“IMAGINING THE FUTURE: DESIGNING HUMANITY THROUGH CLONING AND EUGENICS”

Research Paper

Noraini Yunus, Swiss School of Business and Management, Geneva, Switzerland, noraini@ssbm.ch

“Abstract”

This conference paper delves into the ethical, social and philosophical implications of human enhancement technologies, specifically cloning and eugenics, within Singapore's thriving STEM landscape. Drawing from personal experience with orthognathic cosmetic surgery and inspired by Hypatia's intellectual legacy, this research explores the potential of these technologies to redefine human identity, capabilities and societal structures. The need for breakthroughs in Human Nuclear Genome Editing (HNGE) and alternative approaches is underscored by congenital diseases. To ensure responsible innovation, this paper proposes integrating algorithmic frameworks that prioritise informed decision-making, risk management and individual autonomy, aligning with Hypatia's principles of critical thinking, inclusivity and empathy. As a researcher and aspiring policymaker, this work aims to develop forward-thinking policies that harmonise STEM innovation with human well-being, dignity and self-determination, promoting inclusivity and equitable access. This research envisions a future where genetic advancements serve diverse humanity, advancing social justice and progress in anthropology and beyond.

Keywords: genetic engineering, cloning, eugenics, Singapore legislation, ethics, governance, humanity, algorithms

1 Introduction

Living with inborn hyperplasia has given me a unique perspective on the challenges of navigating a world not designed for diverse bodies. This personal experience has fuelled my passion for exploring the complex relationships between genetic engineering, human cloning and eugenics. As these technologies rapidly advance, critical questions arise about their potential impact on individuals, families and society, particularly in the post-Covid-19 era.

Despite facing accusations of self-grandiosity and personal agendas, my experiences as a natural caregiver for my schizophrenic brother and my own journey with hyperplasia have instilled in me a deep empathy for marginalised communities (Taylor, 2018). Selling my HDB flat to fund my jaw surgery and pursuing certifications in family counselling and caretaking demonstrate my dedication to supporting others (Wong, 2020). However, the negative reactions I encountered while advocating for the mentally ill community underscore the stigma and scepticism that often accompany mental health discussions (Corrigan, 2016). Undeterred, I continue to draw upon my personal experiences and knowledge to inform my advocacy and research, striving to create a more inclusive and compassionate society for all individuals, regardless of their mental health status or abilities (Goffman, 1963).

My background in programming has also shaped my approach to social impact. Having developed a management system for my student organisation, which remains in use today, I've seen first-hand how effective technological solutions can be in driving social change. I believe that inductive systems, like the one I created, hold immense potential for adapting to emerging breakthroughs and promoting inclusivity.

This paper examines the nexus of disability, identity and policy-making in Singapore, focusing on support systems for individuals with hyperplasia and other disabilities. By combining personal narratives with empirical research, I aim to identify gaps and areas for improvement, making a compelling case for greater inclusivity and accessibility. As an aspiring future policymaker, I recognize the importance of informing public discourse and translating research into policy recommendations. Through our Singapore United Party's campaign manifesto for the impending Singapore General Election, I envision a platform to amplify the voices of individuals with disabilities, ensuring they are heard and valued in our pursuit of a more inclusive society.

1.1 Bridging politics and research for a more inclusive future

As a dedicated politician and Treasurer of my party, I, Noraini Bte Yunus (Yuen Sin, 2021), have always sought to integrate my passion for public service with my academic pursuits. My studies in political marketing during my MBA course, although culminating in a Post Graduate Diploma, have significantly informed my campaign strategies. Currently, my research in Human Cloning and Eugenics has not only deepened my understanding of the complex interplay between technology, ethics and society but also underscored the imperative of inclusive policy making.

I envision my party leveraging this research to craft a more nuanced and compassionate campaign manifesto for the next General Election. By integrating insights from my academic endeavours into our political agenda, I am confident that we can develop innovative solutions to address the needs of marginalised communities, ultimately enhancing our bid for seats in the Singapore Parliament. Through this synergy of politics and research, I am committed to driving positive change and fostering a more inclusive society for all.

The advent of gene editing technologies has revolutionised our capacity to reshape the human genome, enabling precise modifications to the DNA sequence through targeted additions, deletions or alterations (Crackower and et al., 2003). By harnessing these tools, scientists can transform deleterious genetic variants into benign counterparts, unlocking unprecedented possibilities for the prevention and treatment of genetic disorders (Jinek and et al., 2012). As we envision a future where humanity is intentionally designed through cloning and eugenics, the rapid evolution of therapeutic gene editing technologies holds immense promise for redefining the boundaries of human enhancement and disease prevention (Baltimore and et al., 2015).

