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The right to science and human germline editing. Sweden, its external commitments and the ambiguous national responses under the Genetic Integrity Act

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THE RIGHT TO SCIENCE AND HUMAN GERMLINE EDITING*

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1. Setting the scene: Germline as a concern and as the object of law-making

The human genome has been the object of hard and soft law-making in a variety of aspects, including genetic testing and screening,¹ sample and data collections,² and germline modifications.³ The desire to regulate the human

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Santa Slokenberga is responsible for the legal analysis, whereas Heidi Carmen Howard is responsible for section 3 and the scientific coherence of the article regarding genetics and genomics.

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¹ See, for example, Additional Protocol to the Convention on Human Rights and Biomedicine concerning Genetic Testing for Health Purposes, ETS 203 and Council of Europe, Committee of Ministers, Recommendation No. R (90) 13 on Prenatal Genetic Screening, Prenatal Genetic Diagnosis and Associated Genetic Counselling.

² See, for example, Council of Europe, Committee of Ministers, Recommendation CM/Rec (2016)6 on research on biological materials of human origin.

³ See, for example, 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, ETS 164.

genome is not surprising. As set forth in Article 1 of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Universal Declaration on the Human Genome and Human Rights, '[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'.⁴ It establishes the foundations for the similarities and differences between individuals within the human species, and contributes to defining the uniqueness of each individual. Even though there are substantial similarities between the human genome and those of some animals, there is something in our genome that we value highly and wish to protect from destructive influences. In Sweden, this protection is expressed predominantly through the Genetic Integrity Act (Lag (2006:351) om genetisk integritet m.m.).

November 2018 marked a moment of failure for human germline modification global governance and highlighted the urgent need to revisit the adequacy of the national legal frameworks, such as the Genetic Integrity Act in Sweden, in responding to scientific advances in the area of human germline modification. Despite numerous restrictive stands on human germline gene modification in professional circles⁵ and among research governance actors,⁶ in the Second International Summit on Human Genome Editing the birth of the first two children whose genomes had been edited was announced. Dr. He Jiankui, at that time an Associate Professor at Southern University of Science and Technology in Shenzhen, China, revealed that he had applied gene editing technology, specifically CRISPR-Cas9, to edit the genomes of twins, Lulu and Nana, at their embryonic stage with a view to conferring genetic resistance to HIV.⁷ He also revealed another pregnancy with a foetus containing an edited human germline.⁸

⁴ UNESCO, Universal Declaration on the Human Genome and Human Rights, 11 November 1997, Article 1.

⁵ See Kelly E Ormond et al., 'Human Germline Genome Editing' (2017) 101 *American Journal of Human Genetics* 167. ASHG reaffirmed its statement of 2017. 'ASHG Reaffirms 2017 Position Statement on Germline Genome Editing' (*EurekaAlert!*), available at: https://www.eurekaalert.org/pub_releases/2018-11/asoh-ar2112618.php, accessed 13 February 2019.

⁶ For example, UNESCO, Report of the IBC on Updating its Reflection on the Human Genome and Human Rights, SHS/YES/IBC-22/15/2 REV.2, 2015, para. 118.

⁷ See Arvin Gouw, 'The CRISPR Advent of Lulu and Nana' (2019) 17 *Theology and Science* 9.

⁸ For a report on the occurrences at the International Summit on Human Genome Editing in Hong Kong, see Kevin Davies, 'CRISPR's China Crisis: Germline Editing Claim Could Raise Danger of Overreaction or Present Opportunity for Regulation' Vol 39 *Genetic Engineering & Biotechnology News*.

The actions made by Dr. Jiankui have generally been condemned by the scientific community⁹ and the Chinese government.¹⁰ The strong reactions against Dr. Jiankui's experimentative interventions are not surprising. The manipulation of human DNA in a way that would make the changes heritable and so allowing them to be passed down through future generations has always elicited strong opinions due to the potential medical benefits, on the one hand, as well as the safety concerns and potential profound effects on humanity, on the other hand. Overall, opinions regarding the permissibility of human germline editing are split;¹¹ even among those who support it expressions of caution over the clinical use of technology are common. Putting to one side the eventual future health benefits, DNA manipulation raises profound social, ethical, legal and technological questions that need to be resolved prior to using the technology on humans, including some related to human dignity and integrity. The interventions carried out by Dr. Jiankui were made in the absence of medical necessity, such as for sidestepping an incurable disease, and have been conducted at a time when the state of art of the above highlighted issues is in its nursery.

The regulation of human germline editing is not a straightforward matter. It raises competence and authority questions over the governance of science. Even though several actors have contributed to shaping the frameworks applicable to human germline governance, there is a lack of strong voices at the beyond-the-state arena to take this matter seriously.¹² Taking the matter seriously does not imply maintaining bans if they are not justified.¹³ It entails first and foremost having in place responsible ways to establish a degree of scientific certainty and ethical reflection that would allow appropriate regulatory approaches to be shaped, be they prohibitive or permissive. However, as of now, the starting point is the national legal order and the approach it has

⁹ For insights see Owen Dyer, 'Researcher Who Edited Babies' Genome Retreats from View as Criticism Mounts' (2018) 363 *BMJ* k5113.

¹⁰ Owen Dyer, 'Creator of First Gene Edited Babies Faces "Stern" Punishment' (2019) 364 *BMJ* l346.

¹¹ See Eric S Lander et al., 'Adopt a Moratorium on Heritable Genome Editing' (2019) 567 *Nature* 165.

¹² Most recently, the WHO has stepped in and announced the establishment of an expert panel to develop global standards for governance and oversight of human genome editing. See WHO, 'Gene Editing', available at: <http://www.who.int/ethics/topics/human-genome-editing/en/>, accessed 21 March 2019. The panel has highlighted that it is currently irresponsible to proceed with clinical applications of human germline editing, although it has not called for a global moratorium. See Sara Reardon, 'World Health Organization Panel Weighs in on CRISPR-Babies Debate' [2019] *Nature*, available at: <http://www.nature.com/articles/d41586-019-00942-z>, accessed 21 March 2019.

¹³ See in that regard also Lander et al., see above note 11.

taken in regulating the human germline and ensuring that the genetic integrity of individuals, as well as that of humanity, is adequately safeguarded, and that these measures are capable of accommodating the state of art of today's gene editing technologies.

The Swedish Genetic Integrity Act was drafted with the international and European regional regulatory trends and Sweden's external obligations, as well as the state of art of genome editing technology in 2006, in mind.¹⁴ Since then, great strides have been made in genomics. Currently, not only has our understanding of the human genome as a whole increased but also of the roles of individual genes and gene-gene interactions, as well as the interplay between genes and environment. A large part of these advances have been made possible through the improvements in genome sequencing technologies¹⁵ (e.g. next generation sequencing) and, more recently, improvements in technologies for gene editing (e.g. CRISPR-Cas9). Additional advances in approaches, albeit with less potential for ubiquitous use, have also played a role, for example, embryonic nuclear transfer (a form of cloning) resulting in the possibility of replacing mitochondria to avoid passing on a mitochondrial condition to children (mitochondrial donation). Many of the resulting experiments and clinical procedures that these technologies currently enable were regarded as mere science fiction at the time of the drafting of the Genetic Integrity Act. The lapse of time, coupled with advances in science and gene editing technology, creates a risk of premature application of human germline editing technology, and consequently could put at risk the level of genetic integrity Sweden aspired to safeguard in its jurisdiction.

