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I. INTRODUCTION

Genome editing is a biomedical tool that can make "precise alterations, additions, [and] deletions" to an organism's genetic makeup.[1] In 2018, the world was shocked by the birth of twin girls in China,[2] the first children to have their genomes modified by the powerful new gene-editing tool, CRISPR. The news was crucial for two reasons: (1) the alterations to the twin girls' genomes was a form of germline genome editing, meaning their genetic modifications are heritable; and (2) CRISPR was a new gene-editing tool known for its revolutionary precision, ease of use, and cost. CRISPR technology possesses potential to be far reaching and broad in its impact; it can be used for human germline modification,[3] as

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1. NAT'L ACADS. OF SCIS., ENG'G, & MED., HUMAN GENOME EDITING: SCIENCE, ETHICS, AND GOVERNANCE 1 (The National Academies Press 2017), https://doi.org/10.17226/24623. This report is an excellent introduction to genome editing and offers a terrific summation of the technology, key governance, and ethical principles at play.

2. Julia Belluz*, Is the CRISPR Baby Controversy the Start of a Terrifying New Chapter in Gene Editing?*, VOX (Jan. 22, 2019, 12:40 PM), https://www.vox.com/science-and-health/2018/11/30/18119589/crispr-gene-editing-he-jiankui; Antonio Regalado, *Exclusive: Chinese Scientists are Creating CRISPR Babies,* MIT TECH. REV. (Nov. 25, 2018), https://www.technologyreview.com/s/612458/exclusive-chinese-scientists-are-creating-crispr-babies/.

3. David Baltimore et al., *A Prudent Path Forward for Genomic Engineering and Germline Gene Modification*, 348 SCI. 36, 36-37 (2015) ("CRISPR-Cas9 technology, as well as other genome engineering methods, can be used to change the DNA in the nuclei of the reproductive cells that transmit information from one generation to the next [i.e., an organism's germline].").

well as for somatic cell modification. Hence, questions and concerns about the ethics and governance of genome editing are now abound in the legal and bioethical discourse.

Because of the global nature of the consequences that genome editing can and will yield, particularly from the perspective of germline genome editing, a global form of governance should be considered. International human rights law provides a logical place to look for such governance because the consequences involve human rights matters, the nature of which covers the profound ethical implications that stem from germline genome editing (i.e., ethical implications most notably relating to principles of autonomy and justice which are linked to the essence of human rights).

This essay explores the linkages of bioethics and international human rights law in the context of genome editing, by first giving a brief introduction to genome editing technology, then an examination into the ethics of genome editing (drawing a distinction between somatic and germline genome editing), and closing with a discussion of the various forms of international human rights law (and their limitations) relevant to the bioethics of germline genome editing.

II. HUMAN GENOME EDITING: TECHNOLOGIES AND TECHNIQUES

To begin this discussion, a brief synopsis of genome editing—a description of the technology and how it functions—is useful. Before the advent of the now-popularized CRISPR (short for clustered regularly interspaced palindromic repeats[4]), the chief genome editing tools relied on these primary nucleases[5]: meganucleases, zinc-finger nucleases (ZFNs), and transcription activator-like effector nucleases (TALENs).[6] These nucleases are effective genome editors, but they are "technically challenging, time-consuming, and expensive," as researchers are required to design ZFNs and TALENs that will be site-specific. That is, researchers have to design the proteins to bind to the spot of DNA that they want to cut or edit.[7] ZFNs and TALENs are not a favored genome editing tool because they are "expensive, technically challenging, and time-consuming," and require protein engineering to target specific DNA sequences.[8]

4. NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 1, at 65.
5. Nucleases are enzymes that biochemically cleave DNA molecules. *See id.* at 62-63.
6. *Id.* at 63-64.
7. *Id*. at 65.
8. Arthur L. Caplan et al., *No Time to Waste—the Ethical Challenges Created by CRISPR*, 16 EMBO REPS. 1421, 1421 (2015).

The discovery of CRISPR was monumental because CRISPR is much more precise, less expensive, and less time consuming compared to previous genome editing tools.[9] Indeed, "[t]he key distinguishing feature" between CRISPR and tools like TALENs and ZFNs "is that [CRISPR] uses RNA sequences instead of protein segments to recognize specific sequences in the DNA,"[10] thus allowing CRISPR to have greater precision. CRISPR was initially discovered to be a function of a bacteria's immunity against viruses; a discovery that "represents a major conceptual advance in its own right."[11] To edit a genome using CRISPR,

> a Cas9 protein [a type of nuclease[12]] along with a CRISPR "guide RNA" can find a target gene among the thousands of genes in a cell's genome and cleave both DNA strands at the target site. It is this cleavage event that can be exploited to create a mutation in, or "edit," the target gene.[13]

CRISPR can broadly employ two kinds of edits: Non-Homologous End Joining (NHEJ), which is an effective way to deactivate a gene; and Homology Directed Repair (HDR), which can help process a "gene replacement" type of edit. NHEJ involves a Cas9 protein essentially cutting the DNA and then the cut ends join together; this process "often deletes a few bases, which may cripple the gene product, or cause a frameshift that inactivates [the gene]."[14] By contrast, HDR will "repair the damaged allele [i.e., an allele cleaved by Cas9] using another piece of DNA with homology to the target,"[15] which will delete and insert genetic material (a "gene replacement") into the genome.

