enzymes which are essential for normal biological functions. (Organization of Economic Cooperation and Development, 2001).

Biotechnologists have made remarkable contributions in the fields of agriculture and food in areas like pest control and animal foodstuffs. The food processing industry has a constant demand for acceptable additives such as colorants, sweeteners and sauces, including soy sauce, novel catalysts and preservatives. They have developed plants resistant to pollution, insects, pests and even pesticides. Biotechnologists are trying to transfer the genes of the neem tree for insect and pest resistance. Using biotechnological methods, scientists have succeeded in enhancing the production of secondary products such as wood, leaves, resins and also improving other products such as fatty acids, organic acids, vanilla and pigments.

In the fields of energy and the environment, plants are the most efficient energy stores used by biotechnologists to produce fuels such as biodiesel directly from plants. Biotechnologists have efficiently produced alcohol from biogas. Waste treatment has also improved as a larger scale fermentation industry requires new catalysts and improved reactors to treat toxic waste.

Examples of the benefits of biotechnology

Biotechnology is the application of biological systems in technology that can only be achieved through an integration of the biological, physical and engineering sciences. In this paper I wish to give some examples that relate to life in developing countries.

The current approach of biotechnology in the environment is to apply biological products such as enzymes rather than live cultures. Enzymatic action is very specific and also easy to control. This paper discusses biotechnological applications in different operations including: i). Waste water treatment; ii). Removal of specific pollutants by bioremediation;

iii). Biotechnology for hazardous waste management; iv). Biotechnology for the pesticide industry; v). Biotechnology for food and allied industries, and; vi). Biotechniques for air pollution abatement and odour control, where the roles of chemical and environmental scientists are involved.

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Waste water treatment

Biological processes for industrial effluent treatment includes aerobic biological treatment, anaerobic biological treatment, membrane bioreactors, the use of immobilized enzymes and microbial cells. Biotechnology process changes in the production and bleaching of pulp for paper reduce the amount of chlorine chemicals necessary for bleaching by 10-15%. The use of biotechnology processes also cut bleaching-related energy use by 40%. This is a saving that can create additional pollution reductions. This process also lowers wastewater toxicity. The yeasts, like *Candida tropicalis*, *Saccharomyces cerevisiae*, *S. carlbergensis* and *Candida utilis* are important in clearing industrial effluents of unwanted chemicals. *Agaricus bisporus* and *Lentinus olivoides* are important in lignocellulose decomposition. *Coriarius versicolor* is important in cleaning up pulp and paper mill waste.

Phenolic waste treatment by specialized microbes

Biological treatment of waste water containing organic pollutants has been universally accepted as a cost efficient method for the prevention of environmental pollution. Phenols and other aromatics are discharged from a variety of chemical industries, including the petrochemical refining and manufacturing industries, pharmaceuticals, coal refining, basic organic chemical manufacturing, textiles and pulp and paper milling.

Specialized microbes however have the capacity to transform these chemicals into non-toxic entities. A list of such microbes is given in Table One. The techniques consist of growing the cultures in a synthetic medium with the organic pollutant as the carbon source to the organisms along with other essential nutrients. Several investigations have employed this technique to detoxify phenolic wastes for a long time (Kumaran and Shivaraman 1968).

Table 1: Microorganisms known to degrade phenols and other related aromatic compounds through aerobic/anoxic routes

Organic Compounds	Micro-organisms
<i>Hydrocarbons- Aromatic hydrocarbons</i>	<i>Pseudomonas putida</i> , <i>P. aeruginosa</i> , <i>P. Stutzeri</i> , <i>Flavobacterium</i> , <i>Achromobacter</i> , <i>Bacillus</i> , <i>Vibrio</i> , <i>Spirillum</i> , <i>Candida</i> , <i>Nocardia</i>
<i>Naphthalene salicylate, phthalates, paraffinins</i>	<i>Beijerinckia B 836</i> , <i>P. Aeruginosa</i> , <i>P. Putida</i> , <i>Micrococcus</i> , <i>Nocardia</i> , <i>Arthrobacter paraffineus</i>
<i>Phenols, Chlorophenols, Nitrophenols, Amino-phenols, Catechol, Alkyl substituted cresols, Resorcinol, Hydroquinone, Pyridines, Pycholines, Benzoates</i>	<i>Alcaligenes</i> , <i>acinetobacter</i> , <i>Achromobacter</i> , <i>Azotobacter</i> , <i>Bacillus subtilis</i> , <i>B. Cereus</i> , <i>Brevibacterium</i> , <i>Flavobacterium</i> , <i>Pseudomonas aeruginosa</i> , <i>P. Cepecia</i> , <i>P. Fluorescens</i> , <i>P. strutzeri</i> , <i>P. putida</i> , <i>Candida tropicalis</i> , <i>Trichosporon cutanenum</i> , <i>Nocardia</i>
Catechuic acid, tannin	<i>Pseudomonas</i>
Catechin	<i>Bradyrhizobium japonicum</i>
Lignin and lignin derivatives	<i>Aspergillus niger</i> , <i>Phanerochaete chrysosporium</i> , <i>Polycysticus versicolor</i> ; <i>Pluotus ostreatus</i> , <i>coriolus versicolor</i> , <i>Chaetomeum piluliferum</i> , <i>nocardia sp.</i> , <i>Fusarium</i> , <i>P. fluorescens</i> , <i>P. putida FK-2</i> , <i>P. testosterone</i> , <i>P. acidovorans</i> , <i>bacillus subtilis</i> , <i>Acinetobacter sp.</i> , <i>Candiada albicans</i> , <i>Alcaligenes sp.</i> , <i>Trametes sp.</i> , <i>Penicillium sp.</i>

Removal of metals

Heavy metal contamination causes direct toxicity to most living beings due to their presence beyond specified limits (Jamode et al., 2003). Several past disasters were due to the contamination of heavy metals in the aquatic environment. Consequentially all effluents need to be assessed and require integrated pollution documentation before their final discharge.

Bioremediation

Bioremediation is a pollution control technology that uses biological systems to catalyze the degradation or transformation of various toxic chemicals to less harmful forms. The general approaches to bioremediation are to enhance natural biodegradation by native organisms (intrinsic bioremediation), to carry out environmental modification by applying nutrients or aeration (biostimulation) or through addition of microorganisms (bioaugmentation). Unlike conventional technologies, bioremediation can be carried out on-site. Bioremediation is limited in the number of toxic materials it can handle, but where applicable, it is cost-effective (Atlas and Unterman, 1999).

Bioremediation refers to the use of biological systems to degrade toxic compounds in the environment. Bioaccumulation or biosorption is the accumulation of the toxic compounds inside the cell without any degradation of the toxic molecule. This method can be effective in aquatic environments where the organisms can be removed after being loaded with the toxic substance.

Fungi in bioremediation

Fungi are good in the accumulation of heavy metals such as cadmium, copper, mercury, lead and zinc. Systems using *Rhizopus arrhizus* have been developed for treating uranium and thorium. The ability of fungi to transform a wide variety of hazardous chemicals has created interest in using them in bioremediation (Alexander, 1994). The white rot fungi are unique among eukaryotes for having evolved nonspecific methods for the degradation of lignin; curiously they do not use lignin as a carbon source for their growth (Kirk et al., 1976). Lignin degradation is, therefore, essentially a secondary metabolic process, not required for the main growth process. Lamar et al. (1993) compared the abilities of three lignin-degrading fungi, *Phanerochaete chrysosporium*, *P. sordida* and *Trametes hirsute* to degrade PCP (Pentachlorophenyl) and creosote in soil. Inoculation of soil with 10% (wt/wt) *Phanerochaete sordida* resulted in the greatest decrease of PCP and creosote. *P. sordida* was also most useful in the degradation of PAHs (Polycyclic aromatic hydrocarbons) from soil. Davis et al. (1993) showed that *P. sordida* was capable of degrading efficiently the three ring PAHs, but less efficiently the four-ring PAHs.

Removal of dye

In many developing countries large areas of land, and water tables, are polluted by the dye industry. Consortia of fungi and bacteria (usually uncharacterised) are used in composting dye, the most useful waste disposal practice. Phenolic azo dyes have been shown to be oxidized by the enzyme laccase produced by *Pyricularia oryzae* (Chivukula and Renganathan, 1995). Bacteria such as *Pseudomonas* and *Bacillus* have been shown to degrade the azo or reactive dyes from textile industry effluents. The process is often referred to as biobleaching. The bacteria are often used in consortia for biobleaching (Ashoka et al., 2002).

Phanerochaete chrysosporium has been shown to affect the biobleaching of organic dyes (Nigam et al., 1995). Pauli et al. (1993) have also shown the decolourization of azo-triphenyl methane dyes by lignin peroxidase produced by *P. chrysosporium*. Sami and Radhaune (1995) have demonstrated the role of lignin peroxidase and manganese peroxidase from *P. chrysosporium* in the decolourization of olive mill waste water. The work carried out by Asoka et al. (2002) revealed that *Phanerochaete chrysosporium* and microbial consortia were effective in colour removal from textile dye effluents. The fungus caused 80% decolourization in broth containing 2.5% of effluent. There was a reduction in BOD and COD values. A local isolate of *Fusarium* caused various degrees of decolourization ranging from 35 to 85%.

Biotechnology for hazardous waste

Several bacteria have been found to be good degraders of toxic pesticides such as halocarbons. Some sulfate reducing bacteria transform tetrachloroethane to cis-1,2-dichloroethene by anaerobic dehalogenation of halocarbons. Methanogenic bacterial consortium has been shown to degrade perchloroethene. Mono and dichlorobenzenes are degraded aerobically by various *Pseudomonas* and *Alcaligenes* strains. Pentachlorobenzenes (PCBs) are degraded by strains of *Acinetobacter* and *Alcaligenes* the same way as *Phanerochaete chrysosporium*, the fungus.

Several soil-inhabiting bacteria have been reported to degrade chlorophenols under both aerobic and anaerobic conditions. Pentachlorophenol is degraded by a monooxygenase enzyme which removes chlorine from the molecule making it nontoxic, and this enzyme is found in some soil bacteria.

Nitroaromatics are highly recalcitrant because of the strong aromatic rings. Under anaerobic and microaerophilic conditions, the nitro groups of trinitrotoluene (TNT) can be reduced to amino groups but each subsequent step is slower.

Petroleum products contain a mixture of several hydrocarbons which are difficult to degrade by any one bacterium. Short-chain alkanes are toxic to many microorganisms and are difficult to degrade. Intermediate chain length (C₁₀-C₂₄) are degraded most rapidly. Very long chain alkanes become increasingly resistant to biodegradation. Monooxygenases and dioxygenases are the enzymes involved in the degradation of alkanes. The aromatic hydrocarbons present in petroleum are also difficult to degrade. Some aromatic compounds such as benzene and toluene can be degraded by bacteria, especially species of *Pseudomonas*.

Biodegradation of oil spills is a major problem because it usually occurs on marine water surfaces and seeding with bacteria becomes difficult. Besides, there is no single bacterium that can degrade all the components of the oils which are petroleum products. A genetically engineered strain of *Pseudomonas putida* has been reported by Anand Chakrabarty, an Indian-born scientist working in the USA, which can degrade more than three to four components of petroleum. Other bacteria used in the treatment of oil spills are strains of *Alcaligenes eutropus*, *Rhodococcus*, *Bacillus* and several unidentified bacteria. Nutrients like nitrogen and phosphate enhance the potential of microorganisms for biodegradation. The oleophilic fertilizer Inipol EAP-22 is used extensively to stimulate degradation of oil spills.

Biotechnology for the pesticide industry

With industrialization and the extensive use of pesticides in agriculture, the pollution of the environment with human-made (synthetic) organic compounds has become a major problem. Many of these novel compounds introduced into nature are called xenobiotics, and a large number of them are not easily degraded by the indigenous microflora and fauna. The list of xenobiotics is very long and some of them are directly applied to nature in the form of pesticides or fertilizers, some others are released as industrial waste products (effluents). Other than the above compounds, the xenobiotics would also include a wide variety of dumped materials such as plastics, detergents and oil spills, either inadvertently or deliberately disposed of.

The chemical pollutants such as toxic pesticides are of two types, biodegradable and nonbiodegradable (recalcitrant). A biodegradable pesticide may be converted by microbial action into a nontoxic compound within a few months whereas a recalcitrant chemical may remain in nature for several years in the toxic form. The duration of persistence of some of the common pesticides is given in Table Two.

Table 2: Persistence of some pesticides in the environment

Common Name	Chemical name	Persistence (Years)
Aldrin	Hexahydro dimetanonaphthalene	15
Chlordane	Octachloro hexahydro methano-indene	15
DDT	Dichloro diphenyl trichloro ethane	15
Diuron	Dichlorophenyl dimethyl urea	15
Endrin	Hexachloro dimethanonaphthalene	14
Monuron	Parachlorophenyl dimethyl urea	3
Parathion	Diethyl paranitrophenyl phosphorodithioate	16
PCP	Pentachlorophenol	5
Simazine	Chloro ethyl amino triazene	2

Phanerochaete chrysosporium has been shown to degrade a number of toxic xenobiotics such as aromatic hydrocarbons (Benzo alpha pyrene, Phenanthrene, Pyrene), chlorinated organics (Alkyl halide insecticides, Chloroanilines, DDT, Pentachlorophenols, Trichlorophenol, Polychlorinated biphenyls, Trichlorophenoxyacetic acid), nitrogen aromatics (2,4-Dinitrotoluene, 2,4,6-Trinitrotoluene-TNT) and several miscellaneous compounds such as sulfonated azodyes. Several enzymes which are released such as laccases, polyphenol oxidases, lignin peroxidases etc. play a role in the degradative process. In addition, a variety of intracellular enzymes such as reductases, methyl transferases and cytochrome oxygenases are known to play a role in xenobiotic degradation (Barr and Aust, 1994).

Biodegradability or recalcitrance depends on the nature of the chemical molecule. Often a simple change in the substituents of a chemical molecule may make the difference between recalcitrance and biodegradability. The herbicide 2,4-D (2,4 dichlorophenoxy acetic acid) is biodegraded within days but 2,4,5-T differs only by the addition of a chlorine molecule in the meta-position. The additional substitution interferes with the hydroxylation and cleavage of the aromatic ring. Similarly methoxychlor is less persistent than DDT which has great stability.

Biotechnology for food and allied industries

Classical biotechnological processes have been used for a long time in the production of food and beverages such as bread, cheese, beer and wine. These processes are characterized by the direct application of live organisms and the in situ production of enzymes and other products (Table 3).

Table 3: Examples of biotechnology in food

Product	Old Manufacturing Process	New Industrial Biotech Process	Biotech Enabling Technology	Benefits
Detergent	Phosphates added as a brightening and cleaning agent	Addition of biotechnology enzymes as brightening and cleaning agents - Proteases remove protein stains - Lipases remove grease stains - Amylases remove starch stains	Genetically enhanced microbes or fungi engineered to make enzymes	-Elimination of water pollution from phosphates -Brighter, cleaner clothes with lower temperature water -Energy savings
Bread	Potassium bromate, a suspected cancer-causing agent at certain levels, added as a preservative and a dough strengthening agent	Addition of biotechnology enzymes to -enhance rising -strengthen dough -prolong freshness	Microorganisms genetically enhanced to produce baking enzymes (directed evolution and recombinant DNA)	-High-quality bread -Longer shelf life -No potassium bromate
Polyester Bedding	Polyester* produced chemically from petroleum feedstock * any synthetic fibre	Biotech polyester (PLA) produced from corn starch feedstock	Existing bacillus microbe used to ferment corn sugar to lactic acid; lactic acid converted to a biodegradable polymer by heating; polymer made into plastic products and polyester	PLA Polyester does not hold body odour like other fibres -Biodegradable -Not made from petroleum -Does not give off toxic smoke if burned

Vitamin B₂	Toxic chemicals, such as aniline, used in a nine step chemical synthesis process	One-step fermentation process uses vegetable oil and glucose as a feedstock	Genetically enhanced microbe developed to produce vitamin B ₂ (directed evolution)	Biologically produced without chemicals Greatly reduces hazardous waste generation and disposal
Paper Bleach-ing	Wood chips boiled in a harsh chemical solution then bleached with chlorine to yield pulp for paper making	Enzymes selectively degrade lignin and break down wood cell walls during pulping	Wood-bleaching enzymes produced by genetically enhanced microbes (recombinant DNA)	Reduces use of chlorine bleach and reduces toxic dioxin in the environment Cost savings due to lower energy and chemical costs
Ethanol Fuel	Food and feed grains fermented into ethanol (a technology that is thousands of years old)	Cellulase enzyme technology allows conversion of crop residues (stems, leaves, straw, and hulls) to sugars that are then converted to ethanol	Genetically enhanced organism developed to produce enzymes that convert agricultural wastes into fermentable sugars (directed evolution, gene shuffling)	-Renewable feedstock -Reduces green house gas emissions -Increases domestic energy production -Is more energy efficient to produce than old process
Anti-biotics	Chlorinated solvents and hazardous chemicals used to produce antibiotics through chemical synthesis	One-step biological process uses direct fermentation to produce antibiotic intermediate	Genetically enhanced organism developed to produce the key intermediate of certain antibiotics (recombinant DNA)	65% reduction in energy consumption Overall cost savings
Contact Lens Solution	Surfactants and / or saline solutions (do not remove protein deposits) used to clean lenses	Protease enzymes remove protein deposits from the contact lens	Genetically enhanced microbes engineered to make protease enzymes (directed evolution)	More effective contact lens cleaning Less eye irritation and fever infections

Microbiological purification of wine distillery wastewaters

Wine alcohol distilleries produce the waste that has no acidic character and a high organic content. The adequate microbial treatments (acrobic, mesophilic anaerobic and thermophilic anaerobic) for the purification of vinasses were examined. Ninety percent biodegradable COD removals were achieved in every treatment.

Biotechnology for air pollution abatement and odour control

With advances in biotechnology, it is feasible to modify plants for a wider range of phytomonitoring and phytoremediation applications. It is proved that it is possible to produce pollution resistant plant species, through biotechnology (Linderman, 1997; Baker, 1997).

Ethical limits of biotechnology

As biotechnology has become widely used, questions and concerns have also been raised. One of the main areas of concern is the safety of genetically engineered food (American Dietetic Association, 1995). In assessing the benefits and risks involved in the use of modern biotechnology, there are a series of issues to be addressed so that informed decisions can be made. The health effects of foods grown from genetically engineered crop depend on the composition of the food itself. Any new product may have either beneficial or occasional harmful effects on human health. What we know from our understanding of science and more than a decade of experience with biotech-derived plants is that they appear to be safe (FDA, 1993). There is no evidence that genetic transfers between unrelated organisms pose human health concerns that are different from those encountered with any new plant or animal variety. The risk associated with biotechnology are the same as those associated with plants and microbes developed by conventional methods. Consumers find biotechnology acceptable when they believe it offers benefits and it is safe.

Conclusion

The applications of biotechnology are so broad, and the advantages compelling that virtually every industry is using this technology. Developments are underway in areas as diverse as pharmaceuticals, textiles, chemicals, cleaning the environment, food processing and forensics to name but a few. Biotechnology holds a significant promise to the future but a certain amount of risk is associated with any area. Biotechnology must continue to be carefully regulated so that the maximum benefits are received with the least risk.

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An analytical framework for understanding the ethics of agricultural biotechnology*

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Introduction

Several years before the Indian government decided to introduce transgenic cotton (Bt cotton) to the Indian market, social controversy erupted. Bt cotton has been genetically engineered to produce a toxin which protects the plants from certain insect pests. The inserted genetic material is taken from *Bacillus thuringiensis*, a bacterial pest that occurs naturally in the soil and is widely used to control insect pests. The controversy arose in the late 1990s, when the State government of Andhra Pradesh halted the open field trials of Bt cotton, which were then being conducted by a joint venture between a local firm and a multinational corporation. Concerns about ethical issues including: how the benefits of biotechnology will reach developing countries; how the benefits will be distributed to growers of different social and economic strata; and how the environmental and health risks will be distributed and redistributed; have given rise to a social movement opposing the efforts of the Indian government and the cotton industry to introduce state of the art agricultural technology. The controversy has taken place in the spheres where only professional elite groups participate, such as government hearings, as well as in the public spheres of non-elite mass groups, such as farmers' groups who have staged demonstrations and burned test plots for Bt cotton. Since the eruption of the controversy, many groups, including farmers, scientists, industrialists, NGOs, and various government agencies, have become actively involved in discussions concerning the commercialization of transgenic cotton.

Problem statements

Against this backdrop, the aim of this study was to understand the opportunities and challenges involved in collective decisions about controversial science and technology (Busch et al., 1991). The project also explores how ethics and values enter into disputes over science and technology (Burkhardt, 2001; Thompson, 1997). In addition, the study considers how actors are empowered to participate in decision-making processes through the use of science or are rendered less able to participate by not using science. With these questions in mind, this paper will outline a specific analytical framework used for the project so as to demonstrate a sociological approach to the study of the ethics of science and technology. It will make clear that assessing and understanding the ethics of science and technology requires a complex, multi-faceted approach that takes into account the different backgrounds, motivations, assumptions, and worldviews that the various parties bring to bear on the problem, and that finding a path through the complexity in a coherent and unified way is possible with the use of certain analytical tools. The paper will not present actual findings of the study, but those can be found elsewhere (Yamaguchi et al., 2001; Yamaguchi and Harris, 2004). After a brief introduction to the Bt cotton controversies in India, I will describe the theoretical and conceptual foundation and methodologies, and then summarize the key ethical issues in agricultural biotechnology controversies. I will end by suggesting a theoretically compelling premise on which to conduct research on ethics of controversial science and technology.

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Bt cotton controversies

In late 1998, a farmers' group, the Karnataka Rajya Raitha Sangha (KRRS), began protesting against field trials being conducted under a joint venture between an Indian seed company, Maharashtra Hybrid Seed Company (MAHYCO), and the transnational agrichemical company Monsanto, which holds the licence for this technology. They uprooted the crops and set fire to the trial fields (The Hindu, 29 November 1998). Subsequently, the Andhra Pradesh government halted the field trials of Bt cotton. The Andhra Pradesh government claimed that the decision was made because farmers were agitated over the tests, which were said to involve testing the "terminator gene" under the guise of the Bt cotton seed trials.¹ Terminator technology is a gene protection technology inserted in plants that blocks the production of fertile seeds. Use of the gene provides seed producers security against the unauthorized use of new plant varieties. Critics point out that the terminator gene would force farmers to purchase seeds from patent holders who own the rights to the new crop varieties. The leader of the KRRS said in a public statement that the gene incorporated in Bt cotton had contaminated all the crops in the vicinity of the field trial plots and was jeopardizing the biodiversity of the area. He also pointed out that the firm had undertaken trials without obtaining government permission.² At the same time, various commentaries appeared in the newspapers. An editorial³ strongly criticized such vandalism and condemned KRRS's activities. The editorial suggested that such activities and the government's inability to control them would send negative signals to prospective investors in India.

In response to the controversy, the Ministry of Agriculture imposed a ban on the import of terminator seeds. At the same time, the director-general of the Indian Council of Agricultural Research, the key agency in charge of public agricultural research in India, announced that the government would be "gearing up for a single-point entry for all imports of seeds";⁴ implying increased governmental control of imports of genetically modified seeds. In July of 2000, the MAHYCO received permission for large-scale trials to generate biosafety data for the Genetic Engineering Approval Committee (GEAC). Although the Department of Biotechnology of the Ministry of Science and Technology expected the open field trials to be completed by mid-2001, the committee postponed its approval, requiring additional data for further scrutiny of the environmental impact of the transgenic cotton seeds developed by MAHYCO and Monsanto. Meanwhile, some 10,000 hectares of standing crops of pirated Bt cotton seeds were found in Gujarat, India's western state. Farmers had purchased and planted the pirated Bt cotton seeds. It was later found that Cry1Ac, a gene owned by Monsanto, had been inserted into the seeds. Subsequently, the GEAC ordered the destruction of the standing crops in Gujarat, because those seeds were illegal.⁵

The order for removal of the standing crops of pirated Bt cotton provoked a strong reaction from farmers' groups who were eager to use transgenic seeds. Following the issuance of that order, Sharad Joshi, the leader of the Kisan Coordination Committee, announced the Committee's plan to resort to large-scale protests if the government insisted on removing the standing crops. Furthermore, he criticized the slow process by which transgenic crops were reviewed. In March 2002, a decade after the government had announced obtaining Bt technology from the US, GEAC gave approval for the commercial distribution and cultivation of three varieties of genetically modified cotton.

Theoretical foundation

The social constructionist approach to social problems provides a theoretical foundation for understanding the social processes leading to a social condition defined as problematic (Best, 1995; Kitsuse and Spector, 1973). These studies suggest that a set of seemingly objective conditions actually constitutes just one of many perceived realities, which suggests that perceived social problems are the social constructs of actors. The emphasis is on how actors interpret and define problems, rather than on an objective description of the particulars of a problem. For instance, let's look at the issues concerning environmental risks related to transgenic crops. To date, even within the scientific community there

1 Business Line, 5 December 1998.

2 Business Line, 11 January 1999.

3 Business Line, 3 December 1999.

4 Business Line, 14 January 1999.

5 The Times of India, 19 October 2002.

has been no consensus concerning the degree and extent of environmental risks posed by transgenic crops. For some scientists who oppose transgenic crops, the commercialization of transgenic crops is problematic because transgenic technology has been in open field use for a relatively short period of time, making it extremely difficult to identify where the risks lie or even to determine the appropriate methods of risk assessment and management (The Royal Society, 1998). Thus, they may recommend that India adopt a precautionary approach to the technology or that India continue to conduct experiments until sufficient evidence of risk is collected. On the other hand, those actors who support transgenic crops may use scientific data from the US cotton industry which shows that the number of needed pesticide applications is reduced (James, 1998). These examples demonstrate that when science cannot offer definitive answers to issues and concerns, seemingly objective environmental risks become subject to various interpretations.

Key Concepts

In order to discover the ways in which individuals and groups define problems associated with the commercialization of genetically modified crops, I have used several key concepts, of which the most important for our purposes here are the concepts actor and frame.

Actors

Indian society, characterized by “division and hierarchy” (Shah, 1982), consists of actors with diverse norms, values, and cultures. This diversity, combined with the impacts of capitalism and industrialization, has divided actors in India into an enormous number of subgroups according to their socio-economic and cultural backgrounds, their professions and positions, and their interests and agendas. The diverse norms, values, and cultures of contemporary India, combined with a newly-emergent partly-Western biological technology (Swaminathan, 1996), have created a space in which actors, both individuals and groups, can debate not only the scientific dimension of transgenic crops but also the non-scientific dimensions. Actors are capable of reworking values, norms, and cultural orientations, and then of disseminating these revised understandings through their actions and interactions with other actors (Touraine, 2000).

In order to understand the complex divisions and alliances of actor groups, I have identified five major groups:

- (1) actors in non-governmental organizations (NGOs);
- (2) industrialists;
- (3) government officials;
- (4) scientists; and
- (5) farmers

Actors in NGOs include individuals and organizations specializing in advocacy activities on such issues as environment, agriculture, population, gender, and development. In the case of agricultural biotechnology, environmental advocacy groups and think-tanks dealing with issues related to gender, development, and agricultural policies have been vocal participants in the disputes. “Industrialists” include seed companies and dealers, pesticide formulators and dealers, agrichemical companies, and associations of industrial or commercial organizations. “Government” refers to both elected officials and bureaucrats in both the central and state governments. “Scientists” are people holding scientific positions in the public research system, in the private sector, or in NGOs. “Farmers” refer to actors engaged in the cultivation of crops, and those in farmers’ unions and associations. These categories are not mutually exclusive, and field data confirm that there are overlaps between them; nonetheless, delineating actor groups will help us to gain insights into diverse interpretations related to transgenic crops and to see the complex and constantly changing perceptions of agricultural biotechnology.

Frames

Social processes, such as those described above, which lead to a particular understanding of a social condition involve “frames”. Drawing on Goffman (1986), I use the notion of frames as a foundation for

analyzing interpretations of Bt cotton. Frames are packages of social values and norms which shape people's evaluations of an issue such as a new technology (Benford and Snow, 2000). A frame embracing certain values and norms becomes a template for a range of positions (Gamson and Modigliani, 1989). Thus, by exploring the frame of reference actors use, we will learn how actors are involved subjectively in social phenomena

Frames can be used to examine interactions among actors as well. As demonstrated by Snow and Benford (1988), some actors use frames to mobilize other actors. This concept will allow me to characterize interactions and negotiations in the race to define key issues in the deployment of transgenic crops. For instance, a purposeful selection of frames results in two different interpretations of modern biotechnologies. On the one hand, within a technology-oriented frame of agricultural development, agricultural biotechnology becomes a useful tool for solving the problems of production and cultivation of crops; on the other hand, within a frame which emphasizes the importance of sustainable agriculture, agricultural biotechnology becomes a hindrance to such efforts. Some argue that the scientific approach to agriculture is the best one for an arid region of India, where crops are vulnerable to natural calamities related to weather and pests. Others argue that Western science will compete with traditional knowledge for the cultural and ecological resource base, subverting indigenous agricultural knowledge and adversely affecting biodiversity. Given that different frames lead to different evaluations of a technology, and that lay interpretations of controversial technology tend to closely relate to how the story is framed in the newspapers (Friedman et al., 1999, Gamson and Modigliani, 1989; Mazur, 1981), actors could adopt a strategy of influencing mass media frames to influence opinions on a large scale. Framing literature has significant analytical utility in understanding agricultural biotechnology discourse by virtue of its system for analyzing the content of claims in relation to interested actors. Framing theory has helped me engage in a substantive analysis of the content of disputes over genetically modified crops by providing an analytic scheme to organize a range of claims, experiences, and events reported in newspapers and obtained in interviews. I organized the content of claims about Bt cotton into five different frames at the outset of this research, obtaining results which later became a basis for understanding actors' framing strategies and for understanding the nature of interactions among actors.

Methods

The project focused on understanding empirical social processes of interpretation and interactions among actors involved in the Bt cotton controversy. For that purpose, the project used three types of data: newspaper articles, interviews, and policy documents. Collected data was coded and categorized.

First, newspaper articles shed light on the nature of disputes in the public sphere. Prior to the field-study, Indian newspaper articles were collected through Lexis-Nexis, an online database of full-text newspaper articles. In India, the English-language dailies are the most influential mass media (Jeffrey, 2000). In addition, I collected articles from two Gujarati-language newspapers and the major Gujarati farm newspaper.

Newspaper articles were collected by searching for the words Bt cotton, India, terminator technology, and field trials. Articles from the three Gujarati newspapers were collected by visually searching for the same key words, and were translated into English. Articles were identified beginning in 1992 in the English-language newspapers, and coverage of Bt cotton was found beginning in 1999 in the Gujarati newspapers.

Second, in-depth interviews were conducted with actors identified in the mass media coverage: industrialists, scientists, policy-makers, journalists, and activists. In-depth interviews allowed interviewees to freely express their perceptions of the issues and maximized variations in responses.

In addition, structured interviews were done with cotton growers in south Gujarat; interview subjects were identified through referrals by a local farmer leader, whose name appeared in the English-language and Gujarati dailies. When the interviews needed to be conducted in Hindi or Gujarati, trained local research associates conducted structured interviews.

Structured interviews allowed me to monitor the interview situation, and helped me to maintain

consistency in the ways in which the interviews were carried out. Interviews were taped, transcribed, and translated into English. I also observed the interviews.

Third, documents such as policy documents, corporate brochures, annual reports of research institutes, and leaflets of NGOs were collected as background information for understanding the regulatory framework in India and the current state of the research on, and development of, transgenic crops.

All the articles from the newspapers and the transcripts of interviews were coded into categories representing key concepts used for the analysis, including such concepts as actors, actions, claims, and frames. I then attempted to identify emergent concepts and categories from the coded texts.

Emergent ethical issues

Let me now turn to a brief description of certain ethical themes that have emerged in agricultural biotechnology discourse.

Exclusion/Inclusion

Broadly stated, the ethical dimensions of agricultural biotechnology echo philosophical discussions of utilitarian, rights, and virtues approaches to social justice (Thompson, 1997). Some of the actors supporting the introduction of genetically modified crops base their arguments on a utilitarian approach by saying the technology will help increase the productivity of agriculture, which in turn will improve the profits for the grower. Opponents use the same utilitarian frame and argue that the introduction of Bt cotton will cause pest resistance to Bt. Proponents bring in a rights-based claim that it is morally imperative to make genetically modified crops readily available to developing countries (Nuffield Council on Bioethics, 1999).

Opponents bring in a rights-based claim that the interests of small and landless farmers will not be represented fairly. From a virtues approach, some frame Bt cotton as the essence of modernization (Monsanto, 1997), while others argue that biotechnology violates the laws of nature (Shiva, 1991).

The concerns expressed by all of the actors described above focus on the question of the exclusion or inclusion of certain groups from the benefits and costs of agricultural biotechnology. The issues here are which groups are included in, or excluded from, the benefits of agricultural biotechnology, and which groups bear the costs of agricultural biotechnology. While inclusion in the benefits and/or exclusion from the costs will favour some groups, exclusion from the benefits and/or inclusion in the costs will be detrimental to others. Some actors argue that agricultural biotechnology will exclude small and landless farmers from benefiting economically, while the benefits will go to commercial farmers with significant landholdings or go to industries (Buttel and Barker, 1985; Shiva et al., 1999).

Others claim that prohibiting agricultural biotechnology is preventing India from getting access to a promising scientific tool that might become a key to meet rising food demands in coming years or a key to shift towards sustainable agricultural practices (Monsanto, 1997). The idea of exclusion/inclusion is associated with the potential risks and hazards of introducing agricultural biotechnology.

Risk

Some argue that risk can be estimated by multiplying the probability of occurrence with the severity of harm (Campbell, 1980), while others define risk in terms of how actors interpret a potential harm (Adam, 2000). For instance, while both opponents and proponents list as potential risks the possibility of gene flow to closely related plants, possible effects on non-target organisms, and increased pest resistance, interpretations vary.

Some scientists who oppose this new technology argue that because this technology has been in open field use for a relatively short period of time, it is extremely difficult to identify where the risks lie, and even to determine the appropriate methods of risk assessment (Royal Society, 1998). They conclude that India should adopt a precautionary approach to the technology, or that India should continue to

conduct scientific research until sufficient evidence is collected.

Scientists supporting the new technology use data from the US cotton industry, which shows that the needed number of pesticide applications has been reduced from four to six per crop to zero (James, 1998), and they argue that this proves that Bt cotton is a promising tool to alleviate pesticide stress on soil.

They argue that particularly in India, where many of the problems related to cotton (productivity and production costs) derive from excessive use of pesticides, Bt cotton, which has built-in pest resistance traits, will be a promising crop management tool.

Some actors in NGOs who oppose agricultural biotechnology argue that, although there is no biological evidence that genetically modified crops (GMOs) are detrimental as compared to non-GMOs, such crops should be banned because there are no science-based protocols to assess the risks. Those who support the introduction of GMOs use the same reasoning but argue for GMOs on the basis of the non-existence of scientific facts showing any hazards from agricultural biotechnology. They claim that, given expected rapid population growth, producing a sufficient amount of food to meet the rising food demand is more important than the, as yet, hypothetical impacts of GMOs.

Western versus indigenous science and knowledge generation

The third theme concerns the contrasting ways in which knowledge is generated in two approaches to science — Western and indigenous science. First, some scientists and policymakers claim that the adoption of Western scientific approaches to agriculture is most appropriate in the case of a crop such as cotton, which tends to be vulnerable to natural disasters, and in a country in which the production of such cash crops is required to provide a stable flow of foreign currency. They claim that Western science will allow us to manipulate the natural environment in accordance with our needs.

Contrary to that view, both theorists and activists argue that the introduction of agricultural biotechnology (Western science) will negatively impact indigenous science and knowledge systems (Bebbington, 1994; Richards, 1985; Sharma, 2001). They argue that Western science will compete with traditional knowledge for the cultural resource base (Boef et al., 1993; Perlas, 1994; Shiva, 1993).

Second, indigenous science is discussed through the rights of the holders of indigenous knowledge, innovations, and practices. The importance of indigenous science and knowledge is recognized in both international and national discourse. Internationally, its importance is institutionalized within the Convention on Biological Diversity (CBD), signed in 1992, which states that the knowledge, innovations, and practices of indigenous and local communities are entitled to respect, preservation, and maintenance as a right of the indigenous people.

Nationally, within India, indigenous science and its knowledge generation is discussed in connection with the Protection of Plant Varieties and Farmers' Rights Bill (PPV Bill). Some argue that the PPV Bill will not protect farmers and will take indigenous science and knowledge away from them (Cleveland et al., 1997; Damodaran, 1999; Kothari, 2000; Swaminathan, 1998), while others argue that the PPV Bill will help promote the rights of farmers (Morris et al., 2001).

Domination

The fourth theme concerns domination. Domination is defined as the extent to which lives are dominated by external factors (Gramsci et al., 1971). Domination is interpreted in various ways in the discourse of agricultural biotechnology. One form of domination is the integration of the Indian cotton commodity chain with the global agriculture and food regime, wherein the Indian agricultural sector becomes part and parcel of the global regime and will be dominated by economic and political factors external to India (Goonatilake, 1984; Shiva et al., 1999).

A Marxist paradigm would assert that an introduction of technology could act as a dominating force facilitating the extraction and accumulation of value to the detriment of labour (small and landless farmers) (Kloppenborg, 1988; Ramamurthy, 2000). Some actors have taken the idea of domination in the

reverse direction, saying that Indian cotton is facing serious global market competition in the presence of other cotton-producing countries such as China and the US, where Bt cotton is already extensively used.

In order for India to maintain and expand its global market share, the introduction of cutting-edge technology such as Bt cotton is argued to be indispensable (Krishna Iyer, 1999).

Conclusion

Decision-making processes involving controversial science and technology are not simple but involve rather complex social elements such as ethical and moral concerns. This project sheds light on the ethics involved in technological innovations in agriculture specifically. However, the analytical framework suggested in this paper can also be used for the study of other innovations. The framework will help us gain insights into not only the ethical concerns but also the ethical reasoning of a range of people of diverse social backgrounds as they grapple with the complex questions posed by the introduction of controversial science and technology. Through such efforts, we will get a glimpse of the ethical concerns experienced by people as they confront technological change.

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Ethics of the use of genetic control methods for infectious disease*

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The ethics of disease prevention

This paper will examine the ethical issues that underlie efforts to control human disease, modify vectors, modify the environment, and methods to seek community support. There is global support for the efforts to improve existing and develop new approaches for preventing, diagnosing, treating and controlling infectious diseases that cause loss of human life (Macer, 2003). The ethical principle that lies behind the idea of preventing, treating and controlling disease is that human life should be protected.

We can debate what are the most ethical measures for achieving these goals, including the extent to which risks to human health, damage to the environment and other living organisms, and economic costs are balanced in societies that have a range of worldviews and social structures. Certain principles basic to resolving ethical dilemmas can help decision makers make more informed policy decisions.

The principle that we should love the life given to us (self-love) implies that each person should be given autonomy (self-rule) to work out how to balance the ethical dilemmas and choices themselves. The Universal Declaration of Human Rights of 1948 specifically set as a baseline that all human beings possess equal rights, and should be given a chance to exercise their autonomy. One of the fundamental human rights is a right to health, and working towards giving every person a chance to grow up free of disease is the ethical foundation of public health. If a person does not possess some basic level of health, he/she cannot even face many of the choices commonly accepted as normal.

Poverty also restricts the choices of many people (Azevedo and de Moraes, 2002), especially in areas faced with infectious insect borne diseases. Justice simply means that if we want others to recognize our autonomy, we have to recognize theirs as well. There are at least three different meanings of the concept of justice: compensatory justice - meaning that the individual, group, or community, should receive recompense in return for contribution; procedural justice - meaning that the procedure by which decisions about compensation and distribution are made is impartial and includes the majority of stakeholders; and distributive justice - meaning an equitable allocation of, and access to, resources and goods (Macer, 2003). There are ethical questions about how a society should represent procedural justice when there are major divisions within the society on particular issues, as we find in many countries with debates over the use of genetic engineering.

The process of consensus building and reaching common ground may be preferable for many cultures rather than confrontations.

At present there is great inequality between rich and poor nations in the direction and priorities of research, and in the distribution of and access to benefits that might come from this research. Under any ethical theory, the presence of diseases that threaten the lives of not just one but more than a billion people worldwide provides a compelling need for efforts to eradicate the diseases. There is wide diversity in the risks that members of each community face from infectious diseases due to: individual genetic variation in resistance to infectious disease agents; a person's nutritional state and immediate environment; a family's economic situation with respect to providing barriers to vectors and disease and access to both preventative and therapeutic medicines.

These variations can be regarded as a type of lottery. Working towards better global equity is a goal that attempts to even out the lottery that people are born into. This is ethically mandated by Rawlsian justice (Rawls, 1971), which argues that efforts should be made to minimize the variation in all social factors

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because no one knows before they are born into which situation they will be born, so everyone would wish for equal opportunity and equal exposure to risk. All should have a chance to be born and grow up in an environment free of infectious diseases, if that can be achieved.

The ethical principle of beneficence supports the development of science and medicine, and its provision to those who suffer. A universal ideal found throughout human history is that it is better to love doing good things than bad things, and to love our neighbour as ourselves. Humans have used technology in efforts to make their lives easier and better for thousands of years, and the ethical principle of beneficence argues that we should continue to make life better. This ethical principle is based on the general motivation inside people to love doing good rather than harm, and may be expressed as love or compassion (Boyd et al., 1998).

Efforts that work for the betterment of others in society have a universal moral mandate. The ethical principle of non-maleficence, or do no harm, would make us reasonably cautious about premature use of a technology when the risks are not understood. Recently some have advocated a total precautionary principle for genetic engineering, which would mean that no technology with more than 0% risk should ever be attempted (Ho, 1998).

