HUMAN GERMLINE EDITING AND A CHRISTIAN VIEW OF HUMAN NATURE

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I. INTRODUCTION

In April 2015, Dr. Junjui Huang and fifteen colleagues stunned the world.[2] They announced they had successfully edited the DNA of human embryos.[3] DNA—deoxyribonucleic acid—is a molecule that serves as the blueprint for organisms; it contains the genetic information that determines how they grow and function.[4] Using a biological system known as CRISPR-Cas9, Huang and his colleagues cut unwanted DNA sections from the embryos and replaced them with new DNA sections.[5]

What made the announcement startling wasn't that Huang had edited human cells; gene editing of ordinary cells had been done before, a technique known as somatic cell editing.[6] It was that he had done it on human embryos.[7] Had the embryos been able to develop and reproduce, the DNA changes made would have been passed on to future generations. Such genetic editing of embryos, sperm, and eggs (which affect reproduction) is called germline editing.[8]

The international response to Huang's announcement—and to human germline editing itself—was mixed. For some, the announcement was one of great joy and promise. Human germline editing holds out the hope that we can not only treat, but completely eradicate genetic diseases such as Tay Sachs, cystic fibrosis, and sickle cell anemia.[9] Others, though,

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[2] Puping Liang et al., *CRISPR/Cas9-Mediated Gene Editing in Human Tripronuclear Zygotes*, 6 PROTEIN & CELL 363, 370 (2015).

[3] David Cyranoski & Sara Reardon, *Chinese Scientists Genetically Modify Human Embryos,* NATURE (Apr. 22, 2015), http://www.nature.com/news/chinese-scientists-genetically-modify-human-embryos-1.17378.

[4] *Deoxyribonucleic Acid (DNA)*, NAT'L HUM. GENOME RSCH. INST., https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid (last updated Jan. 28, 2023).

[5] Cyranoski & Reardon, *supra* note 3.

[6] G. Owen Schaefer, *Why Treat Gene Editing Differently in Two Types of Human Cells?*, IFLSCIENCE (Dec. 8, 2015, 5:24 AM), https://www.iflscience.com/why-treat-gene-editing-differently-two-types-human-cells-32568.

[7] Cryanoski & Reardon, *supra* note 3 (noting that Huang's research was "set to reignite the debate on human-embryo editing" because the use of CRISPR/Cas9 on human embryos had not yet appeared in a published study).

[8] Shaefer, *supra* note 6.

[9] Antonio Regalado, *Engineering the Perfect Baby*, MIT TECH. REV. (Mar. 5, 2015), https://www.technologyreview.com/2015/03/05/249167/engineering-the-perfect-baby/; *Editing Humanity*, ECONOMIST, Aug. 22, 2015, at 11.

responded with concern. They warned that editing human embryos could cause unpredictable and possibly dangerous changes to the human genome.[10] Many, including some engaged in genetic research, urged that further human germline editing research halt while the world considers its ethical implications.[11] Leading genetic scientist Edward Lanphier, for example, counseled, "we need to pause this research and make sure we have a broad based discussion about which direction we're going here."[12]

Human germline editing research did not stop. Experiments—approved by national governments—continued both at the Francis Crick Institute in London and the Karolinska Institute in Stockholm.[13] So did other, less official, germline editing efforts.

In November 2018, another Chinese researcher, Dr. He Jiankui, made an announcement perhaps even more startling than Huang's three and a half years earlier. Jiankui revealed on YouTube that he had genetically edited the embryonic DNA of twin girls, Lulu and Nana, who had recently been born.[14] Jiankui had edited their DNA to strengthen their resistance to HIV.[15] Jiankui made his announcement just days before the Second Summit on Human Genome Editing was held in Hong Kong.[16] Jiankui also discussed his work at the Summit, and that work was the subject of much discussion and debate.[17] The Summit ended with a cautionary closing statement from its organizing committee, a group of leading genetic scientists including CRISPR co-developer Jennifer Doudna, "[t]he organizing committee concludes that the scientific understanding and technical requirements for clinical practice remain too uncertain and the risks too great to permit clinical trials of germline editing at this time."[18]

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[10] Regalado, *supra* note 9.

[11] Antonio Regalado, *Years Before CRISPR Babies, This Man Was the First to Edit Human Embryos*, MIT TECH. REV. (Dec. 11, 2018), https://www.technologyreview.com/2018/12/11/138290/years-before-crispr-babies-this-man-was-the-first-to-edit-human-embryos/ ("[T]he scientific community is deeply uncertain and conflicted about how to roll out a technology that will affect humanity's shared gene pool.").

[12] Cyranoski & Reardon, *supra* note 3.

[13] Ewen Callaway, *Gene-Editing Research in Human Embryos Gains Momentum*, NATURE, Apr. 19, 2016, at 298–90.

[14] Owen Dyer, *Researcher Who Edited Babies' Genome Retreats from View as Criticism Mounts*, 363 BRITISH MED. J. k5113, k5113 (2018).

[15] *Id.*

[16] *Id.*

[17] *See* David Cyranoski, *CRISPR-Baby Scientist Fails to Satisfy Critics*, NATURE, Dec. 6, 2018, at 13–14 (Dec. 6, 2018), https://www.nature.com/articles/d41586-018-07573-w (describing how some criticized and condemned Jiankui's work for violating international ethical norms, while others wanted to give him a chance to further explain his actions).

[18] *Statement by the Organizing Committee of the Second International Summit on Human Genome Editing*, NAT'L ACADS. OF SCIS., ENG'G, & MED. (Nov. 28, 2018), https://www.nationalacademies.org/news/2018/11/statement-by-the-organizing-committee-of-the-second-international-summit-on-human-genome-editing [hereinafter *Statement by*

Since 2018, there has been a flurry of debate and activity to decide what can and should happen next. Human germline editing continues at the Francis Crick Institute and Karolinska Institute,[19] though none of the edited embryos are permitted to develop past 14 days or be used to establish a pregnancy.[20] Editing research undoubtedly continues in many other laboratories as well; the CRISPR technology is widely accessible.

On the debate front, voices urge everything from moving to clinical application of human germline editing as quickly as possible to banning the practice altogether. As is often the case, legal responses to germline editing trail both the science and popular debate.

What is clear is that this is a seminal moment for humanity. We are presented with a technique that promises to eliminate diseases that afflict many. But it is also a technique that poses unknown risks to future generations—and a technique that to perfect will require experimentation on and destruction of many human embryos. What path should we take?

Patrick Dixon describes the significance of the moment this way: "[g]enetic engineering has given us the power to alter the very basis of life on earth."[21] Jeremy Rifkin similarly observes, "[w]e are about to remake ourselves as well as the rest of nature."[22] Richard Dawkins says:

> I think it's a very exciting prospect, because as a naturalist, in the philosophical sense, I'm committed to the view that there is nothing mystical or supernatural about life, and therefore in principle, it must be possible to construct life either by chemically, making your own by chemistry, or in a computer, and I find that both exciting and a bit alarming.[23]

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the Organizing Committee].

[19] *See, e.g.*, Gregorio Alanis-Lobato et al., *Frequent Loss of Heterozygosity in CRISPR-Cas9—Edited Early Human Embryos*, 118 PROCS. NAT'L ACAD. SCIS., no. 22, June 2021, at 1, 2 (reporting "unintended genome editing outcomes" resulting from the use of CRISPR-Cas9 to edit human embryos); *see also* Ganna Reint et al., *Rapid Genome Editing by CRISPR-Cas9- POLD3 Fusion*, 10 ELIFE e75415, 2 (2021) (studying the effect of "DNA repair protein-Cas9 fusion on CRISPR genome editing outcomes").

[20] Kathy Niakan, *Human Embryo and Stem Cell Laboratory*, FRANCIS CRICK INST., https://www.crick.ac.uk/research/labs/kathy-niakan/human-embryo-genome-editing-licence (last visited Aug. 13, 2022).

[21] Patrick Dixon, *Genetic Engineering: What Is Genetic Engineering?*, GLOB. CHANGE, https://www.globalchange.com/geneticengin.html (last visited Mar. 13, 2023).

[22] JEREMY RIFKIN, THE BIOTECH CENTURY: HARNESSING THE GENE AND REMAKING THE WORLD 32 (1998).

[23] Carole Cadwalladr, *Richard Dawkins Interview: 'It Must Be Possible to Construct Life Chemically, or in a Computer'*, THE GUARDIAN (Feb. 14, 2018, 4:36 PM), https://www.theguardian.com/science/2015/sep/11/richard-dawkins-interview-twitter-controversy-genetics-god.

These are bold claims. They make clear that decisions about human germline editing—whether scientific, ethical, or legal—are not just matters of technology. They go to the heart of the nature of humanity itself.

Before committing to any path that has such significant implications for the nature of humanity, it is vital to examine what that nature tells us. Unlike germline editing, consideration of human nature has a long history. One of the richest traditions of exploring human nature is found in Christian theology.[24]

This Article explores some of what Christianity says about human nature and its implications for how to approach human germline editing. Section I shares more details about human germline editing and what it promises. Section II examines the current legal and regulatory environment for human germline editing. Section III surveys various legal and ethical approaches to address human germline editing. Section IV explores a Christian view of human nature and concludes that the proper path is to move forward with human somatic cell gene editing but to ban human germline editing.

II. GERMLINE EDITING—ITS PROMISE AND CHALLENGES

As noted above, germline editing involves genetic changes to sperm, egg cells, or embryos.[25] Such changes are "heritable" and can be passed on to descendants.[26] Germline editing is not the only form of genetic editing. Somatic cell editing involves modifying ordinary cells that make up tissue or organs like the heart, brain, or liver.[27]

Human somatic cell gene editing is much less controversial than germline editing. It is done in a single patient to cure disease—and changes made do not alter the human genome for future generations.[28] The genetic changes only affect the individual patient.[29]

Human somatic cell editing has been done with significant success. For example, in December 2015, scientists introduced a gene therapy that modified a patient's prostate cancer cells so that the patient's body attacked and destroyed them.[30] The BBC notes that this technique has

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[24] *See infra* notes 138–169 and accompanying text.

[25] *See* Shaefer, *supra* note 6.

[26] Laura Blackburn et al., *Somatic Genome Editing—An Overview*, PHG FOUND. 1 (2019).

[27] NAT'L ACADS. SCIS. ET AL., HUMAN GENOME EDITING: SCIENCE, ETHICS, AND GOVERNANCE, 3, 115 (2017).

[28] Mary Todd Bergman, *Perspectives on Gene Editing*, HARV. GAZETTE (Jan. 9, 2019), https://news.harvard.edu/gazette/story/2019/01/perspectives-on-gene-editing/.

[29] Rebecca Rodriguez, *Beyond Dr. Frankenstein's Monster: Human Germline Editing and the Implications of Waiting to Regulate*, 38 N. ILL. UNIV. L. REV. 585, 591 (2018).

[30] *'Suicide' Gene Therapy Kills Prostate Cancer Cells*, BBC (Dec. 12, 2015), http://www.bbc.com/news/health-35072747.

improved patient survival by twenty percent.[31] Scientists similarly report using somatic cell editing to successfully treat chronic lymphocytic leukemia, HIV, inherited retinal disease, and beta thalassemia (an inherited blood disease).[32]

The tool used by Huang and He and other scientists performing human germline editing is known as CRISPR-Cas9.[33] "CRISPR" is an acronym for clustered regularly interspaced short palindromic repeats.[34] It is a biological system that performs a cut-and-paste function on DNA.[35] Scientists insert a piece of RNA, "a chemical messenger designed to target a section of DNA," and an enzyme that cuts out the defective gene section and pastes in a new one.[36] Professors Jennifer Doudna and Emmanuelle Charpentier received the 2020 Nobel Prize in Chemistry for developing this gene editing tool.[37]

The enticing promise of human germline editing is that it provides a way to eradicate diseases altogether. Because DNA changes are made to sperm or egg cells or early-developing embryos, they affect every cell in the body. The changes are also passed on to future generations, so somatic cell therapy need not take place each generation.[38] Proponents hope to eliminate certain genetic diseases like Huntington's Disease, Tay Sachs, and cystic fibrosis.[39] Genetic changes could also be made to make individuals less susceptible to Alzheimer's or heart disease.[40]

In addition to curing disease, human germline editing holds out the possibility of enhancing human mental and physical capacity and performance. One could make genetic changes designed to increase

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[31] *Id.* A form of somatic cell gene therapy was used as early as 1990 when Dr. William Anderson modified the white blood cells of a four-year-old patient. Jeffrey Laurence, *Preface* to TRANSLATING GENE THERAPY TO THE CLINIC: TECHNIQUES AND APPROACHES, at xi (Jeffrey Laurence & Michael Franklin eds., 2014). The process was temporarily successful in treating a genetic based immune system disorder. *Id.*

[32] *See, e.g.*, *Gene Therapy Successes*, LEARN.GENETICS, https://learn.genetics.utah.edu/content/genetherapy/success/ (last visited Mar. 16, 2023) (describing the successful gene therapy treatment of beta-Thalassemia through the modification of blood stem cells); Scott J. Schweikart, *Global Regulation of Germline Genome Editing: Ethical Considerations and Application of International Human Rights Law*, 43 LOY. L.A. INT'L & COMP. L. REV. 279, 283 (2020) (explaining that CRISPR gene therapy trials have shown potential to treat HIV "by editing the genomes of immune cells").