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9. HENRY T. GREELY, THE END OF SEX AND THE FUTURE OF HUMAN REPRODUCTION 180 (Harvard Univ. Press ed. 2016) ("Like cars before the Model T, other genome editing methods existed earlier [e.g., ZFNs, TALENs], but they were expensive, difficult, and, as a result, not commonly used. With CRISPR/Cas9, cheap, easy, and fast genome editing is now available, like the Model T was, to everyman—or at least everyone with molecular biology training and a few thousand dollars.").

10. NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 1, at 65.

11. *Id.* at 222. This point often gets overlooked in recent discussions about CRISPR technology, especially in the popular media. The amazing biochemistry of how CRISPR-Cas9 naturally functions as an immunity tool is an impressive and intricate mechanism; as Carl Sagan once said, an example of "the awesome machinery of nature."

12. Cas is short for "CRISPR-associated." Cas proteins are a type of nuclease, i.e., "a class of proteins that facilitate chemical reactions" that will "cut DNA." *See* John M. Conley, *Introduction: A Lawyer's Guide to CRISPR*, 97 N.C. L. REV. 1041, 1044 (2019).

13. Kelly E. Ormond et al., *Human Germline Genome Editing*, 101 AM. J. HUM. GENETICS, 167, 168 (2017).

14. Devashish Rath et al., *The CRISPR-Cas Immune System: Biology, Mechanisms, and Applications*, 117 BIOCHIME 119, 126 (2015) (presenting an instructive scientific explanation for how the CRISPR-Cas system functions).

15. *Id.*

Critically, there are noted frequent errors with CRISPR, such as off target changes to the genome and mistakes where parts of DNA are wiped-out or rearranged.[16] We are in the early stages of this technology, so safety risks remain.[17] In fact, there are concerns of unknown side effects that may not necessarily be harmful,[18] but do carry inherent risks with a full range of consequences that are unknown in scope.

Techniques for implementing genome editing technologies typically involve either *ex vivo* (outside the body) or *in vivo* (in the body) methods.[19] *Ex vivo* methods involve removing the "target cell population . . . from the body, [which are] modified with programmable nucleases and then transplanted back into the original host."[20] *In vivo* genome editing is a "direct delivery of programmable nucleases to disease affected cells in their native tissues."[21] A viral vector is often used to deliver the nucleases (e.g., CRISPR-Cas9) to the targeted cell's nucleases.

III. ETHICAL ANALYSIS OF HUMAN GENOME EDITING

Before diving into the ethics of genome editing, it is important to first understand the key distinctions between somatic and germline genome editing. Notably, the heritable nature of germline genome editing as opposed to the individualistic nature of somatic genome editing has profound relevance in any ethical analysis because of the divergent potential consequences.

16. Ricki Lewis, *Is CRISPR Gene Editing Doomed, Even as Gene Therapy Enters the Clinic?,* DNA SCI. BLOG (Aug. 9, 2018), https://blogs.plos.org/dnascience/2018/08/09/is-crispr-gene-editing-doomed-even-as-gene-therapy-enters-the-clinic/ (noting a recent study showing a "mess of missing and moved chromosome parts in the wake deploying the famed 'molecular scissors' [i.e. CRISPR]"); Brad Plumer et al., *A Simple Guide to CRISPR, One of the Biggest Science Stories of the Decade*, VOX (Dec. 27, 2018), https://www.vox.com/2018/7/23/17594864/crispr-cas9-gene-editing ("Cas9 enzymes can occasionally 'misfire' and edit DNA in unexpected places, which in human cells might lead to cancer or even create news diseases.").

17. Lewis, *supra* note 16 (noting that while there are harmful side effects of CRISPR being discovered now, in the long term these issues will be worked out, i.e. "[t]he unexpected genomic damage is simply a problem to be solved").

18. Antonio Regalado, *China's CRISPR Twins Might Have Had Their Brains Inadvertently Enhanced,* MIT TECH. REV. (Feb. 21, 2019), https://www.technologyreview.com/s/612997/the-crispr-twins-had-their-brains-altered/ [hereinafter *China's CRISPR Twins*] (noting that with regard to the now famous "CRISPR twins" in China, "new research shows that the same alteration introduced into the girls' DNA, to a gene called CCR5, not only makes mice smarter but also improves human brain recovery after stroke, and could be linked to greater success in school").

19. David Benjamin Turitz Cox et al*., Therapeutic Genome Editing: Prospects and Challenges*, 21 NATURE MED. 121, 126 (2015).

20. *Id.* at 126.

21. *Id.*

A. Somatic vs. Germline Genome Editing

Somatic genome editing involves editing an individual's cells in a part of their body, rather than the germline. Some potential therapeutic uses of CRISPR for somatic-based treatments may range from "cancer immunotherapy, to treating infectious diseases, to creating stem cell models of disease."[22] For example, CRISPR has the potential to treat diseases like sickle cell,[23] and CRISPR gene therapy trials in China show potential to treat cancer and HIV by editing the genomes of immune cells.[24] Hence, there is great promise of therapeutic somatic cell treatments; however, some scholars and bioethicists have concerns that such edits may be "enhancements" and not merely therapeutic measures.

Germline genome editing (also sometimes referred to as heritable genome editing) refers "to all manipulations of germline cells," which include primordial germ cells, gametes, zygotes and embryos.[25] CRISPR technology can affect the germline of subsequent generations via a tool called a gene drive.[26] A "gene drive actively copies a mutation made by CRISPR on one chromosome to its partner chromosome and thereby ensures that all offspring and subsequent generations will inherit the edited genome."[27] While discussion of gene drives often center around their use in insects (such as mosquitos), they can potentially be used in humans as well.