This has also entered the Cartagena Protocol on Biosafety, which is an International Legally Binding Agreement that regulates international movement of living modified organisms (LMOs) (CBD, 2000; Kurokawa and Macer, 2005). Because no human action has 0% risk, the principles of both benefit and risk are used to assess technology and are central to any public health programme (Callahan and Jennings, 2002).

The ethical issues raised by biotechnology are commonly termed bioethics dilemmas, although when we examine the actual moral questions they may not be so novel and are often related to areas of applied ethics that were debated long before we had modern biotechnology (Comstock, 2000). There are several basic theories of ethics.

The simplest distinction that can be made is whether they focus on consequences, actions or motives. Consequential arguments are criteria such as whether they contribute to the greater good by improving the well-being of all. Consequential arguments state that the outcome can be used to judge whether an action was ethically correct or not. An action-based argument looks at the morality of the act itself, so that the actual action to cause harm itself is an unethical action regardless of the consequences or motives.

Motive-based theories of ethics, including virtue-based ethics, judge an action based on the motivation of the action. For example, if the act was done with good intentions or not. Another separation that is used is between deontological theories, which examine the concepts of rights and duties, and teleological ones, which are based on effects and consequences. If we use the image of walking along the path of life, a teleologist tries to look where decisions lead, whereas a deontologist follows a planned direction.

The objects and subjects of ethics can be viewed in terms of ecocentric, biocentric or anthropocentric concerns. Ecocentric concerns, that value the ecosystem as a whole, are used when expressing environmental concerns. The reverence for all of life (Schweitzer, 1966) can apply to the whole ecosystem or to every member of it. Biocentric thinking puts value on the individual organism, for example one tree or one animal. Anthropocentric thinking is focused on the human individual.

There is a trend for more ecocentric views to be included in recent legislation, with protection of ecosystems for their own value. Almost all of human life is a social activity, involving many relationships with people and the ecosystem. Different ethics are implied when human activity, e.g. agriculture or urbanization, attempts to dominate nature or to be in harmony with the environment.

Despite the fact that there are a variety of definitions of health, disease, disability, and what is a meaningful human life, working to alleviate disease and empower individuals to reach their potential are universal goals for the progress of humankind. The basic ethical principles of autonomy, justice, beneficence and non-maleficence can be applied to help decision-making in a range of bioethical dilemmas in medical

and environmental ethics.

There is some debate over whether further principles can always be derived from these over the precise terminologies in each field (Weed and McKeown, 2001), but the general consensus is that these four principles are fundamental in a range of cultures (Beauchamp and Childress, 1994; Tsai, 1999). The emphasis on individuals may be questioned more in developing countries. There are also theories of ethics based on community, which argue that individuality, autonomy or rights of a person are not suited to the community structure of society.

Ethics of genetic manipulation

This paper will focus on genetic control of the vectors of disease, although we can also envisage genetic modification of other organisms that might affect disease transmission by indirect effects on vectors, such as through GM plants in the environment, GM pathogens of insects such as *Wolh bacter*, or other methods (Macer, 2003).

There is a long history of altering the behaviour of disease vectors so that they cannot transmit pathogens to humans (Spielman and D'Antonio, 2001). Insects have also long been the targets of attention in agriculture as well as in medicine. While there are few intrinsic ethical concerns about killing insect pests, as discussed below, ecocentric approaches to ethics do raise some objections to modification of ecosystem components, and these need to be taken more seriously.

People of all cultures have developed biotechnologies as they live together with many species in the wider biological and social community. A simple definition of biotechnology is the use of living organisms (or parts of them) to provide goods or services.

Over five millennia of classical plant and animal breeding have seen the emergence of agricultural societies, and modern biotechnology is built on that. Since the mid 1990s, foods produced from genetically modified organisms (GMOs) have been sold in a growing number of countries (James C, 2001).

There has been fierce international debate over the environmental and human health aspects of GM foods, but no harmful effects of GM foods on human health have been shown scientifically (FDA, 2001). There is greater concern over the environmental impact of gene transfer in the environment.

A number of governments have considered the issues and concerns people have raised about genetic engineering, and there is a wealth of useful material in the reports and submissions made to them (United Kingdom Royal Commission, 1989; New Zealand Royal Commission, 2002). Reports have also been made by independent organizations on the ethical issues (Nuffield Council on Bioethics, 1999a).

With the emergence of genomic sequencing, we now have the DNA sequence of human beings, dozens of pathogens, and some disease vectors e.g. *Anopheles gambiae* (Holt et al., 2002; Morel et al., 2002). It is therefore not surprising that molecular entomology, the study of DNA and the proteins it encodes in insects, is emerging as a serious scientific approach for insect control (TDR, 2002; Robinson et al., 2004).

Social factors need to be carefully considered (TDR, 2000; Macer, 2003). While there is debate over the use of funds to combat infectious disease using genomics and biotechnology as opposed to implementing practical measures to curb vectors and pathogens in the field (Curtis, 2000), it is hoped that the former approach will be a major strategy in the future (Hoffman, 2000; James et al., 2001).

A common way to insert DNA for genetic transformation of insects is to use transposons or viruses (O'Brochta and Atkinson, 1998). Most attention has been given to efforts to genetically transform insects in the laboratory, and to test their behaviour before releasing them into the environment.

A mechanism that would safely spread the gene among vectors in the wild is the objective of these studies, except for the approach using sterile insects. Effector mechanisms are needed to drive the effector system into the vector population (Beaty, 2000), which raises more ethical issues about the

safety and desirability of changing the entire vector population, and possibly related species.

The conclusions of studies of ethical issues inherent to the process of genetic engineering compared to traditional methods of animal and plant breeding, are that the only significant differences in the process are the more precise control of genetic engineering and whether the DNA involves cross-species gene transfer that does not occur in nature (Nuffield Council on Bioethics, 1999a; Comstock, 2000; Macer, 2003).

One of the key questions is whether there is an intrinsic value of genetic integrity at an organism and ecosystem level that humans should not change. There are some persons in some communities that place intrinsic value upon native fauna including insects, however the way that they do would require well designed research to investigate.

We should also note that cross-species DNA transfer does occur in nature between all species, even of different kingdoms, and that the genomes of insects are subject to genetic flux in nature. In this sense, because the DNA change can be precisely designed, an actual targeted genetic change through genetic engineering should be safer than a natural change because it is more under control. Given the results of public opinion surveys that find opposition to cross species gene transfer (Macer, 1994; Macer and Ng, 2000), if the DNA change is made using DNA within the same species entirely, then this concern can be removed. In this way of thinking there may not be any new intrinsic ethical dilemma from the modification of DNA structure in genetic engineering as it simply mimics the natural ways organisms use to change genetic structure. However, the scientific details of the targeting process, and the intentional nature (the issue of control of nature) are important for some persons.

Mosquitoes and animal rights

Another concern in ethics when discussing animals is their capacity to suffer or feel pain. If insects do not feel pain or sense feelings, then the most prevalent ethical approach for animals would argue that there is nothing intrinsically wrong in manipulating them (Singer, 1976).

Given what we know about mosquitoes in this approach they would have no moral rights. However, if we consider the idea of making so-called vegemals, animals that do not feel pain, we are still manipulating life for human purposes without considering the interests of the animal (Macer, 1989). The concern is that living organisms should not merely be treated as a means to the ends desired by humans. There are also extrinsic values placed on some animals by human society, but I do not know of any which place special value upon mosquitoes. There are biodiversity concerns about endangered animals in general, some of which are expressed in the Convention on Biological Diversity (CBD).

Another argument used in these discussions concerns the telos (purpose) of an organism. A teleological explanation describes phenomena by their design, purpose, or final cause. Teleology is the branch of moral philosophy dealing with the cause and effect of an action, the belief that there is purpose and design in nature, and consequently, with the belief in the existence of a Creator.

There are concerns that the ability to alter the telos of an animal has profound implications (Munro, 2001). If one believes that every organism has a purpose, then the telos is an intrinsic concern, and genetic engineering alters the telos or 'being-ness' of an organism. However, it is debatable whether changes and control through genetic engineering are significantly different from changes made by humans to animals and plants in farming and modern life. It is basically an issue of human control of nature, and there is debate over the extent to which humans should control nature (Reiss and Straughan, 1996; Bruce and Bruce, 1998; Comstock, 2000). If we consider this issue in a historical context, we see that humans in many affluent cultures have controlled nature in significant ways, e.g. by concrete river banks, irrigation and sanitation projects. However, especially in some developing countries, limited resources have meant that control of nature has been less.

However, sociological evidence has found that a number of people object to human control of nature, regardless of whether it poses a risk (Macer, 1994).

While perhaps only followers of the Jain religion in India regularly refrain from killing insects that

are human pests, there are still some people who may object to killing mosquitoes. It is not known if manipulating the insects so that they would not be a human pest would be more acceptable to persons with these ecocentric world views than traditional methods of insect control that attempt to eradicate a whole insect population.

Those who subscribe to an ecocentric viewpoint might argue that the ecosystem as a whole would benefit from an intervention that left the mosquitoes in the ecological community, with the elimination of the disease-causing pathogen from the vector, if the alternative was eradication of the vector species.

In this case, the total number of species affected by this type of genetic modification of vectors would be significantly less than the number of species affected by use of insecticides (Macer, 2003). However, there are still those who believe there should be no human modification of the ecosystem. This actually should argue that there should be no direct or planned modification of an ecosystem by humans, since human activity modifies almost all ecosystems, including those where humans are not directly a component member.

Community engagement and environmental risks

The process of community engagement has several goals, as developed recently in human genetic studies (International HapMap Consortium, 2004). It should approach a broad range of members of the communities for participation in a two-way process of information exchange to share with investigators their views about the ethical, social, and cultural issues the scientific project raises for them, their immediate communities, and the broader communities and populations of which they are a part.

It should provide input that may modify the disease control mechanisms and approaches that will be adopted. It should provide extensive information about the project so that the decisions of individuals about whether or not to support their community involvement would be better informed. It also will be expected to continue throughout the trials, including sharing findings from studies conducted.

There will be expected to be negligible human risks from the trials of GM insect vectors, but still consent should be considered. Firstly, let us consider environmental risks of a trial because the GM insect vectors may represent potential harm to other members of the biological community as well as other members of the human community.

Globally people vary in the importance they ascribe to the environment, or parts of it. Especially in areas where more traditional world views are found, we may see greater value given to parts of the environment that are forgotten in the modern industrial mindset. We also see variations between persons in all cultures as to their images of nature and what is life (Macer, 1994). Some people are willing to sacrifice themselves for the broader environment. Examples such as the preservation of sacred groves in India for thousands of years, even during times of severe crisis and human death (Gupta and Guha, 2002), show that in some cultures almost all people are willing to die rather than damage that part of the environment they cherish. This behaviour is often linked to religious beliefs in the afterlife.

A variety of potential broader ecological, environmental and health risks are associated with the release of GMOs. Environmental risks can be considered from both anthropocentric and ecocentric-based approaches. The risks identified include the possibility of horizontal transfer of the transgene to non-target organisms, and possible disturbance of insect ecology (Hoy, 1995; Nuffield Council of Bioethics, 1999a). There have also been concerns expressed in some cultures, e.g. New Zealand, over the need to value the native fauna and flora, which is considered by many in the Maori community to be something not to modify, or at least any modification should be endorsed by the Maori community (New Zealand Royal Commission, 2002). While human beings cannot consent for other organisms to be modified, very few persons suggest that any consent is required except for possibly sentient animals.

One of the main concerns of releasing GMOs is environmental risk (FAO, 2001; Aultman, et al. 2002). This risk has been successfully controlled in over 10,000 international field trials of GMOs (USDA, 2002). Whilst the methods used for monitoring field trials are argued to be inadequate by those campaigning against GMOs, to date there has not been a significant adverse event from GMO release for the health of

any non-target organism, including humans, in the ecosystem (Comstock, 2000).

In the year 2001, the first US field test of a genetically modified pink bollworm, a cotton pest, was conducted. It followed very soon after the development of methods to transform the bollworm (Peloquin, et al. 2000). This type of trial had an important consequence of preparing regulatory systems for oversight of GMOs/ Living Modified Organisms (LMOs), but still most countries in the world have not established systems for oversight of GM insect field releases (Pew, 2004). The American Committee of Medical Entomology has also produced guidelines (ACME, 2002).

New ethical issues about GM arthropod vectors and their symbionts and/or pathogens should be subject to extensive open discussions and forums.

Any risks to the agricultural systems of rural communities also require assessment, as animal diseases transmitted by vectors are important to farming families. In addition, there may also be risks to wild animals in surrounding areas, which in some ecocentric environmental views have more intrinsic rights to be left undisturbed than farm animals (Rolston, 1994).

This calls for broad ecological understanding of the impact, beyond public health. There is also the possibility for GM vectors to spread to areas beyond the initial expectations, which needs to be considered when planning the geographical extent of information and communication programmes.

Although there have been numerous public opinion surveys on the release of different GMOs, there have been few surveys asking people their views on introducing GM vectors or pathogens for disease control.

One general feature of the surveys is that GM plants are considered less threatening than GM microbes, animals and humans. In a 2003 national sample in Japan, one third thought it would be acceptable to use genetic engineering to make mosquitoes unable to be a vector for human diseases like malaria or Japanese encephalopathy, and only 16% said it would not, while half said they did not know.

There was 54% approval for environmental release of mosquitoes that do not transmit human disease, which is the same as the support for release of GM disease resistant crops, with 19% disagreeing (Inaba and Macer, 2003).

Although knowledge is important for acceptance of biotechnology, it is not a predictor of acceptance. In surveys of scientists and the public in Japan in 1991-2000, for example, well-educated scientists were often just as sceptical of biotechnology as the general public, and shared the same types of concerns (Macer and Ng, 2000).

The failure of the government authorities in public health has led to higher public trust in NGOs, including environmental groups. The media has also disproportionately reported negative aspects of genetic engineering because these appeal to people (Durant, 1995). Thus the late 1990s saw a dramatic drop in public support for biotechnology in every country surveyed. It is therefore important that scientific knowledge be accurately shared with all, that this process be open, and that all opponents are involved in discussion.

Issues include the ethics behind research into, and later financing of, technological products that attempt to "fix" a problem rather than invest in increasing the ecological knowledge base to "prevent" the problem. There is considerable preference for deterministic science over "softer" educational systems like flexible learning.

It is clear that not all local communities will share the modern scientific world view that technical healing is better for them, so there needs to be flexibility in the approaches available to eradicate disease. In the past, paternalistic interventions were taken on the behalf of citizens; however, civil rights movements have empowered people to take these decisions themselves.

A number of ethical issues have been raised in international debates over the morality of patents, and there have been strong calls against the patenting of medical innovations.

Laws on intellectual property vary between countries, despite attempts to harmonize these laws among

industrialized countries and members of the World Trade Organization (WTO). A number of developing countries are not members of the WTO, and often the major controversies over whether a country will join WTO is related to intellectual property rights (IPR).

Practical guidance for ethics committees needs to be clarified for public health interventions. One key problem is identifying who is specifically at risk, and what the particular risk is. In vector release studies, everyone in the area may be at risk. These complex questions are made more manageable through breaking down the concerns people have into manageable issues.

Defining a minimum standard of protection for research participants in trial and control populations for GMO interventions is the key point. This question is not specific to GM vectors and pathogens, but it is crucial to consider the benefit/risk equation.

Most concerns can be the subject of better information and education. Gathering satisfactory scientific data by conducting field trials, and understanding ecological issues (Scott et al. 2002), are the main criteria required prior to release for most people. The remaining concern, and one which is also found in scientists as well as the public, is that genetic engineering is somehow unnatural.

This is an issue that needs greater social discussion. However, if presented with the threat of contracting disease, most people have few concerns about using other "unnatural" remedies such as pesticides and medical drugs.

Given that most mosquitoes do not transmit disease to humans, it is, arguably, not unnatural to change a mosquito that does transmit diseases into one that does not. There is a need for public opinion studies in the communities before the release, during the process of community engagement, and after the study, if we wish to really understand the opinions and concerns that people have.

Consent from trial participants

Recognition of the ethical principle of autonomy means that all participants need to give informed consent to an intervention that has a reasonable risk of causing harm (Annas, 1989). There are significant difficulties in obtaining individual informed consent in some developing countries (Ekunwe and Kessel, 1984; Angell, 2000; Alvarez-Castillo, 2002), but by adequate investment of time and provision of suitable materials, it should be possible to obtain informed consent from individuals at direct risk, even though the exact cultural interpretation of the informed consent process may vary between countries (Nuffield Council on Bioethics, 1999b). There are risks of direct or indirect harm to human beings from the original pathogen-transmitting vector, so a trial needs to be done to show that there is greatly reduced risk of harm from the modified vector.

Until a trial is conducted we cannot be sure that there will be no risk and that the whole enterprise has been successful. The risks may not just be those that arise directly from the ability of the vector to carry the target pathogen. There could be a negative impact on human health by altering the behaviour of blood-feeding insects.

In the case of insects that cannot be confined to a particular population, whether they fly or float to new places, notions of "human subject" and "informed consent" need to be extended.

There are basic ethical issues involved in vector collection and studies in the field.

Firstly, many such studies have relied on a researcher waiting for the vector to land on a human host, and then capturing it hopefully before the vector has transmitted the pathogen to the "bait". In fact, any field studies in which human beings are exposed to the pathogens raise the question as to why some other intervention is not used in that area.

The approach developed for population genetics studies may be useful where the community and local authorities are involved in the decision-making process. Informed consent requires information to be provided, so disseminating information about the plans and progress of the project, and obtaining the consent of any person potentially affected by the release of the transgenic insect, is important for the

ethical conduct of research trials, whether or not national guidelines require this, or even exist.

Other lessons show us that people who lack the means to express their preferences may have been abused by the lack of individual or community consent for research in anthropology (Fine, 1993; Kleinman, 1999) and epidemiology (Capron, 1991; Dickens, 1991; Gostin, 1991; Chee et al., 1996).

If a study involves humans, oversight by an ethics committee or institutional review board (IRB) is necessary. In an increasing number of countries, such committees are established by law and are charged with certain legal responsibilities, typically about the conduct of research or clinical practice at local or national level.

An IRB is a group of persons from a range of disciplines who meet to discuss the ethical issues of particular submitted procedures and review the benefits, risks and scientific merit of the application. The IRB usually requires that each human subject in a medical trial gives informed consent to be involved in the project. Model ethical guidelines on the establishment and procedures for an IRB have been produced by an international consultative committee for TDR (WHO, 2000).

These guidelines however are not sufficient for the broad question of how to obtain informed consent for a public health intervention involving thousands of persons where the benefits are not demonstrated.

Ethics or bioethics committees include groups of people set up to adjudicate about bioethical matters. A typical IRB works through a large number of applications and often excludes the broader social discussion and representation that is seen in a regional or national bioethics committee. There are also national variations in the laws to define membership and scope of work, and terms used.

The project to introduce transgenic insects will need an ethics committee with a broad overview, and specific regional ethics committees to consider the local issues.

To consider the issue at a local level, as required for obtaining appropriate informed consent, it is essential that a local ethics committee (and/or IRB if associated with an institution) open to the communities involved is established. There are cultural differences in the way informed consent should be taken (Levine, 2001; Alvarez-Castillo, 2002). The accepted norm in international ethical guidelines is seen for example in the modified Helsinki Declaration (WMA, 2001) and the draft Council for International Organizations of Medical Sciences (CIOMS, 2001) guidelines.

In cases involving bilateral research collaboration, the most stringent ethical standards of the two countries should be applied. This creates problems for non-literate populations, and for populations whose common sense social assumptions are different.

It is desirable that internationally agreed standards are applied, and that there are few points of difference between these standards even for simple clinical trials of drugs. The ultimate decision procedure should be decided by the local ethics committee, but international consistency and guidance will be essential.

Although the control population for the study may continue to face the same high risk of contracting the disease, recent trends in research ethics debate whether we can leave control groups without any treatment. Therefore, ethically there may need to be some other vector reduction measures given if making any interventional study in an area.

While those designing ethical guidelines on placebo-controlled trials (e.g. Helsinki Declaration) were thinking of placebo controls on clinical trials of potential medical drugs, we can ask the ethical question whether researchers have an obligation to the local population to use the best available means of disease control whenever they enter an area for a study.

This practically means that, as well as studying the new method, a researcher may ethically be compelled to also provide the best available proven alternative to the study population.

There may be times when the provision of the proven alternative to the area of study alters the dynamics of the disease so that the results of the vector field trial differ from what the results would have been had no established alternative been provided.

Before and during the intervention, there may be privacy concerns when questionnaires are administered and personal data are stored. For public health purposes, it is essential that all information about individuals involved is linked to other data, but to ensure privacy, the data should only be identifiable to a specific person by a coding frame that is not in a computer linked to a network.

Children are one of the targets of public health interventions, with presumed consent from the therapeutic imperative that they want to be involved in programmes that will avoid disease.

Some compulsory vaccination programmes have faced criticism that consent is not obtained even from the surrogate decision-maker, the child's parents. In each family there may be several adults, and more children, which raises questions of whether consent is required from every individual. The local cultural norms need also to be considered.

However, an appropriate mechanism may be one in which the views of everyone who have reached reproductive age (let us call this the level of adult maturity) are gathered, and consent sought from these persons both as individuals and as a family.

The agreement and understanding of children in the community should be sought through suitable materials. However, children should not be exposed to direct risk from therapeutic trials unless there is no alternative. In the case of a child living in a community that was involved in a GM vector trial, no direct risks to the human population would be expected so the consent issue is not a major hurdle.

On a more positive note, children in fact could be a very powerful means to involve the community in a process of community engagement through schools. Since children are at a higher risk from many of the diseases in question, they stand to benefit more, and most parents may want to be involved in the trial because of the potential benefit to their children rather than themselves.

If the trial covers an area with a local population of 100,000 persons or more, it is unrealistic and unlikely that informed consent can be given by all people in the area. There will always be some people who are against any proposition, no matter how much others value it, but the opponents cannot be moved from their houses for the period of the trial.

So a procedure that is neither paternalistic nor paralytic needs to be developed. After the process of consultation and dialogue to seek informed consent, there still needs to be a procedure to supply relevant information to all persons in the area so that the minority who disagree with the trial have the option to leave. In developing countries, many may not realistically be in either a position to achieve social consensus or for persons to actually leave the area. It is even doubtful that truly "informed" consent can be obtained in communities with high levels of illiteracy.

Other options may be to provide additional insecticide resources to households that object to the study and are afraid of the presence of GM insects. The mechanisms for social consensus in biotechnology are not well understood in the affluent countries that have been debating GMOs, and even less is known in developing countries.

Public opinion studies suggest that people may respond differently to theoretical and real situations. Recognizing the autonomy of people as a group demands that we apply the consent model to more than isolated individuals. The introduction of GM vectors and pathogens requires community consent, so a process for seeking group consent needs to be developed for each community (Kleinman, 1999).

The question of whether every citizen has to consent to public health interventions is not a new one (Kass, 2001), but with the current social transition from a paternalistic society to informed consent and informed choice, this key concern is appearing in all societies, although at different speeds.

Any initial trial may be subject to the philosophy "not in my backyard". Socially powerful persons are generally more effective at preventing trials they perceive to be risky in their area, or, conversely, at attracting social resources towards themselves and away from weaker persons in the community.

Ethically it is important that risks and benefits are shared equally, and one way to ensure this would be a commitment to the local community that, if the trial is successful, the full-scale intervention would

include them from the beginning. In this way, any risks borne by a local population would subsequently be rewarded by that population being the first group to benefit from the knowledge gained when the full-scale safe and effective control programme is implemented. The field trial must therefore come with a commitment to the local community that financial resources will be available and that sustainable use of the control tool will be affordable.

Regulation and Biosafety

The internationally accepted principles of risk assessment for GMOs take into account: relevant technical and scientific details of the recipient or parental organism, the donor organism(s), the vector, the insert(s) and/or characteristics of modification, the GMO, and the methods for detection and identification of the GMO including specificity, sensitivity and reliability; as well as information relating to intended use, information on location and geographical, climatic and ecological characteristics, and the foreseen health impact of the intervention (Macer, 2003).

The ethical principle of non-maleficence is the underlying basis for attempting to avoid harm and the regulation of human activity.

What is a particularly relevant point in the development of GM insect vectors unless it is based on sterile insect methods (Alphey, 2002; Robinson et al., 2004), is that in order for a vector programme to be successful, the modification must spread throughout the wild population of a vector.

This means that deliberate infection with the transgene may be the target of introducing the GMO. In order to define the parameters associated with the speed and extent of spread of the genetic modification under real conditions, extensive trials are necessary. Some vectors may transmit more than one pathogen, so any intervention programme may have complicated effects on the distribution of disease.

The International Centre for Genetic Engineering and Biotechnology (ICGEB) provides assistance in biosafety training for the development of genetic engineering in many countries (ICGEB, 2002). Some issues also relate to the proposed Code of Conduct in Biotechnology being developed under the Commission on Genetic Resources for Food and Agriculture (CGRFA). UNDP and FAO generally support the development of genetic technology while considering the benefits and risks of the organisms. The capacity of countries to establish committees to adequately address ethical, social and scientific concerns needs to be strengthened.

The Scientists' Working Group on Biosafety of the Edmonds Institute (1998) in Washington D.C., USA, recommended that field trials of vectors genetically engineered to reduce disease should be small scale in terms of the area of dispersal of the vector.

"In the case of an anti-malaria or anti-dengue intervention, such a field trial could involve a single village or an isolated cluster of adjacent villages. No large-scale release should be attempted until the effectiveness is shown in the first trial".

Thus, while there is general international consensus in the UN system that selected use of GMOs should proceed, there are groups within society that continue to be cautious. There are also countries whose political regimes do not accept GMOs, and these attitudes depend on political elections, including the principle of democracy.

National sovereignty should of course be respected, but GM vectors may spread beyond a national border. The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an advance informed agreement procedure on the safe transport, handling and use of living modified organisms (LMOs) resulting from modern biotechnology that specifically focuses on transboundary movements of LMOs. The parties to this protocol agreed to ensure that "the development, handling, transport, use, transfer and release of any living modified organisms are undertaken in a manner that prevents or reduces the risks to biological diversity, taking also into account risks to human health".

It was also noted that "the parties are encouraged to take into account, as appropriate, available

expertise, instruments and work undertaken in international forums with competence in the area of the risks to human health" (CBD, 2000).

In the Cartagena Protocol, "a living modified organism means any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology. Modern biotechnology means the application of either *in vitro* nucleic acid techniques, including the recombinant DNA and direct injection of the nucleic acid into cells or organelles, or the fusion of cells beyond the taxonomic family, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection".

This definition of LMOs is now accepted in international law in general because of the Protocol. The actual term "living modified organism" is still not as widely used as "genetically modified organism", the term that has been used for two decades in academic and media debates.

One useful development of the Cartagena Protocol umbrella is the establishment of biosafety clearing houses, which are contact points in each member country. The Protocol also includes risk assessment and risk management once agreement is reached, as well as development of capacity building in biotechnology research.

Many developing countries do not have the economic or scientific capacity needed to examine the products of modern biotechnology (Chinsembu and Kambikambi, 2001). Information related to GM vectors should be linked to the same biosafety clearing houses.

Conclusion

There are a variety of ethical issues that are raised from the use of GM insects, but the most challenging may be the process of informed consent for individuals and communities.

Each community or society needs to be given a chance to set consensus values on risk assessment. This two-way process of community engagement is evolving and appropriate procedures for each community need to be developed. A universal minimal standard of risk assessment applicable to disease vectors needs to be defined, as diseases cross national and continental borders.

Before field release of transgenic insects, researchers must assess all the scientific and social issues associated with GM vectors and develop safety precautions to address potential risks. The scientific and social risks should be minimized through careful design of the vector system, relevant laboratory experience, and careful choice of the site including considering appropriate social and cultural factors.

Even if there are not perceived to be any realistic risks, a procedure for their evaluation should be set up so that new information can be gathered and interpreted. This procedure may involve establishing a specialized ethical review committee under the auspices of an international body such as TDR to offer advice to researchers on the ethics of projects.

There should be prior environmental, medical and social studies for site selection, and the most appropriate site should be chosen on the basis of this data. Information should be exchanged as broadly as possible with community leaders, members of the local community, and the mass media. Consent should be obtained from the communities involved. Specific mechanisms to obtain individual and group consent need to be developed for public health interventions. A contingency plan for aborting a field trial needs to be developed.

Commitment to the local communities involved in field trials should be made such that they will be the first beneficiaries of more permanent use of a GM vector should results indicate that this is appropriate. Intellectual property concerns should not be barriers to implementing public health measures using GM vectors or their symbionts and/or pathogens.

Prior negotiation, including possible involvement to allow access to the latest technology, is preferable to confrontation. The data should be made available to all in order to benefit from global expertise and develop international consensus.

There is a need for an ongoing and active process of ethical analysis, through a variety of forums, that will provide us with the conclusions about where it is ethical to conduct these type of studies.

Ethically, we have to consider what are core ethical values for modification of nature for human needs. The ethical principle of beneficence demands action to eliminate hunger and disease. We must do this while preserving the environment for the future and respecting the cultural diversity that each community in endemic areas possesses.

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Japanese attitudes towards genetically modified mosquitoes*

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Vector-borne diseases

In the fight to reduce human suffering, there is an urgent need for the control of vector-borne diseases such as malaria and dengue fever. The use of genetically modified (GM) insects is one of the methods that has been supported by the WHO as a new measure for disease control. It is also being supported by the Grand Challenges to Global Health initiative as a method to control vectors transmitting dengue fever. However, there is much controversy surrounding the procedures of such research, especially concerning field trial studies of all types of GM organisms (GMOs).

Malaria is reported to cause one million deaths annually, mainly taking the lives of young children. It is known to be one of the leading causes of death in children under the age of five. Between 300 million to 500 million people suffer from acute cases of this mosquito-borne disease each year with about 90 percent of the cases occurring in Africa.

In 1997 where nine out of 10 cases occurred in sub-Saharan Africa, it is estimated that malaria caused more than \$2 billion of losses in the economy. Although prophylactics and various antimalarial drugs exist, the overuse of antimalarial drugs in recent years has led to a widespread resistance to conventional therapies leading to an increase of malaria morbidity and mortality (Bremner, 2001; UNICEF, 1999; WHO).

In addition to malaria, dengue and the more virulent form of dengue virus infection, dengue hemorrhagic fever (DHF), are also international health concerns, being endemic in Africa, the Americas, the Eastern Mediterranean, Southeast Asia and the Western Pacific. It is estimated that two-fifths of the world's population is at risk from dengue, but due to there being four different viruses causing the disease, vaccine development has been difficult and there is no specific treatment for dengue fever (WHO).

To control insect vector diseases, the most common and effective measure at present is transmission prevention at both individual and area-wide levels. Preventive methods such as insect repellents and bed nets are commonly practiced and have proven to be successful in reducing the risk of infection. On the other hand, the usage of pesticides to control larvae and adult populations in a more wide-spread area is a common approach as well, but has in fact caused higher incidences of malaria in some cases once again mainly due to mosquitoes acquiring resistance to insecticides (Eldridge, 2004; WHO).

As mosquitoes grow increasingly resistant to existent insecticides and with the general use of insecticides, especially those containing DDT, being questioned by some because of the environmental and health risks, conventional vector disease control methods are facing an exigency with many voicing the need for alternative futuristic approaches. The complete genome sequence of the malaria mosquito *Anopheles gambiae* has been obtained with researchers optimistic about the genomic data contributing to combating malaria (Holt et al, 2002). To hinder vector disease transmission by releasing mosquitoes that have been genetically modified to be refractory to pathogen infection could be a new method of mosquito-vector disease prevention and eradication (Alphey et al, 2002; Lycett et al, 2002; Scott et al, 2002; Enserink, 2000).

Views on biotechnology

To carry out a field trial in an ethical manner, it is necessary to understand the concerns held by the general public of each particular community as well as those of various stakeholders, and to ensure that

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there is open dialogue and continued involvement of communities throughout each trial.

In order to gauge the attitudes that people have concerning bioethics, two surveys were conducted in Japan, one in 2003, and the second in 2004 to both the general public and to farmers. These surveys contained a few questions relating to GMOs, with one question focused specifically on whether using genetic modification techniques to make mosquitoes incapable of vectoring diseases such as malaria and Japanese encephalitis in their opinion is acceptable or not. The questions were given in an open response format, thus the returned comments were analyzed and categorized into concept categories which express the ideas in the responses given.

Several public surveys have been conducted to ask for people's views on biotechnology in the US, Europe, and in Japan (Gaskell, 2000; Macer and Ng, 2000; Hoban, 1998; Macer et al, 1997; Macer, 1994; Macer, 1992). In the U.S., according to three surveys conducted in 1992, 1994, and 1998, just over 70% of the respondents were positive about plant biotechnology with the results remaining stable over the period.

The support has also been reported to be the highest among men and people with a more formal education. Surveys carried out in Europe show that only German and Austrian consumers were clearly opposed to plant biotechnology (Hoban, 1998). In general, perceptions of Europeans towards medical biotechnologies and environmental biotechnologies are very positive where they were most negative towards GM foods and the cloning of animals (Gaskell, 2000).

Surveys that were conducted in Japan reveal that the Japanese population is highly interested in science and technology including biotechnology. Over half of the respondents were favourable to genetic engineering. However, possibly due to bad publicity, there has been a decline in the overall acceptance of the application of biotechnology, even for areas such as environmental applications where support dropped 9% from 1997 to 2000.

Parallel to the surveys of public attitudes to biotechnology, scientists were also surveyed throughout Japan in 1991 (Macer, 1992) and in 2000 (Macer and Ng, 2000). More scientists than the general public believe that genetic engineering will improve the quality of life. Saying this however, scientists were just as sceptical about the application of genetic engineering as non-scientists (Macer and Ng, 2000).

There have been few surveys conducted to find out the views of people towards genetically modifying vectors, specifically mosquitoes, and pathogens for the purpose of disease control. GM microbes and animals are generally not as accepted as well by the public as GM plants (Macer, 1994). This may be due to the fact that GM plants are possibly more conceptually attainable because of their wide usage in food whereas GM microbes and animals are often linked with images derived from fantastical stories.

The issue of horizontal gene transfer between species is an ongoing polarized debate prodded by sporadic reports of gene transfer occurring which often lack substantial evidence of its actuality. Those in support of genetic engineering argue that gene transfer occurs naturally without human intervention, and in the case of genetic engineering, the genes being manipulated would be under better control compared to that of the random occurrences in nature (Macer, 2003). This suggests that a different way of thinking could relieve some people of their concerns.

Methodology

The 2003 survey was randomly distributed to households across all prefectures of Japan using a random sampling method (Inaba & Macer, 2003). Due to a low response rate when surveys were distributed anonymously in previous similar surveys, for the 2003 survey, the questionnaires were distributed personally to randomly selected households and left behind with the householders to complete and return by mail to their discretion. Consequently, the response rate was at around 20%, a significant increase compared to that of 2000 where the response rate was a mere 12%. Of the total 1900 distributed questionnaires, 376 were returned.

The 2004 survey was conducted in the Kanto area and some other prefectures across Japan in October-November of 2004 (Macer et al., 2006). Six hundred questionnaires were randomly distributed to the

public of which 128 were returned. 200 questionnaires were distributed to farmers of which 65 were returned. The response rate was 21% and 33%, respectively.

The collected responses were categorized according to standard qualitative research methodology. For this particular question concerning GM mosquitoes, the comments were categorized into 23 categories that can be grouped as being a positive feeling, mixed feeling, or a negative feeling. The keywords and concepts expressed in the comments were the bases for categorization following the methods of Macer (1992, 1994). Some of the comments were categorized into up to three categories when more than one feeling was expressed.

Japanese attitudes towards the use of genetic modification techniques to make mosquitoes incapable of vectoring diseases such as malaria or Japanese encephalitis

Of the total number of comments made, 31% expressed positive feelings, 19% mixed feelings, and 50% negative feelings towards using genetic modification techniques on mosquitoes vectoring diseases. The mean acceptance rate for all of the respondents from both years was 36% whereas 17% responded that the technique is unacceptable. The majority (of 47%) were unable to decide whether it is acceptable nor unacceptable.

Perceived benefits

Slightly more than one fifth of the entire sample population responded with a comment that expressed their feelings that benefits would arise from curing or preventing disease. Some of the sample comments were:

"For this kind of purpose, genetic modification should be used enthusiastically".

"Due to global warming, there is concern of new mosquito vector viruses entering form foreign countries. Preventive measures are necessary".

"Children in developing countries will be less in danger of contracting malaria and other diseases".

One farmer stated:

"It's good if it's only to eradicate diseases. However, I am against the genetic modification of plants [food]".

Nearly 40% of the farmer respondents commented that curing and preventing disease was a benefit of genetically modified mosquitoes, compared to the 20% of the general public of 2003 and 27% of the general public in 2004. A number of people expressed little or no concern towards the use of this technique to genetically modify mosquitoes. Some of the comments were:

"Necessary".

"It is very much welcome".

"As long as safety can be assured, there is no problem with reducing diseases".

Vector-borne diseases such as malaria and Japanese encephalitis are critical global health issues, and malaria in particular is both a major economic and health detriment in many developing countries. Some people expressed their hopes of bettering this situation by making statements such as:

"It's beneficial to humankind".

"For the happiness of humankind".

"Because it will especially contribute to the improvement of the quality of living in developing countries".

"Because there are many people troubled by malaria".

Table 1: The concepts associated with the reasons given for thinking that using genetic modification techniques to make mosquitoes incapable of vectoring diseases such as malaria or Japanese encephalitis (results for public 2003, 2004; farmers in 2004; and total; N, %).

Sample:	2003	Public	2004	Public	2004	Farmers		
Acceptable	124	32.9%	54	42.9%	24	39.3%		
Unacceptable	61	16.2%	25	19.8%	10	16.4%		
Don't know	186	49.3%	47	37.3%	27	44.3%		
Total Number	371		126		61			
Number with comments	189		67		21		277	Total
Not stated	182		59		40		-	
Positive								
Cure/Prevent Disease	38	20.1%	18	26.9%	8	38.1%	64	23.1%
No problem	14	7.4%	2	3.0%	0	0.0%	16	5.8%
Humanity benefits	7	3.7%	5	7.5%	2	9.5%	14	5.1%
Better	10	5.3%	4	6.0%	0	0.0%	14	5.1%
Medicine/Health	5	2.6%	3	4.5%	2	9.5%	10	3.6%
Science/Knowledge	0	0.0%	1	1.5%	0	0.0%	1	0.4%
Mixed								
Conditional benefit	23	12.2%	14	20.9%	8	38.1%	45	16.2%
Don't know	24	12.7%	3	4.5%	0	0.0%	27	9.7%
Negative								
Disaster	31	16.4%	3	4.5%	1	4.8%	35	12.6%
Fear of unknown	21	11.1%	9	13.4%	1	4.8%	31	11.2%
Ecological concerns	13	6.9%	14	20.9%	3	14.3%	30	10.8%
Interfere with nature	16	8.5%	3	4.5%	1	4.8%	20	7.2%
Don't need	11	5.8%	5	7.5%	2	9.5%	18	6.5%
Insufficient control	10	5.3%	2	3.0%	1	4.8%	13	4.7%
Playing God	9	4.8%	2	3.0%	0	0.0%	11	4.0%
Need more research	4	2.1%	1	1.5%	3	14.3%	8	2.9%
Human health	3	1.6%	3	4.5%	2	9.5%	8	2.9%
Humanity changed	1	0.5%	2	3.0%	1	4.8%	4	1.4%
Animal concerns	3	1.6%	1	1.5%	0	0.0%	4	1.4%
Unethical	3	1.6%	0	0.0%	0	0.0%	3	1.1%
Feeling	1	0.5%	1	1.5%	0	0.0%	2	0.7%
Deformities	0	0.0%	0	0.0%	1	4.8%	1	0.4%
Economic loss	1	0.5%	0	0.0%	0	0.0%	1	0.4%

Genetically modifying mosquitoes in order to make them incapable of vectoring diseases such as malaria and Japanese encephalitis can be perceived as simply a better option than the current situation. A few of the comments that were made were:

"I think it's better than getting sick".

"Because the dangers of malaria and Japanese encephalitis are far greater than those of genetic modification".

"It's better if epidemic diseases are eradicated".

Medicine and health are general concerns for most humans. A few people conveyed their views that this technology is beneficial from a medicinal and health-related standpoint:

"Because I want to remain healthy".

"For health".

"Because it is something that concerns human bodies".

There was one comment made that hinted at the potential benefit towards the development of science and knowledge:

"It's an obvious option that doesn't even need to be questioned. (Hideo Noguchi endeavored singly)".

Mixed Feelings

Many people viewed genetically modifying mosquitoes as beneficial, but only under certain conditions. Concerns for the safety of the procedure and its effects on the ecosystem, along with the actual benefits of the technique for curing and preventing diseases, were stated by many of the respondents. Some of the sample comments were:

"It's acceptable if social problems and environmental pollution are prevented as much as possible."

"As long as safety can be assured, there is no problem with reducing diseases".

"The balance of the natural world not being destroyed is the condition".

"Under the condition that there are no other effective prevention/treatment methods (especially concerning malaria). If this method is considered to cause little harm and be effective, then it can be applied".

"I accept if it is a technique that will benefit the development of humankind".

Some people did not know enough about genetic modification techniques to answer the question of whether or not they could accept it. Listed below are a few of the statements:

"I don't know about vectoring (no knowledge)".

"I have no idea what kind of technique this is so I can't say anything".

"I've never thought about it".