The advancement of science that results in better care and cures, which ultimately leads to better lives, has been the driving engine for research in genetics and genomics. However, between the science and its application lies a gorge. Although there are numerous questions that emerge in this regard, including under what circumstances, if any, can a scientific advancement, and more specifically, a genetic advancement, be applied in healthcare, in this article we focus on the advances in the area of human germline gene editing from the right to enjoy the benefits of scientific progress and its applications (hereinafter referred to as "the right to science") perspective and examine the various challenges that human germline editing presents to the lawmakers. An area of specific concern is the Swedish regulatory perspectives on germline editing and, particularly, the national regulatory responses under the Genetic Integrity Act.

¹⁴ Government bill, Genetisk integritet m.m., 2005/06:64, Chapters 8 and 16.

¹⁵ Such technologies allow the sequence of, *inter alia*, individual genes to be determined.

In order to achieve this aim, Section 2 scrutinizes the right to science and identifies two domains in which Sweden ought to act to meet its right to science obligations under the International Covenant on Economic, Social and Cultural Rights (ICESCR). Section 3 contextualizes the right to science obligations with scientific advances in the area of human germline editing in order to highlight the areas that need further attention. Thereafter, Section 4 examines the current regulatory responses from the Swedish perspective by analysing the state's external commitments and internal regulatory approaches under the Genetic Integrity Act. Finally, Section 5 reflects on the challenges related to responding to human germline editing technology and scrutinizes whether other national legal frameworks, particularly those related to the ethical approval of research, could offer additional safeguards for genetic integrity. Moreover, it describes how the question of human germline editing could be taken seriously from the right to science perspective.

2. The right to science

2.1 Introductory remarks

Provisions relating to the right to science are just as old as any other of the human rights enshrined in post-WWII human rights catalogues. Initially the right to science was included in Article 27.1 of the Universal Declaration of Human Rights (UDHR), then it was enshrined in Article 15 of the ICESCR, and it has subsequently been given expression in various area-specific instruments, for example, UNESCO Universal Declaration on Bioethics and Human Rights which is tasked with tackling 'ethical issues related to medicine, life sciences and associated technologies as applied to human beings, taking into account their social, legal and environmental dimensions'.¹⁶ In Sweden, constitutional protection to the freedom of research, which is an essential component to the right to science, is granted in Chapter 2, Article 18 of the Instrument of Government (*Regeringsformen* (1974:152)).¹⁷

Unlike many other human rights, this right has suffered from limited scholarly attention. As argued by Boggio and Romano, the right to science is 'arguably the least known, discussed and enforced international human right'.¹⁸ Along with the limited discussions on what this right means, there is

¹⁶ UNESCO, Universal Declaration on Bioethics and Human Rights, 19 October 2005, Article 1.1.

¹⁷ *Regeringsformen* SFS 1974:152.

¹⁸ Andrea Boggio and Cesare PR Romano, 'Freedom of Research and the Right to Science: From Theory to Advocacy' in Simona Giordano, John Harris and Lucio Piccirillo (eds), *The Freedom of Scientific Research: Bridging the Gap between Science and Society* (Manchester University Press

a corresponding ambiguity about the content of this right and obligations it places on states. There are some, also relatively recent, attempts to remedy the obscurity of the right to science both in academia¹⁹ and by the UN bodies. The latter includes the work of Ms. Farida Shaheed, Special Rapporteur in the field of cultural rights, who submitted a report on ‘The right to enjoy the benefits of scientific progress and its applications’,²⁰ and the Committee on Economic, Social and Cultural Rights which is currently working towards adopting a general comment in the area.²¹ Despite some recent discussions, it has been argued that ‘we are still far from a full understanding of this right, its normative content and having a cohesive and authoritative list of duties that states must abide by to fully realise the right’.²² With this ambiguity in the background, this section is not an ambitious attempt to identify exhaustively the depth and breadth of the right to science. Instead, it is a humble attempt to scrutinize the nature of the right and ascertain the state’s obligations with a particular focus on genetics and genomics, and human germline editing, as an area of concern. It is hoped this will then serve as a yardstick with which to measure the current regulatory responses to human germline gene editing under the Genetic Integrity Act and to look for ways forward.

2.2 Normative framework of the right to science and some historical and contextual highlights

The right to science can be seen as having two aspects: that which relates to the benefits of scientific advances, and that which relates to the protection of benefits related to the authorship of the scientific achievement. Moreover, in its construction, the normative content of the right to science is related to taking part in cultural life. In this article, the focus is primarily on the former, although other questions, such as the interplay between scientific advances and benefits, and the protection of material and moral interests, as well as the

2018). Preprint version available at: https://digitalcommons.bryant.edu/cgi/viewcontent.cgi?article=1089&context=histss_jou, p. 1, accessed 13 February 2019.

¹⁹ See, e.g., Lea Shaver, ‘The Right to Science: Ensuring That Everyone Benefits from Scientific and Technological Progress’ (2015) 4 *European Journal of Human Rights* 411.

²⁰ UN General Assembly, Report of the Special Rapporteur in the field of cultural rights, Farida Shaheed, ‘The right to enjoy the benefits of scientific progress and its applications’, A/HRC/20/26 14 May 2012.

²¹ See, e.g., CESCR, ‘General discussion on a draft general comment on article 15 of the International Covenant on Economic, Social and Cultural Rights: on the right to enjoy the benefits of scientific progress and its applications and other provisions of article 15 on the relationship between science and economic, social and cultural rights’, available at <https://www.ohchr.org/EN/HRBodies/CESCR/Pages/Discussion2018.aspx>, accessed 17 February 2019.

²² Boggio and Romano, see above note 18.

interplay between science and culture, may be relevant in the area of genetics and genomics.

Article 27.1 of the UDHR states that '[e]veryone has the right freely ... to share in scientific advancement and its benefits'. In a similar vein, Article 15.1.b of the ICESCR states that '[t]he States Parties to the present Covenant recognize the right of everyone: ... [t]o enjoy the benefits of scientific progress and its applications'. The wording of these provisions cannot be praised for their generosity in unpacking the content of these rights. Moreover, the way these rights are worded could create an incorrect understanding of what a right to science is as they merely focus on entitlements. Therefore, prior to scrutinizing obligations on the state to ensure the right, it is crucial to reflect on the historical background of these rights.

The development of the UDHR coincided with the period of the Nuremberg trials (1945-1946), including the Doctors' trial in which 23 doctors were prosecuted for the horrific scientific experiments which culminated in the torture and deaths of their subjects in Nazi concentration camps in the 1930s and 1940s.²³ At the end of the trial, the Nuremberg Code was drafted. This set forth 10 key principles in scientific experimentation to protect the fundamental rights of research participants. Even though some criticism of the document was made, including on its limited importance²⁴ and strictness,²⁵ it is a key early document in medical ethics²⁶ and has served as a seed to the subsequent instruments in the field, including, for example, the WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subject.²⁷ Moreover, it created an awareness that science is not merely about benefits and advances but also about harms, the need for protections and measures to tackle and mitigate them.