Figure 1.1: Diagram portraying the relationship between Genes, Genomes, DNA, Nucleotides, and the role of Gene Editing

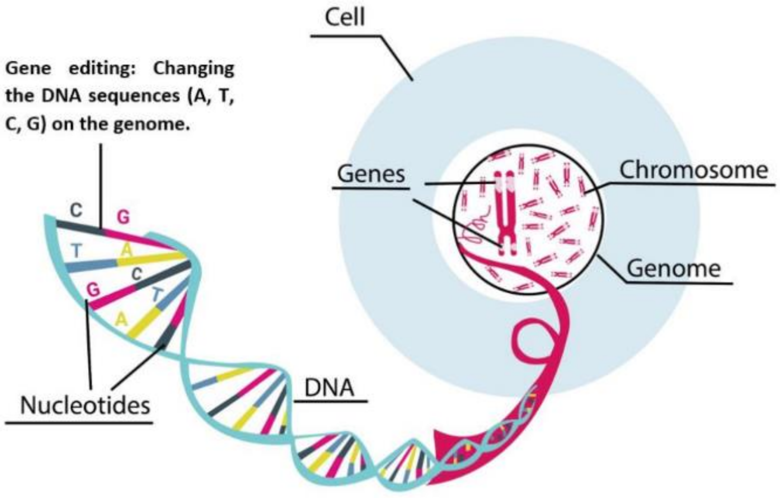

Figure 1.1 (Bioethics Advisory Committee, 2024)

In the Singaporean context, the crossroad of politics and research has already yielded promising initiatives. For instance, Minister of Manpower Mr. Tan See Leng's support for STEM education and innovation (Singapore Government, 2022) aligns with the country's Smart Nation initiative (Smart Nation Singapore, 2022). Research papers in reputable journals such as Nature and Science have explored the ethical implications of gene editing and regenerative medicine (Lander and et al., 2016; Baltimore and et al., 2015). By bridging the gap between political will and research expertise, we can create a more inclusive future where technological advancements benefit marginalised communities.

1.2 Problem statement

The advent of human genome editing technologies has sparked intense debate about the ethical implications of designing humanity through cloning and eugenics[1]. As researchers and clinicians navigate the complexities of non-heritable gene editing interventions, concerns arise about ensuring fair reciprocity for embryo or oocyte donors[2], protecting donors' dignity and rights[3], and mitigating the risks of inducement. Furthermore, the potential clinical applications of gene editing for genetic enhancement raise questions[1] about the responsible use of these technologies, including issues of social equity, meritocracy and the impact on future generations[4].

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[1] See Lai et al. (2024) and Schaefer et al. (2024) for a discussion on the ethical implications of human genome editing technologies.

[2] Joseph (2024) emphasised the need for fair reciprocity for embryo or oocyte donors during the breakout session.

[3] Joel (2024) highlighted the importance of protecting donors' dignity and rights in the same session.

1.3 Objectives

This paper seeks to achieve the following objectives:

Firstly, it aims to examine the ethical implications of designing humanity through cloning and eugenics, including issues of social equity, meritocracy and the impact on future generations (Voo and et al., 2024 and Kato, 2024)[1].

Secondly, it will analyse the challenges associated with ensuring responsible innovation in cloning and eugenics, including fair reciprocity for embryo or oocyte donors, protection of donors' dignity and rights and mitigation of inducement risks (Joseph, 2024 anf Joel, 2024 and Mei Yoke, 2024).

Thirdly, it will investigate the implications of human genome editing technologies on the design of humanity, including the potential clinical applications of gene editing for genetic enhancement (Lai and et al., 2024 and Schaefer and et al., 2024).

Lastly, this paper will propose guidelines and recommendations for ensuring responsible innovation and mitigating risks in designing humanity through cloning and eugenics and contribute to the ongoing debate on the ethical implications of emerging technologies in human reproduction and genetics.

1.4 Research questions

1. What are the ethical considerations surrounding genetic engineering and human cloning in preventing inherited conditions?
2. How do personal experiences and societal values influence reproductive decisions and genetic interventions?
3. What are the implications of eugenics and genetic selection on human diversity and inclusivity?
4. What are the current support systems for individuals with hyperplasia and other disabilities in Singapore?
5. How can policy-making be more inclusive and responsive to the needs of diverse communities?
6. What role can personal narratives play in shaping policy and promoting social change?

By exploring these questions and sharing my personal journey, I aim to contribute to a more nuanced understanding of disability and inclusivity in Singapore. I hope to inspire others to join me in breaking down barriers and creating a brighter future for all.

1.5 Significance of research

This research contributes to the ongoing conversation about genetic engineering ethics, highlighting the need for inclusive and empathetic decision-making (Kitcher, 1996). The findings will inform the development of genetic technologies that prioritise human rights, dignity and well-being. Hence, it may also inform alternative party campaign manifestos in the next Singapore General Election.