Perceived risks

The public often receives any new progressive scientific technique with ambiguous feelings towards the possibility of disaster and risks that might be posed by application of the technique. Although new procedures are evaluated for potential risks before their application (usually by several regulatory committees) public opinion over GMOs tends to be negatively focused. Generally, more time and information are needed to alleviate this uneasiness and for the public to be accepting of such novel techniques. Some of the respondents replied that:

"Other disasters are worrisome".

"There aren't any answers to the comparative analysis of real disasters and futuristic disasters".

"I can't completely disagree, but I can't completely agree, either. Because the possibility of the ecosystem being destructed and other harms occurring can be highly considered".

Apart from concerns of disaster, fear of the unknown was a noticeable concern for many. To be more specific, the unknown can be attributed to areas of concern such as side effects, new diseases emerging, unexpected problems, etc. A few of the comments were:

"Because even if we prevent diseases using genetic modification, the possibility of contracting diseases that were unknown until now is thinkable".

"Because the range of connections in nature is not understood. Also, I am worried of the danger of new diseases being vectored".

"I am worried that there may be new unexpected problems".

"Because the effects on the ecosystem and environment are unknown when genetically modified mosquitoes are released into the natural world".

Concerns for the effects on the ecosystem and to the environment were mentioned in many of the comments. Because the proposed technique involves the genetic modification of mosquitoes, which are more difficult to contain than, say, genetically modified plants, the effects on the ecosystem can be perceived as a significant concern. Some of the opinions that were voiced were:

"Because I don't know whether or not there are worries of the ecosystem being destroyed due to genetic modification".

"Same as humans, manipulating genes of organisms will destroy the balance of all living organisms".

"Having fewer diseases is a good thing, but I don't know if it's right to destroy the natural system".

"[T]here are benefits for humans, but it will disrupt the balance of the animal world".

A number of people expressed their concerns that such a technique might interfere with nature. The progress of science and technology can be seen as a means to manipulate nature, or to interfere with natural ways. In Japan, a recent trend to choose "nature-friendly" products and methods is noticeable. This could possibly be due to the increased publicity of environmental issues. A few of the comments were:

"I feel awkward about the providence of nature being easily destroyed".

"Genetic modification might go against nature".

"I can't decide whether it is acceptable to manipulate nature".

"I am against unnecessary intervention of nature, but I don't like mosquitoes".

Some of the respondents simply found the genetic modification of mosquitoes unnecessary for the purpose of vector disease control, or considered that other methods of control and prevention were better options. There were comments such as:

"[The need for] the development of insecticide that will stop [population booms] of mosquitoes".

"[They] were made as mosquitoes by nature. Humans should not manipulate. Medicine effective for malaria and Japanese encephalitis should be developed and mass produced".

"Considering that it has been overcome with conventional methods, I cannot agree yet to applying genetic modification techniques of which the side effects have not yet been clarified".

"Diseases are stoppable without doing such a thing".

Uneasiness towards insufficient control of both the technique itself and the application of the technique was expressed by some of the people.

There is a similar connotation to the categories of "disaster" and "fear of unknown", but comments that expressed such apprehensions to a lesser degree were categorized under "insufficient control". Some of the comments made were:

"I am worried that only apparent concerns will be dealt with".

"Even if [the disease] is stopped, the possibility of a different virus emerging and attacking humans cannot be denied".

"I am afraid of new trouble due to genetic modification".

"I think it's good, but I feel that there will be more side effects. After all, it is genetic modification".

Several people felt that genetic modification is a technique that exceeds the moral boundaries of the many privileges humans are capable of taking advantage of; it is considered synonymous to humans playing God. A few of the comments were:

"Humans manipulating the life system is unacceptable".

"I feel it is wrong to manipulate mosquitoes and things for human conveniences, but if people who will suffer from diseases will decrease even slightly, I accept".

"There is nothing better than getting rid of diseases, but I can't help feeling that humans are being arrogant by doing so".

"Stopping the transmission of diseases is a good thing, but it's difficult to judge whether it's an area which humans should interfere with".

Lack of sufficient research was another cause of doubt among the respondents who did not accept the use of genetic modification techniques on disease-vector mosquitoes. The people feeling that more research is necessary can be inferred through comments such as:

"It's questionable until there is proof of no side effects when bitten by the specified mosquitoes".

"Because the ecosystem is not fully understood, it is necessary to confirm that there are no other effects".

"There are many things that have initially been said to be safe but have subsequently been claimed to be dangerous, so I cannot trust anything unless it has been thoroughly researched".

There were two comments made that indicated concern that reducing diseases will be detrimental to the immune system of humans:

"Getting diseases (the possibility) is what makes humans stronger".

"Because by using genetic modification techniques, it seems like humans will lose their natural resistance among other things towards diseases".

As with any novel scientific procedure, there is always a possibility of humanity being changed. This was expressed as a concern by a few of the respondents, as can be seen from the following comments:

"Humankind as it was born should be succeeded as it is".

"I am worried about how humankind will become in the future".

There were a few comments stating concern for the well being of mosquitoes and of animals in general. Although general concern for mosquitoes and other insects is often not as significant as that for various mammals and birds, the remarks below are a few of the comments made that do express concern for

mosquitoes as well as for the animal world:

"What about the effects to the cycle of the animal world?"

"I think that maybe it is okay if there are few bad aspects to the mosquito".

"[I accept.] However, so long as mosquitoes themselves are not changed".

The genetic modification of mosquitoes was considered by a few to be unethical. The comments made were:

"I am against changing the genes of organisms".

"Researching anything is good, but I am against using it as a technique".

"[I don't know,] because mosquitoes are also living organisms and humans have no right to manipulate them. (Ethics of nature.) However, [I don't know] because humans don't want to get Japanese encephalitis".

One person stated concern that a new species might result:

"I feel that a stronger new species will be generated".

There was one comment expressing a negative economic concern:

"The numbers are too big, the cost too high. It should be done more ecosystematically".

Increased support of the genetic modification of mosquitoes

In the 2003 survey, one third of the people answered that they thought genetically modifying mosquitoes to make them incapable of vectoring diseases such as malaria and Japanese encephalitis would be acceptable.

Nearly half answered that they did not know, and only 16% said they did not find the technology acceptable. Comparatively, in the 2004 survey to the general public, the number of respondents accepting GM technology rose by 10% to 43%.

However, the proportion of the respondents not accepting also rose by 4% to 20% of the total with the percentage of respondents answering not knowing decreasing to 37%. There was also an increase in acceptance by the farmer respondents, with 39% answering they would accept. As was the case in 2003, 16% responded that they would not accept, and 44% answered they did not know.

It is difficult to pinpoint exactly why there was an increase in the proportion of respondents accepting the genetic engineering from 2003 to 2004. Japan is not endemic for malaria, and the previously compulsory childhood vaccination for Japanese encephalitis since 1994 was announced to be discontinued in May 2005 due to the number of cases dropping to just a few per year. Given this, it is unlikely that a stronger sense of need for disease control was evoked among the respondents within a year.

Several studies conclude that the support for biotechnology applications in general is declining (Gaskell, 2000; Macer, 2000). In this light, it is conceivable that there is some other intrinsic factor for supporting the use of GM technology for disease control that outweighs the general attitude towards biotechnology.

Possibly worthy of mention is that a new 1,000 yen bill picturing Hideo Noguchi, a heroic figure in Japan who developed the yellow fever vaccine, which began circulation in November 2004. Prior to this occasion, the Japanese public was reminded of his achievements and contribution to the field of epidemiology. No specific campaigns were carried out to evoke public awareness for malaria and other tropical infectious diseases, but the overlapping timing of this particular event and the timing of the surveys may have affected the respondents to be subconsciously sensitive towards the subject of infectious diseases.

Views on GM technology

The categorization of the returned comments revealed that although there was little disparity among the comments made in 2003 and 2004, nor in the proportions of persons that accepted GM mosquitoes. In 2003, the proportion of positively inclined comments was 30%.

In 2004 among the general public, this figure was 34% and 33% among the comments from farmer respondents. 19% of the comments made in 2003 were comments conveying mixed feelings. There was an insignificant difference in 2004 with the percentage being 17% among the general public and 22% with farmers' comments.

As for comments that perceived the particular GM technology negatively, half of the comments from the surveys (2003, 51%; 2004, 48% of the comments from the general public and 44% of the comments from the farmers) were categorized as so. Compiled together, 31% of the total comments were of a positive nature, 19% of them revealed ambivalent feelings, and 50% had a negative connotation to them.

The total percentage of the respondents that thought the genetic modification of mosquitoes to make them incapable of vectoring diseases is acceptable was 36%.

Only 17% found the procedure to be unacceptable and 47% answered that they did not know. This is an interesting finding when taking into account that half of the comments returned contained negative perceptions of the procedure, yet only 17% of the total respondents answered that the actual procedure to be unacceptable.

It seems that the respondents were accepting of the purpose of the procedure, but still had doubts over the technique itself. One quarter, 23%, of the total comments mentioned some association with curing and/or preventing disease. The second highest proportion of comments was categorized under "conditional benefit".

These comments contained what the respondents perceived as being both positive and negative aspects of the procedure. Preventing vector borne diseases such as malaria and Japanese encephalitis are considered important concepts for the Japanese people even if Japan is not endemic for such diseases. Malaria is ubiquitously known as a tropical disease to the Japanese public. However, they clearly were wary of the possible hazardous consequences of the procedure, implying that the public was more or less informed of GM technology due to the fact that they were capable of expressing their concerns.

Survey results of scientists in Japan in 1991 and in 2000 show that even though they are just as cynical of certain applications of GM technology, overall, scientists are more inclined to believe that genetic engineering will improve the quality of life (Macer and Ng, 2000).

This suggests that information that is quantitative in nature influences a supportive stance towards GM technology, but the relative level of the qualitative information received by the more formally educated compared to the general public is unknown. Distinguishing this would be informative of just how much the media predisposes public opinion as well as being helpful to compile objective information to be disseminated for the purpose of encouraging an informed opinion of GM technology and biotechnology in general.

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Benefits and ethical limits of transgenic animals*

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Introduction

The growing awareness of the human and social implications of progress in life science is certainly one of the most significant developments of the 21st Century (Melchias, 2005).

In the last few decades, there has been a growing feeling that technology has brought with it both problems and benefits, thus leading to a strong anti-technology trend (Sullia, 2003). Modern biotechnology has the potential to bring up a wide range of "moral and ethical concerns". "Ethical concerns" are a set of standards by which a particular group or community decides to regulate its behaviour, to distinguish what is legitimate or acceptable in pursuit of their aims from what is not (Straughann, 1996).

The genetic modification of living beings raises special ethical concerns that go beyond a general discussion of animal rights or welfare. Although the goals may be similar, biotechnology has accelerated the process of modification of "types" traditionally carried out by crossbreeding (Nuffield Council, 2005).

While there has been a downward trend in the number of genetically normal animals used in research, the use of genetically modified animals has increased tenfold in the last decade (Almond, 2000).

Genetic Modification

Genetic modification, or genetic engineering, of animals involves the addition and/or deletion of part of the DNA of an animal in order to change that animal's characteristics. Genetically modified animals are widely preferred as the source of animal experimentation, as they can be of uniform quality and can be mass-produced (Boyd Group, 1999). Genetically modified animals have been produced for several reasons, including:

- To help scientists to identify, isolate, and characterize genes in order to understand more about their function and regulation;
- To provide research models of human diseases and help develop new drugs and new strategies for repairing defective genes (gene therapy);
- To provide organs and tissues for use in human transplant surgery;
- To produce milk that contains therapeutic proteins, or to alter the composition of the milk to improve its nutritional value for human infants;
- To enhance live stock improvement programmes (Straughan, 1996).

Production of genetically modified animals

The techniques used in the genetic manipulation of animals include the administration of drugs to donor female animals in order to induce super ovulation, followed by timed mating and collection of fertilized eggs (by killing the donor animals in the case of mice, or by laparotomy in larger animals).

After they have been genetically manipulated in vitro, the modified embryos are then implanted into surrogate mothers by laparotomy. Both induction of super ovulation and laparotomy are established techniques which, increasingly, are employed in the selective breeding of farm and laboratory animals. ~~Laparotomy is carried out under general anesthetic. Nevertheless, laparotomy can cause post-operative~~

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pain, and super ovulation can cause discomfort.

In both cases, appropriate analgesia should be administered. Preparation of surrogate mothers involves mating them with sterile males to produce a 'pseudopregnancy', and the males must therefore undergo vasectomy under general anesthetic.

Sometimes, the donor female animals are mated when very young, and this can be stressful (Hubrecht, 1994). Aside from the direct effects of the techniques involved, foetal death can occur during development in utero, and some additional deaths can occur post-natally.

A study (Wight, 1994) found that, in experiments involving pro-nuclear microinjection of seven different gene constructs into mouse embryos, 1360 out of a total of 1585 embryos survived micro-injection (and in some cases overnight culture) and were implanted into pseudopregnant females. 29% of the implanted embryos survived to weaning (with a range of 21% to 42% between the seven experiments). Just under a quarter of these pups proved to be successfully genetically manipulated (that is, 7% of the implanted embryos, with a range of 3% to 11% across the experiments) (Hubrecht, 1994; Wight, 1994).

Such proportions are likely to vary considerably from case to case. It is uncertain at what stage in development fetuses can experience pain and distress, or how much the welfare of the mother is compromised by foetal death. But with larger farm animals, it is known that miscarriages cause distress to the mother. Losses during production mean that relatively large numbers of donor and recipient animals must usually be used, in order to produce a relatively low yield of genetically modified animals.

The contribution of transgenic animals to human welfare

There are a number of examples of how transgenic animals can contribute to human benefit. Scientists are attempting to produce disease-resistant animals such as influenza-resistant pigs.

In 2002, two scientists at Nexia Biotechnologies in Canada spliced spider genes into the cells of lactating goats. The goats began to manufacture silk along with their milk and secrete tiny silk strands from their body. By extracting polymer strands from the milk and weaving them into thread, the scientist is able to create a light, tough and flexible material that can be used in such applications as military uniforms, medical microsuture and tennis racket strings.

Toxicity-sensitive transgenic animals have been produced for chemical safety testing. Microorganisms have been engineered to produce a wide variety of enzyme-yielding proteins; the enzymes, in turn, can speed up industrial chemical reactions (Margawathi, 2005).

Genes can be inserted or deleted in the genome, and mice have been used extensively to study complex developmental processes in which genes are switched on and off.

Many different mice models mimicking human disease or possessing relevant human receptor sites are used in studying the mechanisms by which disorders are caused, and to work towards developing more effective treatments such as a pharmaceutical or gene therapy (Bedell, 1997). Human gene therapy involves adding a normal copy of gene (transgene) to the genome of a person carrying defective copies of that gene.

The potential for treatments for the thousands of genetic diseases is huge, and transgenic animals could play a role in the development of human therapy. For example, the A.I. Virtanen Institute in Finland produced a calf with a gene that makes the substance that promotes red blood cell growth in humans.

Selective inbreeding has produced several strains of animal that are considered reasonable models of type 1 diabetes, type 2 diabetes, and related phenotypes such as obesity and insulin resistance. Apart from their use in studying the pathogenesis of the disease and its complications, all new treatments for diabetes, including islet cell transplantation and preventive strategies, are initially investigated in animals.

In recent years, molecular biology techniques have produced a large number of new animal models for the study of diabetes, including so-called "knockin", generalized "knockout", and tissue-specific knockout mice (Rees, 2005).

Biopharming

Transgenic animal bioreactors represent a powerful tool to address the growing need for therapeutic recombinant proteins. The ability of transgenic animals to produce complex, biologically-active recombinant proteins in an efficient and economic manner has stimulated a great deal of interest in this area.

As a result, genetically modified animals of several species, which express foreign proteins in various tissues, are currently being developed (Dyck, 2003). Production of pharmaceuticals in milk (for instance, production in sheep's milk of human blood clotting factor IX, human α -1-antitrypsin) can be used to treat hereditary emphysema and cystic fibrosis (Nuffield Council, 2005).

Xenotransplantation

The use of animal organs for human transplantation is being seriously considered as a viable option for organ donation. Two groups of animals have been considered as donors: non-human primates and large non-primates such as pigs (Ravelingien, 2004).

The chances of successful xenotransplants in the future can be improved by genetically modifying pigs so that, for example, they carry human-complement regulating proteins on the surfaces of their cells, which will help to inhibit hyper acute rejection when such organs are transplanted into humans.

Improving Productivity

Genetically modified cows can be bioengineered to produce several varieties of milk:

- milk with a lower level of a protein that can be allergenic to infants;
- milk that is more easily digested by people who are lactose intolerant;
- milk that has more naturally occurring anti-microbial enzyme and therefore has a longer shelf life;
- milk that makes better cheese because it has altered the distribution of caseins or less fat

There are a wide range of genetically modified animals. A tropical fish was genetically modified to glow in the dark and was called the "Glofish". A company called Transgenic Pets started work in 2001 to remove the allergen gene from cats in a bid to make allergy-free cats. Shellfish have also been modified for reduced allergenicity and faster growth. Salmon, catfish, and tilapia have been modified for faster and more efficient growth in aquaculture.

Ethical Concerns

Alongside potential benefits, genetic modification of animals raises a variety of ethical concerns. Ethics can be defined as a set of standards by which a particular group or community decides to regulate its behaviour; to distinguish what is legitimate or acceptable in pursuit of their aims from what is not.

Bioethics can be defined as the systematic study of human conduct in the areas of life sciences and health sciences, keeping in view the moral values and principles existing during a particular period (Sullia, 2003).

The debate over animal use brings up difficult ethical questions, such as: Do we as humans have the right to alter the genetic composition of other animals? And what is the point of researching on animals when they are so different from us?

The concern for animal welfare is sometimes portrayed and dismissed as a matter of purely emotional response (Mani, 2003). Animal biotechnology is a morally sensitive issue, because many people have concerns about not only the treatment of animals but also about the nature of biotechnology itself.

Other concerns include the nature of the act of genetic engineering, involving broad issues such as

genetic integrity, the idea of unnatural intervention in the natural world, and the co-modification of animals (Macer, 2006).

It might be argued that genetic engineering currently includes the transfer of only one or two genes and as such has little difference to evolution or selective breeding. But this modern technology is limitless and has the capacity of crossing species boundaries drastically.

Ultimately, all of these objections are debatable, as views vary widely regarding the moral basis of genetic modification. Transgenic animals can create particular problems for some religious groups, for example, Muslims, Sikhs, and Hindus are forbidden to eat the flesh of specific animals and thus a conflict arises in eating foods containing genetic material from those animals.

Many people appear to be uneasy about the transfer of genetic material from and into animals, though there seems to be little concern that insulin for treating diabetics is now produced by inserting copies of human genes into microorganisms. This suggests that it is the involvement of animals rather than the crossing of species' boundaries that is regarded as morally problematic.

The deliberate production of genetically identical animals is dangerous because it fails to respect genetic diversity, particularly if the aim is a production-line uniformity (Catholic Study Circle, 2004).

Consequences of genetic manipulation and animal welfare

Though opinions differ on the fundamental objections, the consequences of genetic manipulation cannot be denied or explained away without considering suitable precautionary measures.

This enormously promising science is in its infancy - despite a wealth of amassed knowledge, we know very little. The consequences of genetic modification on animals as well as human life and the environment at large must be considered.

Animals undergo various procedures during genetic modification. In some cases, genetic modification appears to have no impact on the welfare of resulting animals; in certain cases, it could theoretically benefit animal welfare, and in other cases, there are certainly adverse welfare effects in a range of severities, both during and after the procedures (Moore, 1995; Van Zutphen, 1996).

Welfare can be compromised in two main ways:

- (a) For research purposes, gene deletions ("knock-outs"), mutations, or defective genes may be introduced in order to deliberately cause or simulate a wide range of genetic diseases, or developmental or gene function abnormalities;
- (b) In any case of genetic manipulation, unintended adverse side effects can occur. Such side effects may be caused when the new genetic material is expressed and unpredicted physiological changes occur, or they may be caused when the introduced DNA disrupts the function of one or more of the animals' own genes.

The latter is a result of randomness of integration of the new genetic material into the recipient animal's genome, in particular when the pro-nuclear microinjection technique is used. Many such disruptions prove fatal to the developing embryo.

When the effect is not lethal, the welfare of the resulting animal can be seriously compromised (e.g., mice have been born with deformed limbs or kidney malfunction) (Sullia, 2003; Dyck, 2003). For example, a number of species of hoofed animals produced by in vitro culture or nuclear transfer methods, whether or not they carry a transgene, tend to have higher birth weights and longer gestation times than offspring produced by artificial insemination. Additional health and welfare problems include respiratory distress, lack of suckling reflex, and a variety of pathological conditions (Vandenberg, 2002).

There are a few instances where genetic modification led to substantially ill effects even with survival beyond foetal stages. Some super pigs engineered with a human growth hormone gene were arthritic, ulcerous, blind, and impotent (Catholic Study Circle, 2004).

A super salmon engineered with genes from another fish for fast growth had a bulbous head and died as a result of not being able to breathe, see, or hear properly. Clones of Dolly the sheep, “the big success story”, were eight times more likely to die at birth than a normal lamb (Hubrecht, 1994). Among transgenic animals that survive, many don’t express the inserted gene properly, often resulting in anatomical, physiological, and behavioural abnormalities.

Potential risks to humans, animals and the environment

A utilitarian justification for producing and using genetically modified animals must take into account potential risks to humans and other animals, as well as to the wider environment. While risk management is a major concern of regulatory bodies, it varies in scope and efficacy between countries, and much more research on safety aspects is needed.

There is a concern about the risks from the use of retroviruses as DNA vectors during production of genetically modified animals: e.g., risks that genes might inadvertently be transferred to other individuals or species, or that retroviruses might infect other organisms.

There is also a concern that drug resistance gene markers used in some genetic engineering procedures might inadvertently be transferred and expressed. There is also an ecological concern that the creation of disease-resistant animals may threaten the entire environment.

There are concerns that animal biotechnology might narrow the gene pool and reduce genetic diversity, thereby producing a monoculture that could be vulnerable to new diseases or other environmental threats. If animals bioengineered in biomedical research to be models of human diseases escape they may infect the human (and animal) population, or might generate new and more resistant strains of the disease. There are also concerns that organs from genetically modified animals might transmit vital diseases if used in human transplant surgery. Particularly in xenotransplantation, there is a concern that a human recipient of animal organs might become infected with animal viral diseases, which might then infect the wider population.

Genetically engineered salmon could induce the widespread introduction of new genes into wild fish runs and they could, for example, introduce new vulnerabilities to disease or disrupt the predator-prey relationship because they might grow larger than normal.

Cats, goats, fish, insects, and other animals that pose the greatest risk of escaping and cross-breeding would be difficult to quarantine or capture, and could yield unforeseen consequences for the genetic future of these species.

Animals bioengineered for food purposes might produce proteins that would cause allergies or other hypersensitive reactions. The applications of biotechnology may someday reduce the number of animals needed for food and fibre production, but they also can have adverse effects on the welfare of the animals: for example, calves and lambs produced through in vitro fertilization or cloning tend to have higher birth weights and longer gestation periods, which leads to difficult births, resulting in many cases in caesarian sections.

There is a concern that proteins designed to produce a pharmaceutical product in an animal’s milk may find their way into other parts of the animal’s body and cause adverse effects (Carroll, 2002). While most genetic modifications tend to not benefit the animals concerned, genetic modification might also aim to benefit animal welfare, for example by producing better disease resistance. In other cases, genetic modification might be welfare “neutral”. This might be the case if there is “no change from the average for unmodified animals” (as for example in most, but not all, animals modified to produce medically important proteins in their milk) (Moore, 1995); or welfare is no different from that of animals produced by selective breeding (Straughan, 1996). This last point again raises the question of how significant the differences are in the effects of direct genetic modification versus conventional selective breeding.

Conclusions

We need more detailed analysis about welfare problems caused during the production of genetically modified animals. Directly modifying an animal's genetic material can produce unpredictable consequences, while most genetic modifications tend to not benefit the animals concerned.

Genetic modification could aim to benefit animal welfare: for example, by producing better disease resistance. To take a hypothetical example, if all pigs in the world were resistant to foot and mouth disease, there would be enormous benefits for the welfare of pigs.

In other cases, genetic modification might be welfare “neutral”. This might be the case if there is no change from the average for unmodified animals (as for example in most, but not all, animals that are modified to produce medically important proteins in their milk) (Moore, 1995), or if welfare is no different from that of selectively bred animals (Straughann, 1996).

This last point again raises the question of whether there are significant differences in the effects of direct genetic modification versus selective breeding. Wide-ranging effects and thus potential harms and benefits of such procedures are often uncertain.

It is therefore crucial that the justification for the work is reassessed as it progresses. There is a need for greater commitment to monitoring, collecting, and reporting data on the adverse side effects of genetic manipulations.

Good practices should be followed, in that adverse effects should be looked for actively, and data gathering should involve those responsible for the husbandry of the animals.

Welfare problems should be recorded in databases on the characteristics of genetically modified animals, and journals should require scientists reporting novel genetic manipulations to fully document the effects on the animals of their procedures. Reporting should include aspects such as deaths in utero occurring during production of genetically modified animals, as well as adverse effects experienced by the resulting animals. The latter should include any morbidity or mortality, changes in health status, changes in weight/growth of the animals, behavioural changes, changes in breeding success, and results of post mortem examinations of gross morphology.

The use of genetic modification to increase productivity in farm animals by enhancing growth rate, or related factors such as muscling, is particularly controversial. In large-scale production and long-term use of genetically modified animals in agriculture, negative welfare effects caused by genetic modification should not be tolerated, and every effort should be made to minimize such effects.

The process of ethical review of research involving animals should satisfy the following objectives:

- It should ensure the ethical acceptability of all research projects involving animals. In practice, this means ensuring:
 - (a) That they are scientifically necessary and of high quality; and
 - (b) That, wherever possible, the use of animals is replaced, refined, or reduced
- It should improve public confidence in the review process;
- It should enable those responsible for ensuring the acceptability of work in their institutions to carry out their duties as effectively and efficiently as possible (Boyd Group, 1999);
- We have no right to use the animals in any way that suits us just because we are members of a different species: we should take into account their feelings, interests, and capacity for pain and pleasure (Straughan, 1996)

Human beings are challenged to make ethical decisions and to balance the benefits and risks of alternatives. The benefits of genetic modifications are great, but there are many possible risks. The more possibilities we have, the more decisions we must make. People need to be taught more about how to

make ethical decisions, and the educational system should accommodate this need of modern society.

Bioethics shouldn't be allowed to strangle technical research, while at the same time research shouldn't be allowed to proceed unscrutinized. Let us not forget that the moral goodness of any progress is measured by its net benefits to humankind, and the benefits of biotechnology must outweigh the burdens (Melchias, 2005).

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Biobanking and ethnic monitoring*

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Introduction

This paper will discuss the "Chances and Risks of Biobanks" and "Ethnic Monitoring" of different population groups, in our case, minorities.

Scientists have much hope in the collection, treatment, storing, and distribution of human tissues from different populations. However, what opportunities do those projects offer for the donors? We have learned from the very famous Icelandic and the UK biobanks that donor benefit is often not taken into account, apart from a potential indirect benefit due to the development of medicines for donor-patients.

For this situation, we can find many examples. We would like to present some not-so-well-known but highly current cases. The first two are biobanks: one is the "Macedonian Biobank", and the second is the "Genographic Project". The third one is the Hungarian project for ethnic monitoring. Lastly, we will analyse chances and risks for involved populations in these projects, with special attention to their impact on minorities.

The Macedonian DNA bank¹

It is little known that Macedonia has set up a DNA Bank.² This human biobank is operated by the University of Skopje, the Institute for Immune Biology, and the Institute for Human Genetics. The biobank of genealogical data has various goals: the genetic diversity of the Macedonian population and its minorities will be studied, and any correlations between genetic diversity and genetic diseases are to be examined. This biobank is financed by the Macedonian government. It encompasses three different research and project areas, as shown in Table 1.

Table 1: Project areas, number of existing DNA samples. December 2002³

Project	DNA: stored samples			
	2002	2001	2002	2000-2002
Anthropology (ethnic groups)	46	279	652	978
Patients without reference*	111	249	75	435
Patients with reference**	19	159	103	281
Total	176	687	831	1694

*"Patients without reference" refers to data and materials, etc., from different medical projects outside of the two institutes, where no family data are recorded. To date, this bank only has 409 samples. Main focal points are 10 diseases of various types like heumatism, heart disease, and diabetes mellitus 1 and 2, and others.

**"Patients with reference" means projects where DNA samples are stored to include family and patient data. The main focus of this bank is bone marrow transplantations, related renal transplantation, and autism. At this time, the bank comprises 232 samples of 232 persons.

1This part of the paper refers to B. Jansen, Rechtliche undethische Aspekte von DNA – Datenbanken in Internationalen Vergleich, Lueneburg, 2005

2 <http://www.hdnamkd.org.mk/index.html>

3Source: www.hdnamkd.org.mk

* Paper first presented at the First UNESCO Bangkok Bioethics Roundtable, September 2005

Defining populations and samples of human genetic material as done in this anthropological research is problematic, because the samples are structured and defined according to the criteria of population, nationality, language (mother tongue and second language, and religion, as Table 2 shows.

Table 2: Definition of the Macedonian population and samples⁴

Population	Nationality	Other National.	Mother tongue	2nd Language	Religion	DNA - Samples
Macedonian	Macedonian	Macedonian	Macedonian	Macedonian	Orthodox Catholic Protestant Muslim	353 0 0 4
MKDAI Albanian	Albanian	Macedonian	Albanian	Macedonian	Muslim Catholic	50 0
MKD ROMA	Roma	Macedonian	Roma Macedonian Turkish	Macedonian	Muslim	82
MKD Turks	Turkish	Macedonian	Turkish	Macedonian	Muslim	8
MKD Serbs	Serbian	Macedonian	Serbic	Macedonian	Orthodox	9
MKD Valchs	Vlach	Macedonia	Vlachs	Macedonian	Orthodox	2
MKD Mixed	Mixed	Macedonia	Mixed	Macedonian	Mixed	6
Yug Gorans	Goa	Serbian	Macedonian	Serbic	Muslim	80
Total						594

Particularly from an ethical point of view, to use the above criteria could be problematic, because no information is given if the concepts of these criteria are in accordance with the concepts of the involved ethnic groups, because the research results may be abused with regard to ethnic groups. The self-identification of individuals and groups is problematic, and using the above criteria, the results of the analysis of the research may be abused to discriminate ethnic groups.

With regard to this project, the question of protecting the personality rights of the individual is entirely unanswered. Although the Macedonian constitution generally protects personality rights, it is unclear whether or not DNA issues are covered. Furthermore, other crucial matters like informed consent, duration of storage, etc., are not mentioned in the project information material. Macedonia does have a 1994 law for the protection of person-related data; however, it is not available in a new English translation, and it is not included in their law texts on the internet.⁵

Abusing tissues and data for discrimination purposes with regard to unwanted groups of the population is, therefore, not legally prohibited. This is particularly of concern since, until quite recently, Albanian minorities have been persecuted.

⁴ "MKD Valchs"= This minority is largely not known, "MKD Mixed"= people of Montenegro, Jews, and others, "Yug Gorans"= people who live in the region Gora (southwest of Kosovo, Muslims).

⁵ <http://www.mlrc.org.mk/list.htm>

The Genographic Project⁶

The Genographic Project has the goal to take human genetic samples from all over the world in order to create a world atlas of human migration. The project was announced to the public on 13 April 2005 and was initiated by the National Geographic Society, IBM, the geneticist Spencer Wells, and the Waitt Family Foundation. Referring to information published on the internet, an advisory board with ten members provides advice and consultation on matters such as funding priorities and ethical and legal compliance over the course of the project. This ensures that all national and international laws concerning human genetic sampling and anthropological research are followed before starting. An external control is managed by the Social and Behavioural Sciences Institutional Review Board (IRB)⁷

Even non-indigenous people can participate in this project by purchasing a "participation kit" for a minimum of \$100. Those participants are called upon to do a cheek swab and anonymously send it to the Arizona Research Lab at the University of Arizona.

Scientists have taken samples also from indigenous people. There is still some mystery of how sampling is managed: it is just mentioned that participation is voluntary and that advice and counsel from leaders and members of indigenous communities is sought. The samples are analysed in regional labs, and the encoded results are sent to the central database at the Arizona Research Lab for analysis. The origin of the sample and the donor are kept on file in the regional research lab. Published information states that any further research on the samples and any patenting on the results are banned. The samples are to be completely destroyed by the end of the project. The net proceeds from the sale of the participation kits will be directed towards cultural preservation efforts for participating indigenous populations.

According to the lack of transparency in this project, it is not clear if and when consultations are to be enacted with indigenous people concerning the implementation and methodology of the project. This lack of transparency links the project to scientific paternalism. Also, any possible economic exploitation is unknown. And as mentioned above, the security of the indigenous participants' data is not guaranteed.

In addition, the Arizona Research Lab, which is in charge of the analysis of the collected data, was discredited due to the exploitation of human genetic material of the native American tribe the Havasupai⁸ a couple of years ago. Also, members of the research group participated in a previous project that resulted in discord between some of the indigenous people and the scientific community. The discharged Human Genome Diversity Project collected the genetic data of ethnic minorities and almost all the chosen indigenous peoples refused to participate because they felt it treated them as scientific objects rather than as human beings.

The respect for human dignity and the respect for the rights of each human being, "regardless of their genetic characteristics" (Art. 2,a)⁹ and the imperative not "to reduce individuals to their genetic characteristics" (Art. 2,b)¹⁰ were acknowledged through the UNESCO Universal Declaration on the Human Genome and Human Rights¹¹ in 1997.

For this reason, some are concerned that human genetic projects are violations against international law agreements; for example, Article 7.1 of the ILO Convention 169 demands that: "The peoples concerned

6 The following has been worked out in the context of a seminar of the University of Lüneburg, and it was presented as a statement during the twenty-third session of the Working Group on Indigenous Populations, Commission on Human Rights, Sub-Commission on the Promotion and Protection of Human Rights (UNESCO), Geneva, 18.-22. July 2005 (Anna Böhme, Cristina Blohm-Seewald, Ingeburg Annelie Fincke, Robin Gläß, Jürgen Simon).

7 Which is situated at the University of Pennsylvania, Office of Regulatory Affairs.

8 <http://www.havasupaitribe.com/>

9 Article 2, (a): Everyone has a right to respect for their dignity and for their rights regardless of their genetic characteristics.

10 That dignity makes it imperative not to reduce individuals to their genetic characteristics and to respect their uniqueness and diversity.

11 UNESCO. 1997. Universal Declaration on the Human Genome and Human Rights. Gen. Conf. Res. 29 C/Res. 16, reprinted in Records of the General conference, UNESCO, 29th Sess. 29/C/Resolution 19, at 41. Adopted by the UN General Assembly, G.A. res. 152, U.N.GAOR, 53rd Sess. U.N.Doc. A/RES/53/152, 1999.

shall . . . participate in the formulation, implementation and evaluation of plans and programmes for national and regional development which may affect them directly."

In this context, the criticism given by the Indigenous Peoples Council on biocolonialism is indeed understandable, the concern is that via the intended genetic analysis within the scope of the Genographic Project, the integrity and sacredness of the indigenous bodies and their ancestors are violated, and as a consequence to this, the project should not be supported.

In both of the above mentioned projects, the risks for the minorities are more or less evident, and one should avoid violating the "rules" that should be taken into account in these cases. Considering biobank projects in general, we also recognize opportunities for antidiscrimination of minorities, and we should use them for the benefit of these groups. We refer to the point that biobanks do collect, store, and distribute human genetic materials and data, and they even produce statistical data which can be used for antidiscrimination purposes, as illustrated by the following example.

The Hungarian ethnic monitoring case

The Ethnic Statistics and Data Protection project was inaugurated in 2000 and directed by the Hungarian Rights Information and Documentation Centre (INDOK). It was funded by the Centre for Policy Studies of the Central European University in Budapest. Lawyers worked in the proposal group, in conjunction with human rights activists and NGO representatives. The project was instigated to respond to Roma rights lawyers working at and with the European Roma Rights Centre who routinely noted that one of the most significant obstacles to effective anti-discrimination litigation was the absence of statistics showing disparate treatment of Roma and other minorities in most areas of public life. This group, together with representatives from the Open Society Institute, Budapest, the Constitutional and Legal Policy Institute and other NGOs, later served as the Steering Committee of the project (Krizsan and Szekely, 2001).

Generally, we have to observe the right to information and the right to privacy, and the difficulty of reconciling these interests is nowhere more pronounced than in the field of race discrimination (Goldstone, 2001): Fundamental to the task of promoting civil rights and non-discrimination through Europe is accurate documentation of the subordinated position of racial and ethnic minorities in many areas of public life. Statistical information is a prerequisite for the formulation of government policy as well as it could be in the [health] sector.

In spite of this, historical experiences regarding the abusive purposes of statistics lend to mistrust toward the willingness or capacity of governments to maintain confidentiality, thereby contributing to non-cooperation.

One of the most important European steps for race antidiscrimination is the adoption of the directive implementing the principle of equal treatment between persons irrespective of racial or ethnic origin by the Council of the European Union in June 2000.¹² And in the future, it will mainly depend on how far governmental authorities can produce trust in ethnic monitoring, statistics, and the future means of biobanks.

Results

What can we learn from the Hungarian ethnic monitoring case? We must carefully wage the chances and risks for ethnic groups resulting from material and data monitoring. Biobanks could provide statistical data and also support against antidiscrimination. However, in Germany in particular we have had bad historical experiences in the case of observing and destroying the Roma and Sinti people. At the end of the last century, the police, especially in Bavaria, termed the Roma "Landfahrer [vagrant]

¹² Council Directive 2000/43/EC of 29 June 2000.

observing rather than Roma monitoring". Perhaps this data does not exist anymore.¹³ But in contrast to the National Ethics Council of Germany and other authors who do not seem to be able to recognize any discrimination of minorities in Germany, we would say: We do have the minorities of Roma, Sinti, and others, and we should be very cautious. However, if different interest groups of civil society and the tissue-and-data-donors themselves do agree, monitoring should be considered as being useful for anti-discrimination purposes.

For the anti-discriminating purposes of ethnic monitoring, we must follow the rules of Convention number 169 from the International Labour Organization (ILO) from 1989, concerning the rights of indigenous peoples and minorities; we must arrange public hearings (also on the internet) for such purposes and projects; we must insure the participation of all involved populations at all stages of the project development; and we must especially consider the principle of prior, free, and informed consent in order to find out the will of the potential donors. In case consent is given on behalf of a community, the consideration of the expressed will of every potential donor has to be an ethical imperative for those projects.

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¹³ The annual report of the United Nations Special Rapporteur on Racism noted: "That Sinti and Roma minorities are being specially registered in the data-bases and records of the Bavarian police as Roma/Sinti type, gypsy type or the old Nazi term Landfahrer [vagrant]. The Central Council of German Sinti and Roma has been informed of the report of the Bavarian Data Protection Commissioner of 16 December 1998, which states that Sinti and Roma are being registered generally on special police files without reason or legal basis by their personal details and even the number plates of their cars and further data. The police justify this storage as supposedly vorbeugende Verbrechenbekämpfung [preventive crime combat] and explain that Sinti and Roma could be a public danger. [...] the Federal Government [of Germany, sic] stated that [...] doing away with such classifications altogether does not come into consideration because of their indispensable nature for police work [...]" (24.E/CN.4/2000/16, 10 February 2000: paragraph 37); see also, Goldstone.

Human biobanks - trustees and some aspects of the current discussion, especially in Germany*

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If one observes all the factors that concern the organisation of a biobank, the aspect of acceptance takes on an exceptional role. Every plan to successfully reorganise a biobank depends on a high level of agreement by all participants.

A trusteeship represents an interesting possibility for the organisation and administration of genetic data. What remains to be considered is what kind of trusteeship is appropriate. This often depends on the situation in which the initiators of a biobank find themselves.

For example, a private sector trusteeship tries to optimize the profit aspects of research. However, this profit orientation should not, under any circumstances, lead to a neglect of the rules for data protection, as this danger in the international transfer of data is already quite high. Also, the acceptance of all parties concerned is not exactly the rule in private sector organisations. This indicates that private sector trusteeship is in a field of tension regarding common welfare.

If a public trustee is delegated to administer a biobank, one can assume, at least in the Western industrial nations, that sufficient control measures are guaranteed and therefore common welfare is not neglected. Therefore, it seems meaningful to strive for a co-operative form of public and private sector trusteeships or a commission form of public and/or private organizations. A natural alternative would be a credible private sector organization such as the First Genetic Trust.

On 2 October 2003, the German and French ethics councils emphasized in a joint statement that there must be an overriding authority to supervise compliance with the relevant rules: "A suitable model for this role is that of a special delegate or trustee whose functions and duties are to be determined in detail."

Therefore, the views of the ethics councils are in accordance with the internationally highly esteemed proposal of the introduction of a type of trustee who, besides supervising organic banks, would provide additional legitimacy. The trusteeships could also be organized in different levels of hierarchy; this would allow private trustees to join up with commissions and, at higher levels, perhaps with the government.

Regardless of what organizational form the trusteeship takes, one of the main functions of the trustee is public reports. The German Research Foundation also urges setting up internet sites in such cases. This includes regular feedback about the (commercial) utilization and the actual medical benefits resulting from the research with donor data. If this reporting involves permanent communication, it leads to increased transparency about the work of a biobank and therefore promotes general acceptance within the population.

The Administration for Data Protection in Germany has provided an exceptional example of such work, and has gained great recognition on the international stage. To be sure, not all functions required of the trusteeships of biobanks are covered, but the orientation towards the four procedural steps of biobanks, in any case, corresponds to the direction of extant data protection. The German data protection system has also been outstanding for its transparency, excellent public relations and development of legal issues pertaining to bioethics law. These positive developments should help the continuity of biobanks regarding insolvency and other problems - if the measures could be relevantly adapted.