With this background in mind, there was not much disagreement about the need for Article 27 of the UDHR in the human rights catalogue. This led to a relatively smooth elaboration process, with the key, yet contrasting, highlights coming from the Soviet and Chinese delegates. The Soviet delegate suggested it should 'recognize and proclaim the people's right to enjoy the

²³ Evelyne Shuster, *Fifty Years Later: The Significance of the Nuremberg Code*, 337 *NEW ENG. J. MED.* 1436, 1437 (1997). See also J Vollmann and R Winau, 'Informed Consent in Human Experimentation before the Nuremberg Code.' (1996) 313 *BMJ: British Medical Journal* 1445.

²⁴ Ravindra B Ghooi, 'The Nuremberg Code—A Critique' (2011) 2 *Perspectives in Clinical Research* 72.

²⁵ George J Annas, 'The Changing Landscape of Human Experimentation: Nuremberg, Helsinki, and Beyond' (1992) 2 *Health Matrix, The Journal of Law-Medicine* 119.

²⁶ Ghooi, above note 24.

²⁷ WE Seidelman, 'Nuremberg Lamentation: For the Forgotten Victims of Medical Science.' (1996) 313 *BMJ: British Medical Journal* 1463.

application of science mobilized in the service of progress and democracy'.²⁸ This was criticized for politicizing science and subsequently rejected. In contrast, the Chinese delegate suggested adding the wording 'share in its benefits' in order to emphasize that the beneficiary of the right is everyone, not only the members of the scientific community, which was supported and found its place in the adopted version of Article 27 UDHR.²⁹

The awareness of the risks of science is not only a phenomenon found in UDHR development. It was also seen in the drafting and adoption of the ICESCR. As early as 1975, the United Nations (UN) General Assembly emphasized that 'scientific and technological developments provide ever increasing opportunities to better the conditions of life of peoples and nations, in a number of instances they can give rise to social problems, as well as threaten the human rights and fundamental freedoms of the individual'.³⁰ In particular, these advancements 'can entail dangers for the civil and political rights of the individual or of the group and for human dignity'.³¹ Acknowledging the risks science presents, the General Assembly called on states to 'whenever necessary take action to ensure compliance with legislation guaranteeing human rights and freedoms in the conditions of scientific and technological developments'.³² A similar call was made in the Vienna Declaration in 1993³³ as well as in the UNESCO Venice Statement on the Right to Enjoy the Benefits of Scientific Progress and its Applications of 2009. These concerns continue to be highlighted by policy-makers and stakeholders, including the

²⁸ See Audrey L Chapman, 'Towards an Understanding of the Right to Enjoy the Benefits of Scientific Progress and Its Applications' (2009) *Journal of Human Rights* 8, further references omitted.

²⁹ *Ibid.*

³⁰ UN General Assembly, Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind A/RES/30/3384 10 November 1975, preamble. At the time of development of the ICESCR concerns regarding the nuclear weapons had emerged. See Chapman, see above note 18, p.7. For a detailed overview on the development of the right to science see Maria Green, Drafting History of Article 15 (1) (c) of the International Covenant on Economic, Social and Cultural Rights, E/C. 12/2000/15, 9 October 2000.

³¹ *Ibid.*

³² *Ibid.*, para. 9.

³³ 'Everyone has the right to enjoy the benefits of scientific progress and its applications. The World Conference on Human Rights notes that certain advances, notably in the biomedical and life sciences as well as in information technology, may have potentially adverse consequences for the integrity, dignity and human rights of the individual, and calls for international cooperation to ensure that human rights and dignity are fully respected in this area of universal concern.' UN, Vienna Declaration and Programme of Action, the World Conference on Human Rights in Vienna on 25 June 1993.

UN Special Rapporteur in the field of cultural rights,³⁴ state representatives,³⁵ and scholars.³⁶

2.3 Unpacking the content of the right to science

We understand the ICESCR to contain both negative and positive rights, whereby a negative right relates to the freedom from interference with a right, and a positive right addresses a right to something.³⁷ In this sense, the right to science under Article 15.1 ICESCR can be construed as a positive right, requiring the state to act in order people can ‘enjoy the benefits of scientific progress and its applications’, and under subsequent provisions of Article 15 steps are listed that states should take in order to ensure the development of science. Yet, approaching the right to science as a positive right does not answer the pressing questions that are of concern to advances in human genetics, including human germline editing. In particular, whether all scientific benefits should be pursued? And if they are equally enjoyable, or whether differentiation can be made and restrictions placed. If so, at what stage should this be done – pre-clinical research, clinical research or clinical care?

As follows from the Vienna Declaration and Programme of Action, drafted in the aftermath of the Cold War, all human rights are universal, indivisible, interdependent and interrelated.³⁸ While some have attempted to examine the differences and links between some of these notions,³⁹ it is also common that they are used interchangeably,⁴⁰ indicating the close links between the two traditional groups of rights, and connoting that realization of the right to science requires that states parties also meet their obligations under other provisions of the ICESCR, as well as other human rights instruments, in particular the UDHR and the International Covenant on Civil and Political Rights (ICCPR).

³⁴ Special Rapporteur in the field of cultural rights, Farida Shaheed, see above note 20.

³⁵ Ibid.

³⁶ Written submissions are available here: <https://www.ohchr.org/EN/HRBodies/CESCR/Pages/Discussion2018.aspx>, accessed 17 February 2019.

³⁷ Isfahan Merali and Valerie Oosterveld, *Giving Meaning to Economic, Social, and Cultural Rights* (University of Pennsylvania Press 2011) 42.

³⁸ Vienna Declaration and Programme of Action, see above note 33, I.5.

³⁹ For example, between interdependence and indivisibility, arguing that ‘[i]ndivisibility is a very strong form of interdependence (or bidirectional support)’. James Nickel, ‘Rethinking Indivisibility: Towards a Theory of Supporting Relations between Human Rights’ (2008) *Human Rights Quarterly*, Vol. 30, pp. 984–1001.

⁴⁰ Helen Quane, ‘A Further Dimension to the Interdependence and Indivisibility of Human Rights: Recent Developments Concerning the Rights of Indigenous Peoples’ (2012) 25 *Harv. Hum. Rts. J.* 49.