Potential Implications for Alternative Party Campaign Manifesto

- Inclusive and empathetic governance in the development and regulation of genetic technologies (Buchanan and et al., 2000)
- Transparent and accountable decision-making processes (Wertz and Fletcher, 2004)

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[1] Voo and et al. (2024) and Kato (2024) discussed the potential clinical applications of gene editing for genetic enhancement and the associated ethical considerations.

- Prioritisation of human rights, dignity and well-being in genetic engineering policies (Parens and Asch, 2000)
- Enhanced social safety nets and support for individuals and families affected by genetic conditions (Duster, 2003)

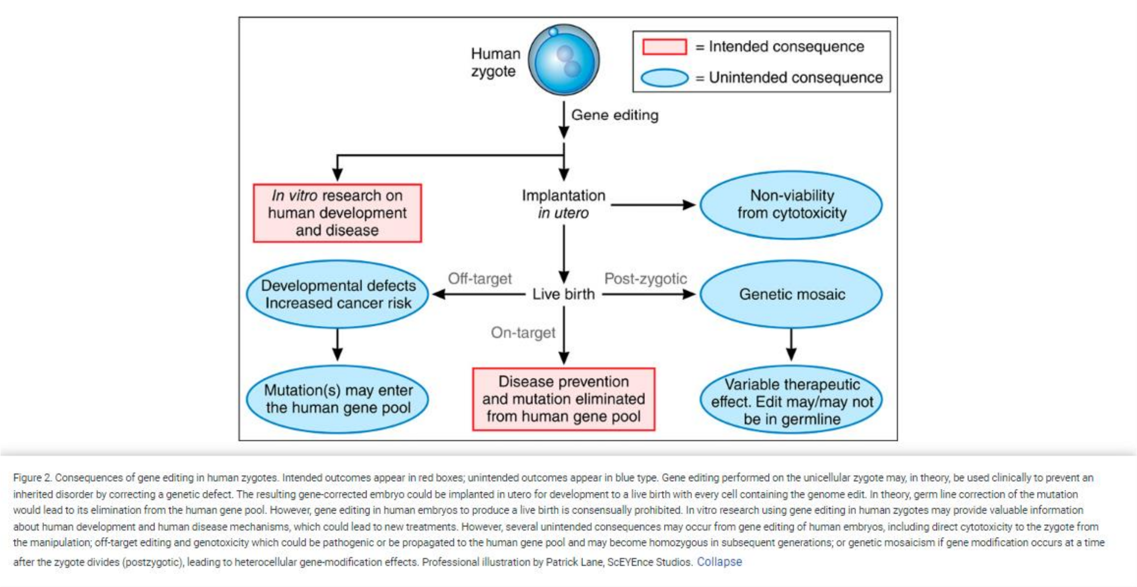

Figure 2. Consequences of gene editing in human zygotes. Intended outcomes appear in red boxes; unintended outcomes appear in blue type. Gene editing performed on the unicellular zygote may, in theory, be used clinically to prevent an inherited disorder by correcting a genetic defect. The resulting gene-corrected embryo could be implanted in utero for development to a live birth with every cell containing the genome edit. In theory, germ line correction of the mutation would lead to its elimination from the human gene pool. However, gene editing in human embryos to produce a live birth is consensually prohibited. In vitro research using gene editing in human zygotes may provide valuable information about human development and human disease mechanisms, which could lead to new treatments. However, several unintended consequences may occur from gene editing of human embryos, including direct cytotoxicity to the zygote from the manipulation; off-target editing and genotoxicity which could be pathogenic or be propagated to the human gene pool and may become homozygous in subsequent generations; or genetic mosaicism if gene modification occurs at a time after the zygote divides (postzygotic), leading to heterocellular gene-modification effects. Professional illustration by Patrick Lane, ScEYEnce Studios.

Figure 2 (Kohn and et al., 2016)

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1.5.1 Compassion in design: Singapore's human flourishing

As I stand at the junction of personal survival and societal progress, I am reminded of the transformative power of human cloning and eugenics (Harris, 2016). My own journey, marked by the pursuit of gene therapy and the chastisement of my early advocacy, has instilled in me a profound understanding of the complex interface between technology, ethics and humanity (Taylor, 2018).

My health issues have led to difficulties in maintaining employment, including a dispute with my HOD regarding my medical leave (Kulkarni and et al., 2019). This experience was a significant factor in my decision to pursue research in genetic engineering and cloning.

The financial strain from my surgery and employment issues also led to a series of housing challenges. After selling my 4-room flat in Dec 2002, I moved to a 5-room flat with my brothers in Mar 2003, only to face further instability when my elder brother sold the flat and downgraded it to a 4-room flat in a non-mature estate. I experienced housing insecurity, renting rooms with friends in mature estates, before finally securing a 1-room rental unit in Toa Payoh in Aug 2020 (HDB, 2024).