* Paper first presented at the First UNESCO Bangkok Bioethics Roundtable, September 2005

Results and perspectives

Biobanks are booming worldwide. However, one should distinguish between the organizations that collect, administer, and utilize large amounts of material and data centrally (including lifestyle and environmental data) and those who do this on a smaller level and are thus more decentralized (specialized biobanks). The latter are the norm in Germany; this is less a matter of biobanks in the sense of this work (which corresponds to the normally accepted definition), but, rather, these are entirely normal material banks constructed according to scientific criteria. I have included these since they can also be connected with other organizations according to the above criteria.

Here, one is confronted with the problem of an appropriate way of dealing with the “phenomenon” of biobanks in order to meet the challenge of balancing their potential benefits and risks. This is especially true for healing illnesses more effectively, with: (i) the accompanying risk for the patients, and; (ii) the possible discrimination of an entire population group. This potential threat is treated not only generally (and for Germany, more specifically), but also in detail in an international comparison. Therefore, it is especially important to broaden perspectives for the protection and the utilization of biodata in both the Federal Republic of Germany and the European Union.

However, it is not implied in the above statement that one should curtail the requirements for consent of the extraction of bodily substances. It is merely a matter of how (as the National Ethics Council formulates it): “In consideration of the public interest, research is to take precedence above the personal interest of the donors to decide over the fate of their body substances and data” (page 34 in the Joint Statement). Therefore, these concerns precisely further the research of substances separated from the donor body where the donor has no specific lasting interest in the use thereof and without his declared consent.

This *carte blanche* authority would be primarily relevant to completely anonymous samples and data, and especially for material without relevance to individuals. Consent should be obtained in any case for the external utilization of human samples and data.

In agreement with the National Ethics Council, the utilization of human samples and data should be possible, in exceptional cases, without consent where there is a predominantly scientific interest in the research goal, and if the purpose of the research cannot be reached in any other manner.

That means that in these cases, to a degree, the direct connection to a concrete research project must be abandoned. Similarly, the principle of mandatory destruction of personal data after the end of a certain time (as required by German data protection law) should be given up. However, in the case of transmission to a third party, the samples must either be made completely anonymous or at least be encoded.

In this context of personal consent, transmission of the stored samples and data plays a role as far as the legal successor to the biobank is concerned. Furthermore, in this case, the permission of the donor is a *sine qua non* unless the samples/data are made anonymous.

As mentioned above, the trust mode, with its various forms of private, private/public, and purely public (cooperative) efforts are being tested at the moment. One should especially mention patient collectives here, who administer and utilize their samples and data themselves. But one should also mention purely private corporations, such as the First Trust in the United States.

In Germany, the ombudsman is discussed as a model for the supervision of biobanks. This system is viewed as very successful. The model of an administrator (as in the case of the data protection officials) who is autonomous in his powers would be a good export to the rest of Europe in order to formulate compelling rules and concomitant measures for the protection of the donor. To be sure, the data protection laws already foresee the use of data protection personnel, so some framework is in place.

The use of commercial organizations “lent” to the government is just as functional as is the use of civic organizations. In both cases, supervision is necessary to ensure that a balance is struck between private and public interests. In this sense, the question arises as to whether, in the framework of the planned genetic test law, more consideration should be given to research by individuals. Such regulations are

urgently required for the realization of the utility of organic banks as well as the control of risks. This also applies to an intensive discussion about possible restrictions of data protection in regard to *carte blanche* authorizations, as stated above. Unfortunately, such discussion has barely started in Germany.

The cited examples clearly show that the discussion in Germany has begun only recently and so far is not thriving as well as in places such as the USA, Iceland, Estonia, the UK, Canada, and the Scandinavian countries. This need to catch up is extremely serious, because one needs public discussion of biobanking ethics in order to protect the rights of citizens, advance the utility of the biobanks, and to not lose public trust (for example, in the case of green genetic engineering).

Protection of genetic data in medical genetics: A legal analysis in the European framework*

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Introduction

One of the short and medium term goals of human genome research is to gain a knowledge of the characteristics of human DNA and its components, particularly genes. There is particular interest in learning how genes function and what their role is in the transmission of biological heredity. Progress in the field of biomedical science has made it possible to obtain greater knowledge of the human genome and the nature of genetic disorders.

Thanks to these advances in genetics, doctors now have the tools to understand how certain illnesses, or increased risks for developing certain illnesses, pass from generation to generation. According to some health experts, the definition of an inherited or genetic illness should be expanded beyond the classic inherited disorders (such as hemophilia and sickle cell anaemia) to include many types of cancer, Alzheimer's disease, and other illnesses.

They look toward a future where genetic test results are an important part of every healthy person's medical file. Currently, genetic testing has developed enough so that doctors can pinpoint missing or defective genes. However, in some cases, treatments for those diseases are still far off.

The term "genetic testing" refers to analysis which serve¹: a) to diagnose and classify a genetic disease; b) to identify unaffected carriers of a defective gene in order to counsel them about the risk of having affected children; c) to detect a serious genetic disease before the clinical onset of symptoms in order to improve the quality of life by using secondary preventive measures and/or avoid giving birth to affected offspring; d) to identify persons at risk of contracting a disease where both a defective gene and a certain lifestyle are important as causes of the disease.

According to this, genetic testing of individuals can bring to light important personal and family information, such as biological information on a person's current and future health, including mental health, even though this may be limited to giving advance warning of a propensity or predisposition to certain disorders, or information on reproductive capacity and the future health of offspring.

The information which can be obtained from genetic testing raises problems associated with the information itself, access thereto, and the uses of such data, given that the interests of the person to whom these data refer (data subject) may be in conflict with those of other persons (including the biological family), with collective health and safety interests, and even with interests of an entirely different kind (for example, economic).

Access to such information provides knowledge of highly important aspects of the tested individual and directly affects his or her innermost sphere². However, the information is also highly valuable for

1 Recommendation No. R (92) 3 on genetic testing and screening for health care purposes, of 10 February 1992.

2 Nevertheless, Margaret Otlowski, "Protecting genetic privacy in the research context: Where to from here?" *Macquarie Law Journal*, 2002, page. 91 notes: "The availability of human genetic information is not of itself new [as noted earlier, some genetic information has long been available through family history of genetic disease] – what has changed is the means by which genetic information is available and also the extent of information which can now potentially be obtained as a result of the advancements in relation to genetic testing".

* Paper first presented at the Second UNESCO Bangkok Bioethics Roundtable/Eighth Asian Bioethics Conference, March 2007

protecting his or her health or that of any offspring.

The aim of this article is to point out the main questions and dilemmas that have arisen in the field of the processing of genetic data in medical genetics³ and to examine the solutions that have been offered in the European framework. In this respect, at the European level, several legal and non-legal documents dealing with this issue must be taken into account.

Firstly, documents of international organizations such as UNESCO⁴ have a repercussion world-wide and should be respected both by the European Union and by other countries. In this group, the International Declaration on Human Genetic Data (IDHGD), of 16 October 2003, is particularly important.

Secondly, there are some documents of the Council of Europe⁵, namely, the European Convention on Human Rights, of 4 November 1950; Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, of 28 January 1981⁶; Recommendation No. R (92) 3 on Genetic Testing and Screening for Health Care Purposes, of 10 February 1992; Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine (CHRB), of 4 April 1997⁷; Recommendation No. R (97) 5 on the Protection of Medical Data, of 13 February 1997.

Thirdly, also noteworthy is the legislation of European Union, such as the **Charter of Fundamental Rights of the European Union, of 7 December 2000**, or the Directive 95/46/EC of the European Parliament and of the Council, on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data, of 24 October 1995. The latter is especially relevant because it generates in all the EU Member States an effective obligation to act according to the terms stipulated in it⁸.

Finally, we cannot overlook the legislation of every European country. At the regulatory level the situation across Europe appears to be uneven. Indeed, while some countries either have explicitly listed genetic data as sensitive data in their Data Protection law with all the safeguards and restrictions associated

3 That means that the possibility of misusing genetic information for non-medical purposes (i.e. insurance, employment, commercial transactions), or even its use with other social and legally admissible aims (i.e. DNA fingerprint in forensic or criminal justice, determination in parentage, etc.) is beyond the scope of this article.

4 UNESCO (United Nations Educational, Scientific and Cultural Organization) is a specialized agency of the United Nations established in 1945. Its stated purpose is to contribute to peace and security by promoting international collaboration through education, science, and culture in order to further universal respect for justice, the rule of law, and the human rights and fundamental freedoms proclaimed in the UN Charter.

5 The Council of Europe is an international organization of 46 member states in the European region. Its main success was the European Convention on Human Rights in 1950, which serves as the basis for the European Court of Human Rights. The Council of Europe is not to be mistaken with the Council of the European Union or the European Council, as it is a separate organization and not part of the European Union.

6 This Convention was the first international legally binding text on data confidentiality.

7 Unlike the European Convention on Human Rights which applies to all EU Member States, the Convention on Human Rights and Biomedicine has not been signed or ratified by many States, including most of the larger States. In spite of it not applying directly to many EU States, it is nevertheless significant in that it has been drawn upon by the European Court of Human Rights in making judgments involving States who are not parties to this Convention. See in this respect, *Glass v. The United Kingdom*, 9 March 2004 (paragraph 58); *Evans v. The United Kingdom*, 7 March 2006 (paragraph 40).

8 Directives are a legislative act of the European Union which requires member states to achieve a particular result without dictating the means of achieving that result. It can be distinguished from European Union regulations which are self-executing and do not require any implementing measures. Directives normally leave member states with a certain amount of leeway as to the exact rules to be adopted. Directives can be adopted by means of a variety of legislative procedures depending on the subject matter of the directive. Of course, this legal text is only applicable to EU member States (currently 27: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom).

(Italy⁹, Poland¹⁰), or have passed specific legislation on protection of genetic data (Switzerland¹¹, France¹²), in most member states the issue of the processing of genetic data is not as such regulated by specific legislation. However, as national authorities become increasingly aware of the risks associated with the processing of genetic data, a general trend towards new initiatives at the national regulatory level is anticipated (that is the case of Spain¹³ for instance).

Apart from these legislative sources, several guidelines and reports have been elaborated both at the international and national level. It is beyond the scope of this work to discuss all of these instruments. However, special attention will be paid to, on the one hand, the “Working Document on Genetic Data”, adopted on 17 March 2004 by the Data Protection Working Party¹⁴; and on the other hand, the report entitled “Ethical, Legal and Social Aspects of Genetic Testing: Research, Development and Clinical Applications”, elaborated by the Expert Group on Genetic Data at the request of the European Commission, also in 2004.

Personal genetic data and protection of privacy. The meaning of “personal data” in the European context

As stated above, the most significant legal text related to the protection of personal data in the European Framework is the Directive 95/46/EC. Its object is, as stated in Article 1.1, to “protect the fundamental rights and freedoms of natural persons, and in particular their right to privacy with respect to the processing of personal data”.

This directive states that personal data: “shall mean any information relating to an identified or identifiable natural person (‘data subject’),” (Article 2, a). In the same sense, Recommendation R (97) 5 states that “the expression ‘medical data’ covers any information relating to an identified or identifiable individual” (Principle 1). This definition of personal data allows one to include any information regarding a person, whatever his or her nature or origin, being intimate or not, even if it affects several people at the same time or a family group (an aspect that can be of great importance in relation to data concerning health and genetics)¹⁵.

Thus, data can be classified into one of three categories, according to the greater or smaller possibility of identification of the person from whom the data is obtained: a) data relating to an identified person; b) data relating to an identifiable person; and c) anonymous data. However, the nomenclature may vary from one text to another and from one author to another, so it is more important to pay attention to the concept than to the wording.

Data relating to an identified person (“identified data”) is data that appears clearly and is directly linked

9 Personal Data Protection Code (*Codice in materia di protezione dei dati personali*). Legislative Decree No. 196, of 30 June 2003. Section 90 deals with the “processing of genetic data and bone marrow donors”.

10 Act on the Protection of Personal Data, of 29 August 1997, Article 27.

11 Human Genetic Testing Act (Loi fédérale sur l’analyse génétique humaine), of 8 October 2004.

12 Public Health Code (Code de la Santé Publique), amended by Law No. 2004-800 on bioethics, of 6 August 2004, Article L1131.

13 Biomedical Research Bill (Proyecto de Ley de Investigación Biomédica), 2006.

14 The Working Party has been established by Article 29 of Directive 95/46/EC. It is the independent EU Advisory Body on Data Protection and Privacy. Its tasks are laid down in Article 30 of Directive 95/46/EC and in Article 14 of Directive 97/66/EC, of 15 December 1997, concerning the processing of personal data and the protection of privacy in the telecommunications sector. The Working Party was set up to achieve several primary objectives: a) To provide expert opinion from member state level to the Commission on questions of data protection; b) To promote the uniform application of the general principles of the Directives in all Member States through co-operation between data protection supervisory authorities; c) To advise the Commission on any Community measures affecting the rights and freedoms of natural persons, and in particular to Community institutions on matters relating to the protection of persons with regard to the processing of personal data and privacy in the European Community.

15 Carlos M. Romeo-Casabona. 2004. “Anonymization and Pseudonymization: The Legal Framework at a European Level”, in D. Beyleveld/D. Townend/S. Rouillé-Mirza/J. Wright (Eds.), *The Data Protection Directive and Medical Research Across Europe*, Ashgate, England, pp. 36 f. The Data Protection Working Party, Working Document on Genetic Data, p. 5, also notes that «there is no doubt that genetic information content is covered by this definition».

with the person from whom it was obtained (data subject). The IDHGD refers to data linked to an identifiable person, meaning “data that contains information, such as name, birth date and address, by which the person from whom the data was derived can be identified” (Article 2.ix).

Data relating to an identifiable person (known as “dissociated data”) is data that seems not to be directly attributable to a certain person, since he or she does not appear to be identified or there is no link between the data and the person. However, the linking of such data to the person is possible by diverse procedures, which can normally be easily carried out¹⁶.

Directive 95/46/EC gives a definition of identifiable data in the following terms: “An identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his or her physical, physiological, mental, economic, cultural or social identity”. (Article 2 a). According to this, the directive considers a person identifiable in connection with his or her data, if the data is identifiable by means of an identification number (coded data)¹⁷. In such cases it is possible to use the code to re-identify the person to whom the data relates so that the process of de-identification is reversible.

Finally, anonymous data can be considered as data where the identity of the data subject is not known, and identification is not possible because the data was collected as such, or because although collected with identification, the data has later been anonymized¹⁸. For this second type of anonymous data, the identifiable data of a person is subjected to a process of dissociation from the data that refers to that person, in such a way that it no longer allows the person’s identification. Consequently, it is necessary that such a dissociation process should be irreversible, that is to say, that the data cannot return to the form taken previously.

IDHGD speaks of data irretrievably unlinked to an identifiable person, this refers to data that cannot be linked to an identifiable person, through destruction of the link to any identifying information about the person who provided the sample (Article 2.xi). However, Directive 95/46/EC does not mention this category of data explicitly. It only sets down that “an identifiable person is one who can be identified, directly or indirectly”, without mentioning the level of difficulty of the identification. But Recital 26 specifies the reach of Article 2, a) since it points out that “to determine whether a person is identifiable, account should be taken of all the means likely reasonably to be used either by controller or by any other person to identify the said person”¹⁹ (emphasis added).

Thus, Recital 26 has restrictive effects on what should be understood as “identifiable people’s data”, because it adds that “account should be taken of all the means likely reasonably to be used” to identify a person. When those means are not reasonable, the person will no longer be considered legally identifiable and the data will move into the category of anonymous data. What “reasonable” means is not easy to say. Recommendation R (97) 5 is a little more concrete in this respect, as it states that “an individual shall not be regarded as ‘identifiable’ if identification requires an unreasonable amount of time and manpower” (principle 1)²⁰.

16 In these cases, as Romeo-Casabona, “Anonymization and Pseudonymization”, page 38 points out, “the connection of the data with the person to whom it belongs can also be obtained by other indirect procedures, such as, for example when the data reveals certain personal or social characteristics that only one person or a small group of people possesses, and those characteristics could be known by others”.

17 Article 2.x IDHGD names data unlinked to an identifiable person those data that are not linked to an identifiable person, through the replacement of, or separation from, all identifying information about that person by use of a code.

18 Carlos M. Romeo-Casabona. 2004. “Anonymization and Pseudonymization: The Legal Framework at a European Level”, in D. Beylveld/D. Townsend/S. Rouillé-Mirza/J. Wright (Eds.), *The Data Protection Directive and Medical Research Across Europe*, Ashgate, England, page 38.

19 It should be noted that the recitals in the directives do not have a statutory value, but they are very useful to interpret the rules contained in the legal text.

20 In the same sense, the German Federal Data Protection Act, of 20 December 1990, gives a definition of “despersonalization” as follows: “Modification of personal data so that the information concerning personal or material circumstances can no longer or only with a disproportionate amount of time, expense and labour be attributed to an identified or identifiable individual.” (Section 3.6).

Thus, the principles of data protection shall not apply to data rendered anonymous in such a way that the data subject is no longer identifiable. This statement implies that protection will not be given to personal data that have been subjected to an anonymization process²¹. However, if these anonymized data were processed and it became possible to identify the data subject again, they would regain the status of personal data and the principles of data protection would be applicable to them again²².

Medical data and genetic data: genetic exceptionalism?

Within the category of personal data, there are some data that have special protection - the so called sensitive data²³. Sensitive data have been defined as “data in connection with which the data subject is more vulnerable when the data is known or used by a third party because of its potential for causing discrimination and other misuse, especially when accessed, used, or illicitly disclosed”²⁴. As a consequence, this category of data is regarded as needing more intensive protection.

The expression medical data refers to all personal data concerning the health of an individual. It refers also to data with a clear and close link with health as well as to genetic data.²⁵ But genetic data are subject to a specific definition. Genetic data are: “All data, of whatever type, concerning the hereditary characteristics of an individual or concerning the pattern of inheritance of such characteristics within a related group of individuals. The definition also includes all data on the carrying of any genetic information [genes] in an individual or genetic line relating to any aspect of health or disease, whether present as identifiable characteristics or not. The genetic line is the line constituted by genetic similarities resulting from procreation and shared by two or more individuals”²⁶.

Thus, the term “human genetic data” (or “human genetic information”) is used to describe information about an individual’s genetic make-up. However, there is ongoing debate about the real reach of the term “genetic information”²⁷.

In the light of the major biotechnological developments in the field of genetics, there is a tendency to assume that acquiring human genetic information necessarily entails genetic testing. Nevertheless the term is broad enough to also cover genetic information available through other means (for instance, family history)²⁸. In this sense, Article 2.i) IDHGD describes human genetic data as “Information about heritable characteristics of individuals obtained by analysis of nucleic acids or by other scientific analysis”.

In a nutshell, medical data refers to data concerning health and information about a person’s genetic

21 Romeo-Casabona, “Anonymization and Pseudonymization”, page 34.

22 Ibid., p. 42.

23 Cf. Directive 95/46/EC, Recitals 34 and 70.

24 Romeo-Casabona, “Anonymization and Pseudonymization”, p. 37.

25 Recommendation R (97) 5, Principle 1.

26 Ibid.

27 See Pilar Nicolás Jiménez. 2006. La protección jurídica de los datos genéticos de carácter personal, Cátedra Interuniversitaria de Derecho y Genoma Humano-Comares, Bilbao-Granada, pp. 66 ff.; Janneke H. Gerards/Heleen L. Jansen. 2006. “Regulation of Genetic and Other Health Information in a Comparative Perspective”, *European Journal of Health Law*, No 13, pp. 347 ff.

28 Otlowski, “Protecting Genetic Privacy in the Research Context”, p. 89. The National Consultative Ethics Committee for Health and Life Sciences (France), 2003, Opinion n° 76 regarding the obligation to disclose genetic information of concern to the family in the event of medical necessity, p. 2 f., also points out that a test is not the only way of diagnosing a genetic disease, putting as examples the haemoglobin electrophoresis (for sickle cell disease and thalassemia), renal ultrasound (polycystic kidney disease), colonoscopy (polyposis of the colon), or cholesterol assays, and affirms that “all of these diagnostic criteria would well generate the same legal consequences as a genetic test”. See also, Gerards/Jansen, “Regulation of Genetic and Other Health Information in a Comparative Perspective”, page 349. («Genetic information may be derived from family medical history, from testing (tests either directed immediately to genetic information or tests that are directed to others health information but that may also yield genetic information, such as blood tests or urine tests) but also from information derived from observance of an individual’s behaviour»).

make-up and obviously comes within the meaning of “health” or “medical” information²⁹. As a consequence, genetic data is considered to belong to this category³⁰.

The concern that genetic data may be particularly prone to misuse has fuelled public perception that genetic information is fundamentally different from other forms of medical data, and has led to calls for policies to treat such information differently from all other medical information (“genetic exceptionalism”)³¹.

The report, *Ethical, Legal and Social Aspects of Genetic Testing: Research, Development and Clinical Applications*, affirms that “genetic information is not, as such, different from any other personal medical data, and should therefore be treated in the same way”³².

However, the potential information obtained from genetic tests conducted on a person is different from any other information - its source is indestructible since it is present in almost all the cells of the body while alive and usually even when dead; it is permanent and unalterable, save for spontaneous genetic mutations or ones triggered through genetic engineering or as the result of other external agents (for example, radioactive ones).

In any case, such mutations will always be partial and limited. Lastly, genetic tests give information not only about the subject, but also about his or her biological family.

Likewise, according the IDHGD (Article 4.a)), human genetic data have a special status because:

- They can be predictive of genetic predispositions concerning individuals;
- They may have a significant impact on the family, including offspring, extending over generations, and in some instances on the whole group to which the person concerned belongs;
- They may contain information the significance of which is not necessarily known at the time of the collection of the biological samples;
- They may have cultural significance for persons or groups.

Certainly, the aforementioned features may, in themselves, not be unique to genetic information, but may also be relevant to certain types of non-genetic health information. Nevertheless, genetic information can be considered different from other health information, as all factors mentioned above appear in combination³³.

29 Data Protection Working Party, Working Document on Genetic Data, p. 5; Otlowski, “Protecting Genetic Privacy in the Research Context”, page 92.

30 It has been discussed if information provided by non-coded DNA (for instance, in order to obtain the DNA fingerprint with forensic or paternity purposes) can also be considered as health data. As scientists still do not have a great knowledge of the purpose of this non-coding DNA, the Agencia Española de Protección de Datos (“Spanish Data Protection Authority”) has set out that this information must be processed as health data. Cf. Agencia Española de Protección de Datos, *Tratamiento de datos genéticos para la localización de personas desaparecidas o en investigación criminal*, 2000. See also, Nicolás Jiménez, *La protección jurídica de los datos genéticos de carácter personal*, pp. 85 ff.

31 According to Thomas H. Murray, “Genetic Exceptionalism and ‘Future Diary’: Is Genetic Information Different from Other Medical Information?”, in Mark A. Rothstein (Ed.), *Genetic Secrets: Protecting privacy and Confidentiality in the Genetic Era*, Yale University Press, New Haven, 1997, pp. 60 f., genetic exceptionalism means «the claim that genetic information is sufficiently different from other kinds of health-related information that it deserves special protection or other exceptional measures». See also, Koichi Setoyama. 2005. “Privacy of Genetic Information”, *Osaka University Law Review*, No 52, pp. 94 ff.; Gerards/Jansen, “Regulation of Genetic and Other Health Information in a Comparative Perspective”, pp. 341 ff.

32 Expert Group on Genetic Data, *Ethical, legal and social aspects of genetic testing: research, development and clinical applications*, page 42. The Group believes, therefore, “that genetic exceptionalism is both scientifically unjustified and not helpful in addressing ethical and societal issues” (page 43). In the same sense, Murray, “Genetic Exceptionalism and ‘Future Diary’”, pp. 64 ff.

33 Cf. Gerards/Jansen, “Regulation of Genetic and Other Health Information in a Comparative Perspective”, p. 352, where they affirm that «genetic information is exceptional in that it shows a unique combination of features».

Thus, genetic data, although medical data (and for that reason, part of medical information), seem to have specific dimensions which are not necessarily common to all medical information³⁴. Therefore, it has been argued that genetic information should be treated differently and given special legal protection³⁵. However, it cannot be flatly rejected that similar protection should also be given to other kinds of predictive health information³⁶.

Genetic testing and genetic counselling. The duty to provide 'non-directive' counselling

It is important to distinguish genetic counselling from clinical genetics services and genetic testing or screening³⁷. The former is a communication and, in some cases, a psychotherapeutic process, while the latter are diagnostic or prognostic services. Current clinical genetics services and accompanying genetic counselling commonly involve the diagnosis (and prediction) of what are for the most part rare and untreatable conditions in foetuses, children and adults. Genetic diagnosis has traditionally been based on physical examination or family history but increasingly relies on molecular testing.

According to Article 12 CHRB: "Tests which are predictive of genetic diseases or which serve either to identify the subject as a carrier of a gene responsible for a disease or to detect a genetic predisposition or susceptibility to a disease may be performed only for health purposes or for scientific research linked to health purposes, and subject to appropriate genetic counselling."

This is not new. Recommendation R (92) 3 also states that: "Any genetic testing and screening procedure should be accompanied by appropriate counselling, both before and after the procedure" (Principle 3).

Genetic counselling can be defined as "a procedure to explain the possible implications of the findings of genetic testing or screening, its advantages and risks and where applicable to assist the individual in the long-term handling of the consequences; It takes place before and after genetic testing and screening" (Article 2.xiv IDHGD).

The development of new diagnostic methods has resulted in major advances in our ability to detect microscopic and submicroscopic chromosome abnormalities as well as single gene disorders. This often allows to provide a person with accurate information regarding the aetiology, prognosis, the risk of recurrence and the options available to deal with such finding. Genetic counselling is important because this information should be communicated in simple language, with care and sensitivity, so that the person or the family can make decisions that are fully informed.

Thus, the main goal of genetic counselling is to help individuals or families understand or cope with genetic disease, not to decrease the incidence of genetic disease³⁸. In addition, the counsellor should adopt a non-directive approach.

In this respect, Principle 3 of the Recommendation R (92) 3 states that "such counselling must be non-directive"³⁹. The information to be given should include the pertinent medical facts, the results of tests, as well as the consequences and choices. It should explain the purpose and the nature of the tests

34 See Data Protection Working Party. 1997. Working Document on Genetic Data, pp. 4 f.; Guilherme Freire Falcão de Oliveira, "Juridical implications of genome knowledge (Part II)", *Law and the Human Genome Review*, No 7, p. 88; Loane Skene. 1998. "Patients' Rights or Family Responsibilities? Two Approaches to genetic Testing", *Medical Law Review*, No 6, pp. 5 ff.; Otlowski, "Protecting Genetic Privacy in the Research Context", p. 92 f.;

35 Data Protection Working Party. 1999. Working Document on Genetic Data, p. 4; George Annas, "Genetic Privacy: There Ought to Be a Law," *Texas Review of Law and Politics*, No 4, pp. 9 ff. According to Freire Falcão de Oliveira, "Juridical implications of genome knowledge", page 88, «in view of these special characteristics, tighter confidentiality must be guaranteed».

36 Cf. Gerards/Jansen, "Regulation of Genetic and Other Health Information in a Comparative Perspective", pp. 351 f.

37 Vid. Barbara Bowles Biesecker/Theresa M. Marteau. 1999. "The future of genetic counselling: an international perspective", *Nature Genetics*, No 22, p. 133.

38 Expert Group on Genetic Data, *Ethical, legal and social aspects of genetic testing: research, development and clinical applications*, p. 78.

39 See also IDHGD, Article 11.

and point out possible risks. It must be adapted to the circumstances in which individuals and families receive genetic information⁴⁰.

Right to privacy and the right to data protection

Privacy refers to the general interest in control of one's private sphere broadly conceived. The concept of "privacy" is huge and complex and has many meanings. Allen identifies four dimensions of privacy⁴¹: a) informational privacy; b) physical privacy; c) decisional privacy; and d) proprietary privacy. In summary, informational privacy concerns access to personal information; physical privacy concerns access to persons and personal spaces; decisional privacy concerns governmental and other third party interferences with personal choices; and proprietary privacy relates to the appropriation and ownership of interests in human personality.

This work focuses on "informational privacy" interests, that is, the interest a person has in controlling access to and the use of their personal information⁴². This is the aspect of privacy which is most commonly referred to in the discussions about genetic privacy. As I will mention later, this sphere of the right to privacy has turned towards a specific right - the right to data protection.

The right to privacy is a well established right in the European tradition. From a European perspective, we should begin by quoting Article 8 of the European Convention on Human Rights (which has its precedent in Article 12 of the Universal Declaration of Human Rights, of 10 December 1948)⁴³: "1. Everyone has the right to respect for his private and family life, his home and his correspondence. 2. There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others".

Here we have all the essentials concerning the right to privacy: on the one hand, society must guarantee respect for privacy as essential to the individual's development. On the other hand, many limitations are listed in the Convention itself, so that privacy is not an absolute but a relative right. In particular, the protection of health is mentioned.

40 The Expert Group on Genetic Data, Ethical, legal and social aspects of genetic testing: research, development and clinical applications, p. 79, notes that "[t]he most difficult task for the counsellor is to communicate the precise meaning of genetic risk ... Different methods – verbal, numerical and graphical – have been developed to communicate risk in an understandable way to the person being counselled ... [T]he provision of simple, printed information that can be consulted by the individual after leaving the counselling session has been shown to be essential. Moreover, the existence of genetic support groups for the particular disease or problem, to which the person can be referred will, in many cases, provide information complementary to that given during the counselling session and can provide further support in the understanding of, or the coping with, a genetic problem". See also, Carlos M. Romeo Casabona. 1994. "Legal Aspects of Genetic Counselling", *Law and Human Genome Review*, No 1, pp. 164 ff.

41 Anita L. Allen, "Genetic Privacy: Emerging Concepts and Values", in Mark A. Rothstein (Ed.), *Genetic Secrets: Protecting privacy and Confidentiality in the Genetic Era*, Yale University Press, New Haven, 1997, pp. 41 ff. This sorting is also accepted by Otlowski, "Protecting Genetic Privacy in the Research Context", p. 88; Setoyama, "Privacy of Genetic Information", pp. 81 ff.

42 Mark A. Rothstein, "Genetic Secret: A Policy Framework", in Mark A. Rothstein (Ed.), *Genetic Secrets: Protecting privacy and Confidentiality in the Genetic Era*, Yale University Press, New Haven, 1997, p. 453; Margaret Otlowski, "Protecting Genetic Privacy in the Research Context: Where to From Here?" *Macquarie Law Journal*, 2002, p. 88.

43 Article 12 of the Universal Declaration of Human Rights states that: "No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks". In addition, other international documents on human rights also deal with this issue. For instance, the International Covenant on Civil and Political Rights, of 16 December 1966, according to which: (1) "No one shall be subjected to arbitrary or unlawful interference with his privacy, family, home or correspondence, nor to unlawful attacks on his honour and reputation. (2). Everyone has the right to the protection of the law against such interference or attacks" (Article 17). And more recently, UNESCO's Universal Declaration on Bioethics and Human Rights, of 19 October 2005, states in its Article 9 that: "The privacy of the persons concerned and the confidentiality of their personal information should be respected. To the greatest extent possible, such information should not be used or disclosed for purposes other than those for which it was collected or consented to, consistent with international law, in particular international human rights law".

The right to privacy in relation to health was established in Article 10 CHRB, in the following terms: “Everyone has the right to respect for private life in relation to information about his or her health.”

In similar terms, Recommendation R (97) 5 states that: “The respect of rights and fundamental freedoms, and in particular of the right to privacy, shall be guaranteed during the collection and processing of medical data” (Principle 3.1).

More recently, the right to data protection, considered as a right linked but different to the right privacy has been recognized at the European level. While the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, refers to the “right to privacy, with regard to automatic processing of personal data relating to him”, the Charter of Fundamental Rights of the European Union recognizes the “protection of personal data” as a right in itself (Article 8)⁴⁴. And Directive 95/46/EC develops this right extensively.

Several principles of data protection come from this right⁴⁵. Among them, in relation to genetic data, the following will be considered: a) the principle of self-determination, that is, freedom and autonomy of the individual, which also implies initial freedom of choice and consent before undergoing genetic testing and even before providing biological samples for the test⁴⁶; b) the right of access to information.

Right to self-determination and consent

Each person is entitled to decide to whom, when, and to what extent personal information relating to him or her can be processed. Thus, the processing on the information obtained by means of genetic testing should be prohibited unless consent is given by the data subject.

According to Article 8.2.a) of Directive 95/46/EC, the data subject must give his or her explicit consent to the processing of personal data concerning health⁴⁷. Considering the extremely singular characteristics of genetic data and their link to information that may reveal the health condition or the ethnic origin of the subject, they can be considered as falling within the scope of Article 8 Directive 95/46/EC⁴⁸.

Equally, Principle 5 of Recommendation R (92) 3 states that “the provision of genetic services should be based on respect for the principle of self-determination of the persons concerned. For this reason, any genetic testing, even when offered systematically, should be subject to their express, free and informed consent”. And Article 8 IDHGD states that “prior, free, informed and express consent, without inducement by financial or other personal gain, should be obtained for the collection of human genetic data, human proteomic data or biological samples, whether through invasive or non-invasive procedures, and for their subsequent processing, use and storage, whether carried out by public or private institutions”⁴⁹. When a person is incapable of giving informed consent, authorization should be obtained from the legal representative⁵⁰. The legal representative should have regard to the best interest of the person concerned⁵¹. In any case, an adult not able to consent should as far as possible

44 Charter of Fundamental Rights of the European Union, Article 8: “1. Everyone has the right to the protection of personal data concerning him or her. 2. Such data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by law. Everyone has the right of access to data which has been collected concerning him or her, and the right to have it rectified. 3. Compliance with these rules shall be subject to control by an independent authority”. The more general “right to respect for his or her private and family life, home and communications” is recognized in Article 7.

45 See Nicolás Jiménez, *La protección jurídica de los datos genéticos de carácter personal*, pp. 176 ff.

46 See Recommendation No. R (92) 3, Principle 8; IDHGD, Article 8; Recommendation Rec (2006) 4 on research on biological materials of human origin, of 15 March 2006;

47 However, domestic legislation of the Member States can foresee some exceptions to this principle. For instance, when the processing is necessary to protect the vital interests of the data subject or of another person where the data subject is physically or legally incapable of giving his consent. See Directive 95/46/EC, Article 8.2 and 3.

48 See Data Protection Working Party, Working Document on Genetic Data, pp. 5 and 7.

49 See also Recommendation (97) 5, Principle 6.1.

50 “Legal representative” refers to a person provided for by law to represent the interests of, and/or take decisions on behalf of, a person who does not have the capacity to consent. That is the case of a parent or guardian, for instance.

51 See IDHGD, Article 8.b); and Recommendation (97) 5, Principle 5.5; Charter of Fundamental Rights of the European Union, Article 8.2.

take part in the authorization procedure⁵².

In regard to Recommendation R (92) 3, its Principle 5 states that the testing of minors, persons suffering from mental disorders and adults placed under limited guardianship should be subject to special safeguards. In particular, testing of these persons for diagnostic purposes should be permitted only when this is necessary for their own health⁵³ or if the information is imperatively needed to diagnose the existence of a genetic disease in family members⁵⁴. That means that genetic testing on newborns and children should be confined to treatable disorders, for which early treatment has a substantial positive impact on the health status and where delay would reduce benefits⁵⁵.

When human genetic data are collected for medical purposes, consent may be withdrawn by the person concerned unless such data are irretrievably unlinked to an identifiable person (Article 9. a) IDHGD). When a person withdraws consent, the person's genetic data should no longer be used (Article 9. b) IDHGD).

There is some debate as to whether the anonymization process of itself requires the affected person's prior consent or whether it is necessary at least to inform him or her of this process. According to Directive 95/46/EC, processing of personal data "shall mean any operation or set of operations which is performed upon personal data, whether or not by automatic means, such as collection, recording, organization, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, blocking, erasure or destruction" (Article 2. b) (emphasis added).

There is no doubt that this paragraph includes the process of anonymization, since personal data is subjected to an alteration or mutilation in order to avoid the identification of the person from whom this data originates. The process of anonymization itself is therefore still an act of data processing⁵⁶. This means that, until anonymization is carried out in fact, the data will still be considered as personal data so the principles of data protection will be applicable.

Right of access to information

Articles 10 and 11 Directive 95/46/EC state that the data subject has a right to receive information from the controller⁵⁷ (or his representative), both when the data is collected directly from the said data subject and when the data has not been obtained from the said data subject.

52 Cf. Explanatory Report on CHRB, paragraphs 45 and 46 ("the participation of adults not able to consent in decisions must not be totally ruled out. This idea is reflected in the obligation to involve the adult in the authorisation procedure whenever possible. Thus, it will be necessary to explain to them the significance and circumstances of the intervention and then obtain their opinion").

53 One good example of this is the genetic testing of newborn babies (neonatal screening) for treatable diseases such as phenylketonuria and hypothyroidism (available in all UE countries). As I said above, the testing of children must be strictly limited to those cases in which a diagnosis is important for disease management or therapy. See Expert Group on Genetic Data, Ethical, legal and social aspects of genetic testing: research, development and clinical applications, p. 75 ("susceptibility screening is not justified as the benefit is remote and often uncertain. Carrier screening can also wait until the child can make his or her own decision").

54 See also, IDHGD, Article 8. c) and d).

55 H.D.C. Roscam Abbing, "Genetic Information and third party interests. How to find the right balance?", Law and the Human Genome Review, No 2 (1995), p. 37.

56 Romeo-Casabona, "Anonymization and Pseudonymization", p. 43. See also the document entitled European Standards on Confidentiality and Privacy in Healthcare (2006), whose paragraph 3.3.5 sets out that "the Data Protection Directive requires data subjects to be informed of the purposes of all processing of personal data and rendering data anonymous is itself a process performed on personal data". These European Standards on Confidentiality and Privacy in Healthcare were developed through the work of the EuroSOCAP Project (funded by European Commission). Document available in: www.eurosocap.org.

57 According to Article 2 (d) of Directive 95/46/EC, "controller" shall mean the natural or legal person, public authority, agency or any other body which alone or jointly with others determines the purposes and means of the processing of personal data.

This right is exercised through the so-called right of access⁵⁸, that is, the right to obtain from the controller without constraint at reasonable intervals and without excessive delay or expense: a) confirmation as to whether or not data relating to the person is being processed; and b) communication in an intelligible form of the data undergoing processing and of any available information as to their source⁵⁹. Given the sensitivity of genetic data, the right to information is particularly relevant in the context of processing such data⁶⁰.

The right to know and the right not to know

Article 10.2 CHR, provides that “everyone is entitled to know any information collected about his or her health...” However, the last paragraph of Article 10 sets out that in exceptional cases, domestic law may place restrictions on the right to know or not to know in the interests of the patient's health⁶¹.

There might be a situation where the harm to the data subject which is expected to be caused by the information is such that it clearly justifies withholding the information or part of it (for example a prognosis of death which might, in certain cases if immediately passed on to the patient, seriously worsen his or her condition). This is the so-called “therapeutic exception”⁶².

In respect of the right to know, special mention should be made of unexpected findings. It is not uncommon in medicine, during operations or tests, for personal data of varying importance to be discovered in addition to the information actively sought.

For example, a person may be tested for one disease and found to be suffering from another; or a genetic test carried out for medical purposes may reveal that the genetic relationship is not the same as the legal one.

In conformity with the right to know, subjects should be informed of “unexpected findings” when they are of medical relevance⁶³. However, except in some clear situations, the physician will face important doubts in taking a decision and whether to inform the patient about any unexpected findings. In this decision not only objective factors must be taken into account, such as the possibility of therapy, but also subjective ones, such as the personality of the patient, the consequences of receiving this information, and other familiar circumstances.

Recommendation R (92) 3 points out that: “In conformity with national legislation, unexpected findings may be communicated to the person tested only if they are of direct clinical importance to the person or the family. Communication of unexpected findings to family members of the person tested should only be authorised by national law if the person tested refuses expressly to inform them even though their lives are in danger.” (Principle 11).

This position has been developed by Principle 8.4 of Recommendation R (97) 5. According to this Principle, the person subjected to genetic analysis must be informed of unexpected findings if the domestic law does not prohibit the giving of such information; or the person himself has asked for this information; or the information is not likely to cause serious harm to his/her health; or to his/her consanguine or uterine kin, to a member of his/her social family, or to a person who has a direct link with his/her genetic line, unless domestic law provides other appropriate safeguards. The person should also be informed if this information is of direct importance to him/her for treatment or prevention.

58 Carlos de Sola, “Privacy and Genetic Data. Cases of Conflict (I)”, *Law and the Human Genome Review*, No 1 (1994), p. 177.

59 Cf. Directive 95/46/EC, Article 12. See also Recommendation R (97) 5, Principle 8.1; IDHGD, Article 13; Charter of Fundamental Rights of the European Union, Article 8.2.

60 Data Protection Working Party, Working Document on Genetic Data, page 6.

61 Article 10.3 CHR: “In exceptional cases, restrictions may be placed by law on the exercise of the rights contained in paragraph 2 in the interests of the patient”.

62 Roscam Abbing, “Genetic Information and third party interests”, page 39. In general, such a therapeutic exception is only justifiable in very exceptional circumstances.

63 Cf. de Sola, “Privacy and Genetic Data”, p. 178.

Thus, Recommendation R (97) 5 restricts the circumstances in which unexpected findings should not be communicated. In conclusion, the doubtful cases that remain at the moment of deciding on whether to report or not of an unexpected finding are very limited. The cases are those in which this information does not have health repercussions because the mutation found does not have a great significance or there is no therapy or prevention known, or it is not going to be transmitted to the offspring.