[33] Cyranoski & Reardon, *supra* note 3.

[34] Heidi Ledford & Ewen Callaway, *Pioneers of CRISPR Gene Editing Win Chemistry Nobel*, NATURE, Oct. 15, 2020, at 346.

[35] Marla Vacek Broadfoot, *The Gene-Editing Tool CRISPR, Explained*, DISCOVERY'S EDGE (July 24, 2018), https://discoverysedge.mayo.edu/2018/07/24/the-gene-editing-tool-crispr-explained/ ("CRISPR enables researchers to cut and paste DNA sequences.").

[36] *Editing Humanity*, *supra* note 10.

[37] Ledford & Callaway, *supra* note 34.

[38] Rodriguez, *supra* note 29, at 592.

[39] Regalado, *supra* note 9; *Editing Humanity*, *supra* note 9.

[40] Regalado, *supra* note 11.

height, strength, or intelligence.[41] Genetic changes could make "your bones so hard they'll break a surgical drill."[42]

While human germline editing holds out significant possibilities, the technique also poses challenges. Notably, it is not uniformly successful in making the desired genetic alterations—and only those alterations.[43] Not all desired genetic changes occur when using CRISPR.[44] Further, the technique frequently causes unintended, "off-target" changes to other parts of the genome.[45] And sometimes editing efforts cause genetic changes to some but not all cells, an effect known as mosaicism.[46] Each of these is a matter of serious concern, especially since future generations will inherit any genetic changes.

The work done by Huang and He illustrate the problems. Dr. Huang and his team edited eighty-six non-viable embryos (he specifically chose non-viable embryos because they could not be born alive and reproduce).[47] Forty-eight hours after the procedure, seventy-one of the embryos survived.[48] They tested fifty-four of the seventy-one; only a fraction of the fifty-four contained the desired DNA segment.[49]

Huang's team also noted a "surprising number" of "'off-target,'" undesired mutations to other parts of the genome.[50] While certain off-target mutations, described by some as "collateral damage"[51] in the editing process, may be harmless, some may activate genes known to cause cancer.[52] The editing errors caused Huang's team to halt its work. At the time, Huang said, "[i]f you want to do it in normal embryos, you need to be close to 100%. That's why we stopped. We still think it's too immature."[53]

Mosaicism, too, can be a potentially dangerous effect of the editing process. Mosaicism can cause genetic diseases like Down, Klinefelter, and Turner syndromes; it can also cause fatal genetic mutations.[54]

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[41] Regalado, *supra* note 9.

[42] *Id.*

[43] *Id.*

[44] NAT'L ACADS. SCIS. ET AL., HERITABLE HUMAN GENOME EDITING 7 (2020) ("No [genome editing researcher] has demonstrated that it is possible to reliably prevent . . . the formation of undesired products at the intended target site.").

[45] *Id.* at 7, 58.

[46] *Id.* at 69.

[47] Cyranoski & Reardon, *supra* note 3.

[48] *Id.*

[49] *Id.*

[50] *Id.*

[51] Morgan Mendicino, *Genetically Customized Generations—A Need for Increased Regulatory Control Over Gene Editing Technology in the United States*, 73 SMU L. REV. 585, 591 (2020).

[52] *Id.*

[53] Cyranoski & Reardon, *supra* note 3.

[54] Fatma Betül Ayanoğlu et al., *Bioethical Issues in Genome Editing by CRISPR-Cas9*

An analysis of Dr. He's research report reveals that his efforts may have caused mosaicism in the twins whose DNA he edited.[55] He edited the girls' DNA to make them less susceptible to HIV, but they may face as of yet unknown dangerous effects resulting from mosaicism.[56]

The failure of human germline editing to consistently make the genetic changes desired without causing unwanted changes or mosaicism is a chief source of opposition to the practice. Section III will explore others.

III. CURRENT LEGAL AND REGULATORY ENVIRONMENT

A. United States

The United States Government has not directly banned or regulated human germline editing.[57] It has exercised authority over the process instead through funding restrictions.[58] In 1996, Congress passed the Dickey-Wicker Amendment to an appropriations bill.[59] The Amendment prohibits using Department of Health and Human Services funds for research in which human embryos are destroyed, discarded, or "knowingly subjected to risk of injury or death greater than that allowed for research on fetuses in utero."[60] This Amendment has appeared in the Health and Human Services appropriations bill every year since, thus prohibiting federal funds from being used in human germline editing research.[61]

In 2016, Congress took an additional step during the budget process to restrict human germline editing research. It enacted a rider to the Consolidated Appropriations Act prohibiting the Food and Drug Administration from approving any application submitted "for an exemption for investigational use of a drug or biological product . . . in

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Technology, 44 TURKISH J. BIOLOGY 110, 115 (2020).

[55] Jon Cohen, *Did CRISPR Help—Or Harm—The First-Ever Gene-Edited Babies?*, SCIENCE (Aug. 1, 2019), https://www.science.org/content/article/did-crispr-help-or-harm-first-ever-gene-edited-babies.

[56] *Id.*

[57] Genetic Literacy Project, *United States:Germline/Embryonic*, GLOB. GENE EDITING REGUL. TRACKER, https://crispr-gene-editing-regs-tracker.geneticliteracyproject.org/united-states-embryonic-germline-gene-editing/ (last visited Apr. 1, 2023) ("[T]here is no federal legislation that dictates protocols or restrictions regarding human genetic engineering. Federal controls exist for allocating government funding of research projects, manipulating human embryos and running gene therapy clinical trials.").

[58] *Id.*

[59] Mendicino, *supra* note 51, at 596.

[60] Balanced Budget Downpayment Act, Pub. L. No. 104–99, 110 Stat. 26, 34 (1996); *see also* Kristina M. Smith, *Germline Editing: Two Steps Forward, One Step Back?*, 21 SMU SCI. & TECH. L. REV. 101, 104 (2018) ("The relevant provision of the statute bans researchers from using public funds to create an embryo solely for research purposes or for any research that subjects an embryo to risk of injury or death.").

[61] Mendicino, *supra* note 51, at 596.

research in which a human embryo is intentionally created or modified to include a heritable genetic modification."[62]

These budgetary and regulatory provisions do not prohibit scientists from conducting human germline editing research. Scientists can seek private funding instead.[63] But it is a restraining influence on human germline editing research in the United States.

In addition to these federal restrictions, individual states can act–and have acted–legislatively in ways that impact human germline editing. Eleven states ban research on human embryos.[64] South Dakota, for example, bans "nontherapeutic research that destroys a human embryo."[65] It also prohibits research that "subjects a human embryo to substantial risk of injury or death."[66]

By contrast, eighteen states allow human embryo research.[67] Illinois both permits and funds embryonic research. The state law provides that "[r]esearch involving the derivation and use of . . . human embryonic germ cells . . . shall be permitted and the ethical and medical implications of this research shall be given full consideration."[68]

Twenty-one states do not have laws explicitly addressing human embryo research; however, twenty-two states ban reproductive cloning.[69]

B. International

Many nations have acted more directly than the United States to ban or regulate human germline editing or other research on human embryos. For example, France considers eugenics and reproductive cloning to be crimes against humanity.[70] They are punishable by imprisonment of up to thirty years and fines up to 7.5 million euros.[71] China prohibits human cloning, research on human embryos fourteen days after fertilization, and

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[62] *Id.* at 597; Consolidated Appropriations Act, 2016, Pub. L. No. 114–113, § 749, 129 Stat. 2242, 2283 (2015).

[63] Genetic Literacy Project, *supra* note 57.

[64] Kirstin R.W. Matthews & Daniel Morali, *Can We Do That Here? An Analysis of U.S. Federal and State Policies Guiding Human Embryo and Embryoid Research*, J.L. & BIOSCIS, June 9, 2022, at 1, 10 (explaining that Arkansas, Kentucky, Louisiana, Minnesota, Nebraska, New Mexico, North Dakota, Oklahoma, Pennsylvania, Rhode Island, and South Dakota have laws that ban human embryo research).

[65] S.D. CODIFIED LAWS § 34-14-16 (2000).

[66] *Id.* § 34-14-17.

[67] Matthews & Morali, *supra* note 64, at 12.

[68] 410 ILL. COMP. STAT. ANN. 110/5(1) (West 2008).

[69] Matthews & Morali, *supra* note 64, at 10, 15 (explaining that the twenty-one states lacking specific laws on human embryo research defer to federal laws on the subject, and twenty-two states ban reproductive human cloning but no federal legislation bans exist).

[70] CODE PÉNAL [C. PÉN.] [Penal Code] arts. 214-2, 511-18-1 (Fr.).

[71] *Id.* art. 214-2.

genetic manipulation of human gametes, zygotes, and embryos for reproductive purposes.[72]

He Jiankui, who edited the DNA of twins Lulu and Nana in 2018, is one of the individuals punished under the Chinese law. In December 2019, Jiankiu was convicted by the Nanshang District Court of "illegal medical practice" because he genetically edited human embryos for reproductive purposes and carried out illegal reproductive medical activity. He was given a three-year prison sentence and fined 3 million RMB (approximately $450,000).[73]

Two surveys done in 2020 give a glimpse into national restrictions worldwide: first, the Center for Genetics and Society reviewed the laws and policies of 106 nations. It found that "[seventy] countries prohibit heritable genome editing, while an additional [five] prohibit it but allow for possible exceptions. The policies in the remaining countries either have no clear stance on the permissibility of heritable genome editing or are silent on the topic. No country explicitly permits it."[74] The Center also reported that "only [eleven] countries allow lab experiments to genetically modify human embryos, while [seventy-five] countries prohibit using genetically altered—including with gene editing—embryos to initiate a pregnancy. No country explicitly permits it."[75] Second, Turkish researchers reported that as of January 2020, twenty-four nations had specifically forbidden genome editing in human embryos by law "and [nine] countries have banned it by guidelines."[76]

The work at the Francis Crick Institute and Karolinska Institute reflects that not all nations stand against research—at least non-clinical research—that edits the human germline. The governments of the United Kingdom and Sweden have specifically approved and regulated the research on human embryos.[77]

Two multi-national international instruments—one a convention and one a declaration—also bear on biotechnology and human germline editing. The first is the Convention on Human Rights and Biomedicine (also known as the Oviedo Convention), produced by the Council of Europe

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[72] Lingqiao Song & Yann Joly, *After He Jianku: China's Biotechnology Regulation Reforms*, 21 MED. L. INT'L 174, 176 (2021).

[73] *Id.*

[74] *New Research Shows that Heritable Genome Editing is Prohibited in Most Countries with Relevant Policies*, CTR. FOR GENETICS & SOC'Y (OCT. 27, 2020), https://www.geneticsandsociety.org/press-statement/new-research-shows-heritable-genome-editing-prohibited-most-countries-relevant.

[75] Megan Molteni, *World Health Organization Advisers Urge Global Effort to Regulate Genome Editing*, STAT (July 12, 2021), https://www.statnews.com/2021/07/12/genome-editing-world-health-organization/.

[76] Ayanoğlu et al., *supra* note 54, at 116.

[77] Callaway, *supra* note 13; Kristin R.W. Matthews & Daniel Morali, *National Human Embryo and Embryoid Research Policies: A Survey of 22 Top Research-Intensive Countries* 15 REGEN. MED. 1905, 1909 (2020).

in 1997.[78] The Convention is "not only the first, but still the only legally binding international treaty in bioethics."[79] It very intentionally grounds its prescriptions on protecting human dignity and rights.[80] Article 13 of the Convention addresses human germline editing by stating that "an intervention seeking to modify the human genome may only be undertaken for preventive, diagnostic[,] or therapeutic purposes and only if its aim is not to introduce any modification in the genome of any descendants."[81] It also prohibits "any modification of germline genes, whether for therapeutic or non-therapeutic aims."[82] Twenty-nine nations have ratified this treaty.[83] Significantly, however, the United Kingdom, Sweden, Germany, Italy, and thirteen other European nations have not.[84]

The 1997 UNESCO Universal Declaration on the Human Genome and Human Rights is the second principal international instrument.[85] "UNESCO" is the United Nations Educational, Scientific and Cultural Organization.[86] It created the declaration to insist on protecting the human genome and—like the Oviedo Convention—human dignity. Article 1 of the Declaration states, "[t]he human genome underlies the fundamental unity of all members of the human family, as well as the recognition of their inherent dignity and diversity. In a symbolic sense, it is the heritage of humanity."[87] The Convention does not mention germline editing specifically; instead, it more generally urges nations to pass laws

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[78] 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, Apr. 4, 1997, E.T.S. No. 164 [hereinafter Oviedo Convention].

[79] Peter Sykora & Arthur Caplan, *The Council of Europe Should Not Reaffirm the Ban on Germline Genome Editing in Humans,* 18 EMBO REP. 1871, 1871 (2017).

[80] Oviedo Convention pmbl. For example, the Preamble states: "[c]onvinced of the need to respect the human being both as an individual and as a member of the human species and recognising the importance of ensuring the dignity of the human being . . . ." Article 1 continues: "[p]arties to this Convention shall protect the dignity and identity of all human beings and guarantee everyone, without discrimination, respect for their integrity and other rights and fundamental freedoms with regard to the application of biology and medicine." *Id*. art 1.