The UN Special Rapporteur in the field of cultural rights noted that:

[t]he terms “benefits” of science and “scientific progress” convey the idea of a positive impact on the well-being of people and the realization of their human rights. The “benefits” of science encompass not only scientific results and outcomes but also the scientific progress, its methodologies and tools.⁴¹

In this way, in line with the historical context of the right to science, the right to science should encompass the protection of those scientific achievements that can have a positive impact on humanity which, in the best case scenario, should be assessed through some pre-defined criteria, and leave beyond its scope those interventions that have a destructive impact on humans, their rights and humanity. Therefore, the obligation on states to respect, protect and fulfil the right to science should not mean an absolute scientific freedom resulting in the deregulation of science. These obligations should be carried out insofar as the right to science extends.⁴²

Yet, where can one draw the limits to the right to science, and how should these limits be approached in the context of human germline? Article 4 of the ICESCR sets forth grounds for limiting the rights protected under the Covenant. It states that:

The States Parties to the present Covenant recognize that, in the enjoyment of those rights provided by the State in conformity with the present Covenant, the State may subject such rights only to such limitations as are determined by law only in so far as this may be compatible with the nature of these rights and solely for the purpose of promoting the general welfare in a democratic society.

In other words, the scope of application of the right to science can be restricted provided that it is done for the good of society and the measure meets the criteria set forth in Article 4. These requirements can be regarded as a proportionality assessment for limiting rights set forth in the ICESCR.⁴³ This

⁴¹ Special Rapporteur in the field of cultural rights, Farida Shaheed, see above note 20, III.

⁴² The obligation to respect requires states to refrain from directly or indirectly interfering with the enjoyment of the right. The obligation to respect also requires states to repeal, and refrain from enacting, laws and policies that create barriers in accessing the enjoyable/permmissible scientific benefits. The obligation to protect requires states to take measures to prevent third parties from directly or indirectly interfering with the enjoyment of the right to scientific benefits. The obligation to fulfil requires states to adopt appropriate legislative, administrative, budgetary, judicial, promotional and other measures to ensure the full realization of the right to scientific benefits. See, e.g., UN Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 14: The Right to the Highest Attainable Standard of Health (Art. 12 of the Covenant), 11 August 2000, E/C.12/2000/4.

⁴³ Special Rapporteur in the field of cultural rights, Farida Shaheed, see above note 20, III.C.

assessment should not be seen as discretionary but as a constitutive element of the “respect, protect and fulfil” obligations. In this way, a state can intervene in an individual’s right to science also by not taking measures to protect the individual from harmful science.

Having established these facets of the right to science, what then remains to be examined is whether and to what extent restrictions on human germline gene editing can be regarded as furthering the well-being of people and the realization of their human rights (as individuals and as members of humanity), and to what extent, if at all, the current approaches, including those taken in Sweden, are in line with the requirements that stem from the right to science.

3. Human germline gene editing: the positives and negatives

Gene or genome editing, also known as genome modification, involves the targeted change or modification of specific nucleotides/DNA in the genome. Attempting to change the DNA of a cell is not new, and has been achieved with various methods and different degrees of success *in vitro* in different types of cells for decades. Gene editing has become a particularly “hot topic” in the last few years due to CRISPR-Cas9 (and related tools like CRISPR Cpf1).⁴⁴ This gene editing tool is different from previous tools in that it is more efficient (in terms of the number of sites altered at once) and specific (at the exactly desired location in the genome), as well as being easier to use and more accessible (both in practical and financial terms) to researchers.⁴⁵ This mixture of characteristics makes CRISPR-Cas9 an especially advantageous and powerful tool that allows researchers to modify genes in cells from a large range of different organisms, including microorganisms, plants, insects, non-human animals, as well as human cells.⁴⁶ Importantly, the accuracy and efficiency of the tool compared with other alternatives have led researchers and clinicians to believe that there is a possibility of using CRISPR-Cas9 in a potentially effective and safe (enough) manner in humans in the near to

⁴⁴ Other tools that are available include zinc finger nucleases and transcription activator-like effector nucleases.

⁴⁵ Amber Dance, ‘Core Concept: CRISPR Gene Editing’ (2015) 112 Proceedings of the National Academy of Sciences of the United States of America 6245.

⁴⁶ Arthur L Caplan et al., ‘No Time to Waste—the Ethical Challenges Created by CRISPR’ (2015) 16 EMBO Reports 1421.

medium future to treat disease which, as a matter of science, could be the foundations on which to proceed with clinical trials.⁴⁷

Generally, genome editing technology allows both somatic (any other cell except for reproductive cells) and germline cells (cells that will become gametes, reproductive cells) to be modified. However, only the modification of DNA in germline cells or modification in embryos can result in future descendants having this modification (hence also called heritable modification). Heritable gene editing in human cells raises important scientific (technical) questions and, except for the recent announcement by Dr. Jiankui, is currently only practised in a fairly restricted fashion in human cells or embryos (up to 14 days) in a research context so no gene edited cells that could cause heritable changes are being implanted in women to grow into children.⁴⁸ While the benefits that the technology could eventually offer could improve health, including tackling serious genetic conditions that are as of now incurable, its practical application is currently far from focused on the possible gains. A major issue in human gene editing is lack of accuracy,⁴⁹ specifically resulting in off-target effects which could result in undesired alterations and mutations.⁵⁰ These could result in loss of a particular function, gain of a particular function or even tumour formations, as well as further mosaic modifications.⁵¹ In other words, the technology is currently not advanced enough to be applied in humans, as it brings along a number of uncertainties about its eventual positive and undesired impacts.

Beyond these technical aspects, the potential use of heritable gene editing in humans (not just in human cells in the lab) raises a plethora of important ethical, legal and social issues (ELSI). While not all new, and given that they resemble many of the ELSI raised previously for the use of assisted reproductive technologies, these issues are compounded by the fact that heritable gene

⁴⁷ See Editas Medicine Announces Third Quarter 2018 Results and Update, available at: <https://www.sec.gov/Archives/edgar/data/1650664/000155837018008795/ex-99d1.htm>, accessed 17 February 2019. There is a pressing need to improve the reliability and accuracy of the technology, as a pre-requisite for clinical applications. Piping Liang et al., 'CRISPR/Cas9-Mediated Gene Editing in Human Trippronuclear Zygotes' (2015) 6 *Protein & Cell* 363.

⁴⁸ Countries where germline or embryo gene editing is being conducted in the research context currently include the USA, the UK, Sweden and China. Indeed, heritable gene editing in humans still faces a number of scientific or technical challenges around efficiency and accurate targeting as well safety (i.e. off-target events, or editing at sites that were not desired, an accumulation of which is thought to be related to cancer).

⁴⁹ Relatively low targeting efficiency of CRISPR-Cas9 in human embryos for single-gene interventions has been found. Liang and others, see above note 47.

⁵⁰ Moroko Araki and Tetsuya Ishii, 'Providing Appropriate Risk Information on Genome Editing for Patients' (2016) 34 *Trends in Biotechnology* 86, 87.