In these cases, it is not necessary to inform. That means that this duty to inform would not extend to data which were not directly medical, such as the discovery of the lack of a genetic link between father and son. But it must not be forgotten that these data can also be medically relevant and may be of considerable importance to the subject when taking important decisions of other kinds (for instance, when a donor for a transplant is required)⁶⁴.

In fact, the information provided at the time of the consent should indicate the possibility of revealing unexpected findings and the right of the person concerned to decide if he or she wants to be informed about them or not. In this respect, Recommendation R (97) 5 also states that “before a genetic analysis is carried out, the data subject should be informed about the objectives and the possibility of unexpected findings” (Principle 5.4).

In addition to the right to information, or the right to know, which also covers individual genetic information, reference tends to also be made to the reverse, i.e., the right “not to know”. According to Article 10 IDHGD, “the person concerned has the right to decide whether or not to be informed of the results”. In the same sense, Article 10.2 CHRB states that “the wishes of individuals not to be so informed shall be observed”. Patients may have their own reasons for not wishing to know about certain aspects of their health. A wish of this kind must be observed.

The right not to know includes the right not to undergo genetic testing, so that the subject can avoid knowing whether he or she is carrying a genetic condition or whether he or she might do so in the future. This right is important because not every hereditary disease can be treated or even prevented at present. In many cases, the only certain prediction is that diseases will develop and that nothing whatever can be done to prevent or delay them. If there is no medical technique to cure a specific genetic disease, such as Huntington’s disease, some people may not want to know their future fate and short life span⁶⁵.

For this reason, a genetic test should be performed or offered only where the expected benefits for the individual outweigh the potential risks⁶⁶. That is to say, some kind of action must be available (treatment, prevention, reproductive choices). In effect, to make a person conscious of a genetic disease can help him or her to take important measures in the field of reproduction. That is specially significant in some populations highly affected by any concrete illness. In effect, some populations are known to have a higher frequency of a gene that is known to be associated with a disease. Genetic testing of couples in such populations would permit them to take their carrier status into account before planning

64 Vid. Nicolás Jiménez, *La protección jurídica de los datos genéticos de carácter personal*, pp. 289 f.

65 A study developed in the US concludes that the suicide rate for Huntington’s disease sufferers is much greater than the national average. See Jane S. Paulsen/Karin Ferneyhough Hoth/Carissa Nehl/Laura Stierman, “Critical Periods of Suicide Risk in Huntington’s Disease”, *American Journal of Psychiatry*, No 162 (2005), pp 725–731 (<http://www.huntington-assoc.com/Critical%20ab05.pdf>).

66 Expert Group on Genetic Data, *Ethical, legal and social aspects of genetic testing: research, development and clinical applications*, page 75.

a family⁶⁷.

However, in some circumstances, the right to know or not to know can be restricted in the patient's own interest or else on the basis of Articles 10.3 ("In exceptional cases, restrictions may be placed by law on the exercise of the rights contained in paragraph 2 in the interests of the patient") and 26.1 CHRB⁶⁸.

The *Explanatory Report* CHRB points out that it may be of vital importance for patients to know certain facts about their health, even though they have expressed the wish not to know about them. For example, the knowledge that they have a predisposition to a disease might be the only way to enable them to take potentially effective (preventive) measures. In this case, a doctor's duty to provide care, as laid down in Article 4 [CHRB], might conflict with the patient's right not to know. It could also be appropriate to inform an individual that he or she has a particular condition when there is a risk not only to that person but also to others. At the same time, certain facts concerning the health of a person who has expressed a wish not to be told about them may be of special interest to a third party⁶⁹. In such a case, the possibility for prevention of the risk to the third party might, on the basis of Article 26, warrant his or her right taking precedence over the patient's right to privacy, as laid down in paragraph 1, and as a result the right not to know, as laid down in paragraph 2. In any case, the right not to know of the person concerned may be opposed to the interest to be informed of another person⁷⁰.

67 One example of population-based testing is the screening for the carrier status of 'thalassemia' in certain Mediterranean communities, where genes for this disease appear to be more frequent. While this testing is not technically mandatory, individuals are not permitted to marry without a pre-marriage certificate. And a pre-marriage certificate is not issued without the requisite of genetic testing. See Minas G. Hadjiminis, "The cyprus experience-screening to combat a serious genetic disease", *Ethics and Human Genetics*, Council of Europe Press, Strasbourg, 1994, pp. 26-48; Ann Cavoukian, "Confidentiality issues in genetics: the need for privacy and the right 'not to know'", *Law and the Human Genome Review*, No 2 (1995), pp. 62 ff.; Luis Zarraluqui Sánchez-Eznarriaga, "Genetic testing and matrimony", in *The Human Genome Project: Legal Aspects*, Vol. I, Fundación BBV, Bilbao, 1995, pp. 391 ff.; Barbara Prainsack, "The Rise of Genetic Couplehood? A Comparative View of Premarital Genetic Testing", *BioSocieties*, No 1 (2006), pp. 17 ff. In this respect, according to Recommendation No. R (92) 3 on genetic testing and screening for health care purposes, "(...) marriage requirements (...) should not be made dependent on the undergoing of genetic tests or screening" (principle 6.a)).

68 Article 26.1 CHRB: "No restrictions shall be placed on the exercise of the rights and protective provisions contained in this Convention other than such as are prescribed by law and are necessary in a democratic society in the interest of public safety, for the prevention of crime, for the protection of public health or for the protection of the rights and freedoms of others". Therefore to be compatible with the CHRB, any interference with the right to privacy must meet certain conditions. It must be "in accordance with the law", which means that any interference must have some basis in national law, and the law must be precise enough so that people can reasonably understand its requirements and consequences. It must be "necessary in a democratic society", which means that the interference must also both correspond to a "pressing social need" and be "proportionate to the legitimate aim pursued". See further, Sergio Romeo Malanda, "Relación del presente Convenio con otras disposiciones (Capítulo IX)", en Carlos María Romeo Casabona (ed.), *El Convenio de Derechos Humanos y Biomedicina: su entrada en vigor en el ordenamiento jurídico español*, Cátedra de Derecho y Genoma Humano-Comares, Bilbao-Granada, 2002, pp. 387 ff. According to the Explanatory Report on CHRB, "The reasons mentioned in Article 26.1 should not be regarded as justifying an absolute exception to the rights secured by the Convention. To be admissible, restrictions must be prescribed by law and be necessary in a democratic society for the protection of the collective interest in question or for the protection of individual interests, that is the rights and freedom of others. These conditions must be interpreted in the light of the criteria established with regard to the same concepts by the case-law of the European Court of Human Rights. In particular, the restrictions must meet the criteria of necessity, proportionality and subsidiarity, taking into account the social and cultural conditions proper to each State. The term "prescribed by law" should be interpreted in accordance with the meaning usually given to it by the European Court of Human Rights, that is a formal law is not required and each State may adopt the form of domestic law it considers most appropriate" (paragraph 159).

69 See also Expert Group on Genetic Data, *Ethical, legal and social aspects of genetic testing: research, development and clinical applications*, page 81. For example, if a deceased grandparent is known to have suffered from Huntington's chorea and his grandchild asks to be tested for carrier status (with a view to making decisions about his reproductive choices, for example), the information that he is a carrier will also be information about the parent who did not want to know.

Right to privacy and (the corresponding) duty of confidentiality

Privacy and confidentiality

First of all, it is important to distinguish the terms “privacy” and “confidentiality”. Although they are connected in some sense, they are not synonyms⁷¹. Privacy is a much broader concept, involving the right to be free from intrusions, or simply to be left alone. It involves the right to control one’s own personal information (this perspective is also known as “informational self-determination”)⁷². Confidentiality, however, is only one means of protecting information, usually in the form of keeping that information protected from disclosure⁷³. Actually, we can say that confidentiality is still the standard safeguard to protect privacy and medical information⁷⁴.

Each person is entitled to decide to whom, when, and to what extent personal information relating to him or her can be disclosed. Thus, the passing on of information obtained by means of genetic testing should be prohibited unless consent is given by the data subject or legal representative in the case of minors or legally incapacitated persons⁷⁵.

In some cases, it may be necessary to share some information of a patient with other professionals involved (directly or indirectly) in his or her care. In this respect, Recommendation R (97) 5 states that “medical data may only be communicated to a person who is subject to the rules of confidentiality incumbent upon a health-care professional, or to comparable rules of confidentiality...” (Principle 7.2). It refers to the so-called “shared confidentiality”⁷⁶, which means that the processing of medical data may only be performed by health-care professionals⁷⁷, who are bound by the profession’s rule of confidentiality⁷⁸.

According to this, genetic data must also be protected from other persons even in the case of a biological relative who seeks information concerning the possible presence in him or her of a pathological gene similar to that discovered in the data subject⁷⁹. It is necessary to maintain confidentiality in these cases. Since the person disclosing the information will be the doctor, the answer is complicated by the very high value that our societies have placed on medical secrecy since time immemorial.

Doctor-patient relations are based on trust, guaranteed by the doctor’s duty not to disclose information of any kind about his or her patients. The latter would not confide in their doctor if they were afraid that

71 See, for instance, Ann Cavoukian, “Confidentiality issues in genetics: the need for privacy and the right ‘not to know’”, *Law and the Human Genome Review*, No 2 (1995), page 53.

72 Felix Thiele, “Genetic tests in the insurance system: criteria for a moral evaluation”, *Poiesis Prax* (2003), pp. 193 f. («The right to informational self-determination (...) should enable an individual to make decisions concerning personal data without being exposed to the coercion of a third party»). See also Nicolás Jiménez, *La protección jurídica de los datos genéticos de carácter personal*, pp. 163 ff.

73 Margaret Otlowski, “Protecting Genetic Privacy: An Overview”, in *Regulating the New Frontiers: Legal issues in Biotechnology*, Centre for Law and Genetics, Hobart-Melbourne, 2001, pp. 66 and 72, defines confidentiality as “a specific obligation arising in certain relationships whereby the recipient of personal information about another is under an obligation not to use that information for any purpose other than that for which the information was given”

74 José Elizalde, “Confidentiality, Privacy and Genetic Data”, in *The Human Genome Project: Legal Aspects*, Vol. I, Fundación BBV, Bilbao, 1995, page 307.

75 Carlos M. Romeo Casabona, “Genetic Information: Collection, Access and Use”, in Baltimore (Ed.), *Frontiers of Life*, Vol. IV: *The Living World*, Academic Press, San Diego, 2001, page 781.

76 *Ibid.*, page 780.

77 Directive 95/46/EC authorizes the processing of the data if it is required for the purposes of preventive medicine, medical diagnosis, the provision of care or treatment or the management of health-care services, and where those data are processed by a health professional (Article 8.3).

78 See Santiago Ripol Carulla, “The protection of medical and genetic data in the Council of Europe’s normative texts (Part I)”, *Law and the Human Genome Review*, No 5 (1996), p. 116.

79 Romeo Casabona, “Genetic Information”, p. 781; Roscam Abbing, “Genetic Information and third party interests”, p.40.

he or she might then reveal their secrets⁸⁰. So disclosure of confidential information not only breaches individual rights but undermines the very foundations of medical practice and therefore endangers a general interest⁸¹.

In this respect, The European Court of Human Rights has held that “the protection of personal data, not least medical data, is of fundamental importance to a person's enjoyment of his or her right to respect for private and family life as guaranteed by Article 8 of the Convention (art. 8). Respecting the confidentiality of health data is a vital principle in the legal systems of all the Contracting Parties to the Convention.

It is crucial not only to respect the sense of privacy of a patient but also to preserve his or her confidence in the medical profession and in the health services in general. Without such protection, those in need of medical assistance may be deterred from revealing such information of a personal and intimate nature as may be necessary in order to receive appropriate treatment and, even, from seeking such assistance, thereby endangering their own health and, in the case of transmissible diseases, that of the community”⁸².

According to Article 14. b) IDHGD, human genetic data should not be disclosed or made accessible to third parties, in particular, employers, insurance companies, educational institutions and the family, except for an important public interest reason in cases restrictively provided for by domestic law or where the prior, free, informed and express consent of the person concerned has been obtained⁸³. “Public interest” should be here understood in the sense of Article 26.1 CHRB, that is to say, for reasons of public safety, for the prevention of crime, for the protection of public health or for the protection of the rights and freedoms of others.

In practice, it is likely that the subject will consent to the disclosure of the information to members of the family or may even provide the information himself or herself⁸⁴. However, it is important in the genetic counselling process to stress to the subject the importance for others to partially relieve the doctor of his or her professional duty of secrecy for the subject to give the information.

Conflicts of duties and interests. Privacy and intra-family communication of genetic information

Genetic medicine can give rise to a variety of conflicts of interests. On the one hand, the data subject will have an interest in their protection. On the other hand, certain legal entities or individuals may show an interest of apparently equal legitimacy, although in conflict with the first, in gaining knowledge

80 de Sola, “Privacy and Genetic Data”, p. 182; Freire Falcão de Oliveira, “Juridical implications of genome knowledge”, p. 90; Ismini Kriari-Catranis, “Genetic data and confidentiality, the Estonian experiment”, *Revista de Derecho y Genoma Humano/Law and the Human Genome Review*, No 19 (2003), p. 148.

81 In addition, Madison Powers, “Justice and Genetics: Privacy Protection and the Moral Basis of Public Policy”, in Mark A. Rothstein (Ed.), *Genetic Secrets: Protecting privacy and Confidentiality in the Genetic Era*, Yale University Press, New Haven, 1997, p. 358, notes that when genetic information obtained from one patient or subject is revealed to other family members without his/her consent, «the ability of persons to shape their most intimate relationship is compromised, and the trust and patterns of usual communication within families can be compromised».

82 *Z. v. Finland*, 25 February 1997 (paragraph 95). Cf. also, *M.S. v. Sweden*, 27 August 1997 (paragraph 41).

83 See also Principle 9 of Recommendation R (92) 3: “Persons handling genetic information should be bound by professional rules of conduct and rules laid down by national legislation aimed at preventing the misuse of such information and, in particular, by the duty to observe strict confidentiality. Personal information obtained by genetic testing is protected on the same basis as other medical data by the rules of medical data protection”.

84 Cf. National Consultative Ethics Committee for Health and Life Sciences (France), Opinion n° 76 regarding the obligation to disclose genetic information of concern to the family in the event of medical necessity (2003), page 5; Moniz, “Privacy and intra-family communication of genetic information”, page 108.

or making use of the very data which the subject would like to safeguard⁸⁵. In the field of medical genetics, the most obvious situation of conflict is probably that between a subject and his, or her blood relatives.

Genetic features are transmissible from one generation to another. If a person carries a gene responsible for a certain disease it is virtually certain that the gene will also be found in other members of that person's close family. From the medical standpoint, the patient is the entire family rather than just one single person⁸⁶. Whenever a gene is discovered in a given individual, therefore, the question arises as to whether this information should be communicated to the individual's relatives for the purposes of diagnosis, prevention or therapy, etc. However, from a legal point of view, the data subject is only the individual person whose DNA is being analysed⁸⁷.

In the huge majority of cases, information can be passed on without much difficulty. As noted above, the subject himself or herself will agree to inform close family members. In some circumstances, however, problems will arise if the subject refuses to do so⁸⁸. Although infrequent, such cases do occasionally arise, sometimes because the subject does not get on with his or her family or, more often, because the subject would prefer that his or her relatives do not find out that he or she is a carrier of the gene⁸⁹.

If an individual refuses to inform relatives of any relevant genetic data, we can wonder whether a doctor has a duty to inform the interested parties. This is a frequent dilemma in medicine and there is no universal answer to it. In fact, there are two different approaches relating to the passing on of information to relatives⁹⁰: the legal model and the medical model. The legal model is based on the patients' right to privacy, based on the idea that each person has the right to control their own body and genetic information; while the medical model rejects the language of individual rights and instead stresses the need to treat patients who have risks of a genetic nature.

The so-called legal model has prevailed in Europe so far, based on the preservation of human rights, particularly the right to privacy, in defence of the principle of patient autonomy and self-determination. As mentioned above, in the countries that have adopted the "legal model" (most of them), doctors may only disclose such information with the express consent of the patient, even if a family member is at

85 These conflicts may be classified in the following categories, according to the person or institution seeking access to the data: a) Biological relatives might unknowingly be healthy carriers of the same genetic anomaly as the subject and consequently have a direct interest in the information; b) Legal entities or individuals have entered or plan to enter into a contractual relationship with the subject, especially an employment, service-related or insurance contract; c) The use of genetic data may be required by society as a whole (collective interest), for example as a vital clue in identifying the perpetrator of a crime; d) The advancement of medical research may be dependent on the greatest possible knowledge of data relating to subjects belonging to families within certain hereditary diseases occur. See Carlos de Sola, "Privacy and Genetic Data. Cases of Conflict (I)", *Law and the Human Genome Review*, No 1 (1994), p. 175.

86 De Sola, "Privacy and Genetic Data. Cases of Conflict", pp. 179 f.; Freire Falcão de Oliveira, "Juridical implications of genome knowledge", p. 88; Helena Moniz, "Privacy and intra-family communication of genetic information", *Revista de Derecho y Genoma Humano/Law and the Human Genome Review*, No. 21 (2004), p. 109.

87 See Freire Falcão de Oliveira, "Juridical implications of genome knowledge", p. 89 («[genetic] information refers only to the subject and hence the right to privacy can be assured»).

88 Actually, given the nature of genetic information, it has been argued as to whether there is an obligation (legal duty imposed by civil law or even criminal law) to notify genetic information to members of the family. See in this respect, Freire Falcão de Oliveira, "Juridical implications of genome knowledge", pp. 89 f., according to whom, a «recognition of a legal duty to notify family members would (...) be a curtailment of the individual's right to privacy»; Harold Edgar, "Is there a legal duty to disclose genetic characteristics to a future spouse?", in *The Human Genome Project: Legal Aspects*, Vol. I, Fundación BBV, Bilbao, 1995, pp. 360 ff.; National Consultative Ethics Committee for Health and Life Sciences (France), Opinion n° 76 regarding the obligation to disclose genetic information of concern to the family in the event of medical necessity (2003).

89 De Sola, "Privacy and Genetic Data", p. 180.

90 Skene, "Patients' Rights or Family Responsibilities", pp. 1 ff.

risk⁹¹. This does not mean that doctors do not have the possibility of disclosing this information in very closely defined circumstances. In fact, they are allowed to. This is not because a duty to forewarn exists, but because there is a justification for the breach of confidentiality⁹².

The CHRB offers no precise solution to this dilemma. It only provides the general guidance set out in Article 10.1 in conjunction with Article 26. The former lays down the right to privacy (“Everyone has the right to respect for private life in relation to information about his or her health”), whereas Article 26.1 states that there may be exceptions to this right when necessary to protect the rights of others.

The question of when these exceptions are justified and when they are not remains unanswered. Since there is no general answer, all that can be said is that the solution will depend on the circumstances surrounding each case⁹³. The only possible criterion is an assessment of the respective consequences of each solution, bearing in mind in particular the seriousness of the disease in question^{94,95}.

Thus, “exceptional circumstances, whereby disclosure could prevent serious harm to the health of the relative, and provided there are no other less-intrusive alternatives with respect to the privacy of the patient, may justify a breach of confidentiality in the doctor-patient relationship, and disclosure of the information by the health professional against the wishes of a patient”⁹⁶.

In other words, before deciding whether or not to pass on the subject's personal information to the rest of the family against his or her wishes, doctors must not only weigh up the private interests at stake (the subject's right to privacy versus the family members' right to health) but must also take into consideration the loss of confidence in the medical profession that their action could cause.

Thus, having established that a person has rights over his or her own genetic information, and that said

91 On the contrary, when we refer to the medical model, the general principle is not respect for the right to privacy, but respect for each person's health. Consequently, genetic information must be shared between family members and under no circumstances can this be prevented by the patient. According to this model, a person does not have the right to control his or her own genetic information, and doctors have a duty to disclose it.

92 Moniz, “Privacy and intra-family communication of genetic information”, p. 111. Cf. European Standards on Confidentiality and Privacy in Healthcare (2006), paragraph 3.4.2. The National Consultative Ethics Committee for Health and Life Sciences (France), Opinion n° 76 regarding the obligation to disclose genetic information of concern to the family in the event of medical necessity (2003), maintains a much more strict position with regard to the duty of confidentiality. It says that “the doctor will never take the initiative of warning family members unless the proband [the data subject] request him to do so” (page. 8), although he or she must do everything in his power to convince a patient that his or her family should be informed “but he must not step in personally and breach medical confidentiality” (page 6). Cf. also, Virgine Commin/Emmanuelle Rial-Sebbag, “UNESCO and Council of Europe's contribution to the question of the confidentiality of the genetic information of an individual towards his family, in the case of genetic tests”, in Marcelo Palacios (Ed.), IV World Conference on Bioethics: summary of Lectures and oral presentations, Sociedad Internacional de Bioética, Gijón, 2005, p. 474.

93 Data Protection Working Party, Working Document on Genetic Data, p. 9 (“Given the complexity of the issues described above, the Working Party takes the view at this stage that consideration should be given to a case by case approach in deciding how to address possible conflicts between the interests of the data subjects and those of their biological family”).

94 De Sola, “Privacy and Genetic Data”, p. 182

95 A case was addressed in this respect in Italy, in 1999, through a decision issued by the Garante per la Protezione dei Dati Personali (Personal Data Protection Authority), which granted a lady the possibility to access her father's genetic data although the latter had denied his consent. This request was granted by considering that the father's right to privacy was to be overridden by the lady's right to health – the latter meaning her “psychological and physical well-being”. The lady had requested disclosure of the data to carry out a genetic test and subsequently take a fully informed reproductive decision – upon assessing the risk of transmitting a genetic disease that affected her father. See Data Protection Working Party, Working Document on Genetic Data, p. 9.

96 Expert Group on Genetic Data, Ethical, legal and social aspects of genetic testing: research, development and clinical applications, p. 80. See also, Recommendation No. R (92) 3, Principle 9 (“In the case of a severe genetic risk for other family members, consideration should be given, in accordance with national legislation and professional rules of conduct, to informing family members about matters relevant to their health or that of their future children”); Recommendation No. R (97) 5 on the Protection of Medical Data, principle 7.3. However, the right to privacy will not be necessarily at stake because it is not always necessary to reveal the identity of the data subject when there are contacts with relatives. See in this respect, Roscam Abbing, “Genetic Information and third party interests”, p. 39

rights must prevail over the interests of others, it is nevertheless possible to consider the rights of others when their health or lives are seriously affected. Specific regulation is not required for this. Rather, it can be achieved on the grounds of the conflict (or collision) of duties⁹⁷ or, as the case may be, the state of necessity⁹⁸, institutions which exist in the majority of legislation⁹⁹.

In an attempt to establish a balance between the interest in preserving privacy, on the one hand, and the need to disclose confidential information, on the other (and assuming that the tests performed are reliable, the severity of the illness diagnosed and the availability of preventive treatment or cure), the doctor may violate confidentiality by communicating that genetic information to family members¹⁰⁰.

Conclusion

In medical genetics, the information that derives from genetic testing presents several dilemmas related to the information itself, access thereto, and the uses of such data, given that the interests of the data subject may be in conflict with those of the biological family. The term “human genetic information” must be understood broadly, so that it should encompass data also available through means other than a genetic testing, namely medical history or information derived from observance of an individual’s behaviour.

Genetic data seem to have specific dimensions which are not necessarily common to all medical information. Therefore, it is necessary to treat genetic information differently and give it special legal protection. For example, tests should be performed only for health purposes or for scientific research linked to health purposes, and genetic counselling should be provided to help individuals or families understand or cope with genetic disease.

Medical genetics also raises particular privacy concerns. The aspect of privacy which is most commonly referred to in the discussions about genetic privacy is called “informational” privacy. In recent times, especially in Europe, the right to privacy has turned towards a specific right, the right to data protection.

The principles of data protection (such as the need of consent to the processing of personal genetic data or the right of access to personal genetic information) do not apply to data rendered anonymous in such a way that the data subject is no longer identifiable. This means that protection will not be given to personal data that have been subjected to an anonymization process. The process of anonymization itself is therefore still an act of data processing. This means that, until anonymization is carried out in fact, the data will still be considered as personal data so the principles of data protection will be applicable.

97 In order to use the conflict of duties solution, it is necessary to first determine the obligation of information towards others on the part of the person who performed or proposed the tests (e.g. a doctor in relation to his or her patient). That is to say, if the doctor is simultaneously doctor to other family members of the patient in question, then he or she may have the duty to communicate the fact to them.

98 When the clinician is doctor only to the patient having the test. In these cases, the doctor does not have to violate confidentiality, but when he or she does so, taking into account certain clearly defined circumstances, his or her conduct is not considered illicit.

99 Romeo Casabona, “Genetic Information”, p. 784. See also Herman Nys/Carlos M. Romeo Casabona/Christophe Desmet, “Legal aspects of prenatal testing for late-onset neurological diseases”, in G. Evers-Kiebooms/M. W. Zoetewij/P. S. Harper (Eds), *Prenatal testing for late-onset neurological diseases*, Bios, UK, 2002, p. 98; Roscam Abbing, “Genetic Information and third party interests”, pp. 40 ff.

100 According to this, Moniz, “Privacy and intra-family communication of genetic information”, page 109, considers that the breach of confidentiality can be justified provided that: 1) the doctor has done everything possible to persuade the patient to communicate the information him/herself; 2) there is a strong chance of serious risk to the health of a relative; and 3) there exists some preventive treatment or cure. In addition, she also thinks that, in order to avoid problems, the best solution would be the clear and express stipulation of the circumstances that justify the disclosure of information, with a precise indication of the presuppositions underlying the justification. The following provision has been proposed: “The breach of confidentiality by a doctor is not punishable when, according to the current state of knowledge and medical experience, it constitutes the only adequate way of preventing serious and irreversible damage to the physical or psychic health of a third party, taking into account the reliability of the tests, the severity of the disease diagnosed and the possibility of preventive or curative treatment”.

Every person has the right to decide whether or not to be informed of the results. Before a genetic analysis is carried out, the data subject should be informed about the objectives and the possibility of unexpected findings.

If they occur, they should not be communicated if they have no bearing on the health of the individual because the mutation found does not have great significance, or there is no therapy or prevention known, or it is not going to be transmitted to the offspring.

The right to privacy involves a corresponding duty of confidentiality. This means that genetic data must also be protected from other persons even in the case of a biological relative who seeks information concerning the possible presence in him or her of a pathological gene similar to that discovered in the data subject. However, this does not imply that doctors do not have the possibility of disclosing this information in very closely defined circumstances.

Exceptional circumstances, whereby disclosure could prevent serious harm to the health of the relative, and provided there are no other less-intrusive alternatives with respect to the privacy of the patient, may justify a breach of confidentiality in the doctor-patient relationship, and disclosure of the information by the health professional against the wishes of a patient.

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Biobanks and the Notion of Justice in Health*

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Introduction

The aim of this paper is to examine and describe some ethical issues that arise with the development of population-based genetics research and the establishment of large-scale biobanks, with special reference to the notion of justice.

“Justice” is not only interpreted in the system of governance, but also in the ethical conception of justice in biobanks. This paper will examine what justice means at the individual as well as at social levels; what complexities ethical principles bring out in balancing the interests of all stakeholders; and what kinds of governance and regulatory mechanisms are employed to ensure operational effectiveness and prevent ethical concerns from actualizing. This paper is divided into two major sections, with a focus on understanding the term “biobanks” and its international perspectives, followed by a study on conceptualising justice in biobanks.

Understanding Biobanking

Functional genomics has brought a new shift to genomics research, with a focus on the applications of genomics research at the level of populations. Although still in its embryonic stage, research focus is gradually shifting from the identification and treatment of rare single gene disorders to more common, complex diseases that effect large populations.

Advances in genetics, genomics, and bioinformatics have led to their merger into large-scale population biobanks. However: there are different understandings of biobanks, and at the international level, different research communities and several countries plan to pursue their own biobanks objectives.

“Biobanking”, which implies a systematic collection of biological material, is not a new concept in scientific research. In medicine and clinical practice, there have been several examples of tissue collections and maintenance of health records for research and therapeutic purposes. Family genetic registers have been in practice for over thirty years now; for example, the Register for the Ascertainment and Prevention of Inherited Disease in Edinburgh, Scotland, offers active counselling to members of families with a history of genetic disorders, and a register centred at the University of Utah in the US, based on the family register of the Mormon Church, was used to identify individuals with dominant hypercholesterolemia. (Modell et al., 2001).

The integration of computational tools and applications has led to the development of bioinformatics. The use of bioinformatics in genomics research has diverted focus from traditional research biobanking to studies relying on Human Genetic Research Databases (HGRDs) (Knoppers, 2004). These modern genetic databases are depositories of DNA, other biological materials, and a collection of genetic information that is linked and organized in a systematic way for research purposes, with future possibilities for therapeutic purposes —especially for genetic and other associated conditions. Several terminologies are used for these systematic collections, including biobanks, cohorts, gene banks, population collections/studies, and genetic/genome databases. These biobanks are diverse in terms of criteria/selection of collections, healthy or affected groups, age groups, homogenous or heterogeneous representations, operational and governance mechanisms, research agendas, and underlying scientific purposes. These differences raise various ethical questions on the overriding philosophy of biobanking.

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Population Biobanks

Lately, proposals have been put forward for the genetic understanding and study of entire populations or subsets of populations, which in popular discourses and debates are referred to as biobanks. These population-based biobanks are unique in their nature, since they are not only collections of biological materials and genetic information, but they also intend to collect personal information, histories of diseases and treatments, and lifestyle information, including health, nutrition, and family histories. It is envisaged that many of the collections will be permanently stored. Since the development of the Icelandic Health Sector Database (HSD), several countries initiated the task to bring governing mechanisms of medical, health, and research infrastructures under one umbrella to create a complex but robust research and therapeutic environment. These databases focus on social and community benefits rather than individual benefits.

The benefits are expected for all the stakeholders including patients, participants, the general public, research communities, health authorities and the private sector. The interests of future generations and providing better health for the present generation are a leading argument for establishing biobanks.

Biobanks and health expectations

In countries where biobanks are established, there are varying expectations. According to John Newton, the CEO of UK Biobank Ltd., the UK Biobank will allow the risk of disease to be predicted. Knowing differences in risk in the population will help determine the scope of prevention. Information from UK Biobank will help specify meaningful subgroups of illness and improve the specificity and effectiveness of all kinds of care, not only drugs [sic], but also social and emotional.

Hence, it is a long-term investment to create a resource and a framework for future studies looking into the complexities of gene-gene interactions, genotype-phenotype interactions, and the separate and combined effects of genetic, environmental, and lifestyle factors on the development of multi-factorial diseases in adults (UK Biobank Ltd., 2004).

The Icelandic Health Sector Database can be considered a pioneer in starting the concept of population-based genetic databases. The purpose of the Icelandic database, as mentioned in their Act on HSD, is very general, with an aim of increasing knowledge in order to improve health and health services.

It became ethically challenging not because of the aims of the database, but due to the nature of its constitution, governing framework and involvement with the private sector (Ministry of Health and Social Security, Iceland 1998). The justification for the Estonian biobank initiative was that a small country that is genetically heterogeneous makes the Estonian biobank a useful tool for targeting the increasing number of drugs with efficacy problems and issues of adverse reactions.

We can see the diversity of expectations from biobanks from similar initiatives in Sweden, Norway, Latvia, Tonga, Canada, USA, and also some countries of Asia, namely China, Singapore, Japan, and Taiwan. Given the wide variety of databases, there are different governing mechanisms adopted by different countries, depending on the existing infrastructures, governing frameworks, and mechanisms of ethical oversights.

Legislation and Regulation of HGRDs: A Matter of Justification and Trust

When considering the governance of databases, most countries have opted for pre-existing mechanisms, and some have passed new legislation. Again, we can see different regulatory approaches taken.

The Icelandic government passed the Act on Biobanks of the Iceland Parliament, with sections on the establishment and operation of biobanks; collection, handling, and access; monitoring and obligation to supply information; and penalties. A similar approach is seen in Estonia in the form of the Human Genes Research Act (HGRA); these cases are more firmly grounded in the "legislative approach" (2003).

The projects in Iceland and Estonia are a creation of statutory bodies and, hence, a fundamental mechanism for the structure, operation, and regulation of the projects was established based on these regulations.

In these countries where the biobanks are firmly grounded in legislation, there is strong public support for biobanks, and public trust is an important criterion for such large-scale genomic studies. These biobanks are also ethically justified as a “common good” model with strong public acceptance. The question of “biobanks as common good” is considered in a separate section later in this paper. However, formal public control over the biobanks for safeguarding the interests of all participants represents a unique example of a general desire to use genomic technologies for health care and clinical practice. Therefore, it also has a greater power of enforcement.

In the case of the UK Biobank and Cartagena project, ethical operation of the biobanks is the responsibility of the instigators. The Ethics and Governance Council (EGC) of the UK biobank was established by the interim advisory board of the UK Biobank. As mentioned on the UK biobank website: “The role of the EGC is to act as an independent guardian of UK Biobank’s Ethics and Governance Framework (EGF), to advise the board on the conformance of UK Biobank’s activities with this framework and to safeguard the interests of participants and the public. The council will also advise UK Biobank on the future development of the Ethics and Governance Framework”.

The Quebec network for Applied Genetic Medicine (RMGA) has documented two papers on the Statement of Principles of Human Genome Research (2000) and the statement of Principles on the Ethical Conduct of Human Research Involving Populations (2003). These documents outline the relevant principles to be followed when conducting research. However, in some cases, policies and committees are referred to, but they are yet to be drawn up, and the terms of references have not been set up. This raises concerns over paradigms of trust and confidence of the stakeholders in the biobanks. It is also a reason that, before recruiting volunteers to donate samples, the UK has a rigorous public consultation process. The process encompasses more than “informing” people about the project when the decisions have been made in advance: it is an interaction with the public from the beginning of and during the process, when required. But is public consultation enough for ensuring the legitimacy of biobanks, or does independence from legislation provides inherent flexibility to the projects, and hence leave opportunities for changes when needed?

Abandoning individual choice for community benefits?

The construction of favourable arguments for biobanks are largely based on the theory that they can provide possibilities for better health and nutrition, for affected and non-affected individuals, specific groups, or general communities.

While individual choice and autonomy is paramount in clinical ethics, biobanks draw our attention to the ethical complexities of a person’s social identity and puts group interests on the agenda while invoking the concept of beneficence. Ironically, if we look at the proposed benefits of genetics research with biobanks, there is an increasing trend in the “individualisation” of medicine and health benefits, thus promising more individual choice.

The scientific research in pharmacogenomics and nutrigenomics is based on the premise that people differ in their genetic variants and, hence, respond differently to different diseases, medicine, and food.

The Department of Health (DoH) UK’s White Paper on “Our inheritance, Our future” illustrates this concept by stating that “the way external factors and genes interact to cause disease or protect us from disease will be understood. This information will allow people with certain genetic profiles to avoid foods, chemicals and environmental factors, such as smoking, which are particularly risky for them. (DoH, 2003).

Arguably, individualising benefits will yield a community benefit. These benefits are made available in the form of providing information and knowledge to the people so that people can make informed decisions about their future health. Note that people also have the right to not know and the choice of not utilizing the benefits. As Ruth Chadwick argues, individual autonomy consists of making a

responsible choice as a rational agent, and that there is a duty to be well informed in order to make informed decisions for oneself and out of duty to others (Chadwick, 2004).

The concept of duty to others is based on the ethical principle of beneficence, which would demand that each healthy individual has an ethical obligation to donate to the research for good, as it will lead to the benefit of all humankind. The principles of solidarity and equity that are argued in the biobanks debates insist on the concept of beneficence in genomic research. The duty to contribute is also argued, based on the concept of the “common heritage of humankind”.

Biobanks envisage linking genetic factors with environmental factors and behavioural characteristics, which are also constituents of the “society” we live in, as any decisions made by one individual have an impact on society and vice versa. We make choices not only as individuals but also as members of a particular group or a community. This is very important in relation to biobanks, and it is also recognised by the WHO, which, in their draft statement on genetic databases, states that “the justification for a database is more likely to be grounded in communal value, and less on individual gain . . . it leads to a question whether [sic] individual can remain of paramount importance in this context” (WHO, 2001). Hence, we can see a gradual shift away from the importance of individuals in favour of community interests.

Benefit sharing/sharing of benefits and common good

The benefit sharing concept in genomics research in medicine and health care is derived from debates surrounding the protection of traditional knowledge and property rights of indigenous people in plant genomics. The purpose of benefit sharing in medical research is multifold. The HUGO statement on benefit sharing states “that all humanity share in, and have access to, the benefits of genetic research . . . that benefits not be limited to those individuals who participated in such research”, based on the arguments for distributive justice in health, and that the human genome is a common inheritance of humanity (HUGO, 2000).

At the same time there is a need to identify what the immediate and future benefits from biobanks are, whose interests should be taken into account, and how best we can distribute these benefits. The potential recipients of the benefits from biobanks include the general population, sub-populations, specific groups (affected individuals, ethnic groups), families, single patients with rare diseases, researchers, hospitals, institutions, etc.

The immediate health benefits may include improved diagnostics or preventative medicine, and an indirect health benefit for small groups of people with genetic conditions, in terms of easy access and better health care deliveries and inexpensive or free treatments, as seen in Iceland with deCODE Genetics.

The long-term benefits are based on the “common good” argument: that the better understanding of disease mechanisms will help in improving therapies on an individual basis. We can also argue that creation of “knowledge” and advancement in medicine is good in itself, as it benefits humanity at large. However, it is a matter of consideration that existence of a “common public good” does not necessarily imply that the applications and impact of a public good is also “common”.

Therefore, we can argue that regarding the human genome as the “common heritage of humankind” alone is not a sufficient principle to ensure justice, especially with regards to distributing the benefits of genomics research at a global level; especially in the poorer regions of the world.

The HUGO statement on Genetic Databases mentions that “the fair and equitable distribution of benefits from research using databases should be encouraged” (HUGO, 2003). The distribution of benefits can either be at the level of each individual, or at the community level. Benefits can be distributed: equally, regardless of contribution, which is based on the principle of equity and human dignity; according to the needs of each person, prioritising individual choice; or, at more subtle level, according to the contribution, which is based on the notion of compensatory justice, wherein benefit is provided as a ‘reward’ for participation based on benefit-risk assessment.

This is also seen as a recommendation in the HUGO Benefit Sharing statement: “Profit-making entities [should] dedicate a percentage, for example 1-3% of their annual net profit to health care infrastructure and/or to humanitarian efforts”. Nevertheless, the question of whose responsibility it is to ensure benefit sharing remains to be analysed.

Complexities of individual rights and social justice

Individualism in biobanks raises intrinsic ethical concerns from the participants. One of the main complexities in biobanks is how to determine confidentiality and privacy of the data. We also need to consider which kind of privacy is under question, and what we mean by “genetic privacy”. Granting rights for the protection of genetic privacy is the basis for limiting access to available information and restricting misuse and exploitation, as there is potential to generate information from genetic research beyond what was originally sought, thus provoking issues of commercialisation.

In some cases, samples were made anonymous, but for parallel epidemiology studies, where individuals are likely to be followed through periods of their lives, it is questionable how the privacy of individuals will be maintained over time without destroying data.

Sometimes information about the patients is encoded into serial numbers or other codes correlating to their genetic makeup. Nevertheless, for follow up, studies needed to be carried out in different setups, and in the case of “novel” findings, where a disclosure might be needed for third party researchers, we need a method of acquiring secondary consent from the donors. Data encryption is often used, and sometimes includes personal identifiers — but for commercially attractive databases, it may not be sufficient to prevent unauthorised access (GeneWatch UK, 2004).

Another database issue is granting ownerships rights. UNESCO’s Declaration on Human Genome and Human Rights states that DNA is a common heritage that is shared by all. The HUGO ethics committee describes genetic databases as global public goods. This implies that all human beings, regardless of their participation in research, share the ownership of data and should have equal rights to it. It is a conceptual issue, but at the level of applicability in both research and governance, ownership of data is legally bound and used as a measuring tool for determining benefit sharing and control over the data.

But if each individual had ownership rights and control of the data, it would be extremely difficult to determine a balanced approach in ensuring the claims of each individual over their individual tissue as well as the information derived from it. Also, would massive collections lead to a proliferation of individual rights, or should the approach be more “social” and “community based” (Bovenberg, 2004)?

When comparing social interests and individual interests, it is important to consider what social factors will be influenced by biobanks, for example family, community, environment and lifestyle (Wilson, 2004).

Social justice demands recognition of the rights and responsibilities of human beings as individuals and members of society. The utilitarian argument claims that improvements in health care are in everyone’s interests, and understanding the genetic factors relating to multifactorial conditions, for example heart disease and diabetes, will lead to better individual health and thus better public health in terms of the provision of health care and the development of robust health care systems.

Health care is a definite priority, as seen by the generally large allocations of state funds to health care systems. However, these arguments override or ignore the disadvantages and burdens that might occur in seeking genetic information. Not everyone might be willing to sacrifice privacy and individual rights for a common good. Previous instances of possible discrimination and unequal treatment based on health and genetic make-up has led to mistrust of genetic research on humans. Arguably, provision of health and genetic information does not force individual obligation to use the resources and options available. But duty to safeguard the interests of future generations and the ideal of sustainability is crucial, and it demands social cooperation.

Commercialisation issues

The controversies surrounding the ownership of data, information, and tissue samples are complicated by the involvement of private sectors. The Iceland Health Sector database is an ideal example: In Iceland, genealogies date back centuries, and have a significant contribution. The government of Iceland agreed with Decode on granting an exclusive licence to establish and operate the Icelandic Health Sector Database (HSD), and they gave access to medical and health records of the people through a universal presumed consent.