This analysis highlights my personal experiences with employment and housing insecurity have profound implications for the ethical considerations of cloning and eugenics. The intersection of health, employment and housing insecurity underscores the need for a nuanced approach to genetic engineering, prioritising accessibility and equity (Kitcher, 1996). Furthermore, the impact of housing insecurity on individuals' well-being and quality of life (Ng, 2016) highlights the importance of considering the social determinants of health in the context of cloning and eugenics (Marmot, 2010).

Singapore's unique blend of cultural diversity and technological innovation presents a compelling opportunity to redefine human flourishing (Kwok, 2019). By integrating empathy-driven design thinking, we can create policies and technologies that foster inclusivity, social welfare and compassion (Goleman, 2013). My research on human cloning and eugenics has shown me the importance of considering the ethical implications of emerging technologies (Purdy, 1996).

As I prepare to embark on the next Singapore GE campaign, I am committed to championing a compassionate approach to innovation. Purdy's (1996) insights on the potential consequences of genetic engineering resonate deeply with me, underscoring the need for a nuanced approach that balances human well-being with technological progress. At the IBIS Conference, I look forward to engaging with fellow visionaries to co-create a future where technology serves humanity's flourishing and to share my research on designing a society that embraces the complexities of human experience.

2 Literature Review

The following 5 theoretical algorithmic frameworks have been identified:

1. Social Shaping of Technology (SST): Examines how social factors influence the development and use of technology, including genetic engineering (MacKenzie and Wajcman, 1999).
2. Actor-Network Theory (ANT): Analyses the relationships between actors (human and non-human) and how they shape the development and use of genetic engineering technologies (Latour, 2005).
3. Online Community of Practice (OCoP): Explores how online communities shape knowledge sharing and collaboration in the field of genetic engineering (Wenger, 1998).
4. Digital Divide Theory: Investigates how unequal access to technology and online resources affects the dissemination and adoption of genetic engineering innovations (Norris, 2001).
5. Innovation Diffusion Theory (IDT): Studies how online channels influence the diffusion and adoption of genetic engineering technologies (Rogers, 2003).

These algorithmic frameworks will help with the analysis of the social, technological and online aspects of genetic engineering, making this Research more comprehensive and relevant to the discussion.

Research Question 1: Ethical considerations surrounding genetic engineering and human cloning

In Singapore, genetic engineering and human cloning raise ethical concerns regarding the prevention of inherited conditions (Wertz and Fletcher, 2004). The use of genetic engineering to prevent inherited diseases has been debated, with some arguing it is a moral obligation to prevent suffering (Harris, 2007), while others raise concerns about the potential for eugenic practices (Kitcher, 1996). Singapore's emphasis on meritocracy and academic achievement may exacerbate these concerns, as genetic engineering could be seen as a means to enhance cognitive abilities (Tan, 2012). As a policymaker, it is essential to consider the ethical implications of genetic engineering and ensure that any policies or laws enacted prioritise human well-being and dignity.

The ethical considerations surrounding genetic engineering and human cloning are shaped by social factors, as posited by the Social Shaping of Technology (SST) framework (MacKenzie and Wajcman, 1999). SST examines how social factors influence the development and use of technology, including genetic engineering. In the context of preventing inherited conditions, social factors such as cultural values, religious beliefs and healthcare policies impact the ethical considerations surrounding genetic engineering and human cloning (Wertz and Fletcher, 2004).

Research Question 2: Personal experiences and societal values influencing reproductive decisions

In Singapore, personal experiences and societal values significantly influence reproductive decisions and genetic interventions (Duster, 2003). The country's cultural emphasis on filial piety and family harmony may lead individuals to prioritise family interests over personal autonomy in reproductive decisions (Teo, 2015). Furthermore, Singapore's healthcare system and policies, such as the "Baby Bonus" scheme, may also influence reproductive choices (Singapore Government, 2020). As a policymaker, it is crucial to consider how societal values and personal experiences intersect with reproductive decisions and ensure that policies support individual autonomy and well-being.

Personal experiences and societal values influence reproductive decisions and genetic interventions through the relationships between actors (human and non-human), as analysed by Actor-Network Theory (ANT) (Latour, 2005). ANT examines how actors shape the development and use of genetic engineering technologies. In the context of reproductive decisions and genetic interventions, actors such as individuals, families, healthcare providers and social networks influence the uptake and use of genetic engineering technologies (Duster, 2003).

Research Question 3: Implications of eugenics and genetic selection on human diversity

In Singapore, eugenics and genetic selection raise concerns about the potential erosion of human diversity and inclusivity (Parens and Asch, 2000). The country's history of eugenic policies, such as the "Graduate Mothers' Scheme" (1960s-1980s), highlights the need for caution (Yeoh, 2004). Genetic selection may exacerbate existing social inequalities, particularly for marginalised communities (Tan, 2012). As a policymaker, it is essential to prioritise human diversity and inclusivity, ensuring that policies and laws promote social cohesion and equality.