⁵¹ *Ibid.*

editing, if used in humans (beyond research), seriously pushes and challenges the scope of technological use that had been believed and understood to be possible in humans. The ELSI include issues related to understanding and respect for human dignity, sanctity of life, the moral status of an embryo, and the concept of and value of a human being. They also include the questions of disability rights and the concept of disability; respect and protection for vulnerable persons; respect for cultural and biological diversity and pluralism as well as human autonomy in that regard; potential negative impacts, including protection of future generations, the potential reduction of human genetic variation; stakeholder roles and responsibilities in decision making, as well as how to conduct “globally responsible” science. Last, but not least, similarly to the case of somatic gene editing, they include issues relating to equitable access to new technologies and health care.⁵² In terms of the right to science, they also raise questions over when, if at all, germline editing benefits could outweigh other concerns especially if there are alternative methods to allowing parents to have healthy children (i.e. pre-implantation genetic diagnosis). These issues differ depending on the stage of research or future clinical application, namely, whether it is basic, pre-clinical or clinical research, or whether clinical application is at stake. Moreover, they could also differ depending on the intended application – whether for health-related needs or other purposes, for example, for expanding the physical or cognitive capabilities of a human being (enhancement).

Thus, even though germline gene editing may be technically possible and scientifically feasible for application in humans, there are considerable ethical, legal and social hurdles to be resolved before a responsible practical application. As a matter of technology governance, the possible gains this technology can offer need to be assessed against the scientific risks, as well as the ELSI that the technology presents, before it can be deemed acceptable to apply this technology to humans. Therefore, it can be argued that the right to science currently requires protecting individuals from the harm that human germline editing presents, as well as society from potentially irreversible changes. Conversely, it is our view that it is not the moment to bring into play obligations in terms of enabling people to benefit from human germline modification, at least not until the outstanding concerns, such as those highlighted above, have been settled. However, simultaneously, it will require establishing new knowledge to periodically re-assess the current approach. Whether establishing new knowledge is acceptable is a completely different question to ask as

⁵² Heidi C Howard et al., ‘One Small Edit for Humans, One Giant Edit for Humankind? Points and Questions to Consider for a Responsible Way Forward for Gene Editing in Humans’ (2018) 26 *European Journal of Human Genetics* 1.

it raises other sensitivities, including stepping into (what many states perceive as) a controversial area of human embryo use for research purposes. Sweden is not, however, among those states that seem to share this concern as research on fertilized eggs is permitted until the 14th day after fertilization under Chapter 5, Section 3 of the Genetic Integrity Act.

4. Swedish regulatory perspectives on human germline editing: substantive provisions

4.1 Human germline regulatory arena from the Swedish perspective

Sweden's regulatory environment pertaining to human germline modification is affected by the international and European regional legal orders and organizations of which Sweden is a member. Key actors relevant for Sweden that contribute to shaping the regulatory environment and are reviewed below in Section 4.2 are the UN and the UNESCO, the Organisation for Economic Co-operation and Development (OECD), the European Union (EU) and the Council of Europe (CoE).⁵³ In light of the existing dualism tradition in Swedish law,⁵⁴ and the EU as a *sui generis* legal order,⁵⁵ each influence the national framework differently.

Nationally, the key act in the area that sets forth limits on gene editing use in Sweden is the Genetic Integrity Act. However, depending on the circumstances, other laws could also be relevant. For example, insofar as human germline editing research involving humans is concerned, the Act concerning the Ethical Review of Research Involving Humans Act is applicable, whereas, if medicinal products are concerned, the medicinal products regulatory framework is relevant, in particular the Medicinal Products Act (Läkemedelslag (2015:315)). This Act relates to the transposition measures for the EU Clinical Trials Directive (discussed below), and insofar as ethical approval relating to medicinal products is concerned it currently relates back to the mechanisms set forth in the Ethical Review of Research Involving Humans Act.⁵⁶ This is also the case with the Swedish Biobanks Act in Medical Care (Lag (2002:297)

⁵³ Instrument of Government, see above note 17, Chapter 1, Section 10: 'Sverige är medlem i Europeiska unionen. Sverige deltar även inom ramen för Förenta nationerna och Europarådet samt i andra sammanhang i internationellt samarbete'.

⁵⁴ Ove Bring, 'Monism och dualism i går och i dag' in Rebecca Stern and Inger Österdahl (eds), *Folkrätten i svensk rätt* (Liber 2012), pp. 28–30.

⁵⁵ *Ibid.*, pp. 30–31.

⁵⁶ See Medicinal Products Act, Chapter 7, Section 1 and Ethical Review of Research Involving Humans Act, Section 11a.

om biobanker i hälso- och sjukvården m.m.)⁵⁷ and with the data protection framework. However, as the substantive provisions are set forth in the Genetic Integrity Act, this is the Act that is reviewed below in Section 4.3. Having said this, particular account will be taken of the Ethical Review of Research Involving Humans Act as a potential means to fill the gaps left by the Genetic Integrity Act vis-à-vis the right to science in the concluding part of the article.

4.2 External commitments

Thus far, the UN has been silent on the issue of human germline editing and so has not placed any express obligations on Sweden in the field. Nonetheless, as a contracting party of the ICCPR it is bound to protect personal integrity, which also covers protection from harmful science.⁵⁸ Within UNESCO, the International Bioethics Committee has recommended ‘a moratorium on genome editing of the human germline’, emphasizing that currently ‘the concerns about the safety of the procedure and its ethical implications are so far prevailing’.⁵⁹ This recommendation is in line with the indication in the Universal Declaration on the Human Genome and Human Rights that human germline interventions could be contrary to human dignity.⁶⁰ Neither in this recent statement nor in the declaration is a distinction made between health and non-health applications; the focus is simply on the germline itself. Nonetheless, due to their vague character, they do not place any direct obligations on Sweden for which Sweden could be regarded as externally accountable.

In 2016, the OECD noted that there has been a call ‘on scientists around the world to abstain from germline gene editing research until the risks are better assessed and a broad societal consensus about the appropriateness of these techniques is reached’.⁶¹ However, the OECD has not adopted a policy on the issue.⁶²

⁵⁷ See Biobanks in Medical Care Act, Chapter 2, Section 3 and compare with Chapter 2, Sections 3 and 3a which will enter into force when the government decides so.

⁵⁸ ICCPR. See also Instrument of Government, see above note 17, Chapter 2 that includes protection for physical integrity.

⁵⁹ Report of the IBC on Updating its Reflection on the Human Genome and Human Rights, SHS/YES/IBC-22/15/2 REV.2, para. 118.

⁶⁰ UNESCO, Universal Declaration on Human Genome and Human Rights, 11 November 1997, Article 24.

⁶¹ OECD Science, Technology and Innovation Outlook 2016, p. 106.

⁶² The OECD launched a project on gene editing with a view to creating a forum for evidence-based discussion across countries on the many issues of shared concern. See OECD BNCT, ‘Project on Gene Editing’ (*Innovation Policy Platform*), available at: <https://www.innovationpolicyplatform.org/project-gene-editing-oecd-bnct>, accessed 17 February 2019.