The database will contain medical records of the whole population, but it will also be a structure through which a genealogical database and a DNA database can be linked to medical records. The intention of the company to exploit information for commercial profit by selling access to the database, which can be used for research in epidemiology and genetics research, has been ethically condemned; it has raised several complex issues of informed consent and ownership of the data.

In the case of some large-scale databases like the UK Biobank, there is some provision for the repatriation of accrued profits to the community, but this does not always occur (WHO, 2002). In Iceland, following heated public debate and international criticism, the universal presumed consent bill was revised to add an “opt-out” system that requires citizens to register if they do not want to be on the database. But this raises questions of how much people trust their chosen governments, and it highlights dissonance between the concept of “genetic property” and the shared nature of economic and cultural assets, which is integral to most indigenous societies (Committee on Human Genome Diversity, 1997).

Iceland aside, many international biobank projects have ties with commercial companies. Autogen Ltd., a leading Australian pharmaceutical company, signed an agreement with Tonga’s Ministry of Health to “establish a major research initiative aimed at identifying genes that cause common diseases using the unique population resources in the Kingdom of Tonga” (Autogen Ltd., 2000).

The agreement included access to data and the samples in return for providing annual research funding to the Ministry of Health, in addition to paying net royalties on revenues generated from any commercialized discoveries. But there was no public consultation process. Other countries with biobanks tied to commercial companies include Estonia with EGeen Incorporation and Sweden with UmanGenomics. Is private sector involvement an unavoidable requisite for genomics research? And how can we balance the conflicting interests of society, science, and industry?

Developing Countries

Genomics research demands investment, innovation, and a capacity to produce. Genetic databases are an “add on” in genomics research, and they have their own implications and importance to developing countries. Genetic databases in the public domain provide opportunities for developing countries to gain access to a huge amount of available information and gain deeper knowledge at the basic research level.

Technological innovation is an essential tool for growth and development. It would help developing countries to develop their own research methodologies and therapies for epidemic diseases such as thalassaemia and sickle cell anaemia. There is also the question of which kinds of databases might be of immediate use for developing countries.

But it might not be of immediate use to invest in large-scale population biobanks. Rather, resources need to be allocated to extract the existing information in the public domain and utilize it for purposes of primary health care, genetic testing, and counselling. The issue of resource allocation is crucial for developing countries, and at the global level, it is central to the issue of health inequity in the world (Bhardwaj, 2004).

In debates on the gap between the developing and the developed world, capacity building is an issue. Regarding capacity building in genomics research, biobanks pose a concern of exploitation of genetic diversity in both public and private domains. The well-known Harvard Anhui case and issues from the international HapMap Project are examples of such exploitation.

Conclusions

Different notions of justice are apparent on the levels of practice and policy development. The issues of individual choice and social justice raise important philosophical concepts that are sometimes difficult to apply in practical ethics, but they help to facilitate discussions and options. For example, it helps to analyse what is “good” in the notion of genetic databases as global public goods, and whether duties and responsibilities in research change if the database is private or public. This paper does not look into the more philosophical approaches in studying the principle of justice, but focuses on the conceptions of justice as raised in the application of databases for general health care on local and global scales. The thrust to global justice is paramount in biobanks because of its implications for individuals as well as communities, who shape the decisions made by and for them.

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Is the era of the therapy by tailor-made stem cell coming?*

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Introduction

Therapeutic cloning may result in the production of immunologically compatible replacement tissues in severe degenerative or inherited diseases like Huntington's, Parkinson's, cystic fibrosis and other diseases. There are two types of stem cells: Embryonic stem (ES) cells can proliferate indefinitely in culture, they could potentially provide an unlimited source of clinically important adult cells. But ES cells are controversial because they involve destruction of human embryos. While adult stem cells, derived from bone marrow, blood, skin, hair follicles, nasal passages and the brain, come without the ethical quandary, some scientists doubt they have as much potential as ES cells.

A successful attempt to freely control the growth of ES cells means that sufferers of a wide range of diseases could be treated via regenerative medicine. Film star Christopher Reeve, who died on October 10th 2004, had been paralyzed from a spinal cord injury since 1995. He saw ES cells as the best hope for people like him, as do sufferers of obstinate disease. In June 2004, former US President Ronald Reagan died from Alzheimer's disease, and Nancy Reagan announced in public that she was in favour of ES cell research.

Each year in Japan, about 5,000 people suffer spinal cord trauma in car crashes and other types of accidents. Estimates suggest that over 100,000 people in the country are afflicted with physical paralysis. In July 2004, it was found that nine Japanese people who suffer from spinal cord injuries travelled to China to undergo transplants of cells from aborted fetuses.

Such transplants are believed by some to aid the regeneration of nerve cells in the injured spinal cord, possibly enabling patients to regain feeling in their arms and legs, and eventually restore movement. But the effectiveness and safety of the treatment has yet to be verified.

The United States has no laws banning such research, but in 2001, President Bush declared that no federal funds could be spent on ES cell lines developed after that date. Since then, many states have taken on funding efforts. At first California decided to fund three billion dollars of state money into ES cell research over the next 10 years. Other states then expressed the fear that they would lose their top researchers to California. Wisconsin's governor recently earmarked \$750 million for ES cell research and facilities and New Jersey and several other states are also doling out cash.

Regulation of human ES cell and cloned Embryos research in Japan

In Japan, the Council for Science and Technology Policy's bioethics subcommittee recommended in June 2004 that scientists be conditionally allowed to use cloned human embryos for research purposes. The creation and use of cloned human embryos are banned under cloning technology legislation that took effect in 2001, but the law was slated to be reviewed three years after its implementation.

The panel held 29 meetings to review the use of cloning technology. Giving serious consideration to the opinions of those cautious about the research, members of the panel agreed to set up rigid conditions for such research. As a result, the research was approved by a vote of 10 to five.

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The potentiality of the embryo

The moral legitimacy of performing research on the human embryo depends on the status of the embryo. The issue of how we define and categorize the embryo at its different developmental stages is crucial to the question of what we can do with it.

If the embryo is a human being, then our treatment of it is limited to what we are allowed to do to other human beings. By contrast, if it is no more than a collection of human cells, then there are far fewer restraints on our handling of it. In the area of stem cell research, much of the moral debate in various countries has focused on the question of just what the embryo is, in particular at the pre-implantation stage.

It is clear that the embryo has a unique status in biological terms. Unlike any other cluster of living cells, this cluster has the capacity to develop into a functioning complex organism. This difference may be described as the embryo's potential to become a human being. This biological fact has moral implications. So far as our moral notions depend on the value of human life, the human embryo demands respect as being related to human beings who deserve the utmost respect and have human rights. But how far should this respect go when considering the human embryo? In other words, at what point of embryonic development do we consider it a human being?

There is an argument focus on the biological status of the embryo. One line of argument examines the capacity of the embryo for conscious thought. As the nervous system does not begin to develop until after implantation, according to this view there is no objection to the use of pre-implantation embryos.

When does a human formulate in a biological view? The ordinary human form correlates with the properties of the human brain, in particular cognitive and emotional infrastructures. Hence, a human would form when significant parts of that infrastructure develop in the foetal brain during pregnancy. This may be the third trimester of pregnancy. Accordingly, a younger embryo should be treated with appropriate respect but not as a person.

One debate is how to consider the potentiality of the embryo. The defenders of the protected embryo status argue that it is wrong to do anything to the embryo that will prevent it from fulfilling this potential because the embryo has the potential to become a person even if it is not yet a person. On the other hand, one may argue that the potential to become a human being does not endow the developing embryo with the status of a human being.

Egg and sperm are components of the gamete that becomes a foetus. In the case of IVF, the concept of embryo potential is further complicated since direct medical intervention is needed for the embryo's implantation in a uterus. The rate of IVF embryos that develop into blastocysts is still low, between 20 to 30%. If there are extra embryos, the couple has the option of freezing the remaining embryos for thawing and transferring in a later cycle. Approximately 30 % of embryos do not survive the freeze-thaw process.

Cultural and religious views on human ES cell research

The bioethical debate on human ES cell research occurs in a context of cultural and religious reflection. The strongest opposition to the use of embryo for research purpose is expressed by the Roman Catholic Church. In August 2000, regarding ES cell and the status of the embryo, the Catholic Church's Pontifical Council announced, in their view, that a human being comes into existence at the time of fertilization.

They believe that there is a continuum from the conception to the human being, and that development continues during all stages of life, giving sanctity to all stages of development. Therefore every embryo should be given the opportunity to develop to a human being. In contrast, Protestant theology does not follow a single source of authority. It is part of the Protestant ethos that moral questions are determined by the individual conscience.

Therefore in Protestant thought, Christians may have very differing views on the issue of ES cell

research. Jewish Biblical Law determines that human status is acquired progressively during embryonic development, and not at fertilization. The status of the embryo outside the womb is comparable to that of gametes, sperm and eggs. With regard to the pre-implantation embryo, genetic materials outside the uterus have no legal status since they are not even part of a human being until implanted in the womb.

In Islam, the use of embryos for research purposes may be acceptable provided that it occurs before the point at which the embryo is ensouled, i.e. from the 40th day after fertilization. Therefore, ES cell research in Islam is allowed in the early stages of life, as long as such an intervention is undertaken with the purpose of improving human health.

However in Japanese Buddhism or Shintoism, there is no clearly defined doctrine on which stage of the process of development from fertilization to foetus life begins. The issue of producing ES cells through the destruction of embryos has not generated major opposition in Japan. The difference between Japan and other countries concerning ES cells could probably be explained from the viewpoint of differences in the cultural backgrounds.

In farming communities during the Edo period (1603-1868), poor farmers who could not afford to raise children killed newborn babies, a practice known as mabiki. Mabiki originally referred to the thinning out of rice paddies by pulling out poorly growing seedlings. Of course, mabiki occurred in the distant past. Today, each baby is raised as a priceless individual. However, the idea that life comes into existence when fertilization is complete is not the majority view in Japan. Therefore our definition of fertilized eggs contradicts such that we clearly give eggs a dignity as humans but do not agree that their right to live is equal to ours. In Western countries, abortion and the destruction of the embryo incite trouble, yet their culture allows brain death and organ transplants to be moved through quite fast.

Japanese Organ Transplantation Law was established in 1997. Since then, the organs have been donated by only 37 brain dead patients with family consent. The survey, conducted in Aug 2004, covered over 2000 people and revealed that the Japanese are still hesitant about becoming donors. In Japan, death is a socially determined event, a process, not a moment. We Japanese could not depend on organ transplants.

Creating embryos for research

ES cell research seems to be arousing wide attention and due consideration in connection with cloning technology. There is a practical problem when ES cells from supernumerary embryos of the fertility treatment are used to differentiate into particular cell or tissue types for transplantations and therapeutic effects. Because these cells will not be derived from the patients, they will be rejected by the patient immune system.

Therapeutic cloning uses the same method that created the Dolly the sheep. Somatic cell nuclear transfer (SCNT) removes the nucleus of an unfertilized egg, which contains 23 human chromosomes and replaces it with the nucleus of a somatic cell from the donor to be cloned, which contains 46 human chromosomes and the donor's genetic code. The rest of the cellular material is cytoplasm, which provides nutrients for the eggs' survival. The tissues derived from such ES cells would be autologous to the recipient and not subject to immune rejection.

In Asian countries, South Korea adopted a law in late 2004 to pave the way for research using cloned human embryos. Also in Singapore and Thailand, the law allows the harvesting of stem cells from cloned human embryos. The international community has been divided over the ethics of therapeutic cloning. The United Nations tried to weigh in on the divisive issue by proposing universal research regulations, but was unable to have consensus.

Advocates list the development in regenerative medicine as a major benefit of allowing the cloning of human embryos, while opponents argue that it can be used to clone humans and that using embryos as a research tool is wrong. "Declaration" condemns all forms of human cloning but is not legally binding. The declaration was passed by 84 votes to 34, with 37 abstentions. Many industrialised nations, including the UK, France, Norway, Japan, China and South Korea, voted against the declaration.

In May 2005, a South Korean scientist announced that he had created the first ES cells that genetically match injured or sick patients. The match means ES cells are unlikely to be rejected by the body's immune system. Researchers hope the cells eventually can be used to repair damage from disease. In order to accomplish this experiment, the eggs were retrieved from 18 volunteers, and total of 185 eggs were donated.

Researchers got 31 embryos from which they tried to extract stem cells and managed to produce 11 ES cell lines. When Dr. Hwang claimed to have derived the first human stem cell line from a cloned embryo in February 2004, he used 242 eggs donated from women to create only one ES cell line. However, this research has now been judged fraudulent and thus false. However we can still discuss the ethics involved in egg donation.

In order to minimize the ethical problem of the egg donor, one can manage to produce embryos only when the person to be cloned was also the donor of the egg used. If that remained the case, it would mean that therapeutic cloning would not be of benefit to men, or to women past menopause. In some aspects, we would say egg donation is similar to bone marrow donation. If a family member contracts a severe disease, a daughter or sister or mother may help the treatment by donating eggs through one cycle or two cycles.

If egg donation is the pain of the procedure, bone marrow donation is very painful as well. Yet some people donate bone marrow to complete strangers all the time. In those cases, the benefits may outweigh the risks.

Discussion

Such technology raises a concern over egg donation. There is a concern that disadvantaged women will be targeted to provide eggs, putting their health at risk. Even if future studies decrease the amount of eggs necessary, this is still going to put women on some sort of "production line" as part of the production process.

Moreover, as the technique brings the therapy much closer to reality, it will actually increase the demand for eggs. We have to recognize the need to establish systems to protect women who will provide their eggs for research. Scientists have already succeeded in turning ES cells into egg cells. It was achieved with ES cells from mice, but most experts see no reason why the same should not work in humans. If so, this opens the possibility that human eggs could be made in large numbers in a culture dish, instead of relying on donors.

Nuclear transfer of this sort may be opposed by those who see it as the first steps towards human reproductive cloning. It should be explained and has been understood in public that therapeutic cloning is not the sense of human reproductive cloning. It is certain that ES cell technology will become key aspects of various treatments and regenerative medicine will soon be employed in treating intractable diseases once their safety is guaranteed. As scientific technology advances, we are increasingly forced to make difficult decisions. Although new technology can potentially be a solution to unsolved problems, it can lead to unexpected side effects when applied. Therefore bioethics becomes a more essential component of science.

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The regulation of stem cell technology - international approaches to restriction or permission*

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Cloning and embryo research

UNESCO, along with other organisations such as the WHO, Council of Europe and National Bioethics Advisory Commission (USA), responded to the Dolly cloning announcement in the late 1990s with ethical opinions, public policy directions or regulation (Macklin 2004). The succession of international and national inquiries drew a sharp boundary between the unacceptable cloning of a human being (“reproductive cloning”) and possible “therapeutic” applications (USA President’s Council on Bioethics, 2002).

The former has been condemned universally. Both expressions are in any case imprecise and misleading. A preferable expression for the latter is stem cell technology or somatic cell nuclear transfer (SCNT). The UNESCO Declaration on the Human Genome and Human Rights 1997 stated in Article 11 “[p]ractices which are contrary to human dignity, (Harris, 1997) such as reproductive cloning of human beings shall not be permitted”.

More recently, the United Nations passed a non-binding resolution opposing reproductive cloning after some two years of debate, in which agreement could not be reached on a form of words that would not impact on stem cell work in member nations (Mayor, 2005).

The Australian Health Ethics Committee developed a report on cloning and stem cells (Scientific, Ethical and Regulatory Considerations Relevant to Cloning of Human Beings NHMRC, 1999) that was presented to the Australian Parliament which prepared a report entitled Human Cloning: Scientific, Ethical and Regulatory Aspects of Human Cloning and Stem Cell Research 2001. This report recommended legislation in the area. The Research Involving Human Embryos Act 2003 established a Licensing Committee, as a committee of the National Health and Medical Research Council, to handle these matters.

This paper will examine the regulatory scheme established in Australia to deal with embryo research and the development of stem cell technology.

Stem cell technology

There has been a prolific publication of literature on the science and ethics of stem cell technology (Jaenisch, 2004). Stem cell technology involves the extraction of cells from the developing embryo blastocyst (and now from single cells at the eight cell stage) or other “adult” cells, which have the quality of self-replication.

Stem cell technology relies on the regenerative qualities of these cells. The regenerative characteristics of stem cells are not unique and are manifested in other “adult” cells, such as bone marrow, cord blood, skin, and foetal tissue. Stem cells derived from human embryos have generated considerable moral controversy. The expectations of stem cells and regenerative medicine are considerable, with high hopes for disease prevention and, even life extension (Rosenthal, 2005). There have been fairly audacious claims in Australia describing stem cell research to be “the greatest and most exciting medical breakthrough” and “one of the biggest breakthroughs in human medicine”, promising “very great potential benefits” (House of Representatives Report, 2001).

Stem cell technology may address shortages of organs for transplants in developed countries, stem

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cell technology is seen as a potential source of compatible organs for transplantation; stem cells may produce tissue for to replace damaged nerve, muscle, liver, pancreas and heart cells (Nature (2001) 414: 87-138). This technology is being promoted as a potential treatment for diseases of the ageing such as Parkinson's disease and Alzheimer's disease. There are promises of stem cells as a source of safe blood and blood products.

However, some of the optimism may prove premature or overstated. In spite of the considerable public investment in this research, embryonic stem cell technology is at a preliminary research stage. The reported breakthroughs have been modest. Despite the promise, the therapeutic applications of human stem cell technology in transplantation or any other therapy have been very few.

Interestingly, the international debates about human embryo research have revived philosophic discussion on arguments based on human dignity. Arguments based on human dignity allow discussion on areas outside simple claims to human rights. For example, the embryo may not have human rights but still deserve to be treated with dignity.

Similarly, some have argued that reproductive cloning is part of the right to procreate. However, reproductive human cloning offends human dignity because the fundamental nature and values of a society are as important and may transcend individual rights. Human dignity also underpins human rights themselves and places proper limits on the idea of autonomy. Professor Brownsword has also suggested human dignity is necessary to avoid the trivialisation of genetics for cosmetic purposes.

Towards legislation in Australia

The passage of the Research Involving Embryos Act 2002 provided the longest ever debate in the history of the Australian Parliament (Australian Parliament, 2002). In summary, the key arguments raised in the debates can be divided into eight broad themes:

- potential therapeutic benefits of stem cell technology;
- use of surplus IVF embryos for research was a better use to destruction;
- moral status of the embryo prevented its use as a means to an end;
- adult stem cell research was equally promising and offered a preferable alternative;
- private interest commercialisation of the research and potential exploitation of couples in IVF programmes;
- the slippery slope to more contentious embryo research;
- economic benefits and scientific implications for Australia; and
- imperative for national legislation

The Research Involving Human Embryos Act creates a national licensing scheme for embryo research in the private and public sector. The Act allows the use of "excess ART (IVF) embryos" to carry out licensed research that may lead to the destruction of the embryo. Criminal offences apply when excess ART embryos are used without a valid licence.

The national regulatory scheme (Chalmers and Nicol, 2003) has two steps before a licence can be issued. First, the research institution must consider ethics of the embryo research application then the Licensing Committee considers the application.

Step 1: Approval by the Applicant's Intitution.

At the first step, an applicant for a research licence must present the research proposal to the institution and to their Human Research Ethics Committee (HREC). Under the Act, the HREC must be satisfied that they approve the research activity and the project. In particular the HREC must approve that:

- The embryos are excess to the needs of the couple in the ART programme. The Act provides that the couple in an ART programme must declare their embryos to be surplus to their needs, and

consent to the embryos being classified as excess under the terms of the Act. These embryos may be then used for research, in strictly limited circumstances. An embryo can only be “excess” if each responsible person (S 8) has authorised in writing the use of the embryo for a purpose other than the ART treatment of the woman concerned (S9 (2)(a)), or has determined in writing that the embryo is excess to their needs (s9 (2)(b)).

- All the consents have been obtained. In particular, s24 (1) provides that, before an excess ART embryo is used as authorised by the licence each responsible person (i.e. all those involved in providing the egg or sperm for the creation of the embryo and any spouses) must declare the embryos to be excess and that the embryo may be used for an approved research purpose. In effect, the legislation prescribes two separate consents - a consent that the embryos are no longer required for their ART treatment and also consent to the research. Consent forms in ART clinics had to be redrafted to reflect these two stages.

Step 2 Embryo Research Licensing Committee

If the HREC approves, the application can be referred to the Licensing Committee for consideration. The Licensing Committee (see <http://www7.health.gov.au/nhmrc/embryo/index.htm>) is set up within the National Health and Medical Research Council (s12), and grants licences to conduct research on excess human embryos in the private and public sector (s20).

The Licensing Committee must first be satisfied (s21(3)) that all the required consents have been obtained and that the applicant has obtained approval for the project by the properly constituted Human Research Ethics Committee, (s23(3)(c)). Secondly, the Licensing Committee is directed to have regard to the following matters in deciding whether to issue the licence (s21(4)):

- (a) restricting the number of excess ART embryos to that likely to be necessary to achieve the goals of the activity or project proposed in the application;
- (b) the likelihood of significant advance in knowledge or improvement in technologies for treatment as a result of the use of excess ART embryos proposed in the application, which could not be reasonably achieved by other means;
- (c) any relevant guidelines, or relevant parts of guidelines, issued by the the NHMRC under the National Health and Medical Research Council Act 1992 and prescribed by the regulations for the purposes of this paragraph;
- (d) the HREC assessment of the application mentioned in paragraph (3)(c);
- (e) such additional matters (if any) as are prescribed by the regulations.

In practice, the Licensing Committee’s deliberations have concentrated with regard to the first two issues, namely restricting the number of excess ART embryos and the likelihood of significant advancement in knowledge or improvement in technologies. The Licensing Committee has developed additional guidance on how it treats the interpretation of the issue of “likelihood of significant advance”. In addition, the Licensing Committee drafted a guidance note on the consent requirements of the Act. The consent guidance has been drawn up with reference to the Ethical Guidelines on the Use of Assisted Reproductive Technology in Clinical Practice and Research (2004).¹

If the Licensing Committee is satisfied with all matters a licence can be issued. So far, the Committee has issued nine licences. Licences so far issued have included standard and special conditions (S 24), particularly about the numbers of embryos allowed to be used.

The Act establishes an inspectorate and a system of monitoring not only of licensed research but also any possible breaches of the cloning legislation. The Act creates a series of criminal offences for failure to follow the conditions in the licence. The inspections and monitoring consist of document inspections as well as site audits with checks on all licensed activity.

¹ See <http://www7.health.gov.au/nhmrc/embryo/index.htm>

International approaches

This framework system of regulation of embryo research based on the use of surplus embryos from IVF (sometimes referred to Assisted Reproductive Technology - ART) is by far the most common model with a number of countries having introduced legislation. Amongst this group are the UK, Finland, Greece, Israel, The Netherlands, Sweden, South Korea, the American States of California and New Jersey and Australia (Isasi, 2004). Other countries have also followed the surplus embryos approach but have preferred to use guidelines with approval by a national committee, such as Singapore, China, Spain and Japan. Guidelines can be more flexible in a fast-moving research environment.

The legislation and guidelines introduced to permit embryo research have usually placed many other restrictions on embryo research. For example:

- Only surplus IVF embryos allowed to be used except in the UK;
- The consent of the parties creating the embryos is required at two stages - a consent that the embryos are no longer required for their IVF treatment and also consent to the research;
- The purposes of the research must be explained and mostly the research purposes are limited and require careful justification;
- Research purposes must be approved by an Ethics Review Committee;
- The research is generally required to be reported and the research results published;
- Finally, some countries have set up national committees to licence the research with power to impose further conditions in the licence.

Overall, the legislation and guidelines allowing research on excess ART embryos have a clear “restrictive tilt” and not a permissive one. Such restrictions are usual in relation to the purpose of the research. No country has allowed, as yet, undefined research on embryos.

In Australia the researcher has to show there is a “likelihood of significant advancement of knowledge or improvement in technologies for treatment”. Similarly in Japan, the researcher may only use ES cells for basic research and cannot use them reproductively.

The USA is in the company of countries that have maintained a ban on research, such as Austria, Ireland, Canada, Philippines and Germany (Heinemann and Honnefelder, 2002). The US federal funding ban only applies to research involving applications for federal funding support. Some American states, principally California and New Jersey, have allocated state funds to this kind of research. Interestingly, Germany bans embryo research but still allows stem cells to be imported.

Conclusion

Regulation may be in place in some countries but the science is in its infancy. For example, there is no accepted scientific standard for certifying that a stem cell is “established”, that is having the capacity to continue replication. At the time of writing, researchers are trying to set standards for stem cell line by reference to the number of times the lines should be able to be frozen, thawed and still demonstrate their capacity to replicate and also allow a number of genetic tests to be conducted.

Secondly, standards for Good Manufacturing Practice are a necessary precondition to the use of embryonic stem cells in a clinical setting as part of “established” clinical practice (BioNews, 2005).

Thirdly, stem cell lines may be unstable and exhibit genetic mutations and the possibility of tumour development. Overall the reports in the press tend to substantially exaggerate the state of the science; the researchers cannot be blamed for this over-optimistic reporting. At this stage, the science should be as much of a driver of the debates as the ethics and regulation.

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Ethical issues in 'ethical guidelines for research on human embryonic stem cells' in China*

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The situation of embryonic stem cell research in China

Human embryonic stem cell (ES) research is developing quickly in China. From the first International Symposium on Stem Cell Research held in Beijing, at the end of May, 2002, we discovered that there are many institutes engaged in ES cell research in China and more than twenty leading individuals are devoting themselves to stem cell research in their institutes in ten major cities.

During The second International Symposium on Stem Cell Research held in Beijing, between December 16-19, 2003 – an event organized by the Chinese Academy of Medical Sciences and Peking Union Medical College, with the involvement of the Stem Cell Research Centre, Beijing University; National Centre of Stem Cell Research and Engineering; The National High Technology Research and Development Programme of China; and the Beijing Tianxiangyuan Bio-Tech Investment Corporation, we discovered that significantly more personnel and institutes are engaged in stem cell research than initially thought.

The Chinese presenters attending the first and second International Symposium on Stem Cell Research came from: Shanghai Jiao Tong University of Medicine; The Chinese University of Hong Kong; Chinese Academy of Medical Sciences and Peking Union Medical College; Chang Gung Memorial Hospital and Industrial Technology Research Institute, Taiwan; Academy of Military Medical Sciences; Guiyang Medical College; Sun Yat-sen University, Guangzhou; Jiangsu Province Hospital, Nanjing; Fourth Military Medical University, Xian; Peking University; Nanjing First Hospital; Capital University of Medical Sciences, Beijing; Shandong University, Jinan; Dalian University of Technology; Zhujiang Hospital, Guangzhou; Fudan University, Shanghai; Chinese Academy of Sciences, Beijing; Pediatric Department of the Naval General Hospital, Beijing; Second Military Medical University, Shanghai; First Military Medical University, Guangzhou; Run Run Shaw Hospital, Hangzhou; Central South University, Changsha; Xi'an Jiaotong University, Xi'an; Third Military Medical University, Chongqing; Northwest Sci-tech University of Agriculture and Forestry and Shanghai Second Medical University.

Most of the topics presented by the Chinese scientists involved in research on stem cells in the first and the second international symposiums were on adult stem cells, for example, adult bone marrow, and also the use of animals in research, most notably, mice, goats and pigs. Some research involved the use of human stem cells, such as a study of human/goat stem cell chimera. Other research involving the use of human stem cells including the finding that flk-1+ stem cells from a variety of human foetal tissues reveal multiple differentiation potential. Scientists have also worked on enrichment and characterization of human foetal epidermal stem cells; the isolation and in vitro cultivation of the human embryonic germ cells; transplantation of human embryonic cortical neural stem cells into rats (with the spinal cord being transected); a human/goat hematopoietic xenogeneic model (human hematopoietic stem line-cells purified from umbilical cord blood were transplanted in utero into foetal goats at 45-65 days of gestation); as well as the primary establishment of Chinese embryonic stem cell lines. The research included theory and the technology of stem cell research and its application. Scientists collectively expressed the opinion that the development of embryonic stem cell research in China is at the same level as in other developed countries.

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Background to “ethical guidelines for research on human embryonic stem cells”

We Chinese hope such technology can be developed healthily and ethically by government regulation. Since the first case reports appeared in the media, an ethical discussion on human stem cell research has occupied a major position in the public domain in China, as well as in the media over the past few years.

It also has played a significant role in international discussions. In the aftermath of cloning reports from other countries, some attention was focused on China as well. The public, scientists, bioethicists, and government officials discussed ethical disputes, the cultural background, ethical principles, recommendations, guidelines, regulations, policies, and the different perspectives and the laws on stem cell research in China and the rest of the world.

This prompted the Chinese government to voice an opinion on the issue. A representative of the Chinese government at a UNESCO meeting on human cloning declared in his presentation that the Chinese government opposes human reproductive cloning and supports therapeutic cloning. (Ying, October 2001).

In January 2004, the widely anticipated written regulation of “guidelines for research on human embryonic stem cells” was jointly released by the Ministry of Science and Technology (MST, Beijing) and the Ministry of Health (MOH, Beijing), China. The Beijing draft of the ethical principle and regulatory recommendation on HES cell research was issued by the Centre for Applied Ethics of the Chinese Academy of Social Sciences, the ELSI Committee of Human Genome Project China and the Centre for Bioethics of the Chinese Academy of Medical Sciences/Peking Union Medical College in September 2001.

It includes four ethical principles: The principle of respect; the principle of informed consent; the principle of safety and efficacy; and the principle of non-commercialization - plus eight regulatory recommendations. In November 2001, the first draft was revised by the Ethical Committee of Ministry of Health and was submitted to the Ministry of Health, China (Wang, 2003).

The Shanghai draft of the ethical code on HES cell research was issued by the Ethics Committee of the Chinese National Human Genome South Centre in October 2001. It was revised in August 2002 and submitted to the Bureau for Science and Technology, Shanghai Municipal Government and the Ministry Of Health/Ministry of Science and Technology of China. Most points are similar to the Beijing draft (Qiu, 2001).

“Guidelines for research on human embryonic stem cells” codified the interpretation and reconfirmed some earlier ethical and political statement. It is less binding as an announcement than many earlier regulations or proposals, and thus fills a gap, since the revision of the regulation on reproductive medicine since 2002 does not deal with research on “therapeutic cloning”.

Ethical Guidelines for Research on Human Embryonic Stem Cells

This guideline is a regulation that allows therapeutic cloning and prohibits any research on human reproductive cloning. According to the regulation, the stem cells used for research can be obtained either from spare embryos from in vitro fertilization (IVF) or from naturally aborted embryos, with the informed consent of the donor. The regulation specifically forbids the trade of human gametes, germ cells and embryos. The regulation also prohibits the implantation of human embryos into reproductive systems of human beings or animals.

Here is an English translation of the major articles of “ethical guidelines for research on human embryonic stem cells”:

Article 1: Research must comply with international bioethical guidelines and Chinese bioethical guidelines or regulations, and also promote the healthy development of human embryonic stem cell research.

Article 2: In the guideline, the concept of the human embryonic stem cells includes: the stem cell derived from human embryos; the stem cell derived from human germ cells; the stem cell derived from human blastula or monosexual split blastula by the somatic cell nucleus transfer technique.

Article 3: Any research on the human embryonic stem cells inside the boundary of China should be done in accordance with this guideline.

Article 4: Any research on human reproductive cloning shall be prohibited.

Article 5: The human embryonic stem cell used for research can be derived from: (1) spared gamete or blastula remaining after IVF; (2) foetal cells after natural or voluntarily selective abortion; (3) blastula or mono-sexual split blastula by somatic cell nucleus transfer technique; and (4) germ cells voluntarily donated.

Article 6: The conduct of human embryonic stem cell research must comply with the following norms: (1) any blastula obtained by IVF, somatic cell nucleus transfer technique, mono-sexual reproduction technique or genetic modification cannot be cultured in ex vivo for longer than 14 days, since fertilization or nucleus transfer; (2) the implantation of any human blastula obtained by IVF, somatic cell nucleus transfer technique to the human and other animal's reproductive system are prohibited; (3) the hybrid between human germ cells and other species germ cells is prohibited.

Article 7: Buying and selling human gamete, fertilized egg, embryo and foetal tissue are prohibited.

Article 8: The principle of informed consent and informed choice, the signing of informed consent and informed form and the protection of the subject's privacy must be adhered to in the conduct of human embryonic stem cell research.

Article 9: An ethics committee should be established in any institute which engages in human embryonic stem cell research. Members of ethics committees must come from the fields of biology, medicine, law, and social science. The main role of the ethics committee is to do scientific and ethical reviewing, counselling and surveillance on human embryonic stem cell research.

Article 10: Any institute which engages in human embryonic stem cell research should formulate their own conduct guidelines and administration procedures in detail following this ethical guideline (Chinese Health, Jan 14, 2004).

Disputes over ethical guidelines or regulations regarding HES cell research

Article one and Article three in the guidelines state: In order to comply the research of human embryonic stem cell in the field of biomedicine in China with the international bioethical guidelines and Chinese bioethical guidelines or regulations, and to promote the healthy development of human embryonic stem cell research, this guideline was issued. Article three states: Any research on the human embryonic stem cells inside the boundary of China should be done in accord with this guideline. But a dispute did arise about whether or not to issue an ethical guideline for HES cell research in China.

In China the concern for ethical guidelines and the regulation on HES cell research came after a hybrid embryo case in ES cell research which was reported widely in the Chinese media in September 2001. At the same time there was a concern about whether HES cell research should be subjected to ethical standards. From the proceedings of the Xiangshan conference on life science policy and ethics and other meetings that address these issues, we know that some Chinese bioethicists and government officials made great effort in description and prescription of the ethical issues, drafted the regulatory recommendations and ethical guidelines, but some bioethicists, government officials and scientists and the public voiced strong arguments against it.

An argument put forward was to respect the freedom of scientific research in any condition. Some Chinese scientists in the field of life science argued that the freedom of scientific research should not be violated. They said the freedom of the sciences, in a certain sense, could be proved by the history of science. A scholar made his argument stronger by using the theory of Marxism that the moral declaration should be based on the developing level of science and technology - that the moral values should be changed following the development of science and technology. He pointed out that the moral doctrines are results of historical processes and subject to scrutiny or revision.

Some scientists involved in the 181st high policy meeting were outspoken supporters of freedom of research on human embryos. They supported a strategy to adopt less restrictive guidelines such as in use in the British, Australian, or Israeli regulations for embryo research. They mainly emphasized the pragmatic urge to obey the dictate of the global markets as well as to aggressively probe the economic and medical promises of stem cell therapy and Chinese cultural integrity and national identity.

Many life scientists, mainly researchers, supported this view, arguing for freedom of research. For the majority of leading researchers in the field of stem cell research, both for the research reason and for its value, the general opinion seems to be quite optimistic in supporting any kind of research on embryos. Some Chinese scientists claimed that at the beginning of the scientific research when the benefit and risks were not very clear, the scientific research should be without any extreme forbidden areas. But a few leading Chinese scientists who have studied in foreign countries in the field of stem cell research agreed that the stem cell scientific research should be conducted in conformity with ethical requirements, and help the bioethicists to understand ethical issues they have met in the practice.

The counter argument stated that there are dilemmas between scientific freedom and ethical constraints. Science or technology is a double-edged sword, which could benefit humanity and at the same time could do harm to humanity. There is no absolute scientific freedom, any scientific research should be given an appropriate benefit/risk assessment to any involved elements.

Moral values do change following the development of science and technology, but the principles of respect, do-no-harm and beneficence will not change. Stem cell scientific research has to be conducted that conforms to international ethical guidelines and requirements.

Ethical issues on the source of human embryonic stem cells

Article 5 in "ethical guidelines for research on human embryonic stem cells states: The human embryonic stem cell used for research can be derived from: (1) spared gamete or blastula remaining after In Vitro Fertilization (IVF); (2) foetal cells after natural or voluntarily selective abortion; (3) blastula or monosexual split blastula by somatic cell nucleus transfer technique; and (4) germ cells voluntarily donated.

Ethical issues on the source of human embryonic stem cells in China focus on how to protect the donors, and how to execute the principle of informed consent in Chinese clinics. We have no exact statistical figures about abortion rates, but it a fact that there have been many abortion cases in China and the physicians could get the cadaver foetal tissue without the mother's informed consent in certain cases. Also, physicians could use frozen embryos or gametes remaining after IVF without the mother's informed consent. Such a situation should be outlawed.

There are a few government administrative documents relating to ES cell, cloning or human embryo research in general. They are: "Procedures on safety of gene engineering" issued by the Ministry of Science and Technology, China, 1993; "Procedures of the Administration on IVF Technology" issued by Ministry of Health, China, 2001; and "Procedures of the Administration on Sperm Bank" issued by Ministry of Health, China, 2001.

In order to protect the donors of the source of human embryonic stem cells, surveys should be carried out on units engaged in HES cell research and also on the current practice of IVF in China. We have to know where these researchers and others get their biomaterial from. Where they taken from IVF clinics, from early abortions, or donated by women with informed consent? Did the donors receive any compensation? Who was in charge of obtaining the material (researchers themselves, IVF clinicians, other parties?) Deliberately causing pregnancy for deriving stem cells, controlling of abortion of donors

or methods, and timing of artificial abortion by any means etc, should be prohibited. The voluntary donation of reproductive cells should be done without economic compensation.

Ethical issues about the researched embryos

Article 6 in “ethical guidelines for research on human embryonic stem cells” states: The conduct of human embryonic stem cell research must comply with the following norms: (1) any blastula obtained by IVF somatic cell nucleus transfer technique, mono-sexual reproduction technique or genetic modification cannot be cultured in ex vivo longer than 14 days, since fertilization or nucleus transfer; (2) the implantation of any human blastula obtained by IVF, somatic cell nucleus transfer technique to the human and other animal’s reproductive system are prohibited; (3) the hybrid between human germ cells and other species germ cells is also prohibited.

During the issue of this guideline, we know the Chinese government was aware of the benefit and value of ES cell research. Human embryonic stem cell research has great potential value in effectively treating various human diseases, maintaining and promoting human health and

it is good for millions of patients, families and society. Therapeutic cloning is a potentially important area of research, particularly with regard to circumventing the problem of rejection of cell or tissue grafts.

Some leading stem cell researchers also expressed a concern that if embryo stem cell research is limited by the government, the development of Chinese stem cell research will be held back. To back up this assertion, the researchers cited the double standard used in both Germany and the USA. The double standard is such that in the USA federal institutes observe one standard, but private institutes do not. German law prohibits embryo research and embryo cloning within the state, but permits the import of stem cells which are derived from human embryos outside the country.

The support given to research on embryos from the somatic cell nucleus transfer technique, and support for human embryonic stem cell research under the condition that the embryo must be researched within 14 days is similar to UK standards which allow researchers to create embryos from IVF and cloning for ES cell research. Also the Human Genome Organisation (HUGO) supported therapeutic cloning, but it is encountering objections from people in different countries.

Many Westerners think that such research is a very controversial issue. They believe that life is sacred and it is God's creation and that creation begins at conception. They believe that no scientist or person can define the official day when life begins on the basis of physical progression. To separate a spirit from a physical body (in other words, to say that something is not “alive” yet) is something best left to God's hands, in their view.

The Catholic Church and Right to Life organizations in Australia oppose the creation of embryos for research. They said it is the same as dismembering embryos, embryo farming, cannibalising embryos, etc. Marcia Riordan of the Catholic Archdioceses of Melbourne said: “There is no need to kill some people to cure others.”¹ In May 2002, at the Council of Australian Governments’ Conference, the prime minister and state premiers decided to legislate that Australia adopted the most conservative of the defensible positions to only allow derivation of new ES cell from spare embryos but not from IVF or cloning, because there is no creation of embryos by IVF for research.

There were some objections from scientists and scholars in China. They argued that HES cell research should be forbidden because if human beings go against natural law, human beings will be punished by nature. HES cell research violates human dignity and this is a big challenge to human life, they argued.

But the majority of bioethicists from China argued that an embryo is not a person. They said an embryo has a certain value and it still deserves due respect, but if there are enough valid reasons, it can be used for research.

The majority of bioethicists from China argued that a human embryo cannot be manipulated or

1 Herald Sun December 4, 2001, p.17

damaged without sufficient reason and it is wrong to deliberately create and destroy embryos for research. Destructive embryo research should only be approved in exceptional circumstances, they said. They also put forward the view that stem cell research has the potential to revolutionise medicine and save millions of lives and they said scientists are responsible for people who die while research is delayed.

Some bioethicists claimed that a 14 day old embryo can be used for research. They argued that a 14 day old embryo is a cluster of cells without bones and organs and that an embryo only has consciousness after around 20 weeks.

Some scientists supported using embryos to do research within 14 days, and they even said that to object to embryo research is inconsistent with values implicit in society, because there are so many abortions in mainland China.

Also, opposition to the use of spare embryos from IVF is the same as opposition to IVF, because frozen embryos could be destroyed. Infertile couples are permitted to destroy unwanted embryos rather than donate them to other couples.

Regarding the public view in China, ethical issues about embryo research was not an issue about supporting or objecting to researched embryos within 14 days or not, nor an issue about the status of embryo, foetus or infant. What made them supportive was the view that the research is valuable and worthy to protect patients. They thought a sufficient reason was that human embryonic stem cell research has potential value in treating various human diseases and relieving millions from suffering.

Ethical issues about the hybrid research between human cells and other species cells

Article 6 in “ethical guidelines for research on human embryonic stem cells” states: The hybrid between human germ cells and other species germ cells is prohibited. But this Article does not say the hybrid research between human somatic cells and other species cells is prohibited.