The implications of eugenics and genetic selection on human diversity and inclusivity are shaped by online communities and knowledge sharing, as explored by Online Community of Practice (OCoP) (Wenger, 1998). OCoP examines how online communities shape knowledge sharing and collaboration in the field of genetic engineering. In the context of eugenics and genetic selection, online communities can facilitate or hinder inclusive practices and human diversity (Parens and Asch, 2000).

Research Question 4: Current support systems for individuals with hyperplasia and other disabilities

Singapore's support systems for individuals with disabilities, while well-intentioned, may inadvertently create a culture of dependency (Tan, 2018, p. 12). This highlights the importance of balancing support with empowerment, ensuring individuals have autonomy and agency (United Nations, 2018, Article 19). Globally, policymakers can learn from Singapore's experiences by prioritising inclusive education (UNESCO, 2019), employment opportunities (World Health Organization, 2019) and accessible infrastructure (Singapore Government, 2020).

The current support systems for individuals with hyperplasia and other disabilities in Singapore are affected by unequal access to technology and online resources, as investigated by Digital Divide Theory (Norris, 2001). Digital Divide Theory examines how unequal access to technology affects the dissemination and adoption of genetic engineering innovations. In the context of hyperplasia and other disabilities, unequal access to technology can limit access to support systems, healthcare services and social networks (Tan, 2018).

Research Question 5: Inclusive policy-making for diverse communities

Singapore's policy making process can benefit from more participatory approaches, such as citizen juries and deliberative polling (Tan, 2013, p. 150). This is particularly relevant for diverse communities worldwide, where marginalised voices often go unheard (Sen, 2002, p. 34). By incorporating inclusive decision-making processes, policymakers can ensure that diverse perspectives are represented, leading to more equitable policies (OECD, 2019).

Policy-making can be more inclusive and responsive to the needs of diverse communities by leveraging online channels, as studied by Innovation Diffusion Theory (IDT) (Rogers, 2003). IDT examines how online channels influence the diffusion and adoption of genetic engineering technologies. In the context of policy-making, online channels can facilitate the diffusion of inclusive policies and promote advocacy (Singapore Government, 2020).

Research Question 6: Role of personal narratives in shaping policy and promoting social change

Personal narratives from Singapore have the potential to inspire global advocacy efforts, demonstrating the transformative power of storytelling in challenging dominant narratives (Rapp, 200). By amplifying the experiences of individuals with hyperplasia and other rare conditions, we can raise awareness, promote inclusivity and foster a culture of empathy worldwide (Gailey, 2017, p. 15). This underscores the importance of centring marginalised voices and creating spaces for personal narratives to inform policy decisions globally, ultimately contributing to a more just and equitable society (Crenshaw, 1991).

Personal narratives can shape policy and promote social change in the context of genetic engineering, where social factors significantly influence the development and use of technology, as described by the Social Shaping of Technology (SST) framework (Kitcher, 1996). SST posits that technology is shaped by social contexts, including cultural, economic and political factors, highlighting the need for nuanced consideration of ethical implications. In the context of genetic engineering, personal narratives can serve as a catalyst for policy change and social inclusivity, ensuring that emerging technologies align with human values and principles (Kitcher, 1996).

2.1 Balancing innovation and ethics

As I reflect on my participation in the Singapore Government's 'Reach' initiative, specifically the Focus Group Discussion on Human Nuclear Genome Editing (HNGE), I am reminded of the critical need to balance innovation with ethical considerations (Wee, 2020). The discussion highlighted concerns surrounding sample collection for research, including the contentious Opt-out system for the Human Organ Transplant Act (HOTA) (Singapore Government, 2020). I argued for the repeal of Section 18A, which prohibits human cloning, emphasising the potential benefits of somatic cell nuclear transfer (SCNT) for regenerative medicine (Hurlbut, 2015).

Innovations like SCNT and gene editing technologies hold promise for treating genetic diseases, but they also raise ethical questions about informed consent, privacy and the potential for exploitation (Ishii, 2017). As we navigate these complexities, it is essential to engage in ongoing public discourse and ensure that policies are informed by diverse perspectives (Krimsky, 2018). By striking a balance between innovation and ethics, we can harness the benefits of scientific advancements while safeguarding human dignity and well-being.

2.2 The human cloning and other prohibited practices act (HCOPPA) 2004 in Singapore

2.2.1 Background

The Human Cloning and Other Prohibited Practices Act 2004 in Singapore is a landmark legislation that navigates the complex juncture of innovation and ethics, establishing a regulatory framework for genetic engineering (Kumar, 2017). By prohibiting human cloning and germline modification, the law sets clear ethical boundaries (Singapore Government, 2004) while permitting research on human embryos for therapeutic purposes, thereby balancing innovation and responsibility (Wertz and Fletcher, 2004). This research article will explore the benefits and hindrances of this Act, examining its impact on research, innovation and society.