The only CoE treaty that expressly addresses genome modification is the 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 (Biomedicine Convention), which Sweden signed but has not proceeded to ratify.⁶³ Nonetheless, as a matter of international law, Sweden can be expected not to act against the object and purpose of the convention.⁶⁴ Article 13 of the Biomedicine Convention draws clear lines between what is permissible under the convention and what is not. It states that '[a]n 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'. While this article was drafted to preclude intentional human germline modification, as emphasized in the Explanatory Report to the Biomedicine Convention, it allows intentional somatic gene editing, including that which could cause changes in the human germline.⁶⁵ The scope of this backdoor entry into human germline genetic modification remains unclear due to the existing scientific uncertainties regarding how somatic interventions could affect the human germline. However, this is not the only ambiguity surrounding human germline modification under Article 13 of the Biomedicine Convention. In particular, the provision makes reference to 'preventive, diagnostic or therapeutic purposes', yet one can question what this means in light of the current scientific advances in human genetics. Specifically, it is unclear what, if any, likelihood to develop a condition one has a genetic predisposition to is acceptable for an intervention to be in line with the "preventive" clause under the Biomedicine Convention. There could be risks that the preventive purposes are extensively interpreted, rendering the boundaries that Article 13 sets rather vague.

Disregarding the limited effect of the Biomedicine Convention in Sweden, Sweden is bound to the European Convention on Human Rights (ECHR) and can be expected to comply with the obligations that stem from it. It is

⁶³ Council of Europe, Chart of signatures and ratifications of Treaty 164, available at: https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/164/signatures?p_auth=XBXnH78U, accessed 17 February 2019. There is a relatively recent soft law measure in the area. See Council of Europe, Parliamentary Assembly Recommendation 2115 (2017) The use of new genetic technologies in human beings.

⁶⁴ United Nations, Vienna Convention on the Law of Treaties (adopted on 23 May 1969, entered into force on 27 January 1980) 1155 UNTS 331, Art. 18. Sweden signed the Vienna Convention on the Law of Treaties in 1970 and ratified it in 1975. Vienna Convention on the Law of Treaties 'United Nations Treaty Collection'. Available at: https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&cmdtsg_no=XXIII-1&chapter=23&Temp=mtdsg3&clang=_en, accessed 17 February 2019.

⁶⁵ Explanatory Report – ETS 164 – Human Rights and Biomedicine (Convention), para. 92.

well established that this convention has a rather special place in the Swedish legal order.⁶⁶ Although the convention does not place any express obligations in terms of access to the scientific advances, it requires ensuring that a set of civil and political rights are safeguarded. The doctrines of the ECHR that portray the convention as a living instrument that needs to be interpreted in light of present day circumstances, as well through the narrow margin of appreciation keep at a close lash the signatories when civil and political rights are at stake,⁶⁷ would require Sweden to act in order for the integrity of individuals to be safeguarded, including that individuals are protected from scientific harms.⁶⁸ Having noted this, it should also be pointed out that in terms of access to the European Court of Human Rights (ECtHR), it has become increasingly challenging to get the court to adjudicate on the substantive dimension of integrity safeguarding articles (particularly, Article 2) in individual rights violations in the area of health law.⁶⁹ However, systemic failures – such as deficiencies in the law – are still something for which states can easily be held accountable. The previous Swedish experience with the ECtHR indicates that the ECtHR has contributed to securing the protection of the right to private life at the national level.⁷⁰ It could be argued that because of its obligations under the ECHR, Sweden could be expected to have effective mechanisms in place that mitigate or eliminate the risks that germline gene editing poses to the integrity protected under the ECHR. These mechanisms should be in place regardless of whether the human germline editing interventions are health-related or not.

In the EU, human germline editing is addressed through the medicinal products regulatory framework, and in particular through the regulation of medicinal products – more specifically, clinical trials and advanced medicinal products. Currently, the EU clinical trials regulatory framework comprises the Clinical Trials Directive,⁷¹ which has been transposed into Swedish national

⁶⁶ See, for example, Henrik Wenander, 'Sweden: European Court of Human Rights Endorsement with Some Reservations' in Patricia Popelier, Sarah Lambrecht and Koen Lemmens (eds), *Criticism of the European Court of Human Rights* (Intersentia 2016).

⁶⁷ *S.H. and others v. Austria* (application no. 57813/00) [GC] 3 November 2011, para. 94. On the ECtHR doctrines and methodologies see Santa Slokenberga, 'European Legal Perspectives on Health-Related Direct-to-Consumer Genetic Testing', *Jure*, 2016, ch. 2.3.2.

⁶⁸ See, for example, *Hristozov and Others v. Bulgaria* (application Nos. 47039/11 and 358/12) 13 November 2012.

⁶⁹ See such most recent ECtHR cases that shape the court's restrictive interpretation as *Lopes de Sousa Fernandes v. Portugal* (application no. 56080/13) [GC] 19 December 2017 and *Fernandes de Oliveira v. Portugal* (application no. 78103/14) [GC] 31 January 2019.

⁷⁰ See *Söderman v. Sweden* (application no. 5786/08) [GC] 12 November 2013.

⁷¹ European Parliament and of the Council Directive 2001/20/EC on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implemen-

law, and the recently adopted Clinical Trials Regulation,⁷² which although it has entered into force is not expected to be applicable until 2020.⁷³ Both the Directive and Regulation preclude clinical trials that result in modifications to the subject's germline genetic identity.⁷⁴ This ban is also upheld in regards to Advanced Medicinal Products Regulation, which is directly applicable in Sweden.⁷⁵ However, these frameworks are applicable to a medicinal product, which is defined with a considerable focus on health,⁷⁶ thus potentially leaving the non-health applications (for example, enhancement) uncovered under these frameworks, and consequently subject to the application of national laws.

4.3 Internal responses. The Genetic Integrity Act close up

4.3.1 Aim, scope and construction of the Act

Nationally, human germline editing is regulated under the Genetic Integrity Act. The Act sets forth two key substantive provisions applicable to human germline editing, indicates the scope of applicability of the Act and defines what is understood as "gene therapy" in Swedish law. In light of the current scientific advances in genetics and genomics, already from the start it can be noted that the Swedish Genetic Integrity Act presents several challenges. In part, they can be attributed to the aim of the Act and its intended scope which is presented below. However, these challenges also extend beyond these aspects, in particular, regarding the substantive bans that are set forth

tation of good clinical practice in the conduct of clinical trials on medicinal products for human use [2001] OJ L 121/34.

⁷² European Parliament and Council Regulation (EU) No 536/2014 on clinical trials on medicinal products for human use, and repealing Directive 2001/20/EC Text with EEA relevance [2014] OJ L 158/1.

⁷³ See Articles 80–82, 96, 98 and 99. See also European Medicines Agency, Clinical Trial Regulation, available at: https://ec.europa.eu/health/human-use/clinical-trials/regulation_en, accessed 20 March 2019.

⁷⁴ Clinical Trials Directive, Article 9.6. Clinical Trials Regulation, Recital 75 and Article 90. European Parliament and Council Directive 2001/83/EC on the Community code relating to medicinal products for human use [2001] OJ L 311/67. Directive with amendments as of 27 October 2012. Available at: https://ec.europa.eu/health/sites/health/files/files/eudralex/vol-1/dir_2001_83_consol_2012/dir_2001_83_cons_2012_en.pdf, accessed 17 February 2019, see M9.

⁷⁵ European Parliament and Council Regulation (EC) No 1394/2007 on advanced therapy medicinal products and amending Directive 2001/83/EC and Regulation (EC) No 726/2004 [2007] OJ L 324/1, Article 4.1.