Additionally, there is a significant level of uncertainty about the safety and potential consequences of germline genome editing. For instance, it is uncertain "whether current knowledge of human genes, genomes, and genetic variation and the interactions between genes and the environment is sufficient to enable heritable genome editing to be performed safely."[28]

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22. Caplan et al., *supra* note 8, at 1425.

23. Gina Kolata, *These Patients Had Sickle-Cell Disease. Experimental Therapies Might Have Cured Them.*, N.Y. TIMES (Jan. 27, 2019), https://www.nytimes.com/2019/01/27/health/sickle-cell-gene-therapy.html. The patients discussed in this article were not treated using CRISPR technology, but the article notes that CRISPR has potential for future use as a gene therapy in this realm.

24. Kathryn Ellen Foley, *Chinese Scientists Used Crispr Gene Editing on 86 Human Patients*, QUARTZ (Jan. 23, 2018), https://qz.com/1185488/chinese-scientists-used-crispr-gene-editing-on-86-human-patients/.

25. NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 1, at 111 n.1.

26. Caplan et al., *supra* note 8, at 1422 ("Gene drive is a powerful tool that makes it more likely that the edited trait will be passed on to offspring through sexual reproduction.").

27. *Id.* at 1422. See *Id.* at 1423 Figure 1 for a useful diagram demonstrating a gene drive.

28. NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 1, at 118.

B. Ethical Considerations

Tom Beauchamp and James Childress[29] famously outlined the bioethical principles of autonomy, non-maleficence, beneficence, and justice;[30] all of which are relevant and should be evaluated when considering the ethics of germline genome editing.

1. Autonomy

The ethical principle of autonomy is focused on issues of an individual's liberty, privacy, choice, and freedom of will.[31] Issues of autonomy are relevant to both somatic and germline genome editing. In the case of somatic genome editing, autonomy is key in terms of an individual's desire to do what they want for their own body, whether that is therapeutic treatment or enhancement. In regard to germline genome editing, the concept of autonomy is particularly relevant when considering future generations of "individuals who will be affected by the present intervention."[32] Here, these individuals' informed consent cannot be reached, and hence their autonomy is arguably contravened; future generations of those with germline edits have no say in the previous modifications to their present genome. Some, like Ruth Macklin, have argued that such an autonomy argument is a "red herring" and note that "the fact that they [future generations] did not—and could not—consent to being protected in that way does not demonstrate that their autonomy was somehow violated. Their autonomy is not yet in existence, so there is nothing to be violated."[33] However, others have raised this concern about the right of "future generations to be free of genetic alterations made without their consent."[34] Alta Charo notes that the "concern here is that a child [born with a germline edited modified genome] might feel less unique or less free simply by knowing that some of his or her traits were chosen by someone else," and that such could be violative of individual rights "to the extent that human rights are founded on notions of autonomy and dignity."[35] At the same time, concern for autonomy also comes into view for

29. TOM L. BEAUCHAMP & JAMES F. CHILDRESS, PRINCIPLES OF BIOMEDICAL ETHICS (4th ed. 1994).

30. *Id.* at 120, 189, 259, 326.

31. *Id*. at 120.

32. Ruth Macklin, *Applying the Four Principles*, 29 J. MED. ETHICS 275, 279 (2003).

33. *Id.*

34. Maha F. Munayyer, *Genetic Testing and Germ-Line Manipulation: Constructing a New Language for International Human Rights*, 12 AM. U. J. INT'L L. & POL'Y 687, 698 (1997).

35. R. Alta Charo, *Germline Engineering and Human Rights*, 112 AJIL UNBOUND 344, 346 (2018). Note that the notion of autonomy and its impact on human dignity is critical; the linkage of autonomy and human dignity is one of the key bridges of bioethics to human rights law.

parents who may desire to have their child born free of a certain disease, or born with an enhancement they desire. Hence, autonomy of both parents and future children must be considered with respect to concerns about ethical autonomy and germline genome editing.

2. Non-maleficence and Beneficence

The ethical principle of non-maleficence is essentially a duty to "do no harm,"[36] and the principle of beneficence is the obligation to "act for the benefit of others."[37] These principles require a weighing of the degree in which such actions cause harm or help society; such a weighing of harms and benefits are appropriate for both somatic and germline genome editing technology. Implicit in the weighing of the consequences of genome editing (both at the somatic and germline levels) is the question of whether the given modification is a therapeutic treatment or enhancement. This distinction is important and often there is no clear line between the two. "Enhancement is commonly understood to refer to changes that alter what is 'normal,'"[38] but what is "normal" or "natural" is certainly debatable.[39]

A large component of the ethical debate concerning the "good" and "bad" consequences (relevant to both somatic and germline genome editing) is the concept of "genetic essentialism."[40] Genetic essentialism is the notion that "genes alone account for who humans are" or that "genetics is the foundation of human nature."[41] Sometimes this notion of essentialism suggests a flawed argument for over-regulation of genome editing; this relates especially to whether genome editing involves enhancement or treatment because enhancement is often viewed as changing the "foundation of human nature."[42] The Nuffield Council on Bioethics, however, rejects the notion of an emphasis on genetic

36. BEAUCHAMP & CHILDRESS, *supra* note 29, at 189.

37. *Id.* at 260.

38. NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 1, at 138.

39. The question of enhancement is complex and nuanced. For an excellent discussion on the nature of enhancement, see I. Glenn Cohen, *What (If Anything) is Wrong With Human Enhancement? What (If Anything) is Right With It?*, 49 TULSA L. REV. 645, 685-86 (2014) ("While bioethicists and lawyers talk about "enhancement" with some frequency, the borders of the concept are not well defined. Moreover, enhancements are not all homogenous, so it would be very foolish to try to take a singular position on "enhancement.").

40. Eli Y. Adashi & I. Glenn Cohen, *The Ethics of Heritable Genome Editing: New Considerations in a Controversial Area,* 320 JAMA 2531, 2531 (2018).

41. *Id.* Genetic essentialism is an idea often found in the popular culture which rests on the theory that genetics determines everything. This idea is of course not accurate; however, emphasis on genetic essentialism is often persuasive to the general public.

42. *Id.*

essentialism, noting that doing so "seems incoherent since the human genome is not a single, stable thing, nor is it distinct in particular from the genomes of other organisms."[43]

In addition, the weighing of the "good" and "bad" in the context of germline genome editing can yield a "precautionary principle," where an emphasis of caution is placed on possible negative outcomes. For example, "the extreme caution that individual geneticists and scientific organizations have expressed regarding the unknowns, uncertainties, and potential dangers of germline interventions suggest that precautionary principle may always be operative in this line of biomedical research [i.e. germline modification]."[44]

3. Justice

The ethical principle of justice is derived from concepts of what is fair and equitable.[45] Issues of justice are of concern for both somatic and germline genome editing. Consider the example of germline genome editing that would confer a benefit (such as a modification to help confer immunity):[46] if such an "enhancement is available only to the upper classes, it can further widen the already existing gap between the more advantaged and less advantaged members of society and thus exacerbate injustices."[47] Ethically, the "benefits of heritable genome editing should not preferentially accrue only to the affluent individuals."[48] Indeed, there is a human rights aspect with regard to social justice, as "[t]he potential for discrimination against genetic groups increases dramatically as genetic testing and [germline manipulation] techniques become less

43. NUFFIELD COUNCIL ON BIOETHICS, GENOME EDITING AND HUMAN REPRODUCTION 92 (2018), http://nuffieldbioethics.org/wp-content/uploads/Genome-editing-and-human-reproduction-FINAL-website.pdf.

44. Macklin, *supra* note 32, at 279. Macklin is skeptical about apportioning too much caution to uncertain negative consequences. Macklin notes that, "much less plausible are the negative consequences envisaged by opponents of germline interventions," and that giving voice to a "litany of potential negative consequences" is "another illustration of opponents of a proposed action or policy inventing a fanciful array of worst case scenarios in seeking to demonstrate that the potential harms far outweigh the likely benefits."

45. BEAUCHAMP & CHILDRESS, *supra* note 29, at 327.

46. Macklin, *supra* note 32, at 278. There may be some dispute about whether a modification to give immunity to HIV would be an enhancement or more in line with a therapeutic treatment. Because it is a modification that is "health related," Macklin notes that, "since disease prevention is a central function of medicine and public health, enhanced protection against disease has not been questioned by opponents of other types of enhancement," thus underscoring the debate that takes place around what is or is not an "enhancement" may hinge on whether or not the proposed modification had some medicinal benefit.

47. *Id.* at 279.

48. Adashi & Cohen, *supra* note 40, at 2531 (referencing the Nuffield Council recommendation).

expensive, more reliable, and more widely available."[49] Maha Munayyer explains that "[germline manipulation] provoke[s] discrimination based on genetic status while simultaneously providing the means to alter that status."[50] An additional concern is that the price of the technology is yet another way that inequality may spread, as "editing is likely to be expensive" and "[g]enetic disease, once a universal common denominator, could instead become an artifact of class, geographic location, and culture."[51]

IV. INTERNATIONAL HUMAN RIGHTS LAW

Considering the multiple ethical issues germane to genome editing—particularly that of the germline and its consequential potential—, questions surface as to what the best ways are to regulate or police such biotechnology to ensure ethical practice. International human rights law is a natural place to look for such a regulatory mechanism, in large part because of the linkage of bioethics and human rights.[52] Indeed, legal scholars have noted that "at the beginning of the twenty-first century bioethics and human genome modification started being discussed within the wider international human rights framework and the even wider international law framework."[53] The consequential power to shape humanity, as germline genome editing possesses, arguably makes the technology prime to fall under the jurisdiction of human rights law, as "[m]embership in the human species is central to the meaning and enforcement of human rights."[54] Recognizing the implicit linkage of human

49. Munayyer, *supra* note 34, at 719.

50. *Id.* at 720-21 ("At the very least, gene manipulation can create the social perception that genetic conditions are within human control, weakening the argument for protected status.").

51. Ormond et al., *supra* note 13, at 172.

52. Richard E. Ashcroft, *Could Human Rights Supersede Bioethics?,* 10 HUM. RTS. L. REV. 639, 639-40 (2010) (noting the relationship between bioethics and human rights "are two assemblages of concepts, practices and institutions which take a profound interest in, and exert considerable influence over, the practice of medicine, health policy and the life sciences and technologies").

