Press Release

FOR IMMEDIATE REPORTING

PUBLIC CONSULTATION ON ETHICAL, LEGAL, AND SOCIAL ISSUES ARISING FROM HUMAN NUCLEAR GENOME EDITING

The Bioethics Advisory Committee (BAC) will conduct a public consultation from **3 June 2024 to 13 August 2024** to seek views and feedback on the ethical, legal, and social issues arising from the use of Human Nuclear Genome Editing (HNGE) technologies in biomedical research, clinical research, and healthcare. The consultation paper can be accessed from the BAC website at www.bioethics-singapore.gov.sg or REACH Portal at www.reach.gov.sg.

Ethical Challenges of HNGE applications in biomedical and clinical research, and healthcare

2 In recent years, advances in HNGE technologies have resulted in the discovery of more precise tools that could further advance human biomedical research to improve patient outcomes. For example, the use of non-heritable gene editing[1] holds promise for treating genetic disorders, infertility, enhancing personalised medicine and improving health outcomes. However, these technologies also raise ethical issues such as the unintended consequences and long-term effects on individuals and future generations resulting in social inequalities, and issues on consent. Maintaining a balance between scientific innovation and ethical responsibility remains a challenge in navigating the complex landscape of HNGE.

Scope and Aim of Consultation

3 Recognising these ethical challenges, the BAC has developed a public consultation paper titled 'Ethical, Legal, and Social Issues arising from Human Nuclear Genome Editing' to seek views on the ethical issues from the use of HNGE technologies in biomedical and clinical research and other potential clinical applications. The paper also discusses the ethical principles underpinning the applications of HNGE. The paper is intended to guide academics, researchers, healthcare professionals, research and healthcare institutions, Clinical Ethics Committees (CECs) and Institutional Review Boards (IRBs) on the ethical use of HNGE applications in human biomedical research, clinical research, and healthcare.

4 The paper builds upon previous BAC reports and recommendations, referencing relevant legislation/Acts such as the Human Biomedical Research Act (2015), the Human Cloning and Other Prohibited Practices Act (2004), and the Healthcare Services Act (2020).

[1] Non-heritable gene editing involves making genetic changes to somatic cells, and including all cells in the body that are not involved in reproduction. As a result, changes made to these cells cannot be inherited by any children of the person receiving the treatment.

5 Through the public consultation, the BAC aims to gather views from academics, researchers, research and healthcare institutions, healthcare professionals, professional bodies and societies, CECs, IRBs, religious organisations, industry partners, as well as the public on key ethical questions and issues, which will assist the BAC in developing its recommendations. Please refer to **Annex A** for the outline of key ethical questions and issues raised in the consultation paper.

Period of Consultation

6 The public consultation will take place from **3 June 2024 to 13 August 2024**. As part of the public consultation, the BAC will also conduct focus group discussions with representatives from various academic, research and healthcare institutions, CECs, IRBs, professional bodies and societies, religious organisations, as well as industry partners in July and August to gather their views on the issues.

Feedback Channels

7 The public consultation paper can be accessed from the BAC website at www.bioethics-singapore.gov.sg or REACH Portal at www.reach.gov.sg. Members of the public are invited to provide feedback on the issues discussed in the public consultation paper through the following channels:

a. By email to: bioethics_singapore@moh.gov.sg

b. By post to: Biomedical Ethics Coordinating Office
1 Maritime Square
#09-66 Harbourfront Centre
Singapore 099253

c. By online feedback form at: https://go.gov.sg/hnge-respondent-form

All comments should reach the BAC by **13 August 2024**.

Summary of Response

8 A summary of the main comments/feedback received, together with the final advisory report and recommendations will be published on the BAC website and REACH Portal in 2025.

BIOETHICS ADVISORY COMMITTEE
3 JUNE 2024

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ANNEX A

[Invitation To Comment] Public Consultation Paper: Ethical, Legal, and Social Issues Arising from Human Nuclear Genome Editing

a. Mosaicism[2], Off-Target Effects, and On-Target Undesirable Modifications

1 Gene editing technologies could enable corrections to the genomic sequence to rectify or remove mutations that lead to adverse health conditions. Such technologies could also lead to unintended biological outcomes such as chromosomal mosaicism in embryos, and undesirable consequences (e.g., development of cancer and allergic reactions) arising from off-target mutations and deletions.