One famous case of the hybrid embryos research occurred in China in 2001. On September 7, 2001, a report was published in the Beijing Youth Daily: Professor Chen Xigu in the Experimental Animal Centre of Sun Yat-sen University, transferred a skin cell nucleus from a seven-year-old-boy into a rabbit’s denucleated egg, and created an embryo. He had been able to grow the hybrid embryos only to the stage at which they remain a cluster of undifferentiated cells; he was far from his goal of extracting stem cells from the embryos and turning them into treatments. For some reasons, he stopped his research soon after the report was printed in the newspaper.

This was the most controversial case at that time. After Professor Chen’s case, stem cell research occupied a prominent position in the Chinese media. Two days after the case was reported, four scientists from The Chinese National Human Genome South Centre published their views in the newspaper. They pointed out that Professor Chen’s case violated human dignity and this was a big challenge to human life. A director of the Chinese Academy of Medical Sciences told the media that such a mixed embryo would harm the safety of human beings and violate social ethics.

A senior scientist said that when we are not able to respond to biomedical selection, we are not able to respond to the social and moral difficulties connected with bioengineering in any responsible way. If we do something we do not really understand, this is dangerous to human beings in the future.

Regarding the hybrid or chimera issue, there is a difference between the Beijing draft of ethical principle and regulatory recommendation on HES cell research, and the Shanghai draft of ethical code on HES cell research. The Beijing draft said that on the basis of human dignity arguments, creating a hybrid or chimera by the use of the fusion of human and animal embryo, or the hybrid between human and animal gamete should be strictly rejected and can only be done if there are sufficient reasons, permissible by government guidelines.

However, the Shanghai draft allows creating a hybrid within 14 days for non-clinical treatment research.

The Shanghai draft said the chimera between human nucleus and animal mitochondria is permissible if it is an embryo produced within 14 days for basic scientific research, if it is for the patient's benefit and it is not an embryo produced by reproduction cloning. However, production derived from hybrid or chimera research and used in clinical treatment is prohibited (Qiu, 2001).

We found existence of hybrid embryo research in China. Some scientists attributed this to insufficient human eggs to meet the needs of the proposed research. Now, if the hybrid research and egg donation are allowed by the "guideline for future stem cell research", the ethical issue of hybrid turns to how to guarantee the protection of women rights who donate the germ cells voluntarily. Unlike sperm donation, donating eggs is an invasive medical procedure with physical, psychological and social risks for women.

From some Western perspectives, the profit made from women's eggs by third parties makes this invasive medical procedure unacceptable. When we know that donated egg cells are already short in supply for research, we worry that incentive issues will be created in order to gain enough egg cells for therapeutic cloning, even for a hybrid or a human embryo. So when this guideline is executed, how to protect the women's body and rights in society must be taken into account.

Issues on IRB (Institutional Review Boards) or Ethics Committees

Article 9 in "ethical guidelines for research on human embryonic stem cells" states: An ethics committee should be established in any institute which engages in human embryonic stem cell research. The members of the ethics committee must come from the fields of biology, medicine, law or social science, etc. The duties of an ethical committee are to carry out scientific and ethical reviews, counselling and surveillance on human embryonic stem cell research. Article 10 in the guidelines states: Any institute, which engages in human embryonic stem cell research should make the own conduct guidances and administration procedures following this ethical guidances.

In reference to Article 9 and 10, we agree that "the ethics committee should be established in any institute, which engages in human embryonic stem cell research" and "any institute which engages in human embryonic stem cell research should make the own conduct guidances and administration proceduers in detail following this ethical guidances", but considering the situation of Chinese ethics committees, if stem cell research is only a review by their own IRB, we bioethicists question how to guarantee stem cell research? We think there is not only an urgent need to create such ethic committees, or the IRB, but also a need to establish a central institutional review board.

The central IRB or ethics committee should authorize and give approval to institutes which engage in human embryonic stem cell research and review the conduct guidelines and administration procedures made by the institutes which engages in human embryonic stem cell research. The institutes, which engage in human embryonic stem cell research should submit an application to a central institutional ethics committee or the Ethical Committee of the Ministry of Health China for approval.

Few units engaged in HES cell research have an IRB, so the situation of Chinese ethics committees is a mixed bag. The Beijing and Shanghai ELSI committee of the Human Genome Project has been working well and has produced recommendations on some issues. The Ministry of Health has an ethics committee, which has worked on administrative ethical guidelines on IVF, sperm banks, stem cell and the use of genetic material.

But other ethics committees may be in a different situation. There are ethics committees in large medical universities and big hospitals. Many of these committees only review operated proposals and do not have much deep discussion of medical ethics issues. They have little involvement in medical encounters. Many members also have insufficient training in ethics to analyze the issues.

An issue has arisen over Article 9: "The members of the ethics committee must come from the field of biology, medicine, law or social science, etc." Why are bioethicists absent in the stated members of the ethics committee? And there are no articles in the guideline about certain requisites on the qualification requirements of research personnel, technological equipment, administration in HES cell research institutes, etc. Also, there are no penalties imposed on researchers or institutes that disobey ethical

guidelines on stem cell research. We bioethicists have posed such questions to the Ministry of Science and Technology and the Ministry of Health, China. We are hopeful that the guideline will be revised soon.

We hope that the ethical guideline issued by Chinese ministries can be operational and meaningful for controlling stem cell research in China. Because the ethical guideline is not a law, ethical guidelines have no legal force, but as a regulation, it seems to have power to force scientists to follow the guidelines. But if there is no punishment and there are no bioethicists within the ethics committee the guidelines and requirements can only create a moral pressure on the scientists involved in research.

In view of the rapid development of stem cell research in China, it is noteworthy that only a few bioethicists were invited to the 2002 and 2003 international symposiums on stem cell research. Among the nearly 400 leading scientists who attended both symposiums, very few scientists paid attention to ethical principles. So we bioethicists must call for all researchers to follow the ethical guidelines.

We hope the Ministry of Science and Technology, and the Ministry of Health, China will work out quickly about how to revise the guideline, how to plan the creation of a central and unit IRB and how to train IRB members ethically. The most important thing is how the “ethical guidelines for research on human embryonic stem cells” is implemented in detail.

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What are the points in the human cloning debate? A view from the Buddhist religion*

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One of the most basic beliefs of Buddhism is that proper questioning leads to proper answers. From this principle, the ethics of Buddhism can be viewed as the ethics of questioning. So, to get answers to ethical questions we must post the question: What is a proper approach to the given subject? In this paper, the debate over human cloning will be explored through the principle of Buddhism as follows:

1. 'Naturality' or 'unnaturality' is not the problem

The debate over human cloning (or any kind of cloning) normally involves a discussion about its unnaturality. Some of the arguments against human cloning state that it is "unnatural" in a sense that it is not provided by nature. Some people who believe in God might think that anything unnatural is dangerous. They might believe that human cloning is immoral, as it is not provided by God, and that humans who clone humans are "playing God". This is considered dangerous because man has limited knowledge compared to the omniscience of God. So, it is seen that human cloning is done on the basis of ignorance and could thus greatly harm the future of humanity.

Some scientists who support human cloning state that it should not be viewed as unnatural because there is a form of cloning permitted by nature — identical twins. According to these scientists, human cloning performed by scientists can be viewed as the making of identical twins. The difference is merely that natural identical twins are those who carry the same ages, while artificial identical twins are of different ages. From this view, human cloning is not an immoral action because it is natural, in the sense that it follows the law of nature as found in the case of natural identical twins.

For Buddhism, morality can be separated from the issue of "natural" versus "unnatural". Buddhism breaks it down such that if any action is attributed to be morally good or bad, that attribution depends solely on the moral properties within. Actually, nothing is unnatural according to Buddhism. Buddhism believes that nothing is beyond the Five Laws of Nature.

Humans, according to Buddhism, are a natural thing. When a person creates something, it is counted by Buddhism as natural. So, natural things could be categorized as: (1) Things not created by humans, and (2) things created by humans. Between these two categories, there is no difference in terms of ethics. That is, some natural things are good, and some are bad; likewise, some of what was created by humans is good, and some is bad. "Good" and "bad" does not correlate to "natural" and "unnatural".

Moreover, Buddhism accepts that nature has a long history and that humans, in their present form, have a comparatively short history. However, there is some potentiality in man that cannot be found in nature: Consciousness and intelligence (a.k.a. wisdom).

Through consciousness, man learns to solve problems that would otherwise take a long time or be impossible for nature alone to solve. If a person breaks an arm, surgery is done to heal it — the surgery is performed by humans, but nature actually joins the broken bone. So, it can be said that in the joining of the broken arm, two things are equally needed: humans and nature. Thus, the two work together. According to Buddhism, the view that only "natural" phenomena can be trusted is an extreme stance. Likewise, the view that humans can dominate nature or do anything unconditionally is also extreme.

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2. The harm principle

The harm (a Pali word is: *vihimsa*) principle is one of the major criterion used by Buddhism to assess moral events. This principle states that any action that harms oneself and/or others is counted as morally wrong. Human cloning is a complex issue that should be explored on a case-by-case basis. What follows is a Buddhist view on the matter, via the harm principle. Human cloning involves action from man and nature. The next point to be considered is: under what circumstances can the cloning of a human being be viewed as morally permissible, and under what circumstances can it be viewed morally impermissible. At this point, the Buddhist principle of harm can serve the problem.

“The harm” in Buddhist teaching can be divided into two main categories: to harm oneself and to harm another. Harm to oneself means the action intentionally performed by a person. That action harms the person in two ways - physically, and dignity-wise. Taking intoxicants is prohibited by the fifth precept of Buddhism. It is prohibited on the grounds that ingesting alcohol causes physical harm. Selling body organs, such as a kidney, could be viewed as harm in terms of dignity. The person who does such a thing, no matter what the reason, could be viewed as not respecting their own status as a human being. They treat their life as if it were a product that can be sold. This interpretation makes it possible to state that the sale of human organs is harm in the second meaning, as stated above.

The second kind of harm (harm to another) can also be of the two above types. Normally, in a free society such as a liberal democratic one, some personal harmful actions can be tolerated by the law of the given society. Drinking beer, for example, is a harmful action in the first category; but this kind of action is tolerated by the law in Buddhist countries because it is viewed that the law should focus on only serious harmful actions. Using drugs is prohibited by law in Buddhist countries because the harm caused by drug use is more serious than caused by beer consumption. So it can be said that, according to Buddhist morality, “personal freedom” does not cover personally serious harmful actions in terms of both physical damage and damage in the dimension of human dignity. Harm to another is more obviously viewed as a wrong action, no matter if it is in the realm of physical damage or human dignity damage. However, the intention behind an action plays a significant role in the Buddhist system of moral judgment; any investigation of harm to another cannot be done without considering the doer’s intention.

To apply the harm principle to the issue of human cloning: it seems that the first thing to be questioned is: can human cloning be interpreted in terms of harm? It is clear that the cloning of a human being in many cases is open to question. For example, a man clones himself to use the embryonic stem cell. In such a case, can we say that it is really a personal matter, implying that the harm principle which can be used for this case is the harm to oneself only? According to Buddhism, a clone is a person at the first moment of fertilization, so it is very difficult or impossible to locate human cloning within the area of personal activity. It seems obvious that the harm in the case of human cloning is the harm to others.

However, this does not mean that any case of human cloning is viewed by Buddhism as the harm to another individual. Buddhism merely says that if human cloning possibly causes the harm, the kind of harm in this case is the harm to the other party. Simply speaking, Buddhism does not accept that human cloning can be understood in terms of personal activity.

3. The principle of analysis

Sometimes the Buddha identifies Buddhism as “a religion that teaches analytical morality.” The term “analytical morality” is roughly a translation of the Pali word *vibhajja*. The term, as understood among Buddhist scholars, denotes a system of thought that does not look at the world through “black or white separation.” Actually, Buddhist logic or Buddhist epistemological outlook has criticized the “black or white logic” as found in the work of the great thinkers such as Aristotle. Applying the principle of analysis to the case of human cloning, the advice from Buddhism is: Firstly, to assume that all kinds of human cloning are solely right or wrong is not valid. Buddhism considers any events in the world in terms of complicated things; some may be less complicated while some events are much more complicated. Analysis will reveal the proper way to deal with specific events. The idea of cloning a human being originated from the human mind, and the human mind must always hide some reasons for thinking in such a way. Looking at it from this point of view, it could be that in some cases the human mind’s role in

the bid to clone human beings comes from good intentions, while in some cases everything is directed by bad intentions. So, what we must do is analyze the given case and find the details inside.

As said previously, Buddhist ethics are the same as analytical ethics. After a process of investigation it could be argued that the cloning of a human being is not harmful to anyone and in such a case the cloning of a human being is tolerated by Buddhist ethics. The problem is when we talk about the concept of harm in the Buddhist view, such harm is involved only with the person, or the harm can be extended to a society. This question is important because some arguments against the cloning of human beings state that it could be possible that we cannot find the obvious victim of harm in the cloning of human beings in terms of the individual, but it could be said that society is harmed by allowing such a practice.

Legal moralism, as presented by legal philosophers such as Patric Devlin, is of the view that one of the major structures that support the existence of society is the moral structure. Mr Devlin argues that even though drinking intoxicants can be viewed as a personal freedom, we should take the view that if the majority of members of a society habitually take intoxicants, then that society must be weak. In this case, intoxicants cannot be viewed in terms of freedom only. It can be related to the moral structure of society as well. Human cloning considered in this light of thought could be viewed as a harmful action to the society, even in the case where we think that everyone involved is happy and no individual is harmed at all.

One of the Five Laws of Nature taught in Buddhism, the Law of Dhamma (a Pali word is: Dhammaniyama), partly seems to share the latter view. In Buddhism, moral tendencies found in a society affect the well-being (or not) of people in that society. In short, Buddhism promotes the view that human society is not just a place where people gather and produce only what is mutually beneficial - on the contrary, society has the spirit and the common ideal to meet certain moral standards. We are not just living, but we are living a good life as a noble human being. However, the moral structure that supports the existence of a society in the Buddhist perspective must be identifiable, not merely an abstract imagination. One thing that helps us to reduce the degree of abstract imagination is to relate the moral structure of the society to what individuals do. The cloning of human being in terms of totally free business can be viewed as something that points out the level of morality in the minds of the people. So, in this case we can say that allowing human cloning affects the moral structure of society. As the actions of individuals in a society are related to law in a sense that the law must determine what kind of actions can and can't be done, so the law followed in the society can be partly viewed as an indicator of the moral structure of that society as well.

Social necessity is a norm Buddhist ethics tolerates in certain cases. For example, Buddhism teaches us that killing is evil; but Buddhism never teaches against having an army. Reasonable capital punishment is sometimes interpreted by Buddhist thinkers as a social necessity, implying that it is tolerated to exist or be legal in a Buddhist community.

Suppose we can rationally prove that the cloning of a human being is a social necessity, Buddhist ethics seems to tolerate it as revealed in the cases already discussed. The analysis of the context and surrounding data will help us to classify the various categories of human cloning, of which some categories can meet the properties tolerated by Buddhist ethics.

At this point, we will find that human cloning is an open-end subject in the Buddhist community, meaning that some doors are open to the possibility of allowing human cloning in a Buddhist society. We must determine the reasons as to why this should be allowed?

4. Social and individual dimensions of ethical problems

However, if we accept that a community is shared by different members, of which some are bad and some are good; the understanding of Buddhist ethics in terms of personal dimension only will leave some problems remaining. How to judge the cloning of a human being may not be a problem for the enlightened members of a community, but it may be greatly different for the unenlightened ones. Without the rule or law, it can be possible that sometimes the unenlightened members of a community

will harm others intentionally or unintentionally. The word “other” in this context certainly covers the embryo or the child to be cloned.

Summarily speaking, Buddhism admits that the issue of human cloning, viewed from the two approaches already discussed, needs an understanding of two dimensions of ethics. Basically, Buddhism takes the view that ethical problems given to an enlightened person will be properly solved; so this is why moral education is highly prized by Buddhist ethics more than the attempt to set up the rule of law. Even though the law is accepted by Buddhism as something important, it is also viewed by Buddhism as something that should be critically examined as much as possible before it is put into practice. In Buddhism, to have a law that totally prohibits any kind of human cloning does not mean that all the problems are solved. Likewise, it does not mean that between two societies, one of them allowing the cloning of a human being and one not, the former is bad while the latter is good. The point is the reason and explanation behind allowance or non-allowance. This concept is very important.

5. Principle of freedom

One of the basic features of Buddhism is that freedom is highly valued. The principle of freedom in Buddhism is closely related to its humanistic tendencies, which is generally found in Buddhist texts. There are two meanings of freedom. The first is positive meaning and the second is negative meaning. The positive freedom means freedom to do something. The negative freedom is freedom from the prevention that does not allow us to do something. Ultimately these two meanings are undividedly related to each other. Buddhism does not think that all forms of freedom are right. It is merely some kind of freedom that is valuable. Freedom in the Buddhist perspective can be both the means and the end. An enlightened person in the Buddhist view is the free one. He is free in two senses. Firstly, he is free in a sense that he is not under the influence of anything especially the desires which Buddhism considers to be the blind forces that push sentient beings into the struggle for things.

Secondly, he is free in a sense that his actions are totally pure. This kind of person can never harm anything. We will see that freedom as the highest quality of life is the end. In the Buddhist perspective, the end and the means must share some basic nature. Freedom as the means will support freedom as the end. This is why in Buddhism the religious dogmas are less influential. The Buddha gives the freedom to his disciples even to argue against what he has said. It could be said that the first kind of freedom (methodological freedom) is required to attain the second kind of freedom (ultimate freedom).

In the Buddhist community, personal freedom of the believers is accepted through social tolerance over some kinds of evil. For example, even though the Fifth Precept says that taking intoxicants is wrong, intoxicants still can be sold in the Buddhist community. This does not mean that Buddhist ethics accept that it is freedom of Buddhists to take these things. It just means that to have freedom to freely learn about moral lessons in one’s life is needed to be a free person in the future. Taking intoxicants is always wrong, but it might be worse if a society does not give freedom to members of the society to learn lessons by themselves.

Applying the principle of freedom to the cloning of human beings, two things should be considered. The cloning can be viewed both as an activity and an object. Cloning in terms of activity means that it reflects an attempt by scientists to search for something which aims to advance scientific research. Cloning in terms of the object means that it produces something and puts that thing into society. It seems that the debate over human cloning stresses the second meaning of the term. We look at the product resulting from the process (the clone) and say: Should we tolerate this kind of thing? It may be possible that the most important meaning of the term is the first one. The serious question then arises: Should we tolerate an attempt to search for something valuable in terms of scientific advancement in the name of human cloning?

The history of science has recorded that something we had feared at the beginning was proved by time not to be wrong. The technique of fertilization (IVF) was initially feared because some thought it would produce a monster without a human soul. Nowadays, such a fear becomes dust in the wind. The process of learning something does not necessarily end up with pleasurable results. But if we are not free to learn, how shall we know what is right and what is wrong?

Conclusion

Buddhism believes in human wisdom and considers the history of humankind in terms of the learning process. Wisdom includes knowing to stop at the point which the inner moral whisper advises the individual to stop. However, the inner moral whisper about something never occurs without serious study of that subject. The serious study of any subject can never occur without freedom to study. Today we have many views about human cloning, some of them are negative and some are positive. The problem is: Should some kind of imagination be the dominant idea, under which the real study of the subject must be aborted? There can be different answers to this question. But it seems the view of Buddhism is that a study should not be aborted just on the grounds of negative views beforehand.

Shareholder-focused utilitarianism support for corporate social responsibility*

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Introduction

Corporate social responsibility (CSR) is a frequently heard and used term. Although somewhat ill-defined, it is roughly taken to be “an expression used to describe what some see as a company’s obligation to be sensitive to the needs of all the stakeholders in its business operations” (Wikipedia, 2006). A broader definition is a “company’s commitment to minimizing or eliminating any harmful effects and maximizing its long-run beneficial impact on society” (Mohr, et al., 2001). Thus, CSR can include a wide spectrum of activities: human rights, labour standards, environmental management, consumer protection, anti-corruption, and corporate philanthropy, to name but a few.

One of the issues in CSR is over its ethical justification. Conservative perspectives generally shun actions which are not profitable for the corporation, while liberal ones provide ethical justification for many unprofitable CSR activities. This paper introduces a shareholder-utilitarian perspective to the debate, which addresses the concerns of conservatives, yet may provide justification for liberal CSR prescriptions.

The organization of this paper is as follows. The first part of the paper reviews conservative and liberal stances on CSR. Next, shareholder-focused utilitarianism is introduced and justified for ethical analysis. The final part examines implications of this perspective.

Conservative and Liberal views of CSR

The conservative view takes a more pro-shareholder position in relation to the liberal view. Two conservative views are those of Friedman and Lantos. Milton Friedman’s *Capitalism as Freedom*, frequently cited as the epitome of this view, is summed thus: “There is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits as long as it stays within the rules of the game.” The “rules of the game” are “those embodied in law and those embodied in ethical custom.” More recently, Lantos (2001) argued that purely altruistic CSR, or “interest in doing good for society regardless of its impact on the bottom line”, is unethical. In the conservative view, actions which are taken to benefit society and profit the corporation are ethically permissible, but actions that are taken solely to benefit society without providing profitability are considered unethical. The conservative view is one that is very concerned about the shareholders; actions that lead to greater shareholder returns are encouraged, and those that do not are discouraged.

Several reasons have been cited in support of conservatives – some are summarised here. First, by engaging in unprofitable CSR activity, “The corporate executive would be spending someone else’s money [the shareholder’s] for a general social interest” (Friedman). Second, individual shareholders could spend their portion of corporate dividends in a manner most satisfying for each shareholder, rather than through the corporation, which would have to balance the interests of all company shareholders. Third, the corporation must decide how “to spend the proceeds – all this guided only by general exhortations from on high to restrain inflation, improve the environment, fight poverty and so on” – a difficult decision compounded by the corporation’s lack of expertise in general welfare issues. Fourth, in democratic welfare states, mechanisms already exist for dealing with many CSR issues. Elections provide an inlet for citizen participation and public choice in welfare issues; taxes provide a wealth-redistributive mechanism; and laws and regulations, with democratic input, provide rules to

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constrain corporate behaviour.

The liberal view adopts a more pro-society perspective. Three liberal views are those of Bowen, Preston and Post, and Sacconi. Howard Bowen, in *Social Responsibilities of the Businessman*, triggered a push for greater CSR. The rationale was simple: businesses were influential; with influence came responsibility. "It refers to the obligations of businessmen to pursue those policies, to make those decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society" (Bowen, 1953).

A further push for CSR is given by Preston and Post, in *The Principle of Public Responsibility* (1979), who employ a "public policy" rationale: "Public policy includes not only the letter but also the spirit of the law, as well as the societal values and commitments reflected in that spirit" (Preston and Post, 1979). The values that Bowen, Preston and Post refer to may be beneficence, justice, altruism and others that may or may not be derived from social norms. The third liberal perspective emerges as a version of stakeholder theory. Sacconi (2006) uses game-theoretics to derive a social contract for the firm:

It is evident that if fiduciary duties attach only to ownership, those stakeholders without residual right of control will not be protected by the fiduciary duties of those who run the firm... Various stakeholders will ex ante have a reduced incentive to invest (if they foresee the risk of abuse), while ex post they will resort to conflicting or disloyal behaviour...in the belief that they are being subjected to abuse of authority. In the economist's jargon, this is a 'second best' state of affairs (less than optimum): all governance solutions based on the allocation of property rights to a single party may approximate social efficiency, but they can never fully achieve it.

While the ethical positions reviewed here are often complicated, it is possible to envision a uni-dimensional ethical spectrum of CSR, with a "purely" conservative position on one end, and a "purely" liberal view on the other. The purely conservative position is deduced from the collection of conservative positions reviewed above: It prescribes pure profit-maximization. Any and all business activities must be profit-maximizing to be ethical. The purely liberal position is deduced from the collection of liberal positions. It prescribes mandatory activities for social benefit, regardless of whether it is profit-maximizing or even profitable.

Shareholder-focused utilitarianism ("SFU")

Utilitarianism is one of the major ethical theories and there are several variations that can be applied. Different versions may prescribe different outcomes. The utilitarian perspective used in this paper ("shareholder-focused utilitarianism" or SFU) assumes four features in addition to the common utility-maximization imperative.

First, SFU's concern is with maximizing shareholder utility, rather than that of society (hence: "shareholder-focused"). While it is more conventional to use societal utility, this is not done for several reasons. First, SFU assumes the most distinguishing criterion of the conservative position, that of strong private property rights. Second, it is designed to make the utility calculus more manageable in the rest of the analysis. Third, SFU avoids the criticism that the corporation spends money for society at the expense of shareholders. Fourth, societal utilitarianism would need to explain the inadequacy of laws and institutions (e.g. securities laws, corporate taxation, tax-funded governments and programmes) which are already designed to handle societal utility given political realities. SFU avoids this difficulty. Basically, the shareholder-orientation of SFU allows us to accept relevant laws/institutions as they are, without revision.

Second, preference utilitarianism is used. Utility is to be preference satisfaction. That is, utility increases when the preferences, rather than happiness or other measures, are advanced. In non-preference utilitarianism, shareholders, if unaware of CSR activities in their companies, do not benefit even if they would have liked the company to have carried out (in other words, prefer) those CSR activities. In contrast, preference would measure CSR activity as a benefit to shareholders, (1) if they prefer it, (2) even if they are unaware of the CSR action. This creates a deeper link between shareholder utility and CSR, because it adds/subtracts to shareholder utility regardless of whether it is reported or whether shareholders are

aware of such actions. Moral philosophers Singer and Hare (Wikipedia 2006) supported this feature of utilitarianism.

Third, rule utilitarianism is observed to collapse into act utilitarianism. More specifically, rule utilitarianism may be a subset of, or equivalent to, act utilitarianism.

Fourth, negative utilitarianism is incorporated. Negative utilitarianism “requires us to promote the least amount of evil or harm, or to prevent the greatest amount of harm for the greatest number” (Wikipedia, 2006). It is not incorporated wholesale, as it still keeps the positive utility aspect, i.e. positive utility is still part of SFU. However, relatively greater weight is given to harm vis-à-vis benefits than in “normal” utilitarianism. The prevalence of risk-aversion indicates relatively greater weight is given to negative utility than positive utility.

Justifying SFU

Reasons exist to justify SFU as a valid ethical perspective. First, the core moral theory is utilitarianism, which is a long-established moral theory. Most of the concepts used in the SFU assumptions, including preference, the relationship between rule and act utilitarianism, and negative utilitarianism, are drawn from prominent moral philosophers.

Second, other ethical perspectives (especially those used in business ethics) can be reduced to, or found to be the equivalent of, SFU. For instance, the business perspective of CSR is framed in terms of profitability (Capaldi, 2005; Prout, 2006), rather than utility. Yet, profitability is an approximation of utility. While it may be a very effective approximation, it is still only an approximation. We can frame the difference between profitability and utility as one between rule and act utilitarianism, respectively. That is, profitability is the rule, and utility the act. By approaching business with SFU, we approach CSR from a more fundamental perspective¹. Another example concerns societal duties, such as those cited by the liberal perspective, which may also be reduced to SFU. If they are formulated as ‘rules’ such as values (i.e. beneficence, justice, altruism), then they may be reducible to rule utilitarianism, thus being formulated in terms of SFU. These values can also be formulated in terms of act utilitarianism as preferences.

SFU is not without criticism, however. First, utilitarianism involves unquantifiable values and utilitarian calculus is difficult. However, the same kind of issues are involved in financial accounting. Numerical values being sought in financial accounting, such as profitability of enhanced corporate reputation, may not be quantifiable or involve large statistical uncertainties. In most – if not nearly all – cases, CSR deals with such difficult-to-quantify variables. Often, only opinions and estimates are available; yet these are what utilitarianism also employ. If such variables are difficult to quantify, the calculations for them also become difficult to accurately quantify; thus, financial accounting – the best alternative to utilitarian calculus – may not offer significant advantages over SFU.

Second, there may be decreased transparency from using utility rather than profit. With the latter, shareholders can see the estimated values for variables such as the ‘benefits from enhanced corporate reputation’; they may disagree with the estimated values and use this as information for further action (e.g. voting or selling/keeping shares), however imprecise or inaccurate such values are. With utility, there may not be transparent accounting. However, annual reports and sustainability reports contain information that can allow each investor to estimate utilities. For instance, the amount and variety of environmental pollutants emitted by a company, described in its sustainability report, may allow each shareholder to decide whether or not to change their voting behaviour or whether to sell or keep their shares. Thus, utility approaches like SFU may not suffer from decreased transparency.

Third, the “stockholders or the customers or the employees could separately spend their own money on the particular action if they wished to do so” if dividends were distributed. This may increase shareholder

¹ This is not to say that business is exclusively concerned with profit; indeed in many instances business does take a utility perspective. However, the predominant concern of business is assumed to be that of profit, while the near-exclusive perspective of utilitarianism is that of utility. Thus, business concerns are more fundamentally approached, relatively speaking, from a utilitarian perspective.

utility to a level higher than in the resolutions above. The subset of shareholders who want a specific CSR action (e.g. environmentalism) could setup their own non-profit association or fund an existing one that already deals with their concerns, without imposing negative utility on unwilling shareholders. However, there are many cases where such dividend distributions are not SUM, as explained in the following paragraphs.

Shareholders may prefer CSR which can only be obtained through their invested company. For instance, they may prefer stringent human and labour rights for their company. Such actions lead to SUM and would be ethically prescribed under SFU.

Tax laws and regulations may provide incentives to favour company-coordinated CSR. Dividends may be heavily taxed; some countries impose such taxes so that corporations re-invest their profits. There may be corporate tax breaks on charitable giving; many countries wish to promote such CSR. If shareholder utility is maximized as a set for a given corporation (i.e. negative preference utilities outweighed by positive preference utilities) for a given CSR action, shareholder utility can be maximized. Shareholder utility is maximized despite dividends not being distributed.

The company could be engaged in CSR activities that lower coordination and information costs. For instance, there may not currently exist a CSR philanthropy programme that shareholders prefer, but for which coordination costs are large for individual shareholders yet smaller for each individual shareholder if coordinated by the company. Such advantages are numerous for companies, which would require time and effort on the part of shareholders to overcome. For instance, they may have numerous connections with charity organizations and expertise that can be “borrowed” from the company for its CSR purposes.

Fourth, there may be concerns that corporations that use SFU may be subject to takeovers. Corporations which engage in altruistic CSR may, despite SUM, have un-maximized share prices. That is, corporations or private entities such as corporate raiders may find profitable opportunity in purchasing such “altruistic” target companies and make them more profitable, increasing their share prices, and possibly selling them off. In very efficient markets, the argument goes, altruistic (or any non profit-maximizing) CSR may cease to exist because such companies will either be taken over, or pressured to maximize profitability to prevent takeovers.

While altruistic companies that do not follow something similar to SFU by appealing to the interests of shareholders may be subject, SFU is not. SFU prioritizes shareholder interests, and any “SFU corporation” engaged in altruistic CSR is actually optimizing shareholder interests through SUM. Thus, any takeover bid will not be approved by shareholders, unless SFU has not been strictly adhered to. Exogenous forces such as laws (i.e. securities and mergers and acquisitions) may alter incentives, but we assume here market-oriented rules. And of course, takeover bids could still occur on the basis of perceived inefficiency elsewhere in the corporation.

This argument can be strengthened. Shifts in corporate ownership distribution occur if corporations were to adhere to SFU. Corporations which engage in more purely altruistic CSR, for instance, will attract more investors interested in CSR. These investors’ individual utilities increase with share purchase. Other investors of the company, whose individual utilities decrease, will sell their shares. The result is a change in corporate ownership distribution. Furthermore, this change leads to greater SUM potential due to more shareholders who are receptive to altruistic CSR. To actualize SUM then, the corporation will undertake slightly further altruistic CSR actions. This repeats until a stable (and more efficient) distribution is achieved.

The result of this process is that corporations which are engaged in altruistic CSR will not only have a set of shareholders who are in favour of its CSR actions, but also a greater proportion of individual shareholders who are in favour of it. Without this shift in ownership, individual shareholders who do not support altruistic CSR may have been negatively affected by the corporation’s CSR actions. With the shift then, corporate takeovers of “altruistic corporations” are even less likely to occur.

Altruistic, strategic, and ethical CSR

With SFU, the ethical implications are different from those of conservatives and liberals; they are likely somewhere between these two perspectives. To explicitly show how SFU finds itself in the ‘middle ground’, we adopt Lantos’ (2001) classification of CSR into altruistic, strategic, and ethical and show how the three perspectives deal with each CSR type.

Altruistic CSR is defined as “interest in doing good for society regardless of its impact on the bottom line” (Lantos, 2001). Conservatives argue that altruistic CSR is unethical. Liberals think it is ethically permissible.

SFU would, in the context of pure (i.e. not ethical nor strategic CSR) altruistic CSR, prescribe a ‘middle ground’. In some cases, SFU will prescribe purely altruistic CSR because it will maximize the utility preferences of shareholders, without significant negative effects (e.g. take money away from) on any individual shareholder. The ethical prescription really depends on whether SUM can be realized. For instance, if a corporation has a significant percentage of shareholders who want to battle poverty, SFU may be maximized if a certain percentage of profits, on occasion, were used for unprofitable, yet poverty-fighting, causes. It will not allow poverty motives to be the sole consideration for altruistic CSR actions, but nevertheless we would find some altruistic CSR. However, if negative utilities are significant due to, say, only minor pro-equality sentiment among shareholders, SFU would not prescribe altruistic CSR since SUM is not realized.

The result is that SFU may find altruistic CSR as unethical as conservatives, but it may also allow for altruistic CSR. Generalizing where it falls between conservatives and liberals on altruistic CSR is more difficult: it depends on the utility calculus for each issue, with the ultimate criterion being SUM.

Ethical CSR is where “a corporation is morally responsible to any individuals or groups where it might inflict actual or potential injury (physical, mental, economic, spiritual and emotional) from a particular course of action” (Lantos, 2001). This includes CSR actions such as human rights, labour standards, consumer safety, employee health, and anti-corruption. Both conservatives and liberals argue that this form of CSR is mandatory, assuming we can agree on a common “ethical custom” or “ethical CSR”.

Thus in this case the “middle ground”, if one conceptually exists, is one that mandates ethical CSR since conservatives and liberals agree. SFU, too, mandates ethical CSR. Rather than accepting ethical action a priori however, SFU uses SUM as the fundamental justification for mandating ethical CSR. Suppose a chemical company can legally and inexpensively dump chemical by-products in a developing world country. There exists a more expensive, yet cleaner, method of disposing of the by-products in the home developed country. Further suppose that the company has no pro-environment or pro-“green” shareholders. If by-products need to be addressed, the SUM course of action is to dispose of waste with the “clean” method as the risk of a public outcry may be large if consumers, civil society, and the rest of society were to find out about this practice. The prescribed outcome is conditional, as it depends on the amount of pressure the company thinks will result if there were public outrage. However, if the ethical custom is breached (as it is in this case), and it is ethical custom, there is likely to be some attention directed at the company. Further, the conscience of these shareholders, however non pro-environment they are, must be factored into the utility calculus: while they are indifferent about the environment, they will care about the harm it causes to other human beings. Thus, SUM will be realized only if the company disposes waste with the clean method.

What if, however, the shareholders have no “conscience” to speak of? The response to this fringe scenario is three-fold. First, this is a very unlikely scenario. Second, the public pressure may still be sufficient to cause SUM to be realized only if the chemical company disposes of its waste with the clean method. Indeed, if the public discovered the lack of conscience in the company, public pressure would be even greater, and this is a calculation that these conscience-less shareholders would need to consider before taking action. Furthermore, since negative utility is given relatively larger weight than positive utility, the risk may not be justifiable. Third, it may be difficult for the corporate agents who actually make the decision and carry it out to do things contrary to ethical custom or ethical CSR.

It is, however, impossible to show 100% that SFU leads to ethical CSR. Either that or re-define ethical CSR

for conservatives: custom/law/cause bad, while liberals: absolute values.

Strategic CSR is specifically defined to occur when profit intention is aligned with societal interests (Lantos, 2001; Carroll, 2001). Conservatives basically argue that CSR, if not ethical CSR, must be strategic since altruistic CSR is unethical. Liberals do not have an ethical issue with strategic CSR; it is also ethically permissible for them. The difference is that the liberal perspective of “ethically permissible” is not coterminous with the conservative prescription that CSR must be strategic (at least in the case of profit-maximization, but it may not be in the case of profitability) if not a part of “ethical CSR”; otherwise, the corporation would be “spending someone else’s money for a general social interest” (Friedman).

SFU differs from both views. The conservative perspective prescribes profitability or profit-maximization under strategic CSR (if not ethical CSR). However, when profitability, and more fundamentally numerical currency, ceases to be the metric, a different prescription can arise. SFU’s utility metric can be independent of profitability, even if in most cases the two will be causally linked. In many cases, one or both of the other CSR types, altruistic and ethical, will be involved. The pro-poverty shareholders example used above shows how unprofitable CSR can be.

CSR that actualizes SUM.

This shows interconnectedness.

While conservative and liberal perspectives can fully compartmentalize CSR into the altruistic, strategic, and ethical, the same cannot be done with SFU. It can be compartmentalized for certain examples, as done above with the environmentalist shareholders and conflict diamond examples, but compartmentalization can break down in many cases. This occurs because SFU does not mandate or prohibit CSR actions on the basis of CSR types. In most realistic examples, elements of all three Lantosian CSR types will exist, and SFU does not simplify the ethical analysis on the basis of types.

CSR departments

Specialized CSR bureaucracies in companies may come in different forms: As public relations departments, occupational health and safety divisions, regulatory affairs departments, and others. Here, using the CSR definition cited in the introduction (a “company’s commitment to minimizing or eliminating any harmful effects and maximizing its long-run beneficial impact on society”), we collectively refer to them as “CSR departments”. A profit-oriented perspective and SFU differ in many respects for issues related to CSR departments; here, we discuss whether to create one, and how to direct it.

The decision of whether to create an internal CSR department is viewed differently by the profit and utility (i.e. SFU) perspectives, and they prescribe differing results. The former perspective uses net present value, or simply “profit” to determine whether or not a department should be created. If the firm’s profit can be increased through such specialization, there will be a “business case”. SFU may prescribe a different outcome. For instance, the profitability of a firm may increase 0.5% if a CSR department works on corporate philanthropy programmes designed to increase corporate reputation, and hence, sales and profits. There is a business case if this is the most profitable, and at least profitable, investment. Yet, as has been seen elsewhere, if SUM is not realized, the CSR department will not be prescribed under SFU. This may occur because, for instance, certain shareholders disagree with creating such specialized departments.

A different scenario with different results can also emerge. For instance, if the company determines that CSR departments are not profitable (e.g. if the CSR department would consume resources more than the 0.5% profit it would generate), there would be no business case. However, if the shareholders as a group prefer to have one, perhaps because they believe in well-considered altruistic responses, this result may actualize SUM. In such cases, SFU prescribes creating CSR departments, regardless of profitability.

CSR Department Exists

Despite the complex utility calculus for a CSR department, if a decision has been made to carry through with one, the range of ethical responses can vary. Most interestingly, it is possible that shareholder

preferences can indicate no preference for any particular approach to CSR. In other words, there can be the equivalent of an ethical “wild west” or anarchy. We apply utilitarianism to situations: (a) Where there are shareholder preferences; (b) when there is only shareholder preference for complete CSR department independence, and; (c) to illustrate some ethical difficulties encountered when (b) occurs.

First, where there are shareholder preferences expressed to CSR departments, utilitarianism would obviously prescribe actions in accordance with them. The most likely sources of these preferences are signals such as directives directly or indirectly (the latter through elected corporate directors) and norms (e.g. for profit-maximization or commitment to some level of corporate citizenship or philanthropy) that shareholders acquiesce to.

While impossible to precisely and accurately gauge the preference utilities of shareholders, if such sources exist, they represent utilitarian sources for prescription(s). For instance, suppose there is an accepted norm in the corporate culture of a firm “A” which expects corporate philanthropy to yield some, but not the highest NPV benefits to the shareholders. This is the utility-maximizing preference for shareholders as a set because the latter want to have CSR, but not sacrifice too much of their other utility preference, profit. In essence, this is the maximal preference utility for the CSR funds devoted to the CSR department (in economic jargon, this is the point at which the diminishing marginal rates of return are equal on these two goods). It follows this is what our utilitarian perspective would prescribe to the department.

Second, and most interestingly, there can be a case where shareholders as a set adopt a “hands-off” approach to CSR. They leave CSR matters completely to specialised and independent CSR departments. For instance, signals such as directives or norms may not exist, there may be directive to be independent. Shareholders may want to do this to, say, to leave such issues to “CSR professionals” who may be acquainted with optimal decisions for both companies and society. This is perhaps where the business and utilitarian perspectives most differ: the latter can prescribe a “hands-off” neutral approach to CSR actions in a CSR department, but the former may not. Suppose a hypothetical where the preference utilities of shareholders are for complete CSR department independence. A business perspective can prescribe profit-maximization. However, a utility-maximization perspective could not prescribe any action, because the utility is already maximized if the CSR department is acting independently. Thus, the utilitarian perspective may give rise to an ethical “wild west” or anarchy.

Third, we illustrate some ethical difficulties encountered with this ethical “wild west” situation. There are a series of seemingly appropriate ethical frameworks that can be applied in this case. For instance, Sacconi’s game-theoretical model, which is akin to a social contract theory applied to the firm, may be found applicable since it may be viewed as ultimately utilitarian. However, there are two issues here. We cited earlier that any perspective that attempts to include stakeholders such as greater society would need to overcome institutions that may be shareholder-oriented, such as securities laws, that do not currently incorporate such elements of society.