[81] *Id*. art. 13.

[82] Sykora & Caplan, *supra* note 79.

[83] *Chart of Signatures and Ratification of Treaty 164*, COUNCIL OF EUR., https://www.coe.int/en/web/conventions/full-list?module=signatures-by-treaty&treatynum=164 (last updated Mar. 14, 2023).

[84] *Id.* (signifying that the United Kingdom and Germany are not signatories to the treaty; while Sweden and Italy have signed the treaty, they have yet to ratify it).

[85] UNESCO, 29th Sess., C/Res. 19, at 41 (1997) [hereinafter Universal Declaration on the Human Genome and Human Rights]. The U.N. General Assembly subsequently adopted this resolution two years later. G.A. Res. 152, U.N. GAOR, 53d Sess., U.N. Doc. A/RES/53/152 (1999).

[86] *UNESCO in Brief*, UNESCO, https://www.unesco.org/en/brief (last visited Mar. 17, 2023).

[87] Universal Declaration on the Human Genome and Human Rights art. 1.

that "prohibit those genetic practices that are contrary to human dignity."[88]

Significantly, both documents were created before CRISPR made germline editing such a tangible reality. There is dissatisfaction in some circles with their categorical rejections of research that alters the human genome:

> [N]ow that CRISPR has taken the biotechnology world by storm, these provisions are under increasing pressure. Even the uproar created by He Jiankui's attempts at genetically modifying offspring has not been able to break this trend. Especially, among scientific and medical-professional bodies, academies, and societies, the view is gaining ground that the existing bans should be lifted and that reproductive gene editing should be allowed for therapeutic purposes as soon as the technology is safe for clinical application.[89]

The following Section explores the range of proposals made about how to move forward legally and ethically now that CRISPR and human germline editing are realities.

C. Proposed Paths Forward

The recent breakthroughs in human germline editing have produced much debate and a flurry of proposals for next steps regarding the procedure. This section surveys those proposals and expresses concern over the debate that has led to them.

1. Ban Germline Editing

Some have called for human germline editing to be banned. Such calls are partly motivated by concerns over the procedure's safety in light of the many inaccurate and off-target mutations and mosaicism that it currently

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[88] George J. Annas et al., *Protecting the Endangered Human: Toward an Internationa l Treaty Prohibiting Cloning and Inheritable Alterations*, 28 AM. J.L. & MED. 151, 171–72 (2000). Here, the authors summarize Article 11 of the Universal Declaration on the Human and Genome and Human Rights, part of which invites "States and competent international organizations . . . to co-operate in identifying such practices and in taking, at national or international level, the measures necessary to ensure that the principles set out in this Declaration are respected." Universal Declaration on the Human Genome and Human Rights art. 11.

[89] Britta C. van Beers, *Rewriting the Human Genome, Rewriting Human Rights Law? Human Rights, Human Dignity, and Human Germline Modification in the CRISPR Era*, 7 J.L. & BIOSCIENCES 1, 34 (2020).

produces.[90] Such inaccuracies and unexpected results are particularly concerning given that future generations will inherit the changes.

Others calling for a ban are concerned about misuse of the procedure to enhance human capacity and performance.[91] "The fear is that germ-line engineering is a path toward a dystopia of superpeople and designer babies for those who can afford it. Want a child with blue eyes and blond hair? Why not design a highly intelligent group of people who could be tomorrow's leaders and scientists?"[92] As with the use of steroids or other performance-enhancing substances in sports, some question the physical and ethical wisdom of artificial enhancement of natural human capacities.[93] Marcy Darnovsky, who runs the Center for Genetics and Society, warns,

> [H]owever well intentioned, efforts to allow [genome editing] for "therapy" but not "enhancement" couldn't be expected to hold in the face of commercial pressures. Affluent parents could soon find themselves contemplating fertility clinic ad campaigns for genetically upgraded embryos.
>
> . . . .
>
> CRISPR babies could . . . find a market based on the allure of perceived superiority.[94]

Since enhancements will be available only to those who can afford them, others argue that human germline editing will simply further social inequality.[95]

Related, other commentators have expressed fears that the procedure could be misused in renewed eugenic efforts to purify the human genome and remove those viewed as substandard or defective. At the very least, a new eugenic movement could cause marginalization of and discrimination against those considered as not meeting a certain standard. Christopher Reilly warns,"[u]se of the technology to intentionally alter the human genome (the full array of genetic characteristics of the human species) and to enhance capabilities and features of individuals opens the way to

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[90] *See, e.g.*, Marcy Darnovsky, *Do Not Open the Door*, SW. MED. PERSPS., 2019, at 45, 45.

[91] *Id.*; *see also* Michael J. Sandel, *The Case Against Perfection*, ATL. MONTHLY, Apr. 2004, at 50, 51–62.

[92] Regalado, *supra* note 9.

[93] Sandel, *supra* note 91, at 52.

[94] Darnovsky, *supra* note 90.

[95] *See* Schweikart, *supra* note 32 at 286–87; Sarah Ashley Barnett, *Regulating Human Germline Modification in Light of CRISPR*, 51 U. RICH. L. REV. 553, 570 (2017).

eugenic practices that undermine reverence for the dignity of individual persons who differ from the expected norm."[96]

Still others oppose human germline editing because of its necessary experimentation on and destruction of human embryos.[97] We are far from being ready for widespread clinical application of germline editing. There are too many undesired and unpredictable results from the process. Of course, we will improve our gene editing technique with much more practice and research. But that practice and experimentation will be done on—and cause the death of—many human embryos.[98] Thus, correctly understanding the moral status of embryos (discussed more fully below) is critical to knowing how to evaluate human germline editing from an ethical and legal perspective.

Summarizing the concerns of many, Francis Collins, Director of The National Institutes of Health stated the following in 2015:

> NIH will not fund any use of gene-editing technologies in human embryos. The concept of altering the human germline in embryos for clinical purposes has been debated over many years from many different perspectives, and has been viewed almost universally as a line that should not be crossed. Advances in technology have given us an elegant new way of carrying out genome editing, but the strong arguments against engaging in this activity remain. These include the serious and unquantifiable safety issues, ethical issues presented by altering the germline in a way that affects the next generation without their consent, and a current lack of compelling medical applications justifying the use of CRISPR/Cas9 in embryos.[99]

The call to ban germline editing is strong. But it is a minority view. Most commentators urge moving forward—either expeditiously or with caution.

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[96] Christopher M. Reilly, *A Virtuous Appraisal of Heritable Genome Editing*, 87 LINACRE Q. 223, 223 (2020).

[97] *See e.g.*, Jeffrey R. Botkin, *The Case for Banning Heritable Genome Editing*, 22 GENETICS MED., 487, 488 (2020).

[98] *Id.*

[99] Francis S. Collins, *Statement on NIH Funding of Research Using Gene-Editing Technologies in Human Embryos*, NAT'L INSTS. HEALTH (Apr. 28, 2015), https://www.nih.gov/about-nih/who-we-are/nih-director/statements/statement-nih-funding-research-using-gene-editing-technologies-human-embryos.

2. Move Forward with Expedition

At the other end of the spectrum from those who would ban germline editing are those who believe we should move forward immediately with further research followed by clinical trials as soon as possible.

A strong voice in the full-speed-ahead camp is bioethicist John Harris. He is a professor of bioethics at the University of Manchester and editor of the Journal of Medical Ethics. Harris urges that "[a]ll of us need gene editing to be pursued, and if possible, made safe enough to use in humans . . . . We should be clear that there is no precautionary approach; just as justice delayed is justice denied, so therapy delayed is therapy denied."[100]

Harris dismisses eugenic concerns and fears that we are changing the human genome for generations to come without their consent. Indeed, he views it as a moral imperative that we take the reins of shaping the human genome for good. "If there is a discernible duty here it is surely to create the best possible child."[101] Harris further urges us to replace "natural selection with deliberate selection, Darwinian evolution with 'enhancement evolution.'"[102] He views those who oppose his position "like our imagined ape ancestor who . . . thought evolution had gone far enough . . . ."[103]

Steven Pinker, the Johnstone Family Professor of Psychology at Harvard University, expressed similar sentiments in the wake of Dr. Junjui Huang's 2015 germline editing breakthroughs. In an opinion piece in the Boston Globe, Pinker noted that biomedical research has brought tremendous gains in health, life, and general human flourishing—and promises more.[104] He continued,

> Given this potential bonanza, the primary moral goal for today's bioethics can be summarized in a single sentence. Get out of the way. A truly ethical bioethics should not bog

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[100] John Harris, *Why Human Gene Editing Must Not Be Stopped*, THE GUARDIAN (Dec. 2, 2015, 11:37 AM), https://www.theguardian.com/science/2015/dec/02/why-human-gene-editing-must-not-be-stopped; Julian Savulescu et al., *The Moral Imperative to Continue Gene Editing Research on Human Embryos*, 6 PROTEIN & CELL 476, 476 (2015) (arguing in agreement that "[t]here is a moral imperative" to move forward with human germline editing research and that "[t]o intentionally refrain from engaging in life-saving research is to be morally responsible for the foreseeable, avoidable deaths of those who could have benefitted. Research into gene-editing is not an option, it is a moral necessity.").

[101] Harris, *supra* note 100.

[102] JOHN HARRIS, ENHANCING EVOLUTION: THE ETHICAL CASE FOR MAKING BETTER PEOPLE 4, 11 (2007).

[103] *Id.* at 16.

[104] Stephen Pinker, *The Moral Imperative for Bioethics*, BOS. GLOBE (Aug. 1, 2015, 12:00 AM), https://www.bostonglobe.com/opinion/2015/07/31/the-moral-imperative-for-bioethics/JmEkoyzlTAu9oQV76JrK9N/story.html.

> down research in red tape, moratoria, or threats of prosecution based on nebulous but sweeping principles such as "dignity," "sacredness," or "social justice." Nor should it thwart research that has likely benefits now or in the near future by sowing panic about speculative harms in the distant future.[105]

He rejected the call of some to proceed with caution and to consider the long-term implications of further research before going further,

> First, slowing down research has a massive human cost. Even a one-year delay in implementing an effective treatment could spell death, suffering, or disability for millions of people. Second, technological prediction beyond a horizon of a few years is so futile that any policy based on it is almost certain to do more harm than good. Biomedical advances will always be incremental and hard-won, and foreseeable harms can be dealt with as they arise.[106]

Legal scholar and scientist Paul Enriquez has likewise called for the United States to resist the call for legal bans and to move forward expeditiously to permit research and the use of human germline editing. He calls human germline editing "truly the holy grail of modern-day medicine" capable "sooner rather than later" of eliminating or mitigating many diseases from HIV to obesity and cancer.[107] He expresses concern, though, that the legal landscape is not ready to permit the necessary scientific steps to be taken.[108] He calls for the adoption of what he calls "scientific empiricism."[109] This requires interdisciplinary cooperation

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[105] *Id.*

[106] *Id.*; Mahoney and Siegal agree. Like Pinker, they warn that waiting for governments and leading professional organizations to have "high quality, unhurried deliberations" on how to proceed on germline editing engineering will cause unnecessary delays and lost opportunities. Julia D. Mahoney & Gil Siegal, *Beyond Nature? Genomic Modification and the Future of Humanity*, 81 LAW & CONTEMP. PROBS. 195, 201 (2018). They further argue that

> [H]itting the pause button on human germline editing may not be as viable an option as its proponents assume. There is no way to put individuals and institutions in suspended animation such that, when the resume button is pushed, things are bound to pick up where they left off. Broken momentum means lost opportunities.

Id. at 206.

[107] Paul Enriquez, *Genome Editing and the Jurisprudence of Scientific Empiricism*, 19 VAND. J. ENT. TECH. L. 603, 668–69 (2017).

[108] *Id.* at 608–09.

[109] *Id.* at 672.

among scientists, lawyers, and judges to view scientific questions with precision, rejecting what he terms "deceptive simplicity."[110] Lawyers and scientists must work together to "weld scientific empiricism and jurisprudence" to benefit society.[111] In many ways, he encourages science to take the lead on the way forward.

In a follow-up article, Enriquez addresses why U.S. regulatory and constitutional law need not stand as obstacles to continued research—and ultimately clinical trials—from taking place. First, he proposes a way to view human germline editing that would allow the FDA to take jurisdiction over and approve the process.[112] Second, he uses substantive due process to argue that not only should germline editing be allowed, but individuals have a fundamental right to certain of its uses.[113]

3. Proceed with Caution

The position staked out by most commentators—within both the scientific and legal communities—is that we should move forward with deliberation. We should continue the research but neither ban germline editing research nor move to clinical trials until the technique is improved. Central to most expressing this view is that we should let the science guide us in timing and direction.

An excellent example of this position is found in the concluding statement of the organizing committee at the Second International Summit on Human Genome Editing. The committee noted the great progress in research, but that risks remain.

> The organizing committee concludes that the scientific understanding and technical requirements for clinical practice remain too uncertain and the risks too great to permit clinical trials of germline editing at this time. Progress over the last three years and the discussions at the current summit, however, suggest that it is time to

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[110] *Id.* at 693–94.