Ethical Considerations:

i. How should researchers and clinicians balance the potential benefits of gene editing technologies against the risks associated with mosaicism and off-target effects?

ii. How can researchers, clinicians, and regulatory bodies ensure that patients or participants undergoing non-heritable gene editing interventions are fully informed of the risks associated with such applications?

iii. Should clinical applications of heritable gene editing be allowed, such as for the treatment of diseases or infertility, given the possibility that future generations may potentially suffer from unintended consequences associated with such applications?

b. Safety and Long-Term Effects of HNGE

2 Gene editing may potentially offer new ways of treating genetic disorders, infertility, enhancing personalised medicine and improving health outcomes. However, it has not yet seen widespread use in clinical practice nor evaluated over long periods of time in humans as the technology is still in its early phase of development and there are concerns regarding the safety and long-term side effects of the technology on individuals receiving the treatment.

Ethical Considerations:

i. How should researchers, research institutions, and clinicians ensure favourable risk-benefit ratio is achieved for patients or participants undergoing clinical trials or clinical interventions involving non-heritable gene editing?

ii. What can researchers do to mitigate challenges and alleviate long-term consequences associated with non-heritable gene editing to ensure responsible stewardship of science?

[2] Mosaicism is a condition that occurs when a person has two or more sets of cells that differ genetically from one another. For example, a person with this condition might possess some cells that have 46 chromosomes while other cells have 47 chromosomes.

iii. *Should clinical applications of heritable gene editing be allowed, given the difficulty in predicting the long-term consequences of such applications on future generations?*
iv. *What are the ethical challenges involved in conducting follow-up studies to determine the long-term side effects of gene editing interventions in research participants?*

c. Procurement and Use of Human Embryos and Oocytes in HNGE Research

3 Regulated research with human embryos have greatly enhanced knowledge about human gene function and early embryonic development, as well as advanced research on infertility, genetic diseases, and intractable diseases. While procuring oocytes with the desired genotype from individuals can enable researchers to study gene mutations in embryos for a given disease-causing gene, or to evaluate the treatment for a specific gene mutation, it may lead to health risks for donors during the oocyte extraction procedure. Another ethical issue involved in the use of embryos for gene editing research is potential privacy breach.

Ethical Considerations:

i. *How do researchers and research institutions weigh the potential benefits of gene editing research on human embryos and oocytes against the ethical and safety concerns?*
ii. *What can regulatory authorities do to ensure that embryo or oocyte donors are not receiving any inducement but fairly reciprocated for their contributions to gene editing research?*
iii. *What can researchers and research institutions do to ensure that the dignity and rights and privacy and confidentiality of individuals who donate embryos or oocytes are protected?*

d. Equitable Access and Allocation of Resources

4 Gene editing technologies extend beyond discovering and developing therapies, particularly for rare genetic disorders, severe diseases such as cancer, and treatment of infertility. These technologies can also be used for enhancing specific traits. However, as with many new modalities in medicine, gene editing technologies could be prohibitively expensive and would give rise to concerns of inequitable access by those who are in need but cannot afford them.

Ethical Considerations:

i. *What are the ethical considerations in ensuring equitable access to gene editing technologies?*
ii. *How do we ensure equitable access to gene editing technologies across different socio-economic groups and regions?*

iii. *How can researchers and research institutions encourage more Asian participation in clinical trials for gene editing technologies to ensure inclusivity?*

e. Genetic Enhancement and the Effects on Society

5 Recent advances have increased the possibility that gene editing can also be used for purposes that go beyond therapies and medical interventions, and the possible applications of gene editing technologies include genetic enhancement in areas such as conferring resistance to diseases and enhancement of physical attributes and cognitive abilities. Such potential clinical applications of gene editing technologies raise several ethical issues.

Ethical Considerations:

i. *What are the ethical considerations involved in using gene editing technologies for genetic enhancement?*
ii. *How might potential clinical applications of gene editing for genetic enhancement impact future generations?*
iii. *Should we allow clinical applications of gene editing for genetic enhancement?*
iv. *What can be done to ensure that gene editing technologies are used responsibly and ethically?*

ANNEX B

About the Bioethics Advisory Committee (BAC):

The Bioethics Advisory Committee (BAC) is an independent national advisory body established by the Singapore Cabinet in December 2000 to review ethical, legal, and social issues arising from biomedical research and its applications in Singapore. It develops and recommends policies on these issues, with the aim of protecting the rights and welfare of individuals, while allowing the biomedical sciences to develop and realise its full potential for the benefit of humankind. For more details on the BAC, please visit https://www.bioethics-singapore.gov.sg/.