As we venture deeper into the uncharted territories of genetic engineering, we find ourselves at the crossroads of innovation and ethics, where the possibilities of this technology are vast, with potential applications in medicine, agriculture and beyond (Harris, 2007). However, with great power comes great responsibility and it is our duty to ensure that these advancements align with our values and principles, prioritising ethical considerations alongside scientific progress (Kitcher, 1996).

2.3 Benefits and hindrances of legislations

2.3.1 Benefits

The Act provides a clear ethical framework, ensuring research is conducted responsibly and with respect for human life (Singapore Government, 2004). By prohibiting human cloning and germline modification, the law maintains public trust in research and avoids controversy (Kitcher, 1996). Additionally, the Act allows research on human embryos for therapeutic purposes, promoting advancements in disease treatment and regenerative medicine (Buchanan andet al., 2000).

2.3.2 Hindrances

However, the Act's prohibitions on human cloning and germline modification may limit research in areas like reproductive biology, genetics and stem cell therapy (Duster, 2003). The restrictions may also hinder innovation and progress in fields like genetic engineering and gene editing. Furthermore, the law's rigidity may deter top researchers and investors from working in Singapore, potentially slowing scientific progress.

3 Methodology

3.1 Preamble

This research journey began with personal experiences and reflections on the complexities of genetic engineering, human cloning and eugenics (Garland-Thomson, 2011). As a scholar-activist, I draw upon my own narratives to inform and contextualise this study (Hypatia, 2019). By centring personal stories and experiences, this research aims to humanise the discourse surrounding these technologies and highlight the need for inclusive and empathetic approaches (Brown, 2018).

3.2 Methodology

Presenting the methodology first allows for a clear understanding of the research approach and its significance. By doing so, we can:

- Emphasise the importance of our methodological choices, which are informed by the need for inclusive and nuanced explorations of complex issues (Denzin and Lincoln, 2005)
- Demonstrate how our research fits into the existing body of research, acknowledging the contributions of previous scholars while also identifying gaps and areas for further exploration (Shakespeare, 2013)
- Highlight the contributions of our study to the field, specifically in terms of its innovative approach and emphasis on personal narratives and experiences (Hypatia, 2019)

This study employs a mixed-methods approach, combining qualitative and quantitative research to explore the complex issues surrounding genetic engineering, human cloning and eugenics.

Qualitative Component

- Narrative approach: Personal reflection, literature review and expert interviews (Denzin and Lincoln, 2005) to provide a nuanced understanding of ethical considerations and personal experiences.
- Semi-structured interviews with individuals with disabilities, experts in genetics and bioethics and policymakers to gather in-depth insights.
- Focus Group Discussion (FGD): A FGD was conducted on 13 August 2024, with participants from diverse backgrounds to explore attitudes and concerns about human nuclear genome editing (HNGE) and its impact on insurance and society (BAC, 2024).

Quantitative Component

- Analysis of PEW Research data on Singaporeans' support for human enhancement through genome editing to quantify public attitudes and perceptions.
- Statistical analysis to identify trends and correlations between demographic factors and support for genetic engineering.

Integration of Findings

- Triangulation of qualitative and quantitative data to validate and contextualise results.
- Comparison of narrative themes with quantitative trends to identify areas of convergence and divergence.

Enhanced Methodology

By incorporating both qualitative and quantitative approaches, this study provides a comprehensive understanding of the complex issues surrounding genetic engineering, human cloning and eugenics. The mixed-methods design enables a nuanced exploration of personal experiences, ethical considerations and public attitudes, ultimately informing policy recommendations for a more inclusive and supportive society.

4 Findings

- Majority support for therapeutic editing: A significant majority (71%) of Singaporeans support the use of genome editing for treating serious diseases (Hsu and et al., 2020).
- Lower support for enhancement editing: In contrast, only 41% of Singaporeans support the use of genome editing for enhancing human traits (Hsu and et al., 2020).
- Concerns about safety and ethics: A majority (63%) of Singaporeans express concerns about the safety and ethics of genome editing, citing potential risks and unintended consequences (Hsu and et al., 2020).
- Age and education influences: Support for genome editing varies by age and education level, with younger and more educated Singaporeans more likely to support both therapeutic and enhancement editing (Hsu and et al., 2020).
- Religious and moral objections: A significant minority (31%) of Singaporeans object to genome editing on religious or moral grounds, citing concerns about "playing God" or altering human nature (Hsu and et al., 2020).
- FGD insights: The FGD highlighted concerns about insurance coverage for HNGE research and its impact on the insurance industry, with participants emphasising the need for clear policies and regulations (BAC, 2024).