[111] *Id.* at 693.

[112] Paul Enriquez, *Editing Humanity: On the Precise Manipulation of DNA in Human Embryos*, 97 N.C.L. REV. 1147, 1181 (2019).

[113] *Id.* at 1202–04 (contending that permanent legislative or administrative bans on select uses of germline gene editing cannot withstand constitutional scrutiny because they impinge on a cognizable fundamental right). *But see* Alexandra L. Foulkes, *Liberty's Limits & Editing Humanity*, 98 N.C. L. REV. 1549, 1559 (2020) (suggesting that a right to use germline gene editing for therapeutic purposes likely falls outside of liberty's substantive reach); Andrew Cunningham, *A Cleaner, CRISPR Constitution: Germline Editing and Fundamental Rights*, 27 WM. & MARY BILL RTS. J. 877, 878 (2019) (arguing that individuals do not retain a fundamental right in using CRISPR/Cas9 germline editing to remove hereditary diseases).

> define a rigorous, responsible translational pathway toward such trials.[114]

In March 2019, a few months after the Summit, a group of eighteen leading scientists and ethicists from seven countries (including Emmanuelle Charpentier, co-Nobel Prize winner for her work in developing CRISPR) called for a moratorium on "heritable genome editing."[115] They insisted that they are not urging a permanent ban. Instead, they called "for the establishment of an international framework in which nations, while retaining the right to make their own decisions, voluntarily commit to not approve any use of clinical germline editing unless certain conditions are met."[116] The group supported continued human gene editing research but urged that no clinical application be allowed yet.[117]

Several groups have heeded the call to develop a framework for appropriate next steps. The American Society of Human Genetics ("ASHG") issued a position statement in 2017 setting forth the following three principles:

> (1) At this time, given the nature and number of unanswered scientific, ethical, and policy questions, it is inappropriate to perform germline gene editing that culminates in human pregnancy.
>
> . . . .
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> (2) Currently, there is no reason to prohibit in vitro germline genome editing on human embryos and gametes, with appropriate oversight and consent from donors, to facilitate research on the possible future clinical applications of gene editing. There should be no prohibition on making public funds available to support this research.
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> . . . .
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> (3) Future clinical application of human germline genome editing should not proceed unless, at a minimum, there is (a) a compelling medical rationale, (b) an evidence base that supports its clinical use, (c) an ethical

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[114] *Statement by the Organizing Committee*, *supra* note 18.

[115] Eric Lander et al., *Adopt a Moratorium on Heritable Genome Editing*, NATURE, Mar. 13, 2019, at 165, 165.

[116] *Id.*

[117] *Id.* at 166.

> justification, and (d) a transparent public process to solicit and incorporate stakeholder input.[118]

Similarly, the National Academy of Sciences, Engineering, and Medicine issued guidelines in 2017 articulating under what circumstances clinical applications would be allowed.[119] Those guidelines would permit the genetic editing of human embryos only to address mutations causing "serious disease or condition[s]" when "no 'reasonable alternatives' exist."[120]

Legal commentators assessing next steps for germline editing have largely adopted a similar stance to these scientific organizations. The most common position is that we should permit non-clinical human germline editing research with the goal of permitting clinical application (and supporting the live birth of individuals whose genes have been edited) when the technology is ready (and ethical requirements are met).[121]

Commentators differ on the appropriate source and nature of regulation as we navigate the path from current research to ultimate clinical trials. They have proposed regulations at every level, from state to international. At the state level, some have urged that states apply the same regulations governing in vitro fertilization to human germline

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[118] Kelly E. Ormond et al., *Human Germline Genome Editing*, 101 AM. J. HUM. GENETICS 167, 172–73 (2017). The Position Statement also lists the following professional organizations as ones which have endorsed the principles outlined in the ASHG statement:

> [T]he [U.K.] Association of Genetic Nurses and Counsellors, Canadian Association of Genetic Counsellors, International Genetic Epidemiology Society, and U.S. National Society of Genetic Counselors . . . the American Society for Reproductive Medicine, Asia Pacific Society of Human Genetics (APSHG), British Society for Genetic Medicine, Human Genetics Society of Australasia, Professional Society of Genetic Counselors in Asia, and Southern African Society for Human Genetics.

Id. at 167; *see also* NUFFIELD COUNCIL ON BIOETHICS, GENOME EDITING AND HUMAN REPRODUCTION: SOCIAL AND ETHICAL ISSUES 157–62 (2018) (providing similar recommendations to the ASHG in a 183-page report).

[119] NAT'L ACADS. SCIS., ENG'G, & MED., *supra* note 27, at 11–13.

[120] Pam Belluck, *In Breakthrough, Scientists Edit a Dangerous Mutation from Genes in Human Embryos*, N.Y. TIMES (Aug. 2, 2017), https://www.nytimes.com/2017/08/02/science/gene-editing-human-embryos.html.

[121] *See, e.g.*, Rodriguez, *supra* note 29, at 611–13; Barnett, *supra* note 95, 582, 586–88; Smith, *supra* note 60, at 106. Professor Sheetal Soni expresses well the dominant sentiment in the legal literature:

> Gene editing gives people control over human genetics which was previously impossible. It presents the opportunity to remove disease from the human population. The time is ripe to embrace this technology so that it's safe to use in humans and to establish a framework within which it may be applied.

editing.[122] Others recommend a federal regulatory approach.[123] One, embracing the March 2019 call for a moratorium by the eighteen international specialists, advocates for an international governance framework that would "above all emphasize the principle of human dignity . . . as well as identify some of the most pressing controversies and provide guidelines so each state can tailor their regime while maintaining minimum standards."[124]

IV. CONCERNS OVER THE CURRENT DEBATE ON THE FUTURE OF HUMAN GERMLINE EDITING

Two key themes emerge from the many statements and articles regarding how we should approach human germline editing going forward. The first is that scientific—not ethical—issues are currently driving most of the discussion. That is certainly the case for those who urge us to proceed with expedition. But it is also true of many urging a moratorium on human germline editing—whether a permanent or temporary ban. Indeed, most calling for a temporary moratorium (today's dominant position) only do so for clinical trials; they believe research on the technique should proceed. They do so with an expectation that clinical application will ultimately take place—we just must work out the kinks in the science.

Dr. Benjamin Hurlbut, Associate Professor of Biology and Society at Arizona State University, highlights a significant shift between the first and second International Summits on Human Gene Editing. At the end of the 2015 Summit, the organizers said that we should not proceed with human germline editing until two conditions are met: (1) that safety and efficacy are demonstrated; and (2) that there is "broad societal consensus" about the appropriateness of proceeding.[125] But after the second Summit

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Sheetal Soni, *Human Gene Editing: Who Decides the Rules?*, THE CONVERSATION (Jan. 15, 2020, 9:07 A.M.), https://theconversation.com/human-gene-editing-who-decides-the-rules-128434.

[122] *See, e.g.*, Myrisha S. Lewis, *Is Germline Gene Editing Exceptional?*, 51 SETON HALL L. REV. 735, 740 (2021) (arguing that germline gene editing should be treated similarly to IVF, which is subject to state laws, unlike federally regulated medical products); Daniel Malkin, *Germline Editing Using CRISPR: Why a Moratorium Is Not the Solution*, 55 FAM. L.Q. 69, 71 (2021) (urging the use of regulation similar to that of IVF by states and the federal government).

[123] Mendicino, *supra* note 51, at 601–03 (supporting specialized federal regulations like those adopted by China's National Health Commission or India's Ethical Guidelines for Biomedical Research on Human Subjects); Enriquez, *supra* note 111, at 1181 (proposing new FDA regulation); Rodriguez, *supra* note 29, at 585, 612–13 (advocating for federal adoption of ASHG guidelines).

[124] Melanie Hess, *A Call for an International Governance Framework for Human Germline Gene Editing*, 95 NOTRE DAME L. REV. 1369, 1390 (2020).

[125] J. Benjamin Hurlbut, *Human Genome Editing: Ask Whether, Not How*, NATURE, Jan. 10, 2019, at 135.

two years later, there was no talk of the need for societal consensus. Instead, the organizers urged that, though we temporarily halt clinical germline editing trials, we design a "pathway toward such trials."[126] That there will be clinical trials was a foregone conclusion. The science will drive us forward.

Stanford Law Professor Henry Greely summarized the position of the 2018 Summit organizers when he said, "[t]here are a lot of technical things scientists need to figure out before this can be done. The public should have a chance to comment, but they will not make the decisions. We will."[127]

Britta C. van Beers of the University of Amsterdam Faculty of Law notes that this deference to the scientists is now the default position.

> In brief, although the need for public debate and democratic deliberation on the matter is formally recognized, the common tenor within the scientific community is that the main question to be answered is not whether HGGE should be pursued, but how and under which circumstances. Moreover, the general thought seems to be that the answer to the "how question" can also largely be provided by the scientific community itself, for example, through the erection of self-regulating oversight bodies and the development of protocols.[128]

We are in a dangerous place. Yes, there are significant technique-related questions surrounding human germline editing. Researchers continue to struggle with incorrect and off-target mutations as well as mosaicism. But even if we could resolve those technical issues tomorrow, it doesn't mean we should immediately proceed to clinical trials. The biggest and most impactful questions are the ethical ones about whether we should be making changes to the human genome that future generations will inherit. As Hurlbut rightly cautions,

> In calling for standards for producing such 'CRISPR-edited' babies, these leaders have shunted aside a crucial and as-yet-unanswered question: whether it is (or can ever be) acceptable to genetically engineer children by introducing changes that they will pass on to their own offspring. That question belongs not to science, but to all of humanity. We do not yet understand what making

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[126] *Id.*; *Statement by the Organizing Committee*, *supra* note 18.

[127] Henry T. Greely, *How Should Science Respond to CRISPR'd Babies?* ISSUES SCI. & TECH., Spring 2019, at 32, 36.

[128] van Beers, *supra* note 89, at 32.

> heritable genetic alterations will mean for our fundamental relationships—parent to child, physician to patient, state to citizen and society to its members.[129]

Why is there such deference to scientists on this most critical issue? Part of it is our "technical optimism."[130] In general, scientific and medical advancements have benefited society.[131] Another part of it is that we believe science will move forward regardless of our ethical concerns. Technological innovation and change happen rapidly—usually more rapidly than legal regulation can respond. Martin Jinek expressed scientific determinism when he said, "[y]ou can't stop science from progressing . . . . [s]cience is what it is."[132]

Indeed, one commentator goes so far as to argue that since human germline editing will be used worldwide, the United States must not only approve and regulate it, it must fund it. Only then will we be able to shape and restrain the direction of the work. If we don't take charge of human germline editing, much worse things will happen.[133]

The second strong theme from the many statements and articles regarding human germline editing is that they are based on a utilitarian calculus rather than a reliance on foundational moral or ethical principles. We certainly see this in the words of the scientific community. The message of the organizers of the Second International Summit on Human Gene Editing in their concluding observations is that currently the risks of clinical trials are too great. But they call for the creation of a transitional pathway to such trials when our technical knowledge and expertise expand and those risks decrease.[134]

Legal commentators apply a similar risk-benefit approach to prescribe the best way forward. One argues,

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[129] Hurlbut adds:

> To move forward in a positive direction, science must not presume to set the destination for a technology, but should follow the direction that we, the people, provide. Science is—and must be—in the service of the societies of which it is part. Deviating from that principle harms both science and the human future.

Hurlbut, *supra* note 125.

[130] RONALD L. SANDLER, *INTRODUCTION: TECHNOLOGY AND ETHICS* TO ETHICS A ND EMERGING TECHNOLOGIES 1, 5 (RONALD L. SANDLER ed., 2014).

[131] *See id.* (describing specific areas of life that scientific advancements have helped).

[132] Amy Maxmen, *Easy DNA Editing Will Remake the World. Buckle Up*, WIRED (Aug. 2015), https://www.wired.com/2015/07/crispr-dna-editing-2/.

[133] Michael R. Dohn, *Preventing an Era of "New Eugenics": An Argument for Federal Funding and Regulation of Gene Editing Research in Human Embryos*, 25 RICH. J.L. & TECH., no. 2, 2018, at 1, 3. Dohn also speculates that some nations will undoubtedly use this technology for military uses (genetically producing "super soldiers"). *Id.* at 27.

[134] *Statement by the Organizing Committee*, *supra* note 18.

> The use of CRISPR technology in HGM should be permissible only where the benefits of the proposed therapy significantly outweigh the embryo loss and other associated risks. This situation involves performing a cost-benefit analysis of the proposed therapy with the primary goal of minimizing embryonic destruction throughout the research process.[135]

Another commentator breezily disposes of ethical issues involved in risks to future generations and the certain loss of life by many human embryos with this utilitarian calculation: "[t]he benefits of the proposed gene therapy outweigh the possible embryo loss and risks by offering generations without debilitating genetic diseases."[136] She notes the high failure rate in embryo experiments in China but concludes, "[n]o new biomedical technology is 100% safe and reliable. Oftentimes, it is a matter of determining if the benefits outweigh the risks."[137]

Whether to permit the genetic modification of future generations of human beings without their consent cannot simply be a matter of fiat by scientists engaged in the work. And it cannot just be a utilitarian call. This question is central to the very future of humanity. And we should only determine that future in light of a proper understanding of humanity itself. The remainder of the Article will focus on the nature of humanity and what it tells us about how to approach human genome editing ethically and legally.

