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# Resolution and Definitions

### Resolution

**Public health services should expand access to gene editing technologies**

## “Public Health”

### “Public Health Services” Are Provided by the Government

#### “Public health services” are provided by the government

Mark A. **Rothstein**, Herbert F. Boehl Chair of Law and Medicine and director of the Institute for Bioethics, Health Policy and Law at the University of Louisville, **2002**

[“Public Health Law, Society, And Ethics: Rethinking the Meaning of Public Health,” *Journal of Law, Medicine & Ethics* (30 J.L. Med. & Ethics 144), Summer, Available Online via Lexis-Nexis *// BATMAN*]

n9 Committee for the Study of the Future of Public Health, Institute of Medicine, The Future of Public Health (Washington, D.C.: National Academy Press, 1988): at 19.

**The IOM report also makes public health the responsibility of everyone, although it gives primacy to *government effort*s**: "The mission of public health is addressed by private organizations and individuals as well as by public agencies. But the governmental public health agency has a unique function: to see to it that vital elements are in place and that the mission is adequately addressed." n10 In contrast to this government-centered approach, a more expansive definition of public health cited in, but not necessarily endorsed by the IOM report is the following: "It's anything that affects the health of the community on a mass basis." n11 **Under such a view, efforts to improve access to health care as well as more general measures to prevent injury and illness and reduce morbidity and mortality, such as advice to use sunscreen and eat healthy foods, would be considered public health. I term this conception of public health the "population health as public health" model**.

### “Public Health” Services Can be Mandatory

#### “Public health” is collective efforts to ensure that the population is healthy

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 173-4

**"Public health is what we, as a society, do collectively to assure the conditions for people to be healthy."** In the abstract, the vast majority of Americans believe in public health and support public health goals. More than three and a half decades ago, **this attitude prompted Congress to establish "a separate standard for coverage of children within Medicaid" in order to facilitate baby well-care.**

#### Public health requirements can intrude on civil liberties

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 179-80

Adequately addressing **the identified weaknesses of the** United States' **public health system will involve some friction with individual rights. For example affording public health officials an expansion of authority, will, of necessity, intrude on the protection of civil liberties. More governmental power almost invariably corresponds to less individual liberty; "[i]t is not a new equation."**  Likewise, some of the most popular and commonly used public health measures around the world--namely quarantines, mandatory screening and immunization, and **health information sharing--all intrude upon civil liberties to one extent or another.**

#### “Public health” can trade-off with rights

Lawrence O. Gostin, professor of Public Health at Georgetown, and Johns Hopkins, Summer 2001, Journal of Law, Medicine, and Ethics, Public Health, Ethics, and Human Rights: A Tribute to the Late Jonathan Mann, p. 131

Jonathan Mann viewed human rights as the conscience of public health. He was acutely aware that public health policies can, and do, infringe on human rights. For example, **a decision to compulsorily test, treat, or confine** a person with tuberculosis certainly **invades a sphere of autonomy or liberty. Similarly, surveillance and mandatory reporting invade a sphere of our privacy. It was for this reason that he worked on a "human rights impact assessment" to measure the human rights effects of public health policies.**

### “Public Health” Aims at Overall Population Health

#### “Public health” is aimed at the population’s overall health

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 175-6

**Public health differs from traditional health care in several respects. Some of its distinguishing features include a focus on: "(1) the health and safety of *populations* rather than** . . . individual patients; (2) [the] ***prevention* of injury** and disease rather than treatment[;] . . . (3) [the] **relationship between *government* and the *communit****y* rather than physician and patient; and (4) services grounded on [sic] . . . *scientific methodologies* of public health (e.g. . . . *epidemiology*) rather than personal medical services." **The Institute of Medicine's definition of public health, set forth at the beginning of this article, reinforces these distinguishing characteristics by emphasizing a mutuality of obligation lying with the government and community as a whole, and focusing on increasing the incidence of conditions that facilitate healthy living as opposed to guaranteeing health itself.** People often fail to appreciate the benefits of public health, because the effects of prevention are usually invisible. However, a strong public health system is essential to the welfare of any society, and has accounted for approximately "twenty-five of the thirty years of increased life expectancy in the United States since the turn of the century." The importance of public health to American society has been underscored by the events of September 11th, which confirmed that terrorist attacks, with the potential for biological warfare, are very real threats.

### General Definitions of “Public Health”

#### Various definitions of “public health”

Lawrence O. Gostin, professor of Public Health at Georgetown, and Johns Hopkins, Summer 2001, Journal of Law, Medicine, and Ethics, Public Health, Ethics, and Human Rights: A Tribute to the Late Jonathan Mann, p. 122