53. CESARE P.R. ROMANO, ANDREA BOGGIO, & JESSICA ALMQVIST, *Chapter 2: The Governance of Human (Germline) Genome Modification at the International and Transnational Level*, *in* HUMAN GERMLINE GENOME MODIFICATION AND THE RIGHT TO SCIENCE: A COMPARATIVE STUDY OF NATIONAL LAWS AND POLICIES, CAMBRIDGE UNIVERSITY PRESS 22 (Andrea Boggio, Cesare P.R. Romano, Jessica Almqvist eds., 2019) Authors note the relationship of international human rights law with regards to the governance of germline genome editing: "[g]overnance of human *germline* genome modification is a crucial but narrow facet of the larger question of the governance of human genome modification *tout court*, which, in turn, is a subset of a broader field, international bioethics law, which is itself a specialized branch of international law." *Id.* at 31.

54. George J. Annas, Lori B. Andrews & Rosario M. Isasi, *Protecting the Endangered Human: Toward an International Treaty Prohibiting Cloning and Inheritable Alterations*, 28 AM. J. L. & MED. 151, 153 (2002) (explaining that, "if we take human rights and democracy seriously, a decision to alter a fundamental characteristic in the definition of "human" [i.e., such an alteration

rights and the regulation of human genome editing, Andrea Boggio and other scholars stress that "[i]nternational human rights standards should be central to the development of germline engineering law" as some "national regulatory approaches" to the technology "fail to meet human rights standards."[55]

The Universal Declaration of Human Rights, established by the United Nations (UN) in 1948, is the seminal document in international human rights law and enshrines broad human rights principles.[56] The declaration is given effect and is more specifically addressed through nine core international human rights treaties: e.g., the International Convention on the Elimination of All Forms of Racial Discrimination, the International Covenant on Civil and Political Rights, and the Convention on the Rights of the Child.[57] The declaration "sets out a list of principles that play an important role in bioethics," including such principles as the right to health care, prohibition on discrimination, protection of privacy, and right to life.[58]

Following the advent of the declaration, international human rights turned more specially to bioethics through a few key conventions and declarations—most notably Europe's European Convention of Human Rights and the United Nations Educational, Scientific and Cultural Organization's (UNESCO) series of bioethics declarations—all of which are relevant to influencing germline genome editing.

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that heritable genetic alteration is capable of accomplishing] should not be made by any individual or corporation without wide discussion among all members of the affected population").

55. Andrea Boggio, Barth M. Knoppers, Jessica Almqvist, & Cesare Romano, *The Human Right to Science and the Regulation of Human Engineering*, 2 CRISPR J.,134, 134 (2019). The authors say that

> [n]o matter how technical or specific legislation regulating germline engineering is, governments cannot depart from their international human rights obligations when developing regulatory frameworks. It is not just a matter of legality. It is a matter of legitimacy. International human rights standards are the legal articulation of widely agreed upon values. They are an expression of an internationally negotiated consensus.

56. G.A. Res. 217 (III) A, Universal Declaration of Human Rights, (Dec. 10, 1948), https://www.un.org/en/universal-declaration-human-rights/.

57. *The Core International Human Rights Instruments and Their Monitoring Bodies*, UN HUMAN RIGHTS OFFICE OF THE HIGH COMMISSIONER, https://www.ohchr.org/EN/ProfessionalInterest/Pages/CoreInstruments.aspx.

58. Roberto Andorno, *Global Bioethics and Human Rights*, 27 MED. & L. 1, 2 (2008) (noting the Universal Declaration's role in bioethics, and explaining how its preamble recognizes the principle of the "inherent dignity and of the equal and inalienable rights of all members of the human family;" a principle broadly reflective of bioethical principles).

A. Convention on Human Rights and Biomedicine (Oviedo Convention)

A key piece in the bioethics framework of international human rights is the European Convention of Human Rights (known as the Oviedo Convention).[59] Produced by the Council of Europe, the convention is a legally binding document between signatory European states,[60] codifying notions of bioethics into international human rights law.[61] The Oviedo Convention has particular relevance in international law, as it is "not only the first, but still the only legally binding international treaty in bioethics."[62] Article 13 of the Convention speaks directly to the issue of genome modification, stating, "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."[63] The language clearly makes a distinction between genome editing for either therapeutic or enhancement purposes and favors genome editing for therapeutic purposes as an ethical option. But it also goes further, prohibiting "any modification of germline genes, whether for therapeutic or non-therapeutic aims."[64]

In addition, the Oviedo Convention notably focuses on the protection of "human dignity,"[65] mirroring the emphasis placed on human dignity displayed in UNESCO's Declaration on the Human Genome and Human Rights (discussed below). The interplay of "human dignity" and its

59. EUR. CONSULT. ASS., *Convention on Human Rights and Biomedicine (Oviedo Convention),* 4th Sess., Doc. No. 164 (1997) [hereinafter *Oviedo Convention*], https://www.coe.int/en/web/conventions/full-list/-/conventions/rms/090000168007cf98.

60. While many European countries are signatories, some key nations such as the U.K. and Germany have not yet signed. *See* EUR. CONSULT. ASS., *Committee on Bioethics*, (May 17, 2019), https://rm.coe.int/inf-2019-2-etat-sign-ratif-reserves-bil-002-/16809979a8 (chart of signatures and ratifications).

61. Judit Sandor, *Human Rights and Bioethics: Competitors or Allies? The Role of International Law in Shaping the Contours of a New Discipline*, 27 MED. & L. 15, 17 (2008).

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

63. *Oviedo Convention*, *supra* note 59, at art. 13.

64. Sykora & Caplan, *supra* note 62, at 1871. Sykora and Caplan are critical of the Oviedo Convention's ban on germline editing and would prefer that the language be amended to further distinguish between therapeutic and non-therapeutic editing purposes in both somatic and germline editing. Currently, the language of Article 13 makes a distinction between somatic and germline editing, the latter of which is banned regardless of purpose.