⁷⁶ Under Article 1.2 of the Community Code, a medicinal product is any substance or combination of substances presented for treating or preventing disease in human beings.

in Chapter 2, Sections 3 and 4 of the Act that are analysed below in section 4.3.2.

The Genetic Integrity Act 'sets out provisions on restrictions on the use of certain biotechnology developed for medical purposes and on certain legal effects of such use'⁷⁷ with the purpose 'to safeguard the integrity of the individual'.⁷⁸ Chapter 1, Section 2 of the Act informs that gene therapy is an intervention covered by this Act. What is to be understood by gene therapy is defined in Chapter 1, Section 5. This states that gene therapy is 'a treatment that involves introducing, with the use of a carrier (vector), a healthy gene into the cells of an individual with a genetic disease'. From the point of view of genetics and genomics, two questions emerge. First, as the definition is carrier (vector) dependent, do all gene editing technologies use a vector in the sense described by the Act? Secondly, what is a genetic disease?

Regarding the first, not all gene editing technologies necessarily use vectors, and not necessarily in the way described by the Act (i.e. that the healthy gene carried by the vector is introduced). Hence, it is unclear whether and to what extent differing gene editing technologies are intended to be covered under the Act, as already at the time of adoption of the Act other technologies than those relating to vectors existed. Although unlikely, could it be that the legislature has deliberately chosen to leave a type of technology outside the definition of gene therapy? Consequently, should this mean that application that is not covered under "gene therapy" should be treated as unregulated, and therefore either prohibited or permitted under the Genetic Integrity Act?

As application of the substantive prohibitions could be seen as related to Chapter 1, Section 2 of the Genetic Integrity Act, a closer look at the development of the Act needs to be taken. When the Act was developed, as can be seen from the proposition, the transfer of genetic material could be done using various technologies, which could be grouped into biological and non-biological. The biological methods involved a virus as a vector, whereas the chemical (non-biological) included, for example, the use of electric fields and injections in the nucleus.⁷⁹ However, as a matter of science, even chemical and electrical approaches could be used with a vector, which is something that the government bill has not accounted for. Moreover, the intention of the provisions of the Act was to regulate which forms of gene therapy were not allowed.⁸⁰ Thus, one could argue that even though the wording of the substantive provisions that contained bans was indeed technology neutral, the

⁷⁷ Lag (2006:351) om genetisk integritet m.m. SFS nr: 2006:351, Chapter 1, Section 1.

⁷⁸ Ibid.

⁷⁹ Government bill 2005/06:64, see above note 14, p. 127 and 199.

⁸⁰ Ibid, p. 199.

context in which it was placed should shape its interpretation, and vectorless technologies (or those not “introducing” a healthy gene via a vector) should not be covered under the Genetic Integrity Act.

Regarding the second question, from the outset it should be noted that the Act does not clarify what a “genetic disease” is. Even assuming that it relates to a condition being ‘caused in whole or in part by a change in the DNA sequence away from the normal sequence’,⁸¹ two issues, similar to that regarding the use of vectors, are unclear: first, whether the disease has to be manifested or not, and second, whether the application that does not fall within the scope of the Act should be treated as unregulated, and therefore either prohibited or permitted under the Genetic Integrity Act.

While these questions might seem to be finicky details, they could affect which germline editing techniques fall within the scope of the Act, and what technologies fall outside the application of the Act and so could be at risk of being seen as unfulfilled right to science obligations.

4.3.2 Substantive prohibitions regarding clinical research and clinical care

Gene modification as part of research is regulated under Chapter 2, Section 3 of the Genetic Integrity Act. This states that ‘experiments for the purposes of research or treatment that entail genetic changes that can be inherited in humans may not be carried out’.⁸² Chapter 2, Section 4 of the Act regulates germline interventions in clinical applications. This states that ‘treatment methods that are intended to bring about genetic changes that can be inherited in humans may not be used’.⁸³

These substantive prohibitions are constructed without references to gene therapy as defined in the Act. Therefore, if one disregards Chapter 1, Sections 2 and 5, as well as the title of Chapter 2, Sections 3 and 4 of the Act and merely focuses on the substantive dimension of the provisions through grammatical interpretation, one can conclude that Sweden has adopted measures to safeguard individuals from possible negative effects of germline editing as part of clinical research and clinical care. However, if subsumed under the scope of application of the Act, then the effect of this provision is limited to such germline interventions that fall within the scope of gene therapy as

⁸¹ Frequently Asked Questions About Genetic Disorders: What are genetic disorders?, available at: <https://www.genome.gov/19016930/faq-about-genetic-disorders/>, accessed 17 february 2019. Germund Hesslow, ‘What Is a Genetic Disease? On the Relative Importance of Causes’ in Lenart Nordenfelt and B Ingemar B Lindahl (eds), *Health, Disease, and Causal Explanations in Medicine* (Springer Netherlands 1984).

⁸² Government bill 2005/06:64, see above note 14, p. 128.

⁸³ Genetic Integrity Act, see above note 77, Chapter 2, Section 4.

defined under the Act, and one can identify a risk that Sweden's obligations under the right to science are only partially fulfilled. Insofar as medicinal products are concerned that are covered under the Clinical Trials Directive, the textbook cases of the Court of Justice of the European Union, such as *Marleasing*, guide us through a consistent interpretation of national law vis-à-vis EU law,⁸⁴ and enable applying the provisions of the Genetic Integrity Act to gene editing technologies regardless of their technical nature (being vectorless or not).

In relation to the applicability of the Clinical Trials Regulation, and despite the fact that regulation as a form of EU law is generally directly applicable and does not require national implementing measures that give them effect, a new Chapter 2, Section 3 will come into effect that makes a clear reference to Article 90 of the Clinical Trials Regulation. It retains the above quoted previous wording of Chapter 2, Section 3 and the currently applicable prohibition, and adds that:

Prohibition of conducting gene therapy clinical trials, which results in the genetic identity of the genital identity of the subject, is contained in Article 90 of Regulation (EU) No 536/2014 of the European Parliament and of the Council of 16 April 2014 on clinical trials for medicinal products for human use and repealing Directive 2001/20/EC.

The new provision places a clear emphasis on the clinical trials as regulated under the EU law. In the recent government bill that sets forth foundations for the amendment in Chapter 2, Section 3 of the Genetic Integrity Act, without any reflection on the challenges relating to the operational scope of the Act, it is noted that this provision *will ensure* that the Act clearly applies not only to that research which falls within the scope of the EU Clinical Trials framework, but also other research⁸⁵ potentially, such as enhancement. Thus, instead of taking the opportunity to clarify how Chapter 1, Sections 2 and 5 co-exist with Chapter 2, Section 3, the Swedish legislature has opted to build on the existing ambiguity. While this has created a broad scope of application for this provision, it has also raised considerable questions over the value of propositions for ascertaining the views of a legislature: which are the ones to be followed – the initial government bill that hints at the limited scope of application of the Act, or the most recent one which without any consideration to the previous one claims a broad scope of application of the norms? If the former is followed, one can clearly see the risks in meeting the right to science

⁸⁴ C-106/89 *Marleasing v Comercial Internacional de Alimentación*, ECLI:EU:C:1990:395.