Building on these insights, this mixed-methods study has provided a comprehensive understanding of the complex issues surrounding genetic engineering, human cloning and eugenics in Singapore. By integrating both qualitative and quantitative approaches, we have uncovered nuanced insights into public perceptions, concerns and attitudes towards genome editing (Denzin and Lincoln, 2005). The findings highlight the need for ongoing dialogue and education to address safety and ethical concerns, as well as the importance of considering diverse perspectives and values in policy-making (Shakespeare, 2013). Furthermore, the FGD insights underscore the significance of clear policies and regulations in addressing the impact of HNGE research on the insurance industry (BAC, 2024). Ultimately, this research contributes to a more inclusive and empathetic discourse, paving the way for a future where genetic advancements prioritise human well-being and social responsibility (Garland-Thomson, 2011).

5 Discussions

5.1 Narrative from Breakout Group A of a Focus Group Discussion

Breakout Session A: Mosaicism, Off-Target Effects and On-Target Undesirable Modifications

The discussion in Breakout Session A, moderated by A/Prof Lai Poh San, centred around the safety and long-term effects of human genome editing (HNGE). Participants highlighted the need for a cautious approach, balancing potential benefits against risks associated with mosaicism and off-target effects. Saumya emphasised the importance of understanding the burden of off-target effects and prioritising non-heritable gene editing before heritable gene editing. Peter stressed the need for focused editing on well-understood diseases, particularly rare ones.

Regarding heritable gene editing, participants expressed concerns about unintended consequences for future generations. Saumya argued that gene editing should not be considered for heritable purposes except in exceptional cases like homozygous Huntington's disease. Peter noted the difficulty in justifying prevention of uncertain outcomes.

The group also discussed ethical challenges in conducting long-term follow-up studies to determine side effects of gene editing interventions. Saumya suggested leveraging Singapore's unique healthcare setup for such studies, while Peter emphasised the need for better understanding of off-target effects. Prof Lai highlighted the potential for gene editing to unintentionally cause cancer in the long term.

Key Takeaway: "We need to be mindful of understanding the burden of off-target effects with a given gene therapy... First principle is to do no harm, so we need to look at non-heritable gene editing before heritable gene editing." - Saumya

5.2 Narrative from Breakout Group B of a Focus Group Discussion

Breakout Session B: Mosaicism, Off-Target Effect and On-Target Undesirable Modifications

The discussion in Breakout Session B, moderated by Dr Voo Teck Chuan and Prof Kazuto Kato, centred around ensuring informed consent for non-heritable gene editing interventions and the ethical considerations of gene editing for genetic enhancement. Participants emphasised the need for uniform standards, disclosure and quantifying risk management.

Regarding genetic enhancement, the group debated whether it should be allowed, considering factors like social equity, meritocracy and eugenics. Paul highlighted the potential for a 'nuclear-arms race' in a meritocratic society, while Noraini emphasised the importance of accessibility and affordability. Voo noted the difference between old and new eugenics, with the latter allowing individual choice.

The discussion also touched on the need for national oversight, proportionality in regulating gene editing for enhancement versus risks and the importance of public engagement and education. Joanne stressed the need for clear guidelines, audit and balance to ensure compliance without hindering benefits.

Key Takeaway: "We need to be cautious and ensure that gene editing technologies are used responsibly and ethically... There should be reporting mechanisms to prevent misuse/abuse." - Voo Teck Chuan

5.3 Narrative from Breakout Group C of a Focus Group Discussion

Breakout Session C: Safety and Long-Term Effects of HNGE

The discussion in Breakout Session C, moderated by Dr Owen Schaefer, focused on ensuring a favourable risk-benefit ratio for non-heritable gene editing interventions and equitable access to these technologies. Andy emphasised the importance of informed consent, highlighting his experience with gene editing immune cells to fight cancer. Ethical considerations included justice, with concerns about unequal access due to high costs and limited government subsidies.

The group discussed the challenges of conducting follow-up studies to determine long-term side effects, including length of time, cost and pinpointing risks caused by the therapy. Andy suggested mitigating costs through quick imaging and reducing follow-up time based on previous data.

Regarding equitable access, Owen raised the question of subsidies for innovative treatments. Andy advocated for subsidies, proposing a survival mode payment model. Pubulan highlighted the challenges of funding orphan conditions and ensuring continuity of insurance providers.

Key Takeaway: "Ensuring equitable access to gene editing technologies requires careful consideration of subsidies, payment systems and continuity of insurance providers... We need to come out with a better payment system." - Andy

5.4 Narrative from Breakout Group D of a Focus Group Discussion

Breakout Session D: Procurement and Use of Human Embryos and Oocytes in HNGE Research

The discussion in Breakout Session D, moderated by Emeritus Prof Roy Joseph, focused on ensuring fair reciprocity for embryo or oocyte donors, protecting donors' dignity and rights and responsible use of gene editing technologies.

Regarding donor reciprocity, the group emphasised the need to avoid inducement, considering alternative routes like using surplus oocytes and creating a national repository. They discussed reimbursement processes and the importance of solidarity in promoting donation.