65. Sandor, *supra* note 61, at 18 (noting that the notion of "human dignity" emphasized in the convention stems from French law and its value of human dignity in biomedicine); Francoise Baylis & Lisa Ikemoto. *The Council of Europe and the Prohibition of Human Germline Genome Editing,* 18 EMBO REPS. 2084, 2084 (2017) ("[T]he Oviedo Convention, as currently worded, prioritizes [and quite properly so, in their view] human rights and human dignity over scientific ambition and the technological imperative.").

meaning in the context of germline modification, critically offers a window into the understanding of broader human identity.

B. UNESCO Declarations

Within the United Nations, the specialized agency known as UNESCO has been "dealing with the ethics of science ever since 1970."[66] Since the 1990s, UNESCO has put forth multiple declarations in the realm of bioethics,[67] three of which are explored below.

1. Universal Declaration on the Human Genome and Human Rights

Another piece of international human rights doctrine directly relevant to genome editing is the Universal Declaration on the Human Genome and Human Rights.[68] In 1997, UNESCO created the declaration, which is composed of twenty-one articles, the first of which states, "the 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."[69] The declaration's focus is substantially on "human dignity" in connection with practices involving the genome. While the declaration does not mention germline modification specifically[70] (rather it mentions human cloning[71]), the broadness of the declaration's language is inclusive of genome editing technology.[72] However, the declaration does "not have the direct force of

66. Sandor, *supra* note 61, at 16.

67. *Id.* at 17.

68. United Nations Educational, Scientific and Cultural Organization [UNESCO] Res. 29 C/Res. 16, (Nov. 11, 1997), http://portal.unesco.org/en/ev.php-URL_ID=13177&URL_DO=DO_TOPIC&URL_SECTION=201.html.

69. *Id.* at Article 1. Note how the declaration links together the human genome with the notion of human dignity, suggesting that the genome is fundamental to humanity's essence.

70. *See* Tara R. Melillo, *Gene Editing and the Rise of Designer Babies*, 50 VAND. J. TRANSNAT'L L. 757, 787-88 (2017). Tara Melillo argues that the declaration should be amended to specifically add the language "such as germline genetic modifications" as an example of a practice contrary to human dignity, and thus impermissible under the declaration.

71. UNESCO 29 C/Res. 16, *supra* note 68, at art. 11.

72. Brooke Elizabeth Hrouda, *"Playing God?": An Examination of the Legality of CRISPR Germline Editing Technology Under the Current International Regulatory Scheme and the Universal Declaration on the Human Genome and Human Rights,* 46 GA. J. INT'L & COMP. L. 221, 233 (2017) ("[The Declaration's] articles establish that technology [i.e., technology associated with the human genome] cannot overstep boundaries by interfering with the inherent right of human dignity.").

law"[73] and merely serves as guidance for nations to pass laws that "prohibit those genetic practices that are contrary to human dignity."[74]

The larger question thus becomes: what constitutes "human dignity?" One answer is that human dignity is "respect derived automatically from one's status as a human being."[75] Therefore, some scholars argue that alterations to the genome for "enhancement" purposes is a type of transhumanism that violates human dignity.[76] Indeed, this line of thinking supports the declaration as an ethical tool that can be used to protect against violations of "human dignity" conducted via genetic alterations meant to enhance a human being.[77] As some scholars argue, violations of human dignity via enhancement genome editing calls into question the personhood status of individuals with an altered genome, thus yielding profound implications on the rights and status of such individuals.[78] This is particularly acute under a theory of "personhood" that emphasizes biology and genetics as determinative. Such a worldview that "implicitly assumes that the totality of human DNA is the source of a human essence" will invariably harm "the biological legacy" of children with germline modifications and risk "their entitlement to human rights and legal protections."[79] In other words, human rights protections may be in doubt because germline modified individuals could potentially be deemed as possessing a trans-altered personhood status, thus removing them from the normative status entitled to such protections.

2. International Declaration on Human Genetic Data

As an extension of the 1997 Declaration discussed above,[80] UNESCO enacted the International Declaration on Human Genetic Data

73. *Id*. at 223; *see also* Bridget Toebes, *Sex Selection Under International Human Rights Law*, 9 MED. L. INT'L 197, 207 (2008) (Toebes explains that declarations may be deemed "soft law" instruments" which have "no strict legal obligation, yet there is a growing reliance upon these instruments [i.e., declarations] by lawyers and academics, which reinforces their legal status").

74. Annas, Andrews & Isasi, *supra* note 54, at 171-72.

75. Hrouda, *supra* note 72, at 234.

76. Alexandra M. Franco, *Transhuman Babies and Human Pariahs: Genetic Engineering, Transhumanism*, *Society and the Law*, 37 CHILD. LEGAL RTS. J. 185, 186, 187 n.24 (2017) (defining transhumanism as "a genetically engineered human enhanced beyond baseline human capabilities).

77. *Id.* at 194 (observing how scholars Annas, Andrews and Isasi "espouse the idea that human rights attach to some essential aspect of biological 'humanity' as a justification to oppose Transhumanism and germline genetic engineering technologies").

78. Note that "personhood" and "human dignity" are linked concepts. *See* Hrouda, *supra* note 72, at 234, 241 ("[H]uman dignity means at its core: the right to respect one's individual personhood and uniqueness" and that human dignity "values individual personhood above all else.").