V. HOW TO APPROACH HUMAN GERMLINE EDITING IN LIGHT OF THE CHRISTIAN VIEW OF HUMAN NATURE

A. Christian View of Human Nature

There is a rich tradition of Christian scholarship regarding human nature. Both scripture and leading thinkers have had much to say on the topic. While a Christian view of human nature is rich and multi-faceted, it contains two overriding tenets: (1) humans are made in the image of God Himself; and (2) humans are fallen.

1. Made in the Image of God

A Christian approach to human nature stands opposed to the materialist view that humans are merely the evolutionary product of time, matter, and chance. Instead, the Christian doctrine of creation insists that God created humans as a matter of will and choice—and in His own

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[135] Barnett, *supra* note 95, at 583.
[136] Rodriguez, *supra* note 29, at 614.
[137] *Id.* at 615.

image.[138] Scripture references this concept in many places,[139] but it is introduced in Genesis 1:26–28. This foundational passage describes the sixth day of creation this way:

> Then God said, "Let us make man in our image, after our likeness. And let them have dominion over the fish of the sea and over the birds of the heavens and over the livestock and over all the earth and over every creeping thing that creeps on the earth." So God created man in His own image, in the image of God He created [H]im; male and female He created them. And God blessed them. And God said to them, "Be fruitful and multiply and fill the earth and subdue it, and have dominion over the fish of the sea and over the birds of the heavens and over every living thing that moves on the earth."[140]

The passage establishes that humans have uniqueness and worth. We are created intentionally; we are not accidental. And we are created in the image of God Himself. Humans hold an honored place. We are distinct from animals and are tasked with stewardship over them and the rest of creation.[141]

The notion of being made in God's very image (the *imago dei*) is a concept that scholars (Jewish and Christian) have discussed for thousands of years. That discussion is rich and varied. But there is broad agreement that the *imago dei* reflects four main themes. First, humans are rational creatures who can think, plan, and be self-reflective. This in some measure mirrors God who, even in creation itself, plans and acts with self-reflection: "Let us make man in our image."[142] Second, humans are creative. Even as God creates, He instructs Adam to be creative too. Humans can know and appreciate beauty, be productive, and build and

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[138] William B. Whitney, *Beginnings: Why the Doctrine of Creation Matters for the Integration of Psychology and Christianity*, 48 J. PSYCH. & THEOLOGY 44, 47 (2020); *Genesis* 1:26–27.

[139] *See, e.g.*, *Genesis* 9:5–6; *Deuteronomy* 1:17; 25:3; *James* 3:8–9.

[140] *Genesis* 1:26–28.

[141] Psalm 8 highlights the same themes. It states, in relevant part:

> [W]hat is man that you are mindful of him, and the son of man that you care for him? Yet you have made him a little lower than the heavenly beings and crowned him with glory and honor. You have given him dominion over the works of your hands; you have put all things under his feet, all sheep and oxen, and also the beasts of the field, the birds of the heavens, and the fish of the sea, whatever passes along the paths of the seas.

Psalm 8:4–8.

[142] *Genesis* 1:26.

enhance things that enrich lives.[143] Third, humans have a prominent role in creation. We are to steward our environment—accountable to God as his "vice-regents"—"to manage and utilize together the created world."[144] This role has significant implications for things like biotechnology. As Anglican theologian J. I. Packer put it, God is honored "when the possibilities of [H]is creation are realized and developed by human enterprise, provided that this is done responsibly, in a way that benefits others."[145] Fourth and finally, humans are designed for relationship. They have a relationship with God Himself. The Catholic Catechism states that man is the only creature (of the "visible creatures") "able to know and love his [C]reator."[146] Indeed, "[o]nly in God will he find the truth and happiness he never stops searching for."[147] But humans also are made to be in relationship and community with others. Even ancient writers recognized this truth.[148]

Christianity posits that God instills great worth in His image bearers. One of the leading ways of describing this is that humans possess dignity.[149] The Catholic Catechism summarizes this concept well: "Being in the image of God the human individual possesses the dignity of a person, who is not just something, but someone."[150] The catechism ties this dignity to the concept that we are made for a relationship with God. "The dignity of man rests above all on the fact that he is called to communion with God."[151]

Indeed, the overriding story of scripture is the length to which God goes to restore His relationship with humans even after sin has broken our relationship with Him. God values humans so much that his son,

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[143] *See Genesis* 1:26; 2:15, 20.

[144] CHARLES SHERLOCK, DOCTRINE OF HUMANITY: CONTOURS OF CHRISTIAN THEOLOGY 37 (1996).

[145] J.I. PACKER, KNOWING MAN 23–24 (1979).

[146] CATECHISM OF THE CATHOLIC CHURCH PARA. 356 (United States Catholic Conference, Inc. trans., 1994).

[147] *Id.* para. 27.

[148] For example, Aristotle declared: "Anyone who cannot form a community with others, or who does not need to because he is self-sufficient, is no part of a city-state—he is either a beast or a god . . . . an impulse toward this sort of community exists by nature in everyone." ARISTOTLE, POLITICS bk. I, sec. 1253a, at 5 (C.D.C. Reeve trans., Hackett Publ'g 1998) (c. 384 B.C.E.).

[149] The concept of human dignity is embraced well beyond Christianity. Indeed, it is the foundational concept for the modern human rights movement. The Charter of the United Nations declares its purpose "to reaffirm faith in fundamental human rights, in the dignity and worth of the human person . . . ." U.N. Charter pmbl. Similarly, the Universal Declaration of Human Rights affirms that "[a]ll human beings are born free and equal in dignity and rights." G.A. Res. 217 (III) A, Universal Declaration of Human Rights art. 1 (Dec. 10, 1948). There is great debate today about what that dignity entails. *See* Jeffrey A. Brauch, *Preserving True Human Dignity in Human Rights Law*, 50 CAP. U.L. REV. 115 (2022).

[150] CATECHISM OF THE CATHOLIC CHURCH, *supra* note 146, para. 357.

[151] *Id.* para. 27.

Jesus Christ, became human to take our sin and the punishment for that sin on Himself so that we can receive forgiveness and eternal life. In his letter to the Philippian church, the first century apostle Paul urges Christians to have the same mind that Christ did,

> [W]ho, though He was in the form of God, did not count equality with God a thing to be grasped, but emptied Himself, by taking the form of a servant, being born in the likeness of men. And being found in human form, He humbled Himself by becoming obedient to the point of death, even death on a cross.[152]

This sacrificial act by Jesus Christ had a transformative effect for God's image bearers: "God made Him who had no sin to be sin for us, so that in Him we might become the righteousness of God."[153]

2. Fallen

The truth that humans bear the very image of God Himself is of great significance not just to theology but to ethics, law, and things like human germline engineering, as we will see. Unfortunately, it is not the end of the story. One cannot understand humans and the human condition properly without also recognizing the Christian doctrine of the fall. Sin has profoundly marred the image of God in us.

The book of Genesis, not long after the creation account, also describes sin's introduction into the perfect world God created when the first man and woman, Adam and Eve, chose to disobey God's command not to eat of the tree of knowledge of good and evil.[154] In choosing their own will over God's, they broke communion with Him and suffered severe consequences.[155] Not only were they removed from their home (the Garden of Eden), but sin, decay, and death came into the world.[156] Their sin had implications for all their descendants.[157] Christianity teaches that Adam acted in a representative capacity for all humans.[158] The corruption that

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[152] *Philippians* 2:6–8.
[153] 2 *Corinthians* 5:21.
[154] *See Genesis* 3:1–24.
[155] *See id.*
[156] *Id.*; *Romans* 5:12–18.
[157] *Genesis* 3:15–20, 23; *Romans* 5:12–18.
[158] *Romans* 5:12–18; Iain Duguid, *Were Adam and Eve Real People? How History Hangs on Their Story*, DESIRING GOD (May 11, 2020), https://www.desiringgod.org/articles/were-adam-and-eve-real-people.

came with sin came to all his descendants.[159] We are not only made in God's image, but sin, too, has become a part of our nature.[160]

Sin's introduction into the world did not have a minor impact. Sin affects every human—and every part of our lives. Sin corrupts our wills,[161] minds,[162] and emotions.[163] Theologian Louis Berkhof puts it this way: "sin has corrupted every part of [man's] nature and rendered [H]im unable to do any spiritual good . . . . [E]ven his best works are radically defective."[164] John Calvin puts it even more bluntly, "the whole man is overwhelmed—as by a deluge—from head to foot, so that no part is immune from sin and all that proceeds from [H]im is to be imputed to sin."[165] He continues, "whoever is utterly cast down and overwhelmed by the awareness of his calamity, poverty, nakedness, and disgrace has thus advanced farthest in knowledge of [H]imself."[166]

The image of God is not destroyed; it is marred and obscured. As Charles Sherlock explains, "[t]he structures which show the (ontological) reality of being made in God's image remain, but are corrupted, inverted.

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[159] *Romans* 5:12-19; *see also* JONATHAN EDWARDS, THE GREAT CHRISTIAN DOCTRINE OF ORIGINAL SIN DEFENDED (1834), *reprinted* in THE WORKS OF JONATHAN EDWARDS 144, 146 (1974); ADAM CLARKE'S COMMENTARY ON THE HOLY BIBLE 1047 (Ralph Earle ed., Baker Book House 1967).

[160] *Ephesians* 2:1–3 delivers this blunt assessment:

> And you were dead in the trespasses and sins in which you once walked, following the course of this world, following the prince of the power of the air, the spirit that is now at work in the sons of disobedience–among whom we all once lived in the passions of our flesh, carrying out the desires of the body and the mind, and were by nature children of wrath, like the rest of mankind.

The prophet Jeremiah is equally blunt, "[t]he heart is deceitful above all things and desperately sick; who can understand it?" *Jeremiah* 17:9.

[161] *See Romans* 7:18–19 ("For I know that nothing good dwells in me, that is, in my flesh. For I have the desire to do what is right, but not the ability to carry it out. For I do not do the good I want, but the evil I do not want is what I keep on doing.").

[162] Speaking of those who rejected the knowledge of God that is available to all humans, Paul wrote, "[f]or although they knew God, they do not honor [H]im as God or give thanks to [H]im, but they became futile in their thinking, and their foolish hearts were darkened." *Romans* 1:21.

[163] *See Colossians* 3:5–9; *Ephesians* 4:17–24; *Romans* 6:6–13.

[164] LOUIS BERKHOF, A SUMMARY OF CHRISTIAN DOCTRINE 76 (Banner of Truth Trust 1960) (1938). Theologians sometimes describe the effect of sin as total depravity. *Id.* Total depravity does not signify that humans are as bad as we can be. It means that sin has impacted each part of our nature. Scripture supports this conclusion. Isaiah insisted that even our "righteous deeds" are tainted by sin. "We have all become like one who is unclean, and all our righteous deeds are like a polluted garment. We all fade like a leaf, and our iniquities, like the wind, take us away." *Isaiah* 64:6.

[165] JOHN CALVIN, CALVIN: INSTITUTES OF THE CHRISTIAN RELIGION 253 (John T. McNeill ed., Ford Lewis Battles trans., 1960) (1536).

[166] *Id.* at 267.

They work against their intended nature and purpose, dividing where they should unite, cursing where they should bless."[167]

Humans are still capable of acting with kindness, love, and self-sacrifice. But we are also capable of great selfishness, harshness, and cruelty. Very often, motives and actions are mixed. The eighth century B.C. prophet Isaiah observed that sin taints even our "righteousness." "We have all become like one who is unclean, and all our righteous deeds are like a polluted garment. We all fade like a leaf, and our iniquities, like the wind, take us away."[168]

While the image of God inclines us to engage in meaningful relationships, sin damages them:

> [J]ust as the reflection of Christ and of God's being in our humanity is bound up with our relatedness to God and to one another, so it is with our sin. Relationships which in Christ are characterised by love, truthfulness and reverence are replaced by aggression, exploitation, deceit, brokenness and violence.[169]

While we have creativity and the ability to act as stewards of creation and leaders to help build cultures and nations, we do so inconsistently. At times we act ineffectively or even corruptly. We use science for great good and healing. We also cause significant harm to individuals and our environment. We implement laws to counteract the effects of the fall. But we also use laws in ways that are unnecessarily complicated, inconsistently enforced, or even corrupt or unjust. Whether in law or science, we ignore the effects of the fall at our peril.

B. Implications

Both the doctrine of creation and the doctrine of the fall have implications that help guide our response to human gene editing.

1. Humans Bear the Image of God

That humans are made in God's image first should open us to the possibilities of helpful new technologies. Humans, like the God who created us, are creative beings. We have stewardship over nature and have the capacity to harness tools and technology to protect and improve human life and the environment around us.[170]

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[167] SHERLOCK, *supra* note 144, at 43.

[168] *Isaiah* 64:6.

[169] World Council of Churches, *Christian Perspectives on Theological Anthropology*, *in* 199 FAITH AND ORDER PAPER 1, 16 (2005).

[170] *See Genesis* 1:28–30.