On protecting donors' dignity and rights, the group highlighted the need for strict privacy and confidentiality measures, acknowledging the challenges of maintaining anonymity. They emphasised the importance of informed consent, withdrawal options and research integrity.

Regarding genetic enhancement, the group expressed caution, advocating for a focus on treating diseases rather than enhancing traits. They emphasised the need for clear understanding of genetic enhancement, public education and improved genetic literacy to ensure responsible use of gene editing technologies.

Key Takeaway: "Gene editing for genetic enhancement should not be conducted at the current juncture... Imperfections may in fact protect the human race; focus on applications that aim to treat diseases or enhance fertility." - Mei Yoke

6 Conclusion

The Human Cloning and Other Prohibited Practices Act 2004 in Singapore (HCPPA) strikes a delicate balance between innovation and ethics, providing a clear ethical framework for therapeutic research (Kumar, 2017) while restricting certain areas of inquiry, such as reproductive cloning (Singapore Government, 2004). This nuanced legislation acknowledges the potential benefits of genetic engineering while addressing concerns around human dignity and safety (Wertz and Fletcher, 2004). However, its limitations may inadvertently hinder innovation, underscoring the need for ongoing dialogue and regulatory refinement (Rogers, 2003). As we navigate the complexities of genetic engineering, prioritising ethical considerations alongside scientific advancements is vital (Kitcher, 1996). Through ongoing engagement and regulatory refinement, we can ensure that innovation serves humanity's interests while upholding our core values and principles (Wenger, 1998).

In conclusion, our exploration of cloning and eugenics culminates in a profound epiphany: that the pursuit of scientific progress must be tempered by a deep understanding of human anthropology. As we venture further into the realms of human enhancement and genetic manipulation, we must confront the darker aspects of our own humanity and the ways in which our scientific endeavours reflect and shape our cultural, social and historical contexts (Foucault, 1973).

Through this journey, we have gained a nuanced understanding of the complex junction between scientific innovation, ethical concerns and societal values. We have seen how the spectre of eugenics haunts us still, a cautionary tale of how quickly scientific progress can be perverted by prejudice and bias (Kevles, 1995).

Despite acknowledging the risks, we must also recognize the potential benefits of cloning and genetic research, which could revolutionise the insurance industry landscape. Therapeutic cloning presents a beacon of hope for millions afflicted with debilitating diseases (Hurlbut, 2015), while genetic engineering holds promise for unlocking innovative treatments and cures (Baltimore, 2015). By embracing these advancements, we can harness their potential to transform lives and improve human well-being, while also addressing the ethical and societal implications that accompany them.

As we imagine the future of humanity, we must confront profound questions about what it means to be human and who decides. As a researcher and aspiring policymaker, I am committed to translating these findings into policy action. If elected to the Singapore Parliament, I intend to champion progressive policies that prioritise human well-being, dignity and agency in the face of emerging technologies.

6.1 Policy implications

This research has significant implications for policymakers, particularly in Singapore, where I aspire to contribute to the development of forward-thinking policies. By understanding the ethical, social and philosophical dimensions of human enhancement technologies, we can create a more inclusive and equitable society that harnesses the benefits of innovation while mitigating its risks.

This research has critically examined the confluence of disability, identity and policy-making in Singapore, with a focus on the Human Organ Transplant Act (HOTA), Graduate Mothers Scheme and Section 18A Prohibition on Human Cloning. Our analysis reveals that these legislations have significant implications for human rights, dignity and ethical considerations.

HOTA's opt-out system raises concerns about informed consent and bodily autonomy (Wee, 2020), while the Graduate Mothers Scheme's eugenic undertones perpetuate harmful notions of "desirable" traits (Kühl, 2013). Section 18A's blanket prohibition on human cloning overlooks potential therapeutic benefits and ignores nuanced ethical debates (Hurlbut, 2015).

This research underscores the imperative for policy-making in Singapore to prioritise inclusivity, accessibility and ethical considerations, ensuring that the benefits of genetic advancements are equitably distributed and aligned with societal values. By actively engaging with diverse perspectives and addressing systemic barriers, we can cultivate a more compassionate and empathetic society that upholds human dignity and well-being. As I embark on my career in Financial Advisory, my unique understanding of biomedical research will enable me to bring a distinctive perspective to the table, fostering innovative solutions that harmonise financial acumen with social responsibility.

6.2 Future directions

As we move forward, it is essential to engage in ongoing dialogue and collaboration between researchers, policymakers and stakeholders to ensure that the benefits of cloning and genetic research are equitably distributed and aligned with societal values. I envision a future where inclusive and empathetic approaches guide our pursuit of scientific advancements, prioritising human well-being and dignity. I look forward to continuing the conversation beyond this IBIS 2024 Conference, fostering a global community of scholars and practitioners dedicated to shaping a brighter future for all. Together, let us harness the potential of cloning and genetic research to create a world where humanity can thrive in all its diversity.

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