79. Franco, *supra* note 76*,* at 201-02.

80. Andorno, *supra* note 58, at 4.

in 2003.[81] This declaration focused on the "rules for the collection, use and storage of human biological samples" and the "genetic data" that can be yielded from such collections.[82] While this declaration deals with several bioethical principles (e.g., dignity, privacy, consent, discrimination), particularly noteworthy is its treatment of identity:

> Each individual has a characteristic genetic make-up. Nevertheless, a person's identity should not be reduced to genetic characteristics, since it involves complex educational, environmental and personal factors and emotional, social, spiritual and cultural bonds with others and implies a dimension of freedom.[83]

The declaration's emphasis on identity is particularly interesting, especially in the context of genome editing and its propensity to alter an individual's genetic code. The language of the declaration appears to push back against notions of genetic essentialism, viewing human identity as greater than the mere genetic make-up of an individual. Such a view tends to support a notion of human dignity and identity for all individuals (or future generations), no matter how genetically altered they may be for either therapeutic or enhancement purposes.

3. Universal Declaration on Bioethics and Human Rights

Another widely relevant UNESCO declaration is the Universal Declaration on Bioethics and Human Rights.[84] UNESCO created this declaration in 2005 and it is "more general in character," speaking to bioethical principles more broadly.[85] Indeed, it has been viewed as the "first intergovernmental global instrument that comprehensively addressed the linkage between human rights and bioethics."[86] It is similar to the Oviedo Convention, in the sense that they both reflect broad bioethical principles of autonomy, consent, privacy, and equitable access to health care.

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81. United Nations Educational, Scientific and Cultural Organization [UNESCO] Res. 32 C/Res. 22 (Oct. 16, 2003), http://portal.unesco.org/en/ev.php-URL_ID=17720&URL_DO=DO_TOPIC&URL_SECTION=201.html.

82. Andorno, *supra* note 58, at 4.

83. UNESCO 32 C/Res. 22, *supra* note 81, at art. 3.

84. United Nations Educational, Scientific and Cultural Organization [UNESCO] Res. 33 C/Res. 36 (Oct. 19, 2005), http://portal.unesco.org/en/ev.php-URL_ID=31058&URL_DO=DO_TOPIC&URL_SECTION=201.html.

85. Toebes, *supra* note 73, at 209.

86. Andorno, *supra* note 58, at 4 (contemplating that the entire declaration "is conceived as an extension of international human rights law into the field of biomedicine") (emphasis omitted).

C. Limitations of International Human Rights Law

There are significant limitations in using international human rights law to govern the bioethical ramifications of germline genome editing. The first is that creating a binding international treaty, with key nations as signatories (e.g, China, U.S., U.K, Germany, India), is extremely difficult given the current (or truly any) political climate.[87] Another challenge is that declarations (like the UNESCO declarations discussed above) are non-binding, and therefore some argue that declarations are the world's best global governance option, as they are more feasible than a binding treaty and have persuasive influence in the creation of normative conduct.[88] In addition, because the enforcement of international human rights law is a recurring problem, some scholars argue that further attempts to enforce such treaties are unproductive and recognize that human rights law is no longer in a "golden age."[89]

There is also concern about how bioethical reasoning will find its way into the realm of law, particularly because there is now a clear overlap of bioethics and law rooted in human rights. As Richard Ashcroft notes, "there is no good reason to think that bioethical modes of reasoning will be taken up by courts and policy-makers as tools of reasoning…in contexts where the applications of rights-based reasoning is unclear, ambiguous or unhelpful [i.e, contexts where bioethics reasoning may help resolve an ambiguity]."[90]

Additionally, it is important to consider how international law may have limitations due to its potential inconsistency with an existing

87. Melillo, *supra* note 70, at 785 ("[T]he current political climate hinders the likelihood of negotiating such a treaty.").

88. *Id.* at 788-89. Melillo reflects on the benefits of declarations versus treaties, explaining that "a treaty would likely be unsuccessful at remedying the lack of an international consensus on gene editing, but a declaration provides a solution far less adverse to a country's autonomy" and that "a declaration can indicate international consensus, absent the complexities and complications necessary in drafting, enacting, and ratifying a treaty."

89. *See* Ingrid Wuerth, *International Law in the Post-Human Rights Era*, 96 TEX. L. REV. 279, 279, 320-25, 349 (2017). In her article, Wuerth outlines the history of how human rights have "expanded and changed international law in ways that have made it weaker, less likely to generate compliance and more likely to produce interstate friction and conflict." Wuerth illuminates how enforcement of international human rights is nearly impossible in the modern era, as a result of a historical record of non-compliance and unaccountability.

90. Ashcroft, *supra* note 52, at 659. Ashcroft further explains, "traditional modes of legal reasoning, policy formation, and decision-making will not, and have no reason to, cede the field to the methods of (academic) bioethics." Here, Ashcroft reminds readers that while courts and policy-makers may be taking up bioethical issues in the context of human rights law, they will likely still use legal reasoning to make decisions, not the academic modes of reasoning traditionally used in the field of bioethics. This could be considered a limitation on effectuating or merging bioethical principles into human rights law.

country's national law. A prime example of this is when U.S. constitutional law competes with a human rights treaty; which law—the constitution or international law (e.g., a human rights treaty)—has supremacy as applied to U.S citizens?[91] This question would be relevant under circumstances where a human rights treaty may circumscribe a right guaranteed under constitutional law. An example of this could be a treaty that functions as a moratorium on germline genome editing,[92] which arguably conflicts with constitutional rights of reproductive liberty. There is clear constitutional precedent with regard to rights guaranteeing reproductive liberty; note that a constitutional rights argument premised on privacy and reproductive liberty is reflective of the bioethical principle of parental autonomy.[93] However, it is important to remember that not all perspectives of autonomy will be the same world-wide (e.g., different cultures will have different views on reproductive liberty). Such differences serve as a reminder of another key limitation of human rights law: bioethical principles are not uniform across the world and are strongly influenced by culture.[94] Hence, one set of global laws outlined in a single treaty or declaration will invariably come into conflict when applied to individual nations, as different cultures will have different sets of values and different understandings of bioethics and human rights.