People exercising that creative capacity have created disease-ending vaccines and life-saving surgical techniques and medical devices. In the previous three years, brilliant scientists and medical professionals have given us vaccines and treatments to better protect us from COVID-19, a disease that has taken millions of lives worldwide.[171] Similarly, the Human Genome Project of 1990–2003 let us map the entire genetic code of human beings.[172] From it have come better drugs and therapies for cancer and other diseases. With a Christian view of human nature, our default perspective should be "pro-technology." "We have a mandate to engage in genetic research and therapy, when it is directed toward the healing end of medicine."[173]

We should be excited about developments in somatic cell gene editing. Like heart or lung transplants, "transplanting" healthy genes into patients suffering from disease can bring healing and extend lives. And it does so without destroying human embryos or modifying the human genome in unknown ways for generations to come.

Our response to germline editing should be different, however. For several reasons, the Christian understanding that we bear God's image suggests that we should oppose the practice of human germline editing.

i. DESTRUCTION OF HUMAN EMBRYOS

The first reason to oppose human germline editing is that it necessarily involves experimentation on and the destruction of human embryos.

One of the most important implications of being made in God's image is that all humans—without exception—are made in that image. All have dignity and worth that come from God. As Professor Craig Stern notes, recognizing that "all humans equally bear the image of God" contributed significantly to the rule of law and the common law view that all persons should be treated equally under the law.[174] This principle also formed the foundation of the modern human rights movement: "All human beings are born free and equal in dignity and rights."[175]

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[171] Amanda Montañez & Tanya Lewis, *How to Compare COVID Deaths for Vaccinated and Unvaccinated People*, SCI. AM. (June 7, 2022), https://www.scientificamerican.com/article/how-to-compare-covid-deaths-for-vaccinated-and-unvaccinated-people/; Henrik Pettersson et al., *Tracking COVID-19's Global Spread*, CNN, https://www.cnn.com/interactive/2020/health/coronavirus-maps-and-cases/ (last updated Sept. 30, 2022, 9:45 PM).

[172] *The Human Genome Project*, NAT'L HUM. GENOME RSCH. INST., https://www.genome.gov/human-genome-project (last visited Apr. 27, 2023).

[173] Michael McKenzie, *The Christian and Genetic Engineering*, CHRISTIAN RSCH. INST. http://www.equip.org/article/the-christian-and-genetic-engineering/ (last visited Apr. 27, 2022).

[174] Craig A. Stern, *The Common Law and the Religious Foundations of the Rule of Law Before* Casey, 38 U.S.F. L. REV. 499, 514 (2004).

[175] Universal Declaration of Human Rights art. 1.

There are voices today arguing that dignity and worth are not shared equally by all humans. Some insist that one's worth depends on one's condition and capacities. Therefore, those who don't—or don't yet or no longer—have complete cognitive or communication skills, the capacity to feel pain, or the ability to make plans or exercise autonomy do not have dignity or full worth as human beings.[176] This includes human embryos. Embryos don't feel pain; they don't make plans. They are just collections of cells.

But the Christian view of dignity compels a different conclusion. A human embryo has dignity because it is a human life. As Princeton Professor Robert George notes, a human embryo "not only possesses all of the necessary organizational information for maturation, but it has an active disposition to develop itself using that information. The human embryo is, then, a whole (though immature) and distinct human organism—a human being."[177] While an embryo doesn't display autonomy or self-reflection, neither does a three-month-old baby—yet. But both will continue to grow and develop additional capacities if allowed. They are human lives worthy of respect and protection.

Embryos certainly should not be the subject of experimentation. As Leon Kass, Chairman of President George W. Bush's Council on Bioethics urged, "[n]o decent society can afford to treat human life, at whatever stage of development, as a mere natural resource to be mined for the benefit of others."[178] Yet that is precisely what is taking place in ongoing human germline editing research in England,[179] Sweden,[180] and elsewhere. And to do the kind of research necessary to hone germline editing and to bring it to the point of clinical trials would require the creation, experimentation upon, and destruction of human embryos in

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[176] Peter Singer, *Speciesism and Moral Status*, 40 METAPHIL. 567, 575 (2009); Alberto Giubilini & Francesca Minerva, *After-Birth Abortion: Why Should the Baby Live?*, 39 J. MED. ETHICS 261, 261–62 (2013); Marion Hilligan et al., *Superman—Biotechnology's Emerging Impact on the Law*, 24 T.M. COOLEY L. REV. 1, 42 (2007). For a broader discussion of these competing views of dignity see Brauch, *supra* note 149.

[177] Robert P. George, *Embryo Ethics: Justice and Nascent Human Life*, 17 REGENT U. L. REV. 1, 3 (2004).

[178] Leon R. Kass, *A Way Forward on Stem Cells*, WASH. POST (July 7, 2015), http://www.washingtonpost.com/wp-dyn/content/article/2005/07/11/AR2005071101415.html.

[179] Gretchen Vogel, *U.K. Researcher Receives Permission to Edit Genes in Human Embryos*, SCI. (Feb. 1, 2016), https://www.science.org/content/article/uk-researcher-receives-permission-edit-genes-human-embryos#:~:text=Developmental%20biologist%20Kathy%20Niakan%20has,%2FCas9%20gene%2Dediting%20technology.

[180] *See* Jessica Boddy, *Swedish Scientist Edits DNA of Human Embryo*, SCI. (Sept. 22, 2016), https://www.science.org/content/article/swedish-scientist-edits-dna-human-embryo (noting that Swedish scientist Fredrik Lanner "has started to edit healthy human embryos for the first time" in an effort to discover new treatments for infertility using CRISPR-Cas9 gene editing technology).

much greater numbers.[181] The Christian recognition that those embryos are human lives made in the image of God compels the conclusion that human germline editing must halt.[182]

ii. IMPACT ON INDIVIDUALS WITH DISABILITIES

Among the humans who have full dignity and moral worth are those with disabilities. But the practice of human germline editing fits uncomfortably with recognizing this dignity and worth. A second reason to oppose human germline editing is that it tends to diminish the value of the lives of disabled individuals.

With somatic cell editing, doctors treat an individual for a disorder and seek to restore that person to health. But human germline editing is different. It edits the genes of embryos to ensure that only genetically superior people are born. It also sends the powerful message that certain types of persons—again based on their genetic characteristics—ought not to be born. It is a message that marginalizes and devalues. It says to those with disabilities that they are defective and "less than normal."[183]

Calum MacKellar frames the matter well, "for many persons (whether disabled or not), making sure that individuals with a disability do not exist, especially if no extenuating circumstances exist, expresses a deeply discriminatory message that already existing individuals with a similar disability should not have existed."[184]

Disability rights groups recognize the danger and have spoken out strongly against human germline editing. For example, the Autistic Self Advocacy Network ("ASAN") envisions

> [A] world in which all lives—including the lives of people with disabilities—have equal value. Such a world is simply not compatible with the use of technology to prevent the births of people with disabilities. Ubiquitous

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[181] Botkin, *supra* note 97 ("[S]uccessfully developing heritable genome editing would entail research involving the creation and destruction of numerous human embryos purely for research purposes.").

[182] Even those uncertain about the ultimate moral status of embryos should acknowledge that they are a form of human life that merits a cautious approach to experimentation and destruction. Bioethicist Gilbert Meilaender puts it this way: "[i]f we are genuinely baffled about how best to describe the moral status of that human subject who is the unimplanted embryo, we should not go forward in a way that peculiarly combines metaphysical bewilderment with practical certitude by approving even such limited cloning for experimental purposes." Gilbert Milaender, *Begetting and Cloning*, 74 FIRST THINGS 41, 43 (1997).

[183] Seema Mohapatra, *Politically Correct Eugenics*, 12 FIU L. REV. 51, 77 (2016).

[184] Calum MacKellar, *Why Human Germline Genome Editing Is Incompatible with Equality in an Inclusive Society*, 27 NEW BIOETHICS, 19, 24 (2021).

> germline genome editing technology would, for instance, allow prospective parents of children with developmental disabilities not only to edit a prospective child's genes in order to attempt to eliminate that disability from existence before their child is even born, but also to eliminate those genes in all subsequent generations. Given the present-day use of prenatal testing to prevent the births of people with Down Syndrome, the possibility of this use is more than likely—it is inevitable.[185]

Some push back and insist that human germline editing can be limited to applications that are therapeutic and eliminate only genetic variations that cause grave diseases.[186] But the line between therapy and enhancement is thin and ultimately untenable. For example, as Britta van Beers questions, on the therapy versus enhancement spectrum, where should we place He Jankui's HIV-resistance modification in the Chinese twins?[187] He was not curing them of disease. But he was trying to strengthen their resistance to disease.[188]

Rebecca Cokley, a little person with the genetic condition Dwarfism, wrote a compelling piece in the Washington Post related to van Beers' point.[189] She noted that "disability" is ubiquitous; perhaps one in five individuals have what could be viewed by others as a disability.[190] Some are differences that are viewed as less desirable—or imperfections—by others. Cokley warns:

> Now think about the message that society's fear of the deviant—that boogeyman of imperfection—says to disabled people: "We don't want you here. We're actively working to make sure that people like you don't exist because we think we know what's best for you." This is ableism. It's denying us our personhood and our right to exist because we don't fit society's ideals.

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[185] *ASAN Comments on the Clinical Use of Human Germline Editing*, AUTISTIC SELF ADVOC. NETWORK (Oct. 8, 2019), https://autisticadvocacy.org/2019/10/asan-comments-on-the-clinical-use-of-human-germline-genome-editing/ [hereinafter *ASAN Comments*].

[186] *See, e.g.*, Ormond, *supra* note 118, at 173; NAT'L ACADS. SCIS., ENG'G, & MED., *supra* note 27, at 11, 13; Belluck *supra* note 120.

[187] van Beers, *supra* note 89, at 22.

[188] *Id.*

[189] *See* Rebecca Cokley, *Please Don't Edit Me Out*, WASH. POST (Aug. 10, 2017), https://www.washingtonpost.com/opinions/if-we-start-editing-genes-people-like-me-might-not-exist/2017/08/10/e9adf206-7d27-11e7-a669-b400c5c7e1cc_story.html?utm_term=.40286d48b939.

[190] *Id.*

> Proponents of genetic engineering deliberately use vague language, such as "prevention of serious diseases," leading many people with disabilities to ask what, in fact, is a serious disease. Where is the line between what society perceives to be a horrible genetic mutation and someone's culture?[191]

Cokley has reason for concern. As discussed in more depth below, we have a long history of eugenic efforts to purify the human gene pool that have done great harm to those viewed as less than perfect or not meeting some societal standard.[192] In such efforts, individuals with disabilities have always faced marginalization, discrimination, and worse.[193] Clinical germline editing efforts would be no exception. Indeed, the British Nuffield Council, in its report on the social and ethical issues surrounding human germline editing, agreed. While the Council supports moving forward with caution on human germline editing, it acknowledged that the practice might pose some dangers to disabled people:

> If there are fewer people with a given range of disabilities, the general level of familiarity with and social acceptance of those conditions may decrease. At the same time, specialist medical expertise or skills are likely to become rarer, and there may be less investment in research or measures to alleviate any specific adverse physical effects of disability or into ameliorative environmental adjustments.[194]

iii. COMMODIFICATION OF HUMAN BEINGS

The Christian doctrine that all humans are made in the image of God suggests a third reason to oppose human germline editing. As many scholars have noted, the very process of determining the genetic characteristics of children (and necessarily their descendants) promotes a more subtle form of dehumanization: commodification.

Human germline editing proponents envision a future where parents, guided by genetic researchers and medical professionals, select genetic characteristics of the children they intend to bring into the world. A market will certainly develop where fertility clinics offer to provide

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[191] *Id.*

[192] *See id.* (discussing media and societal efforts to "frame people with disabilities as takers, beggars[,] and unworthy cost drivers for the rest of the public").

[193] *Id.*

[194] NUFFIELD COUNCIL ON BIOETHICS, *supra* note 118, at 84–85.

parents with genetically superior embryos.[195] Francis Collins, Director of the National Institutes of Health and head of the Human Genome Project, warns, "the application of germline manipulation would change our view of the value of human life. If genomes are being altered to suit parents' preferences, do children become more like commodities than precious gifts?"[196] Leon Kass agrees. Speaking of a similar process of parental control over the genetic future of their children through a cloning process, Kass warns, "[p]rocreation dehumanized into manufacture is further degraded by commodification, no matter how good the product."[197]

Such commodification flies in the face of the idea that humans are made with dignity in God's image. It is dehumanizing. Francis Fukuyama says genetic engineering from a Christian perspective "sees a human being not as a miraculous act of divine creation, but rather as [a] sum of a series of material causes that can be understood and manipulated by human beings. All of this fails to respect human dignity and violates God's will."[198]

Kass points to Aldous Huxley's *Brave New World* as a literary illustration of this dehumanization. In the novel, humans have successfully mastered genetic editing to the point that they have eliminated disease, aggression, war, and emotions like guilt and envy. But Kass notes that "this victory comes at the heavy price of homogenization, mediocrity, trivial pursuits, shallow attachments, debased tastes, spurious contentment, and souls without loves or longings . . . ." Brave New Man is so dehumanized that he does not even recognize what has been lost."[199]

This commodification process has a destructive effect on parents as well. The parental control over the childbirth process fosters hubris and the illusion of mastery over nature and their children's future. Michael

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[195] *See* Darnovsky, *supra* note 90 (explaining that "affluent parents could soon find themselves contemplating fertility clinic ad campaigns for genetically upgraded embryos").