⁸⁵ Government bill 2017/18:196, Anpassningar av svensk rätt till EU-förordningen om kliniska läkemedelsprövningar, p. 156. It states 'förbudet i lagen om genetisk integritet har dock en vidare omfattning än förbudet i EU-förordningen och direktivet.'

obligations. These then, because of the nature of the wording of the respective article in the Clinical Trials Regulation, could easily be filled with direct effect, but only insofar as medicinal products are concerned. Whereas if the latter is followed, one can praise the national legislature for having taken actions to safeguard genetic integrity within the Swedish jurisdiction at these times of considerable uncertainty, and this safeguard applies to the medicinal products as well as those interventions that do not fulfil medicinal product criteria.

Could these risks be remedied through other provisions of the Genetic Integrity Act? Chapter 5, Section 3 of the Act sets forth limits for interventions on fertilized eggs. However, insofar as germline interventions are concerned, they relate to gene therapy as regulated under Chapter 2, Sections 3 and 4 of the Act,⁸⁶ and face the above-discussed challenges. However, Chapter 5, Section 5 of the Act sets forth the prohibition on introducing a fertilized egg that has been subject to scientific experiments, and the use of an egg and sperm if the egg, before fertilization, or the sperm used for fertilization, have been used for an experiment or if the egg has been subject to somatic nuclear transfer. Contrary to other provisions of the Act that were discussed above, this prohibition is neutral in its wording. Therefore, if this provision is operationalised without regard to the system in which it functions, it has the potential to preclude those clinical research and care attempts that fall beyond the scope of Chapter 2, Sections 3 and 4 of the Act. This requires the active work of the National Board of Health and Welfare.⁸⁷ However, considerations regarding Chapter 5, Section 5 of the Act apply only insofar as the used germline editing technique involves *in vitro* fertilization.

5. Concluding reflections and further directions

This article sought to scrutinize advances in the area of human germline gene editing from the right to science perspective and identify various challenges that human germline editing presents to the lawmakers. As an area of specific concern, the national regulatory responses in Sweden were analysed with a particular focus on the Genetic Integrity Act, which is the key national act in the field defining the limits of genetic integrity interventions in Sweden.

The right to science is a human right that currently brings with it some uncertainties. Given the historical background during which the right has been adopted and the context in which the right has been operationalized, as well as the possibilities the ICESCR allows for and the doctrine of indivis-

⁸⁶ Government bill 2005/06:64, see above note 14, p. 203.

⁸⁷ Genetic Integrity Act, see above note 77, Chapter 8, Section 3.

ibility of human rights, it has been argued that this right has a dual character and consequently it places on states dual obligations, namely, to further access to benefits from the scientific advances (including taking measures to further science), and to take steps to protect individuals from harmful science. Because of the state of art of gene editing technology and outstanding ELSI, states are required to protect individuals and ensure that their genetic integrity is not compromised through the application of premature germline editing tools.

However, in practice, in Sweden meeting this obligation and safeguarding individuals from harmful science risks being problematic due to the ambiguous character of the Genetic Integrity Act as regards human germline. Instead of resolving the ambiguities with the recent amendments in the respective parts of the Act, the Swedish legislature has opted to build on them and pose further substantive and methodological questions. While the substantive ones have already been raised in Section 4 of this article, here it suffices to note that because of the created ambiguity the value of the government bills as a guide through the legislature's intention in this matter is being compromised.

In light of the highlighted ambiguities, one can scrutinize further the overall research regulatory framework, and examine whether the Ethical Review of Research Involving Humans Act could serve as an additional safeguard mechanism to uphold the protection of genetic integrity in Sweden. Generally, germline editing intervention clinical research could be seen as something that triggers the application of the Act, and thus such research needs to be ethically approved.⁸⁸ As these interventions predominantly concern future persons, the key provision is Section 7 of the Act which enables approving only research that respects human dignity. However, one should also reflect on how that could relate to the rights of the persons involved, and whether it could be ethically approved. This is an assessment, however, that will be done by the Swedish Ethical Review Authority. Therefore, the ability of the Ethical Review of Research Involving Humans Act to further the protection of genetic integrity depends on the interpretation of its provisions by the Swedish Ethical Review Authority.⁸⁹

In relation to the challenges highlighted in this article one could also keep in mind the enforcement avenues offered by the EU law and the ECHR as a means through which the national legal framework could be impacted. Challenges stemming from the Genetic Integrity Act, if not tackled nation-

⁸⁸ Ethical Review of Research Involving Humans Act Sections 4.2 and 4.3, as well as Section 6.

⁸⁹ However, as follows from Section 6 of the Ethical Review of Research Involving Humans Act, ethical approval does not mean that the research will be legal if it is not in line with the Genetic Integrity Act.

ally through other mechanisms, could be seen as a systemic deficiency in the Swedish national law. However, for example, in order to trigger the ECtHR jurisdiction *inter alia* the victim status in the context of Article 34 ECHR needs to be fulfilled. It requires, for example, a person whose human germline has been edited and has failed to reach justice nationally. Because of the technical and ELSI challenges that were previously discussed, in our view, that one case might be one too many.

On the right to science, Boggio and Romano have suggested that

‘[w]aiting for the theoretical debate on the right to science to settle before seeking its protection would delay its realisation. Mobilisation through advocacy and litigation can provide both a remedy to victims of violations in specific cases and cause the development of a body of opinions and other policy outcomes which can contribute, with authority, to defining the content of the right’.⁹⁰

In situations when humanity is at stake because of deficiencies in national law, devising a remedy might not necessarily be an appropriate action tool. In our view, it carries with it the risk of diminishing the value of a human. Effective prevention first and foremost, set out in clear legal provisions, as urged by the Swedish National Council on Medical Ethics,⁹¹ is important and needs to be taken seriously. It requires, firstly, to ensure effective oversight of Chapter 5, Section 5 of the Genetic Integrity Act. Additionally, it is necessary to take immediate measures to assure that interventions that risk falling outside the scope of application of the Genetic Integrity Act are effectively caught under the Ethical Review of Research Involving Humans Act. While the clarity of the Genetic Integrity Act is more than necessary, given the EU’s peremptory framework in the area of clinical trials, it must be borne in mind that Sweden cannot legislate nationally differently than EU law mandates. Furthermore, in relation to taking the question of human germline editing seriously, it is necessary to establish clear avenues for further work from ethical, legal, social and technical perspectives to examine the technological advances, revisit germline gene editing vis-à-vis the right to science and ascertain under what circumstances, if any, it could be acceptable in Sweden for human germline editing to take place. Thereafter, these findings should be shared with the broader community, including with the EU law and policy makers, as well as the Council of Europe, to either strengthen the current regulatory approaches or pave the way to revisit them.

⁹⁰ Boggio and Romano, see above note 18.

⁹¹ SMER, “Skrivelse om utredning av lagstiftning för ny genetik”, 2018-06-07, Dnr Komm 2018/00631/S 1985:A.