Lastly, it is important to remember that any global governance structure that comes from a treaty or declaration is only intended to bind or

91. *See* Peter J. Spiro, *Treaties, International Law, and Constitutional Rights*, 55 STAN. L. REV. 1999, 1999-2000 (2003). Spiro explores this notion of supremacy by asking the question: "Can a treaty override an individual right protected under the Constitution?" In answering this question, Spiro notes that while the long-standing doctrine of "Constitutional Hegemony" suggests the constitution is supreme over a treaty, the reality is more complex, especially with the rise of human rights in the canon of international law.

92. Debate about the necessity of an international moratorium on germline editing is currently ongoing. While debate is spirited, consensus seems to be converging towards overall support of a moratorium on germline editing; if an international treaty were to spring forth tomorrow, a moratorium on germline editing for reproductive and clinical purposes would likely be included. *See also* Eric Lander et al., *Adopt a Moratorium on Heritable Genome Editing*, NATURE (Mar. 16, 2020), https://www.nature.com/articles/d41586-019-00726-5; Charo, *supra* note 35. *See generally* Adashi & Cohen, *supra* note 40.

93. Annas, Andrews & Isasi, *supra* note 54, at 167 n.81. The authors note that, "[t]he right to make decisions about whether or not to bear children is constitutionally protected under the constitutional right to privacy." Right to privacy arguments about reproduction may extend to parents asserting that they have the right to have the kind of child they want, i.e. a so-called "designer baby"—a child whose genome is edited to their parents'desire.

94. David C. Thomasma, *Proposing a New Agenda: Bioethics and International Human Rights*, 10 CAMBRIDGE Q. HEALTHCARE ETHICS 299, 302 (2001). Thomasma explains how notions of autonomy vary in different cultures, noting how in some Western countries "the individual is identified as the locus of decisional capacity for informed consent," whereas the "very concept of informed consent is almost meaningless in societies that stress the overriding importance of an individual's relationship with family and community."

influence individual nation-states, assuming that parties to such treaties would use their own national legal framework to enforce relevant matters in their jurisdiction. However, the relevant matters that national governments generally tackle are not always easily enforceable or identifiable in this rapidly changing world of bio-medical advancements. For example, there is already a growing movement of DIY-Bio or "bio-hackers," who are buying CRISPR kits and are doing genetic modifications at home, outside of the knowledge or purview of any government agency or regulatory authority.[95] Under such circumstances, even if a government follows international human rights law to regulate germline genome editing, it may only have influence over the traditional users of biomedical technology, i.e., corporations and university medical centers. No matter how effective any form of international oversight may be, gaps will remain in policing the ethical practice of germline genome editing.

V. CONCLUSION

Recent events have provided impetus into both the ethical and governance analysis of genome editing. Issues of autonomy, non-maleficence, beneficence, and justice are all relevant and must be weighed. The consequences of germline genome editing can be profound, even unpredictable and difficult to quantify at the moment; it may take many years before the full consequences of certain heritable modifications are understood.[96] As Jennifer Doudna, one of the key discoverers of CRISPR, cautions: "it's important to recognize that we do now have the power to control evolution."[97]

Looking to international human rights law as the face of governance is logical; human rights (and the bioethical principles subsumed) are key in providing guidance to humanity in the face of the new powers created by scientific discovery. Indeed "[s]cience cannot tell us what we should do, or even what our goals are, therefore, humans must give direction [i.e., direction via human rights] to science."[98] Because the consequences of germline genome editing are global in scale and affect all people, the

95. Nancy M. P. King, *Human Gene-Editing Research: Is the Future Here Yet?,* 97 N.C. L. REV. 1051, 1080 (2019). King notes that the rise of CRISPR bio-hacking is an example of how there is a "proliferation of regulatory and oversight mechanisms replete with gaps and overlaps."

96. Amy Gutmann & Jonathan D. Moreno, *Keep CRISPR Safe: Regulating a Genetic Revolution*, 97 FOREIGN AFF. 171, 174 (2018) (noting that the reality is that it may take hundreds of years to detect any changes) ("Unlike the generations of rapidly propagating species, such as mosquitos, human generations span many years, so any harmful change in a human germline could take decades or even centuries to become pronounced.").

97. Jennifer Doudna, *The Ultimate Life Hacker*, 97 FOREIGN AFF. 158, 164 (2018).

98. Annas, Andrews & Isasi, *supra* note 54, at 173.

international structure of human rights law is appropriate. Conceding the many limitations of international human rights law, it is, at its essence, the correct body of law to help guide humanity through the challenges raised by genome editing technology. Therefore, international human rights deserve the focus and energy needed to make it a stronger and more effective governance strategy for germline genome editing. Indeed, how the concepts of human identity and human species are defined and understood in the future depends on our emphasis on international human rights in the present.