[196] Patrick Skerrett, *A Debate: Should We Edit the Human Germline?*, STAT (Nov. 30, 2015), https://www.statnews.com/2015/11/30/gene-editing-crispr-germline/.

[197] LEON KASS, *Preventing a Brave New World*, HUM. LIFE REV., Summer 2001, at 14, 24; Brandon Foht concurs:

> Gene editing is thought to offer a way for parents to maximize their control over the properties of their offspring, transforming a relationship that should be characterized by unconditional love and acceptance into one in which children are seen as products of their parents' desires and wishes, to be provisionally accepted and molded in accord with parental preferences.

Brandon Foht, *The Case Against Human Gene Editing*, NAT'L REV. (Dec. 4, 2015, 5:00 PM), https://www.nationalreview.com/2015/12/human-genetic-engineering-wrong/.

[198] FRANCIS FUKUYAMA, OUR POSTHUMAN FUTURE: CONSEQUENCES OF THE BIOTECHNOLOGY REVOLUTION 89 (2002).

[199] KASS, *supra* note 197, at 15.

Sandel expresses it well. He says genetic engineering is "the ultimate expression of our resolve to see ourselves astride the world, the masters of our nature. But that promise of mastery is flawed. It threatens to banish our appreciation of life as a gift and to leave us with nothing to affirm or behold outside our own will."[200]

The Christian doctrine of creation resists this notion that we are masters with ultimate control of our world and our descendants' genetic futures. We are made in the image of God and dependent—not independent—creatures.[201]

In all these ways, human gene editing denies the dignity inherent in every human being. It helps explain why the Council of Europe in the Oviedo Convention rooted its ban on human germline editing in protecting human dignity. Its preamble states, "[c]onscious that the misuse of biology and medicine may lead to acts endangering human dignity . . . ."[202] Articles 1 and 2 continue the theme:

> Article 1—Purpose and object
>
> Parties to this Convention shall protect the dignity and identity of all human beings and guarantee everyone, without discrimination, respect for their integrity and other rights and fundamental freedoms with regard to the application of biology and medicine.
>
> . . . .
>
> Article 2—Primacy of the human being
>
> The interests and welfare of the human being shall prevail over the sole interest of society or science.[203]

Based on a Christian view of human nature, the Oviedo Convention had it right. We should oppose human germline editing to protect the inherent dignity of each human being.[204]

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[200] Sandel, *supra* note 91. Kass says this transforms the act of "begetting" into "making." Kass, *supra* note 197, at 24.

[201] Mendicino, *supra* note 51, at 593 ("Human awareness that our genetic makeups—and thus many of our qualities, talents, and abilities—are given and beyond our control instills a degree of meekness in our character.").

[202] Oviedo Convention pmbl.

[203] *Id.* art. 1–2.

[204] Iñigo de Miguel Beriain argues that protecting human dignity supports germline editing. In particular, it protects the individual whose embryo is being edited. Iñigo de Miguel Beriain, *Human Dignity and Gene Editing*, EMBO REP., Sept. 2018, at 1, 1–4. Beriain, however, ignores the necessity that perfecting germline editing will require the experimentation on and destruction of numerous other embryos as well as germline editing's impact on individuals with disabilities and its promotion of commoditization in procreation. *See id.*

2. Humans Are Fallen

It is not just the precept that humans bear the image of God that would support a ban on human germline engineering. That conclusion also flows from the reality that humans are deeply marred by sin.

A recognition of human frailty and a resulting humility do not typically characterize proponents of human germline engineering. It is just the opposite. Supporters are often characterized by a utopian view of what we will accomplish once germline editing becomes a clinical procedure. Here are just some of the expectations expressed:

> We are about to remake ourselves as well as the rest of nature.[205]

> The great biotechnical transformation is being accompanied by an equally significant philosophical transformation.[206]

> Genetic engineering has given us the power to alter the very basis of life on earth.[207]

The vision is of a world where genetic disease has been eradicated. And it is a world of countless enhancements to physical and mental capacities. One calls this future "the ultimate expression and realization of our humanity."[208]

A Christian view of human nature, though, would urge caution. Fallen human beings don't create utopias. While we are capable of great feats, our flawed nature always taints both our intentions and accomplishments. This is true of germline editing as well. A Christian view of human nature warns that: (1) any germline editing efforts will be flawed, with mixed results and unintended consequences; and (2) germline editing raises the specter of a new and dangerous eugenics movement.

i. HUMAN GERMLINE EDITING FLAWS

Inevitably, our germline editing efforts will be flawed. We will not perfectly carry out our genetic intentions. And our efforts will have other genetic and medical effects that we don't expect. Some of these won't be known until years later.

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[205] RIFKIN, *supra* note 22, at 32.

[206] *Id.*

[207] Dixon, *supra* note 21.

[208] Gina Maranto, *Deoxyribonucleic Acid Trip*, N.Y. TIMES (Aug. 25, 2002), https://www.nytimes.com/2002/08/25/books/deoxyribonucleic-acid-trip.html.

Human germline editing failures are the main reason many supporters have called for a moratorium on further research—or at least on clinical applications. As noted above, there are several recurring problems with current human germline editing experiments. It is not the case that the process always makes the desired genetic changes to the target area.[209] The process sometimes makes unexpected and unwanted genetic changes away from the target area ("off-target" effects).[210] And the process sometimes results in mosaicism, which can potentially cause diseases like cancer.[211] Section I highlighted these errors in the experiments conducted by Doctor Huang and Doctor He. Those challenges have continued in subsequent research.

In 2021, Francis Crick scientists reported unintended mutations at the target site.[212] Many were small changes, but in 16% of the samples tested, there were "large, unintended mutations" that could cause cancer or other diseases.[213] A year earlier, *Nature* reported similar problems encountered by three teams.[214] In one, Columbia University biologist Deiter Egli sought to use CRISPR-Cas9 to correct a blindness-causing mutation in a particular gene, EYS.[215] He found, though, that "about half of the embryos tested lost large segments of the chromosome—and sometimes the entire chromosome—on which EYS is situated."[216] Summarizing the data in the *Nature* report, Fyodor Urnov a professor at the University of California-Berkeley, says: "[i]f human embryo editing for reproductive purposes, or germline editing, were space flight, the new data are the equivalent of having the rocket explode at the launch pad before take-off."[217]

The Karolinska Institute has also reported unintended consequences from its human gene editing research.[218] In late 2021, it revealed that the gene editing process was activating a particular protein, p53, that could

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[209] *See supra* text accompanying notes 46–49.

[210] *See supra* text accompanying notes 45–52.

[211] *See supra* text accompanying notes 46–56.

[212] Kathy Niakan, *Researchers Call for Greater Awareness of Unintended Consequences of CRISPR Gene Editing*, FRANCIS CRICK INST. (Apr. 9, 2021), https://www.crick.ac.uk/news/2021-04-09_researchers-call-for-greater-awareness-of-unintended-consequences-of-crispr-gene-editing.

[213] *Id.*

[214] *See* Heidi Ledford, *CRISPR Gene Editing in Human Embryos Wreaks Chromosomal Mayhem*, NATURE, July 2, 2020, at 17, 18 (explaining that three separate research groups saw unintentional changes to large segments of chromosomes after embryonic gene editing).

[215] *Id.*

[216] *Id.* at 18.

[217] *Id.*

[218] Felicia Lindberg, *New Findings on the Link Between CRISPR Gene-Editing and Mutated Cancer Cells*, KAROLINSKA INST. (Nov. 18, 2021, 10:00 AM), https://news.ki.se/new-findings-on-the-link-between-crispr-gene-editing-and-mutated-cancer-cells.

potentially cause cancer.[219] Earlier reports, including some from Karolinska had similarly reported that edited cells "have the potential to seed tumors inside a patient."[220] Karolinska researchers noted, "[t]hat could make some CRISPR'd cells ticking time bombs."[221]

The International Commission on Clinical Use of HGGE has summarized the current state of research this way:

> The outcomes of genome editing in human zygotes cannot be adequately controlled. No one has demonstrated that it is possible to reliably prevent (1) the formation of undesired products at the intended target site; (2) the generation of unintentional modifications at off-target sites, and (3) the production of mosaic embryos, in which intended or unintended modifications occur in only a subset of an embryo's cells; the effects of such mosaicism are difficult to predict. An appropriately cautious approach to any initial human uses would include stringent standards for preclinical evidence on each of these points.[222]

Of course, if experiments on embryos are allowed to continue, scientists will become more accomplished and successful. But the successes will never fulfill proponents' highest hopes.

Currently, human germline editing efforts tend to focus on single-gene mutations.[223] But over time, researchers will want to address conditions affected by multiple genes. As Francis Fukuyama points out, "once we move beyond relatively simple single-gene disorders to behavior affected by multiple genes, gene interaction becomes very complex and difficult to predict."[224] Further, "[g]iven that many genes express themselves at different stages of life, it will take years before the full consequences of a particular gene manipulation become clear."[225]

Humans have a mixed record in making changes to complex systems. As Fukuyama notes, "ecosystems are interconnected wholes whose

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[219] *Id.*

[220] Sharon Begley, *A Serious New Hurdle for CRISPR: Edited Cells Might Cause Cancer Two Studies Find*, STAT (June 11, 2018), https://www.statnews.com/2018/06/11/crispr-hurdle-edited-cells-might-cause-cancer/; *see Genome-Editing Tool Could Increase Cancer Risk*, KAROLINSKA INST. (Nov. 6, 2018, 5:01 PM), https://news.ki.se/genome-editing-tool-could-increase-cancer-risk (discussing cancer risks caused by CRISPR-based gene therapies).

[221] Begley, *supra* note 220.

[222] NAT'L ACADS. SCIS. ET AL., *supra* note 44, AT 7.

[223] *See* FUKUYAMA, *supra* note 198, at 92 (discussing that research will shift from single-gene disorders to multiple gene disorders).

[224] *Id.*

[225] *Id.* at 93.

complexity we frequently don't understand; building a dam or introducing a plant monoculture into an area disrupts unseen relationships and destroys the system's balance in totally unanticipated ways."[226]

We have seen many examples of taking steps to solve one problem only to cause other, unexpected ones. Asbestos offered remarkable fire-proofing materials for industrial settings, but it was later found to cause asbestosis, mesothelioma, and lung cancer.[227] Similarly, between 1940 and 1971, doctors regularly prescribed Diethylstilbestrol ("DES") to pregnant women. DES was a synthetic form of estrogen that promised protection from miscarriage and premature labor.[228] Only years later did we learn that DES caused a variety of forms of cancer (breast, pancreatic, cervical, etc.) in the daughters of DES takers who were in utero at the time their mothers took the hormone.[229]

We are sure to see similar unintended consequences with human germline editing. We caught a glimpse of this in He Jiankui's efforts. He may have successfully edited the twins' embryos to provide more robust resistance to HIV. But he may have unintentionally caused mosaicism where some of their cells have genetic mutations, and some do not.[230] This may make them more susceptible to cancer in years to come.

Such unintended changes are inevitable, and we simply don't know the full effect that changes to one part of the complex human genome may have on other parts in the long term.[231]

ii. EUGENICS

Even at our best, we will fall short of our highest intentions in carrying out human germline editing. But our fallen human nature—and history—warn of another danger. Not all intentions will be pure. And gene editing provides a powerful tool to spark a new eugenics movement.

Francis Galton, Charles Darwin's half-cousin, coined the term "eugenics" in 1883.[232] Eugenics is "the selection of desired heritable

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[226] *Id.* at 97.

[227] Daniel King, *History of Asbestos*, ASBESTOS.COM, https://www.asbestos.com/asbestos/history/ (last updated Sept. 15, 2023).

[228] *Diethylstilbestrol (DES) Exposure and Cancer*, NAT'L CANCER INST., https://www.cancer.gov/about-cancer/causes-prevention/risk/hormones/des-fact-sheet (last updated May 24, 2022).

[229] *Id.*

[230] *See* Cohen, *supra* note 55.

[231] *See* Reilly, *supra* note 96 (warning that "[m]odifying human genetics at the embryonic stage, however, can result in both intended and unforeseen consequences that could harm future generations that inherit them").