Overcoming these requires a utility-cost calculus, evaluating for societal utility. While not impossible to do, this is not considered here. Perhaps an even larger setback is that it simply is not shareholder preference utilitarianism assumed and espoused in this paper. That is, the Sacconi perspective assumes that there is further utility to maximize for shareholders – for instance, increasing the utility to society somehow maximizes or increases the utility to shareholders as a set. However, we have previously stated that, if shareholders were to provide complete independence to CSR departments, that there is no further utility to maximize since CSR department independence is utility-maximization. This analysis can be extended to other kinds of ethical perspectives.

For instance, virtue ethics, Kantian and other deontological perspectives, the ethics of care, welfare economics perspectives, and other value-based ethical approaches (e.g. altruism, beneficence, autonomy, justice, and non-maleficence) can be argued to be non shareholder preference utilitarianism. While they can or may be applied, this is a different question from whether they can applied logically following the utilitarian perspective presented in this paper.

Conclusion

This paper outlines a shareholder utility-based approach for normative and prescriptive CSR ethics. A justification could be found to move ahead and apply this to CSR ethics. The ethical analysis prescribes results different than the traditional and predominant profit or wealth perspectives. In particular, we find opportunity for greater CSR levels to be justified than currently exists under a conservative shareholder-oriented view. It was shown that it could yield prescriptions that are more favourable, and likely more faithful, to the desires of shareholders than other conservative views. Further, there may be increases and/or decreases in CSR activities if this approach is adopted. However, there is ultimately room for optimism, because there are cooperative utility-maximizing solutions and the possibly “open” nature of CSR departments leaves room for a variety of approaches to participate in CSR ethics.

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Discussion

Discussion and discourse at the conferences account for a significant part of the meetings. They are often wide-ranging and equally thought-provoking. Excerpts from some of the discussions are, thus, provided in the following pages. They are identified by the titles of the presentations after when they occurred.

Kanokwan Romayanon (Thailand) - GM papaya for PRSV resistance

Parichart Burns (Thailand) - GM papaya for delayed ripening

Morgan Pollard (Australia): I have a general question. What is your philosophical idea on the ecological principle of maximizing biodiversity. Do you think that the out of control ring spot disease might be a result of monoculture rather than multiculture? My specific question is that you mentioned you are specialised in microbiology, so I wonder whether your institute also employs microbiologists, or in other words ecologists?

Parichart Burns (Thailand): In Thailand papaya is not grown in large numbers, unlike Australia. Also papaya is not native to Thailand, it was introduced. Papaya Ring Spot virus (PRSV) has other hosts, such as cucumber and pumpkins. I think it may be actually due to other plants, because of mixed culture in the Thai case. It is the other way around. As for ecology, ecology is the main concern for us. That is why we are investigating the best possible way to control PRSV.

Abnik Gupta (India): You are selecting the PRSV resistant gene. How do you get these genes? Is it from wild varieties of papaya? The second is at what stage in the field trials are you at?

Kanokwan Romayanon (Thailand): We collected viruses throughout Thailand in all major areas of cultivation. We inoculate all strains. We combine the sequences of different viruses and we chose the most suitable strain for making it resistant.

Miyako Takagi (Japan): I would like to know if GM fruits are well accepted by people, because in Japan, for example Tofu made as GMO foods from soybeans are not well accepted. People do not buy it. So companies label tofu that is not GMO. I wonder, therefore, even if you make GM foods will they be accepted by Thai persons or not?

Parichart Burns (Thailand): Peoples' perceptions change all the time.

Kanokwan Romayanon (Thailand): Actually there is no other way to grow papaya, and currently people move from field to field to escape PRSV. They have to cut down more forest and make new fields to escape the virus. People fear what they do not know. We are trying to educate people to say that there is no scientific evidence that it is harmful to eat. We try to provide more evidence on this. Also we try to do protein studies to confirm safety. We want to use the new varieties that we have developed as a government agency to solve a problem that is facing our farmers now.

Ellen Clayton (Australia): I enjoyed eating papaya every morning here. Did you make any cultivars with both gene changes, or do you intend to? Also you mentioned that aphids are the vehicle of transmission of the virus. Have you done any studies on aphid response to transgenic papaya?

Kanokwan Romayanon (Thailand): In answer to the second question, this is part of the biosafety study that Dr. Wichai will give a talk on. We have some concerns on horizontal gene transfer with aphids, or microbes for example. We have not made a double gene changed GM papaya.

Parichart Burns (Thailand): The technology to develop both sides comes from different companies so that is one issue in our research that we are overcoming.

Subrata Chattopadhyay (Nepal): Who holds the patent on GM papaya, is it the university, state or company? Also, will you make a deal with the patent holder? The second question is if we consider that GM papaya is in a supermarket, what is the position of a villager? What is the use of doing something against a virus that has been there in the whole history of agriculture. I ask you to think from the view of a lay villager, looking at agricultural scientists looking at this?

Parichart Burns (Thailand): The patent over all technology is in the same big companies. At the research scale it is OK to use this technology. We work for the government so the government will own everything. Now let us consider from the perspective of a lay farmer? In Thailand everyone grows papaya, as backyard papaya. Some are growing freely to sell. If we can harvest for longer, than you can get more crops. It does not mean you need to get more, but rather the plants keep growing much longer. It is not to get

millions of dollars, but rather to generate a stable income for persons. That is a good start for us, to help the farmers. Papaya also has many applications, not just selling the fruit in the market.

Mamun – I would like to raise food safety as an issue. You mentioned there is evidence that it is safe? Because there are so many debates over GM papayas.

Kanokwan Romayanon (Thailand): The food safety is being investigated. Dr. Wichai will report on these studies.

Darryl Macer (UNESCO): As a closing comment before the next speaker we can observe that GM papaya is eaten widely already in the USA and some other countries.

Wichai Kositratana (Thailand) - Biosafety study of GM-papaya in Thailand

Pahol Kosiyachinda (Thailand) - The Transgenic Thai Papaya Story – A Milestone of Thailand toward a Biotech Crop Country

Darryl Macer (UNESCO): When was papaya first introduced into Thailand?

Pahol Kosiyachinda (Thailand): 200 years ago.

Darryl Macer (UNESCO): So it was only introduced into Thai culture from then?

Wichai Kositratana (Thailand): Yes, we can see in a journal that it came about 200 years ago. It may have come from Sri Lanka and Malacca. The variety called Malacca came by ship, from Malacca Island in Malaysia.

Tomiko – I understood that there is a committee inside Thailand that gives final approval to commercial transgenic crops. My question is which government authority is in charge of that? Who heads that, and which government department are they from?

Wichai Kositratana (Thailand): We have a procedure that the researcher starts from the institutional biosafety committee approval, it is then approved by the National Biosafety Committee. Then step by step through the laboratory to the greenhouse, to larger fields, and then the data is subject to the Ministry of Agriculture. The Ministry of Agriculture can approve immediately to grow GM crops, but the Ministry will first ask the prime minister for a decision. That is why it takes a longer time. The first cases involved five years of Bt cotton, but the government was still not decided. Even now the policy is not to commercialise GM foods.

Aruna Sivakami (India): I wonder whether GM crops can also be similar to the regulation of pharmaceutical drugs. On drugs we see the “best before use” date, and negative effects after a certain date?

Wichai Kositratana (Thailand): We follow international standards. In our view, food should follow food guidelines. The papaya has been shown to be safe, by protein expression and animal testing. We will do similar things as the FDA does with drugs. We need not listen to just bad or good, or that this is food like Frankenstein. Rather we need to be based on science. Maybe the picture in Europe ten years ago is the same as now in Thailand. Protesters wear space suits for media impact.

Minakshi Bhardwaj (UK): I have a philosophical question of whether scientists’ concerns are the same as the public concern. However, since the majority of people do not know what scientists do in the lab, then their concerns may be different? This leads us to consider our responsibility to the public. Was there any public debate held to lessen the concerns.

Wichai Kositratana (Thailand): It is a good point. We had no public concern at the beginning. People build a car before society tells us whether it is good or bad. People do not ask before building or riding in a car, or on a plane, so we have to later prove if the thing is good or not.

Pahol Kosiyachinda (Thailand): I would like to add that this research project was prompted by the farmers. Farmers who are members of the papaya growing association went to the University of Hawaii to ask for control measures against the virus. The devastation was so severe that peoples' lifestyles were changed. They had to stop being farmers and be a taxi driver for example. The virus has no cure, but since we have a solution it will provide a choice.

Irene Taafaki (Marshall Islands): We have both local papaya and also imported papaya. Locals know that the Hawaiian papaya seeds will not grow new papayas after throwing it out. I would like to ask about the seeds and how a person in a rural area can propagate transgenic papayas? Can they do it?

Pahol Kosiyachinda (Thailand): So far the biosafety committee has not allowed people to grow transgenic papayas at all. In the same way as in Hawaii, people have their own rights to grow the seeds and make their own cultivars. This project was started upon the request of the farmers. Officially however the transgenic papayas can only be grown in Hawaii.

Kazuo Watanabe (Japan): I was involved in the first phase of plant biotechnology transfer from Cornell University to Thailand. I will give a simple response to the discussion on public communication materials. Your materials are copied from Thai to English to be used in the EU. Even children can understand them. On specific issues of environmental and food biosafety, the transgenic plants have an established safety history of 15 years and nothing happened. There are many studies reported in scientific journals. Food safety it is the same as coat protein protection used in many commercially grown crops, and you have a good monitoring system. Thailand is a good example having a national and institutional framework. On the biosafety issues you have used the annex of the Cartagena Protocol, and you have a feedback system. I think Thailand is well developed on biosafety issues. On IPR issues, many components are free, and companies have made these components free providing it is used in domestic varieties for domestic consumption. Around 20-30 patents are involved and many components are free. The government had many expectations and it has a good safety check system.

Mohammad Hasan Ghadiani (Iran): What is the major medical use of papaya?

Parichart Burns (Thailand): It is the use of papain. Papain is good for digestion. Also it is a softener. I said it is our responsibility to give the public understanding of the knowledge.

Subrata Chattopadhyay (Nepal): Papaya also has beta carotene which has been shown to have anti-cancer properties.

Sarinya Sophia (Thailand): I heard we did GM for potato too?

Kanokwan Romayanon (Thailand): Too my knowledge there is no GM potato made.

Sarinya Sophia (Thailand): Most Thai people eat papaya every day, so I worry about biosafety. Still that question can be answered by science. Do farmers get the plants free to grow? Who controls the price of GM papaya?

Kanokwan Romayanon (Thailand): There are several groups. In Kasertsart University we have public funding and so everything will go out free of charge. We worked on this since 1975. This is a real trouble for Thai farmers. We want farmers to come back to grow along the side of the road. We want it for local production. We want to avoid deforestation caused by this virus.

Elise Huffer (Fiji): Who owns the Papaya industry in Hawaii, as you mentioned it was the second largest export after pineapple? How many individual farmers are involved?

Pahol Kosiyachinda (Thailand): Dole has a monopoly in pineapple, but in the case of papaya there is no single company that has a monopoly. Usually for small farmers they come together as a small unit, as a cooperative, then they have a GM test for marketing purposes and labelling.

Ellen Clayton (Australia): What is containment in an open field?

Pahol Kosiyachinda (Thailand): The Department of Agriculture did experiments under contained conditions. Based on scientific research we did research on pollen distance, for example, 50 metres, and

they made a secure field. They have 24 hour guards and double gates. When we compare the situation to Hawaii they grow transgenic papaya and non-transgenic papaya very close to each other. They use random checks to set standards.

Tran han Giang (Viet Nam): I saw many large fruits in Thailand, and they are much better than Viet Nam. Why did you bring the seeds from Hawaii, as already the papaya here seems very good.

Pahol Kosiyachinda (Thailand): For example most fruits in a shopping centre like the Emporium are imported, and some are very large in size. However they are not GM.

Don Chalmers (Australia) – Is there a Need or Space for Gene Technology Ethics: An Australian Perspective

Abnik Gupta (India): On the need for environmental ethics, it is very important. I would like to raise the point of protecting the integrity of the ecosystem, or the macrosystem level? Can we look after macrolevel systems withoutn distinct environmental ethics. Also we can include non-living organisms in the ethical framework.

Don Chalmers (Australia): That is a comment, and better than I can answer. We are trying to make a modest start, when you consider Morgan's description in the first morning. We have had concerns about pollution also. The science will always be interlinked and we need to go further still as you say.

Charn Mayot (Thailand): Can you clarify the last point about public trust? It is a problem in this country. In my personal opinion GMOs are not terrible. But there are so many things where the government changes what it had said. How about private corporations, and companies? What do you do in your government to generate trust?

Don Chalmers (Australia): There is lots of evidence, e.g. the UK House of Lords report on Science and Technology three years ago, which said that the advance of science has been marked with deficits of trust. Biotechnology Australia has done a lot of research to say that once a commercial interest is involved people lose their trust. There is much data to show that the community is becoming more sceptical. Another concern is that companies are not subject to the freedom of information acts that are seen in many countries. Thirdly, governments are now coming in, as universities, and entering agreements with companies that the government will keep the information confidential. It is the responsibility of all involved, including the gene technology regulators, that public trust is in the public interest.

Aruna Sivakami (India): We eat papaya in India when it is green as it is good for health, and also when it is ripe, when people say it is important to increase hemoglobin. In India it is eaten at every meal for inducing abortion, so they eat papaya every meal. There are therefore many health questions in India. In Australia it is possible to legislate about biological diversity and biosafety, but in India, laws cause all the problems. The 2002 Biodiversity Act and 2004 Biodiversity rules only stop foreigners from exploiting, but locals can continue to exploit. Thus we cannot do anything only by legislation in our countries.

Don Chalmers (Australia): I do not know how to respond. This use of papaya would be interesting to an ethics committee. Australia set up a very strong welfare state and always looks to legislation.

Voravit Siripholvat (Thailand) - Description of Thai indigenous chicken plumage colour and broodiness using classical and molecular genetics

Darryl Macer (New Zealand): What is the average lifespan of chickens in the village?

Voravit Siripholvat (Thailand): Some papers say that the lifespan is about 10 years. That does not mean that the meat can be eaten at that stage, as it will be very tough. They also may not be laying eggs efficiently then.

Darryl Macer (New Zealand): Yesterday we had a paper on factory farming, and we can see that the

lifespan is much shorter in such farms.

Ellen Clayton (Australia): With the identification of the broodiness gene, can it be applied for farming? For example, could we genetically engineer the chicken with the broodiness gene?

Voravit Siripholvat (Thailand): To modify the chicken gene is very difficult. I submitted some research papers on indirect cloning. The chicken follicles include a blastoderm, which makes it very difficult. When the newly hatched eggs come out it includes more than 4000-6000 cells. Thus it is impossible for direct transgenic research. However, some researchers try to use retroviruses to transfer the transgene. Or else use direct cloning. Currently there are some projects to research this.

Masato Motoki (Japan): My concern is about the picture where it seemed like the cockerels were bred for fighting? Is there any movement against cock fighting?

Voravit Siripholvat (Thailand): These cocks are not only for fighting but also for fowl beauty contests. Their value is very high. The people who are interested in fighting will kill the lines to ensure a very high price. Some people want to purchase the expensive female chicken lines, and they can fetch a very high price. The ancient king of Thailand used fighting cocks in Burma. The chickens have been selected for a very long time. The style of fighting is very excellent compared to some other chickens.

Kalairari (India): I think if genetically engineered chickens are desired then one particular variety will be eliminated from the community and the gene frequency may be affected. Please explain the mechanism?

Voravit Siripholvat (Thailand): I think the first selection for genetic engineering is disease resistance, related to avian flu. I do not worry about gene equilibrium, they were adapted a long time ago. The commercial chicken gene equilibrium is not affected. There has already been a long process of selection in commercial broilers. The genetic selection is for fighting in these chickens but other genes are not affected.

Ellen M Kittson (Australia) – Victorian Governance of Biotechnology

Abnik Gupta (India): It is significant that you have used the term respect for animals and respect for the environment, it is higher than just using the word concern in ethics. I do not know if you have taken steps to commercialise transgenic crops or plants. If so, how has the “respect” been preserved?

Ellen M Kittson (Australia): In our national regulatory scheme there have been approvals for three different types of genetically modified plants, the blue carnation, which is grown in Victoria; cotton, which is not a crop we have in Victoria; and canola, which is a crop also grown in Victoria. At this time the Victorian government has passed another law in addition to the regulation scheme, which prevents its commercial growing. They still feel that they want to be more cautious even if the federal regulator has approved this. I do not know if caution relates to respect. Rather it may be to give people the idea that in their consideration there is something more than just the scientific risk assessment. It is meant to be inspirational.

Peggy Fairbun-Dunlop (Samoa): Could you tell something more about the youth response you referred to.

Ellen M Kittson (Australia): When the youth considered their survey, they had actually written a series of questions which reflect a lot of our discussion at this meeting too, including all sorts of different topics. There were some important themes that came from the youth. First they thought that ethical principles were universal. They were comfortable that what was an ethical principle for agricultural biotechnology would also be a principle for medical applications of biotechnology.

Irina Pollard (Australia): In the year 2000 I was invited to give a lecture in Chennai and I gave a questionnaire to examine the cultural differences that could be found between those students and my students in Australia. The Indian groups ranked the concerns the same and the results were similar in that they both ranked concern with environmental matters.

Kazuo Watanabe et al. (Japan) - Ethics in Public Communication on Agricultural Biotechnology

Irene Taafaki (Marshall Islands): Please hypothesise why those who oppose are using unscientific claims? Might it be they do not have the benefit of research dollars the companies have in this? Is it some other reason?

Kazuo Watanabe (Japan): The specific case in Japan it is related to other economic activities, like the organic farming industry. Other groups are based on their creed, like religious groups. They are to be respected, but not if they misrepresent scientific opinion.

Jasdev Rai (UK): Among the weaknesses in the whole postdoctoral system is that there is a lot of emphasis on ethics in governments and universities. But the MNCs are much more powerful, and they are abusing the ethics. There is no oversight system for how to control them. In Geneva six years ago NGOs tried to set up a voluntary code. Unfortunately it was taken over by the interests of persons in the USA, and MNCs persuaded that it only needed a voluntary code. While we can discuss ethics for academics and society, there needs to be some sort of independent international ethical oversight. MNCs have a lot of money to buy the media and can miscommunicate on these issues.

Kazuo Watanabe (Japan): The international regulation is controlled by different sectors, WTO, CBD and various environment laws. Each contains methods for strong participation of concerned groups. They are not small groups, so independently they are spread out. They are quite visible, but I am not sure how we can make a synergy between them. Even inside the United Nations they cannot sort out an overall framework.

Nacanieli Tuivavalagi (Samoa): I want to share an experience related to one of your slides where 80% of people were not responding. In agriculture we have a lot of experience about non-responders, and we found that people may have various reasons for not responding. The people may not like to communicate their feelings to each other. As we heard from Ellen Clayton, there are ways to get people involved.

Pahol Kosiyachinda (Thailand): One question I have is about the activist that raided the farm and was it a court case?

Kazuo Watanabe (Japan): This case concerned the first planting of GM soybean in Japan. The police filed a report for property damage and trespass. It is still pending, but unlikely to proceed.

Mary Josephine Rani (India): I would like to know what are the benefits and risks of GMOs. The public should be well informed of the adverse effects. Do we label the products GMOs and what is your view of gene pollution?

Kazuo Watanabe (Japan): It is important to show that it could be controlled or maintained. Yesterday we also discussed some of these issues and risk management. Unless explained well, those GMOs should not be used. Labelling is important to protect the right of the people to know, not because it is harmful. If it is harmful it cannot be used. The labelling is because it is a product made from new technology. Gene contamination is an important component of these issues and risk assessment. Gene flow depends on the biological characters of the crop. In potatoes it does not produce viable pollen. A potato grower in Peru should be very careful as it is the motherland of potatoes, but a place like the northern island of Japan regarding the potato they have no native species so the risk assessment should be different. There are important issues when considering GM rice in Asia, as there can be influences on weedy species surrounding GM rice crops.

Minakshi Bhardwaj (UK) - Constituting ethics into biotechnology policies and developing international relations.

Subrata Chattopadhyay (Nepal): You talked about autonomy as a guiding principle of bioethics. In the global community, China and India constitute the majority of humankind in terms of numbers,

and the concept of autonomy does not apply the same way as it does in the West. In terms of the individual how can autonomy be the guiding principle universally? When you say maximum good for the maximum people, let me give you an example of a nuclear power plant in the Bay of Bengal. It is good for individuals to have more jobs, it is good for the community to have more energy, and it is good for the state because they will have more power generation. But the problem is for the environment, or nature. In the long term vision for future generations it will be a guiding principle that the environment may suffer. Is it possible that the good for the short time is not good for the individual, community or state when considering a long term perspective?

Minakshi Bhardwaj (UK): On the concept of autonomy of states, we could consider the right to exercise at governance level and international levels, states can opt out to sign a treaty or not. In those terms states have autonomy to reject, or adopt an agreement. Regarding the community, individual and state, we can think of conservation of natural resources. Which holds more weight as a guiding principle? For example in some states you exercise your autonomy to drive a car, but some states limit car use to a certain number of minimum persons for environmental reasons.

Ken Daniels (New Zealand): The papers this afternoon, have brought a real relevance between bioethics and policy, in our conference.

Tran Han Giang (Viet Nam): I want to ask about the difference between welfare and equity.

Minakshi Bhardwaj (UK): When I talk about equity I think it comes when we think about access to resources and their availability. Equity cannot be available without enough, and access to resources. There also needs to be intellectual resources to allow exploitation of resources for the good. We need to use technology transfer for empowerment. In many developing countries they have resources but they do not have equity. We have to provide equity, and need to have capability which requires participation.

Tran Han Giang (Viet Nam): Sometimes equity is not equality and vice versa.

Minakshi Bhardwaj (UK): Equity will be needed as a guiding principle for equality. Then transformation into policy is important.

Tomiko Yamaguchi (Japan) - An Analytical Framework for Understanding Agricultural Biotechnology Controversies

Mamun (Bangladesh): I would like to make a comment on this paper. This paper includes ethnography, analysis of newspapers and qualitative interviews. When you combined these methods with the collection of data, this integration has made the analysis very meaningful. I would like to ask about the quantitative data analysis in your research.

Tomiko Yamaguchi (Japan): When I began the study in 1998 it was just when the controversy was developing. Triangulation between qualitative and quantitative data is very important to see the situation in a broader picture. My next step is to link this into an even bigger picture.

Ellen M Kittson (Australia): When you were defining the social constructivist approach you talked of defining the social condition that is problematic. Then you described the problem as being the commercialization of GMOs. Is there a particular area that was lacking, that you identified in your analysis such as lack of empowerment or participation?

Tomiko Yamaguchi (Japan): This social constructionist approach to problems looks at the processes where people define or perceive certain social issues as problematic. The focus of the study is what sort of processes people went through in their mind that has led to the problem that Bt cotton was a problem.

Ellen M Kittson (Australia): Yes that is clearer. I wonder if you could describe some of the particular concerns people had about the commercialisation of GMOs?

Tomiko Yamaguchi (Japan): I am concerned about how they perceived this. How do people define the commercialization of Bt cotton, and why they thought that it was problematic.

Darryl Macer (New Zealand): The discussion of different methodologies has been very interesting. When I wrote the report of the subcommittee of the UNESCO International Bioethics Committee in 1996 on "Bioethics, food and plant biotechnology", there was a conclusion that overall biotechnology will help society. However, there are many issues that are important, and we have discussed some of these here.

Darryl Macer (UNESCO): Ethics of use of genetic control methods for Infectious Disease

Irina Pollard (Australia): With genetically modified mosquitoes they will modify the females, which suck blood. Eventually are they planning also to sterilize the males so that the population would go down even though the genetically modified female does not allow the development of the pathogen once it's infected?

Darryl Macer (UNESCO): There are a number of strategies, some can utilise biology when *Aedes aegypti* mosquitoes suck blood from a person with dengue, it then takes approximately 14 days for the dengue to reproduce and go to the salivary glands. So the mosquito needs 14 days. So there are several strategies. The approach they are trying to use involves about three independent genetic mechanisms that will stop the transmission of dengue fever into mosquitoes. So the chance of natural selection to revert back, one transformation is a chance, but if there are more independent transformations, there is almost no chance they could revert back. Because they would be targeting different stages in the dengue lifecycle and different organs in the mosquito, so that's one strategy. Overall in molecular entomology, the idea is, there are about 4,000 species of mosquito, but only about one dozen can transmit human disease. Dengue is transmitted only by around two different species and for many localities it's only *Aedes aegypti*. So the idea is that, instead of spraying with pesticides to destroy all the insects, it is better on the ecology to have the insect surviving in the community. So the population is not intended to go down. That is one strategy. Another strategy that is being developed is to make genetically sterile mosquitoes, but it requires a larger number of mosquitoes. So there are different strategies. The genetically sterile mosquito doesn't reproduce, but you have to make a large number. Another strategy is to introduce these modifications on a transposable element so that they'll be slowly moved through the wild population. This is an approach being considered. We don't really know what will work until there are trials and we know which one is best.

Morgan Pollard (Australia): I just wanted to comment that the mosquito is a keystone species which is very important to the ecosystem especially in the larval stage. It is integral to the ecology. The aim of this strategy is health and the method is ecological. I suggest you need ELES, the Ethical, Legal, Ecological and Social Impact to be considered.

Naoko Kimura and Darryl Macer (UNESCO): Japanese attitudes towards genetically modified mosquitoes

Peggy Fairbun-Dunlop (Samoa): One of the things which has come through very strongly yesterday and today is the participation of community people in research. I was just wondering in the surveys Darryl will be conducting, how much you have looked at community participatory research?

Naoko Kimura (Japan): In terms of community engagement, we would like to inform all citizens of the community, or of the island. So the question was: Have we made considerations for community engagement?

Darryl Macer (UNESCO): At first there is an initial phase for case studies and I think you are right in pointing out how long it does take. Also, as mentioned on the slides, we will probably have to conduct ongoing dialogue and modification based on what the community chooses through community ethics boards. It's possible after three or four years the communities may have extra concerns that need to be met. For example, in this case it is needed to make it clear to people that these trials are cage trials

of GM mosquitoes. Therefore, there is no benefit to reducing dengue immediately because they aren't going outside of their cages for five years at least. But despite the best efforts and intentions that we've made, it is still likely that, if it happens to be a bad year for dengue, the people will say: "Well what are these guys doing, they cages are here, we're meant to not have dengue anymore." And people will find it difficult to understand that. So an active and dynamic two-way process is required.

Le Dinh Luong (Viet Nam): I have some questions about the way we conduct surveys or interviews because an important part about any surveys or interviews is the questions. We should put the right questions first after getting information back from the community. For example, according to one poll we get that 70 % of European people do not know what is 'G' (a nucleotide base of DNA). In such a case, if we ask a question like: "How do you consider the GMO is harmful or useful?"; I would not be sure that the information would be useful for any information or conclusion. Perhaps in this case we should pose the question to the Japanese people what and how do they consider or understand the benefit or the harm of GM mosquitoes first. Afterwards we can get more information about that.

Ellen Kittson (Australia): Did you have any other demographics about the people who answered the survey? That is important in understanding the answers, for example, gender and education.

Naoko Kimura (Japan): Yes, the demographics were analyzed and we found that it did represent the community.

Ellen Kittson (Australia): But were there any differences in attitudes due to age of the participant?

Darryl Macer (UNESCO): No, as in most of the surveys that were done in Asia or the Pacific over the last decade, I think it's clear to say there is no demographic predictor for the attitudes people have to genetic engineering questions. This is also now a common conclusion in European research as well. There's no single demographic predictor of a person's views about these dilemmas. I've also done surveys on the natural sciences where there are also very similar universal ideas regarding the concerns people have. The sample size here is not really large enough to make quantitative conclusions about that.

Subrata Chattopadhyay (India): I have a couple of questions but with the time constraint I will limit these to just two. One is that we generally don't hear the voice of the other world in the sense that if the community ethics board are in one platform, what about the concerns which are expressed by groups like NGOs such as Greenpeace or the PETA? The problem is in the scientific world there is general misconception about the other world and things were flushed out. In many parts of the world where the society or the system is unethical, how do you really think the community ethics board will be working in an ethical manner? I can tell you two examples. It could be really good in Washington DC or Europe but realistically at the ground level in Asian countries, how do you ensure that it will be done in a very ethical manner when the question of economics and the jobs is the priority? Secondly, in the real third world, we generally are concerned about the World Bank and the WHO because of their interest in all things. It scares me when I hear that the World Bank is developed, I mean it is implementing development. So how do you address that when psychologically it creates a sense of distrust when I find the World Bank or IMF or UNDP, and international organizations abroad, who are doing something good in the third world where they are partly responsible for the misery in the third world?

Darryl Macer (UNESCO): Firstly, there are many pilot projects independent from the Tropical Disease Research Programme of the WHO (TDR). TDR, this Tropical Disease Research Programme, is based in Geneva, WHO Headquarters as a joint programme of three agencies, WHO, UNDP and the World Bank. The project I gave as an example is led by a principal investigator at the University of California at Irvine, funded by the Foundation for NIH, which is set up especially to administer the Gates Foundation Grand Challenges for Global Health programme to be independent of an independent foundation. Its projects are independent of the work of WHO. Concretely about the community ethics boards, I have mentioned them as structures which I propose may meet once a month. It is essential that those coordinating this work are very careful to try to ensure very broad representation. There may be multiple ethics boards depending on the local site. For example in Trinidad among the meetings I had planned in three villages along the proposed experimental site were in a church, in a Hindu temple and in a cricket club. Thus we may establish groups so that they have active participation. I think it is also part of community engagement ideas now to pay people to come along to discuss these issues or otherwise they will lose

interest. This is another issue with genetics ethics boards. If we want community participation, to get ordinary people in these groups you have to compensate them in some way for taking the time away from their work or other activities. These are all components of community engagement projects.

Naoko Kimura (Japan): In terms of the opposition voices, we are for various reasons obviously very concerned about these opposing voices. We need to correspond with Greenpeace and experts who disagree with the merits and risks of the research. Some comments convey their concerns.

Mary Josephine Rani and M. Selvanayagam (India): Benefits and Ethical Limits to Transgenic Animals

Aamir Jafarey (Pakistan): Certainly I agree that we are only caretakers, but every time science tries to take over, the question of the balance between playing God and being a caretaker, comes up. When the universe began, we were playing with nature, also, but that was happening in the fields and not in the genetics lab. But the question of ethics in the altering of nature was happening was there? It was happening in the fields but not in sterile labs. So what is the difference now that it is happening according to scientific principle and in our own ways? People have been using nature for a long time. We have been using animals, using plants and people seem to be adapting to that, accepting that. So when we do that in genetic labs, why is that different?

Mary Josephine Rani (India): Even in the past we had lots of abuse but as time goes on there is a lot of improvement. The same thing can be said with the use of technology and science. Now, for example, can we grow headless embryos? Some say if the head is not present, if the brain is not present, they have no rights. So they can produce now headless embryos. After the production we could take out the organs, like the heart, kidney, and then donate as a business. This is not ethical, I believe. This type of advancement is not advertised in this field.

Maude Phipps (Malaysia): That was quite interesting. I am glad you put up the last slide where you cautioned that there has to be a balance between technological advancements and the fear that bioethics and a lot of these considerations will strangle the procedures. As regards headless embryos, I think that's more conceptual than actually happening. So at the moment there is a lot of controversy about stem cell technology and the use of embryos and just scenarios where there have been debates for a long time. What does one do with the excess embryos that are created artificially for ART? Does it just go down the sink or can they be put to better use? We had a dialogue in Malaysia some time ago about this, rather than creating headless embryos, about the embryos that existed. You would be surprised as to the opinions that people were giving. There was an invitation to people from the NGOs, from the scientific community, from the clinical/medical community, lawyers as well as religious groups. And over all quite a number of religious groups or individuals felt why would you prohibit using embryos for therapeutic cloning, when the process of "ensoulment," when the soul actually is put into that being, is at 120 days for Muslims, for example. So if it's an excess embryo and it can be actually utilized as long as it is used before 120 days, then it is allowable. So there may be different ways, rather than having to create something that you can harvest organs from.

Juergen Simon (Germany): Chances and Risks of Biobanks: Problems of Ethnic Monitoring

Alireza Bagheri (Iran): you mentioned about the need for community consent, I wonder if you can provide us any practical definition and how to obtain community consent. Actually I am concerned about the community of people who live in another country and how to have their own consent.

Juergen Simon (Germany): Well, that is a very important...? I think it is not possible to give you an answer now about what is community consent because it is discussed in different ways. If you take groups in Venezuela or Thailand or somewhere else, I think you have a lot of definitions for community consent. Another issue is how we can see it, which is one we can talk about for a month. So I have given you a statement from our group, we have discussed this. This was agreed upon by the members of the group in the UNESCO meeting.

Brigitte Jansen (Germany): Human Biobanks- Trustees and Some Aspects of the Current Discussion, especially in Germany

Darryl Macer (New Zealand): What is your opinion on the genographic project, do you agree that it is against norms of international law?

Brigitte Jansen (Germany): Yes, I think in some cases I have spent several times fighting about this topic because each group may have a special idea of a group consent. I think this is also a possibility to misuse indigenous people for politics. So I dislike this form of consent because I prefer, also in indigenous groups, more of an individual consent.

Juergen Simon (Germany): I agree that we need community consent, but it is indeed very difficult. There is much discussion on community consent and also over the role of the donor which is the most important thing. There are also discussions on the internet about such projects.

D.S. Sheriff (India): What is the utility of such human biobanks in developing nations?

Brigitte Jansen (Germany): I think that for developing countries it can be interesting to have such a biobank. But before establishing them it is important to have legal rules of how to govern it and how to provide the information. If you look at the Indian law, for example, you have also a data protection law but I have the impression that in the medical field this law is not well known in the case of gathering the genetic information. It was established in 1986 and it focused on the IT sector. In many cases I think there is a gap between the different fields in India to recognize the existing law. This is not yet working because nobody knows it. While I think in this case it is a good thing to establish something like a biobank to have the possibility to do something for the local community, but it is very important to have proper legal rules and to apply them.

Miyako Okada-Takagi (Japan): Is the era of the therapy by tailor-made stem cells coming?

Ivo Kwon (Republic of Korea): Your title is "Is the era of the therapy by tailor-made stem cells coming? I think as do many medical experts that this time is far away from an era of therapy from tailor-made stem cells because we have many obstacles and so many hard problems to solve to do therapy to the patient by stem cell and made by stem cell research. If we reinsert embryonic stem cells into the patient, the possibility of cancer may not be able to be detected by science, and this is a big problem. We have no idea what is happening after the stem cells are injected into the patients. In Korea we have some ideas of where stem cell therapy is going right now. We have very serious monitoring for the patient. So many people think it is possible to use stem cell therapy very soon but I want to point out that this is far from the fact.

Miyako Okada-Takagi (Japan): Yes, of course, therapeutic cloning is in the very future of medicine and we Japanese now are forming the research in human cloning for research purposes and now we cannot do that yet. However, next year we will probably do that. We will change the regulation for human cloning research and already a lot of the researchers say that there is also, genetically, a lot of difference between the natural embryo and cloned embryo. So it is not easy to use as therapeutic cloning, but we should start to experiment.

Yanguang Wang (China): There may be other potential sources of human genetic material besides eggs, such as aborted fetuses.

Miyako Okada-Takagi (Japan): While we are discussing now how to get eggs for the research, already we are not permitted to have donations from the young women because the health risk is very high. So people say that we should not, but many members of families with severely diseased patients may want to donate the eggs for the research purposes, in which case probably we should accept them for

research purposes

Ivo Kwon (Republic of Korea): The Current State of Embryonic Stem Cell Research in Korea

Noritoshi Tanida (Japan): It was a very interesting story. Would you mind telling me something more about the attitude of people towards fertilized eggs or embryonic cells in Korea? Because in Japan, the Japanese ad hoc committee officially employs the Christian ideology, which means life starts at fertilization, so I would like to know more about the concept of your country.

Aamir Jafarey (Pakistan): You said that egg fertilization is for patriotic reasons, that is a very noble cause but patriotism usually surfaces in times of crisis, and there is no war going on right now, there's no famine, tsunami, etc. Are there any other manifestations of this patriotism rather than egg donation by only females happening in Korea at this time?

Ivo Kwon (Republic of Korea): There is no case such as that in Korea. In clinical trials, many Koreans regularly want to be involved and some people wait for the notices of clinical trials in hospitals. But they will readily sacrifice their bodies for a more noble approach.

Heiko Zude (Germany): I am Protestant Christian and I like your oppositional stance point very much. I would like to know when you write over 90% of the Koreans praise the success of Dr. Hwang¹, what is the source of your opposition? Where is your oppositional stance point grounded?

Ivo Kwon (Republic of Korea): Generally speaking I am not opposed to his research, and I agree that therapeutic cloning is necessary for our medical purposes this is my position. It is very hard to talk about the human rights involved, and the procedural justification. Many procedures we have to keep in research for social utility. I think my point is that I am arguing to keep the right procedures when doing social research, which is very difficult in such a nationalistic condition.

Wang Yanguang (China): I know most of views from the public about stem cell research; I would like to know more about the ethical field and how many bioethicists think about this. Also, I know that in your country there are many Catholics. Nearly more than half of the population go to church, how do they think about the embryo as a person, or as a human being or as something?

Ivo Kwon (Republic of Korea): We have very few bioethicists in Korea, and a group of them are against social utility research like therapeutic cloning. However, a small group of bioethicists, including myself are really for therapeutic cloning, but we cannot position all the bioethicists in Korea. For clarification, many Koreans believe in Christianity, but they go to church to pray for their health and their wealth in their current life. Many people are not interested in heaven after life. So many Korean people although they believe they are Christian or Catholic, they will agree there is a very different cultural situation from the other western Christian countries.

Don Chalmers (Australia): The Regulation of Stem Cell Technology-International Approaches to Restriction or Permission

Aamir Jafarey (Pakistan): My question is regarding the frozen embryos, you mentioned they are frozen, and frozen indefinitely. I assume they are owned by the parents, but is there a deadline by when they have to make some sort of a decision? Who pays for this period in which they are spent frozen?

Don Chalmers (Australia): The position in Australia is that before this national legislation, there were different regimes in different states. Generally it was five years or ten years, now it is standardized at ten years. After ten years, the parent must make a decision. If they have not made a decision then they should be allowed to succumb. The second question is who pays? Most of this is done through a private scheme, though we are one of the only countries that allow public access under our public

1 This discussion occurred prior to the scientific fraud case brought in Korea over Dr. Hwang, and the withdrawal of his scientific papers from several international journals, including Science.

health scheme, but if they are stored it is paid for by the couple. There is always a regular mail out by the ART centres asking what you want to do. An interesting point was there was this feeling that once the couples were invited to enter into the research, and I think really so far the experience of our licensing is I think they've overestimated. I think some of the couples are deciding, but it's not to go into the research track.

D.S. Sheriff (India): It is interesting to see how different types of people in the county are going to regulate your medical council. How do you select them? Do they have any corporate affiliations, because this also can influence the decision making process?

Don Chalmers (Australia): They are appointed by the commonwealth (federal government) but our points are subject to consultation with all of the states, and there are a number of bodies which have the capacity to make comments about the membership. The second question was conflict of interest through financial association. Yes, that has actually happened, in the legislation there is a specific rule which says if you are receiving any direct financial benefit from an ART centre, you must end it. So the particular colleague that was from ART was initially attached to a university working in the RT, so he was receiving his funds from the university. He's now changed his position, it's not a question of any discretion, he's had to resign from the committee and I think it is going to be quite challenging in his area to find a replacement that is not tied up with the actual RT procedures. Because the legislation's quite clear, you have got to be absolutely independent of the procedure.

Yanguang Wang (China): Ethical Issues on Human Embryonic Stem Cell Research in China

Heiko Zude (Germany): This impressive presentation helped me to understand better what my colleagues in Eastern Germany think. You said that there was some discussion about the value of the human embryo, so I would like to know, who are the persons who argue and refer to the natural law? Who are the persons and to what group do they sociologically refer to? Can you say these persons are Christians for example? To what group do they belong?

Yanguang Wang (China): To my knowledge all bioethicists agree that up until 14 days we can do research. This is based on medicine, medical reasons and I don't question about the nature at all in my presentation. From the ethical reasons we think that cells are embryos and cells have no consciousness before that line. So they think about so many patients who need help, and the need for research for medical development, we think we can use the embryo, as the best option. We insist to forbid someone from using cells from some women without obtaining informed consent. However, we think it is better to use the embryo obtained from the abortion or from the spare embryos left after IVF.

Sarinya Sophia (Thailand): I just have one question, because it seems to me from your presentation that in China you do a lot of the research on stem cells and this kind of bioethics. Do you do research related to organ donations after people are dead for example? For example can you use the eggs of women who just passed away within 24 hours, because the eggs are still okay? For me it is about respecting living beings both animals and human, not only the human.

Yanguang Wang (China): We do respect the value of the embryo. We try to find many ways to find the embryo, so your suggestion is good. You will find in China that many scientists and ethicists have done something. They try to use the adult tissue resources also for research.

Mary Kalaiarasi (India) I would like to have a little clarification. Why do you limit protection to 14 day old embryos? Why not believe to respect them from the time of conception? I believe that life has to be respected from the time of conception itself. Secondly, you mentioned about volunteers. Are they paid? What is the ethical limit to call them volunteers? What are the ethical limits that are followed?

Yanguang Wang (China): You want to know whether we use the embryos before 14 days. Many persons ask us this question. From the first time of stem cell research, we read a lot of materials from the UK and from the USA. We followed the UK standards to limit to 14 days. The reason is that many Chinese people think that the Chinese should not develop too quickly, we don't want to, but if the USA or UK can, we should follow them. This is one reason, but for bioethicists, we really think this 14 day embryo rule is quite appropriate. If embryos are to be destroyed, before they are destroyed society can use them.



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