[232] *See* FRANCIS GALTON, INQUIRIES INTO HUMAN FACULTY AND ITS DEVELOPMENT 24–25 (1883) ("[This book's] intention is to touch on various topics more or less connected with that of the cultivation of race, or, as we might call it, with 'eugenic' questions, and to present the results of several of my own separate investigations."); Philip K. Wilson, *Eugenics*, ENCYC. BRITANNICA, https://www.britannica.com/science/eugenics-genetics (last updated

characteristics in order to improve future generations."[233] Galton saw eugenics as the chance to improve evolution[234] through a system that would allow "the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable."[235]

In the early twentieth century, many states embraced eugenics, especially by sterilizing women deemed unfit physically or psychologically.[236] It is estimated that over 60,000 Americans who had been judicially declared unfit were involuntarily sterilized.[237] One of those Americans was 18-year-old Virginian Carrie Buck, confined to the Virginia Colony for Epileptics and Feebleminded.[238] In 1924, Virginia passed a statute authorizing state officials to sterilize "feebleminded" individuals who were inmates of state institutions like the Virginia Colony.[239] Sadly, the United States Supreme Court approved Buck's involuntary sterilization in the infamous 1927 case *Buck v. Bell*.[240] In an 8-1 decision, the Court held that Virginia's statute was constitutional.[241] The case is perhaps most remembered for Justice Oliver Wendell Holmes' infamous declaration that "three generations of imbeciles are enough."[242]

Nations worldwide likewise involuntarily sterilized hundreds of thousands of women as part of similar eugenic efforts.[243] Not surprisingly, the Nazi regime in Germany embraced eugenics wholeheartedly. It is estimated that the regime involuntarily sterilized over 400,000 Germans.[244] Of those, 200,000 were deemed mentally deficient; 100,000 had mental illness; 60,000 were epileptics; 10,000 were alcoholics; 20,000 had a variety of body deformities; and others had Huntington's, chorea, hereditary blindness, or deafness.[245]

Aug. 17, 2023).

[233] *Id.*

[234] *See* Francis Galton, *Eugenics: Its Definition, Scope, and Aims*, 10 AM. J. SOCIO. 1, 5 (1904) ("What nature does blindly, slowly, and ruthlessly, man may do providently, quickly, and kindly.").

[235] GALTON, supra 232, at, 24–25 n.1 (1883).

[236] Priti Patel, *Forced Sterilization of Women as Discrimination*, PUB. HEALTH REVS., 2017, at 1, 1–2.

[237] Hilligan et al., *supra* note 176, at 54.

[238] *See* Buck v. Bell, 274 U.S. 200, 205 (1927).

[239] H.R.J. Res. 607, Gen. Assemb., Reg. Sess. (Va. 2001); *see aslo Buck*, 274 U.S. at 205 (using language like "feeble minded" as justification for sterilization).

[240] *Buck*, 274 U.S. at 205, 208.

[241] *Id.* at 208 (Butler, J., dissenting).

[242] *Id.* at 207.

[243] *See, e.g.*, David Gems, *Politically Correct Eugenics*, 20 THEORETICAL MED. & BIOETHICS 201, 202 (1999) (explaining a Danish law, for example, that resulted in the sterilization of the "institutionalized mentally handicapped and mentally ill").

[244] Tara Melillo, *Gene Editing and the Rise of Designer Babies*, 50 VAND. J. TRANSNAT'L L. 757, 770 (2017).

[245] *Id.*

The Nazis embraced eugenics in other ways. In 1939, they began exterminating disabled individuals (whom they concluded lived "lives not worthy of life").[246] They killed at least 250,000 people with disabilities before the end of World War II.[247] The Nazis justified such killings on the basis that disabled persons were "empty human husks" and "useless eaters."[248] The Nazis likewise killed "numerous infants born with deformities or brain damage."[249] The full flowering of the Nazi eugenic worldview, of course, took place in the Holocaust, where millions of Jews, LGBTQ individuals, Roma, and others were deemed genetically deficient and useless—and were killed.[250]

Today's proponents of human germline editing insist that there will be no repeat of twentieth-century-style eugenics today.[251] While germline editing by its very nature is inherently eugenic, any germline editing will be a matter of individual choice.[252] Parents—working with medical and scientific professionals—will make genetic decisions for their offspring.[253] Governments will not mandate eugenic choices; this is not the *Brave New World*.[254]

Those embracing a Christian view of human nature will not be satisfied with these assurances. First, it is not at all clear that

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[246] *See* Walter Wright, *Historical Analogies, Slippery Slopes, and the Question of Euthanasia*, 28 J. L., MED. & ETHICS 176, 181, 185 n.37 (2000) (showing how "lives not worthy of life" began with the handicapped and expanded to include numerous other groups).

[247] Maurice R. Berube, *A Spiritual Pilgrimage*, VIRGINIAN-PILOT (Apr. 12, 2015, 12:00 AM), https://www.pilotonline.com/opinion/columns/article_b21873d7-72ce-5396-bd44-6fd37f6b5650.html.

[248] Mark P. Mostert, *Useless Eaters: Disability as Genocidal Marker in Nazi Germany*, 36 J. SPECIAL EDUC. 155, 157 (2002) (noting that two university professors published material which "called for the killing of people with disabilities" on the basis that these individuals' "only societal function" was consuming resources without contributing to the economy in return). This idea was used as the rationale for euthanizing thousands of disabled individuals after a survey showed that even family members were not opposed to killing them. *Id.*

[249]Melillo, *supra* note 244.

[250] Louise Ridley, *The Holocaust's Forgotten Victims: The 5 Million Non-Jewish People Killed by the Nazis*, HUFFPOST (Dec. 6, 2017), https://www.huffpost.com/entry/holocaust-non-jewish-victims_n_6555604.

[251] *See, e.g.*, Calum MacKellar, *Gene Editing and the New Eugenics*, DIGNITAS, Spring 2018, at 3, 5 (noting how American Nobel Prize Laureate and co-discoverer of the structure of the DNA molecule, James Watson, argues against being "held in hostage" to Hitler's evil and rhetorically asks, "if we don't play God, who will?").

[252] *See* Daniel J. Kevles, *The History of Eugenics*, ISSUES SCI. & TECH., Spring 2016, at 45, 48 (theorizing that gene editing would be privatized as family decisions rather than being imposed by the state).

[253] *See* Barnett, *supra* note 95, at 572 (highlighting how parents' desire to care for their children will drive gene editing decisions).

[254] *See* Melillo, *supra* note 244, at 773–74 (stating that there is no government agency regulating private gene editing projects); *see also* Daniel J. Kevles, *Gene Editing and the Rise of Designer Babies*, 32 ISSUES 45, 46 (2021).

governments won't adopt coercive practices to achieve eugenic ends in the twenty-first century, just as they did in the twentieth. The nearly eighty years since World War II have seen governments enforce legal segregation on racial minorities,[255] send hundreds of thousands of individuals from racial and religious minorities to "re-education" concentration camps,[256] and engage in genocide.[257] Recognizing that we live in a fallen world, it is not at all beyond the realm of possibility that corrupt governments will use human germline editing to try to rid their nations of genetic traits or peoples they consider undesirable.

Second, apart from government-sponsored eugenic efforts, the danger for abuse from human germline editing remains. Governments need not mandate eugenic measures. As Professor Seema Mohapatra points out, medical and scientific professionals—and not just governments—played a central role in the eugenic abuses of the twentieth century. "Although eugenics is often thought of as only state sponsored, eugenic idealism went far beyond the government. Eugenic ideals were embraced by medical and professional societies."[258]

In addition, human nature has not changed from a century ago. Yes, we will call our eugenic practices "positive"[259] and a "kinder, gentler eugenics."[260] Indeed, we likely won't use the term. We will just call it health care.[261] But it doesn't mean that there won't be pressure or compulsion.

Sarah Ashley Barnett describes how such pressure might work through social stigma and pressure in a non-government mandated, "positive" eugenic environment,

> If certain genetic characteristics are perceived to be of a lesser quality than others, that stigma, combined with economic pressures from interested third parties—such as

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[255] *See Segregation in the United States*, HISTORY (Jan. 18, 2022), https://www.history.com/topics/black-history/segregation-united-states (explaining how government housing provided for in Truman's Housing Act of 1949 excluded racial minorities); *see also Apartheid*, HISTORY (Mar. 3, 2020), https://www.history.com/topics/africa/apartheid (explaining how the 1913 Land Control Act required black Africans to live in reserves).

[256] Anna Schecter, *New Details of Torture, Cover-Ups in China's Internment Camps Revealed in Amnesty International Report*, NBC NEWS (June 10, 2021, 11:00 AM), https://www.nbcnews.com/news/world/new-details-torture-cover-ups-china-s-internment-camps-revealed-n1270014.

[257] *See* JEFFREY A. BRAUCH, FLAWED PERFECTION: WHAT IT MEANS TO BE HUMAN AND WHY IT MATTERS FOR CULTURE, POLITICS, AND LAW 101 (2017) (ebook) (explaining that between 1973 and 1990, the Chilean Government killed over 3,000 people and tortured as many as 29,000).

[258] Mohapatra, *supra* note 183, at 54.

[259] Barnett, *supra* note 95, at 573.

[260] FUKUYAMA, *supra* note 198, at 87.

[261] *See* Mohapatra, *supra* note 183, at 71 (explaining how no one will openly support eugenics, but that "health" is a more politically correct term for the same ideals).

> insurance companies or drug manufacturers—could lead to greater support for genetic human enhancement for the purpose of making people "better," even where there is no medical necessity. While it is a far cry from the forced sterilization or controlled breeding America experienced in the 1960s, this type of thinking could cause people to associate human "quality" with genetics and make potential parents feel morally obligated to utilize HGM technology—as if doing otherwise would be a disservice to their unborn child and generations to come.[262]

Leon Kass agrees,

> Once it becomes possible, with the aid of human genomics, to produce or to select for what some regard as "better babies"—smarter, prettier, healthier, more athletic—parents will leap at the opportunity to "improve" their offspring. Indeed, not to do so will be socially regarded as a form of child neglect.[263]

It is no wonder that disability rights groups have deep concerns over the future. A view that all lives—including those with disabilities—have equal dignity and worth will face profound challenges when the dominant voices in society call for (and promise) perfect children and lives without limitation and suffering.[264]

Human germline engineering promises a world of medical advance and human enhancement. But it will also produce a world of the haves and have nots. The haves won't just be blessed with more education or greater opportunities. They will be inherently better; their very genetic blueprint will have been enhanced. Others (whose parents choose not to use germline editing for economic, moral, or religious reasons) will be genetically inferior. Their lives, too, will be lesser, in some way defective.

Technology may have changed in the last eighty years, but human nature has not. It is not hard to hear the echo of voices again decrying and resenting useless eaters and lives not worthy of life. Those who don't conform to the accepted standard will always be at risk—for marginalization or worse. "Use of the technology to intentionally alter the human genome (the full array of genetic characteristics of the human

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[262] Barnett, *supra* note 95, at 573.

[263] Kass, *supra* note 197, at 27.

[264] *ASAN Comments*, supra note 185. Alice Wong, a disability rights activist, spoke at Stanford's Medicine X conference and asked this question that is also critical to how we will handle matters of disability in a germline editing world: "In the quest to eliminate suffering and pain, who has the power to decide which mutations warrant human gene editing while others are considered tolerable?" *Id*.

species) and to enhance capabilities and features of individuals opens the way to eugenic practices that undermine reverence for the dignity of individual persons who differ from the expected norm."[265]

> We recognize ourselves, measured against such goals and ideals, to be imperfect creatures. We wish to be more generous, more mathematically able, more musical, more altruistic–less like brutes and more like gods . . . [y]et as noble as our aspirations for shedding our failings might be, our history also suggests that, being flawed as we are, we can never blindly trust our own aspirations to reshape ourselves.[266]

The reality that we are fallen—like the reality that we bear the image of God—warns us of the dangers of engaging in germline editing.

VI. CONCLUSION

Proponents of human germline editing promise a world where genetic diseases are eradicated, and human physical and mental capacities are enhanced. Most scientists, commentators, and observers urge that we move cautiously but steadfastly forward on a path to embrace this world. Their focus is on getting the kinks in the science worked out to the point that we can bring human germline engineering to clinical trials.

Science alone, however, must not determine what path we take. Human germline editing has implications for humanity's future. We must consider humanity's nature before making any decisions that so profoundly affect us and generations to come.

Christianity's account of human nature recognizes that every person has inherent worth and value from God Himself; we are made in His image. We are creative with a tremendous capacity for building, problem-solving, and enhancing life on earth. We should be pro-technology. But we also must protect the dignity of all persons, including those who are most vulnerable, like embryos and those with disabilities.

Christianity also teaches that humans are fallen. We are acutely affected by sin. While we can accomplish much, our best efforts will be flawed. We will fail to carry out our best intentions—and even those intentions will be impaired.

The implications from both aspects of our nature caution us to turn away from the path of embracing human germline engineering. The practice will require the experimentation on and death of many human embryos. And it promotes the marginalization of those with disabilities

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[265] Reilly, *supra* note 96.

[266] CELESTE M. CONDIT, THE MEANINGS OF THE GENE: PUBLIC DEBATES ABOUT HUMAN HEREDITY 245 (1999).

and the commodification of children and childbirth. Human germline editing will also make unintended and potentially dangerous changes to the human genome. And it opens the door to a new form of eugenics that, while different from that of the twentieth century, may be just as dangerous.

In the end, a Christian view of human nature counsels us to walk the path laid out in the Council of Europe's 1997 Oviedo Convention. While we should embrace somatic cell gene editing for therapeutic purposes, we should oppose human germline gene editing. To protect human dignity above all, "an intervention seeking to modify the human genome may only be undertaken for preventive, diagnostic[,] or therapeutic purposes and only if its aim is not to introduce any modification in the genome of any descendants."[267]

[267] Oviedo Convention art. 13.