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|  |  |
| Definition | Society's obligation to assure the conditions for |
|  | people's health |
|  |  |
| Mission | To promote physical and mental health |
|  | To prevent disease, injury, and disability |
|  |  |
| Functions | To assemble and analyze community health needs |
|  | To develop policy informed through scientific |
|  | Knowledge |
|  | To assure the community by providing services |
|  | necessary for its health |
|  |  |
| Jurisdiction/Domain | Narrow focus--proximal risk factors |
|  | Broad focus--distal social structures (e.g., |
|  | discrimination, homelessness, socioeconomic status) |
|  |  |
| Expertise/Skills | Epidemiology and biostatistics |
|  | Education and communication |
|  | Leadership and politics |

ideal state of physical and mental health to a more concrete listing of public health practices. Charles-Edward A. Winslow, for example, defined public health as:

the science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, the education of the individual in principles of personal hygiene, [and] the organization of medical and nursing service for the early diagnosis and preventive treatment of disease. n5

More recent definitions focus on "positive health," emphasizing a person's complete well-being. n6 Definitions of positive health include at least four constructs: a healthy body, high quality personal relationships, a sense of purpose in life, and self-regard and resilience. n7

n5 C.A. Winslow, "The Untilled Fields of Public Health," *Science*, 9 (January 1920): 20-30, at 30.

n6 "Putting Public Health Back into Epidemiology," Editorial, *Lancet*, 350 (1997): 229.

n7 C.D. Ryff and B. Singer, "The Contours of Positive Health," *Psychological Inquiry*, 9 (1998): 1-28; J.W. Rowe and R.L. Kahn, *Successful Aging* (New York: Pantheon Books, 1998).

The Institute of Medicine, in its seminal report on the *Future of Public Health*, proposed one of the most influential contemporary definitions: "Public health is what we, as a society, do collectively to assure the conditions for people to be healthy." n8

n8 Institute of Medicine, *The Future of Public Health* (Washington, D.C.: National Academy Press, 1988): at 19.

The Institute's definition can be appreciated by examining its constituent parts. The emphasis on cooperative and mutually shared obligation ("we, as a society") reinforces that collective entities (e.g., governments and communities) take responsibility for healthy populations. Individuals can do a great deal to safeguard their health, particularly if they have the economic means to do so. They can purchase housing, clothing, food, and medical care. Each person can also behave in ways that promote health and safety by eating healthy foods, exercising, using safety equipment (e.g., seatbelts and motorcycle helmets), or refraining from smoking, using illicit drugs, or drinking alcoholic beverages excessively. Yet, there is a great deal that individuals cannot do to secure their health; to overcome whatever these barriers may be, individuals need to organize, work together, and share their resources. Acting alone, people cannot achieve environmental protection, hygiene and sanitation, clean air and surface water, uncontaminated food and drinking water, safe roads and products, and control of infectious disease. Each of these collective goods, and many more, is achievable only by organized and sustained community activities. n9

n9 L.O. Gostin, "Public Health Law in a New Century: Part I: Law as a Tool to Advance the Community's Health," *Journal of the American Medical Association*, 283 (2000): 2837-41.

The Institute of Medicine's definition also makes clear that even the most organized and socially conscious society cannot guarantee complete physical and mental well-being. There will always be a certain amount of injury and disease in the population that is beyond the reach of individuals or government. The role of public health, therefore, is to "assure the *conditions* for people to be healthy" (emphasis added). These conditions include a variety of educational, economic, social, and environmental factors that are necessary for good health. n10

n10 Institute of Medicine, *Health and Behavior: The Interplay of Cells, Self and Society* (Washington, D.C.: National Academy Press, forthcoming in 2001).

Most definitions share the premise that the subject of public health is the health of populations--rather than the health of individuals--and that this goal is reached by a generally high level of health throughout society, rather than the best possible health for a few. The field of public health is concerned with health promotion and disease prevention throughout society. Consequently, public health is less interested in clinical interactions between health-care professionals and patients, and more interested in devising broad strategies to prevent, or ameliorate, injury and disease.

Scholars and practitioners have long been conflicted about the "reach" or domain of public health. n11 Some prefer a narrow focus on the proximal risk factors for injury and disease. Under this perspective, public health should identify risks or harms and intervene to prevent or ameliorate them. This has been the traditional role of public health, exercising discrete powers such as surveillance, infectious disease controls (e.g., screening, vaccination, partner notification, and quarantine), and sanitary measures (e.g., safe food and drinking water).

n11 See G. Mooney, "Book Review," *Journal of Health Politics, Policy & Law*, 25 (2000): 775 (discussing the debate in Britain in the 1840s between non-physician Sir Edwin Chadwick, architect of a public health system focused on the water supply and sewage system, and Dr. William Alison, who emphasized lack of food, clothing, warmth, and adequate shelter as causes of disease).

Others prefer a broad focus on the societal, cultural, and economic foundations of health. Under this perspective, public health should be more concerned with the underlying conditions that are associated with poor health. n12 For instance, the field of public health is ultimately interested in the equitable distribution of social and economic resources because social status, race, and wealth are important determinants of health. n13 This inclusive direction for public health is gaining popularity; consider how many of the federal government's health objectives for 2010 seek a reduction in health disparities. n14 Public health researchers are also venturing into areas far from their traditional expertise, including violence, war, homelessness, and discrimination. n15

n12 I.H. Meyer and S. Schwartz, "Social Issues as Public Health: Promise and Peril," *American Journal of Public Health*, 90 (2000): 1189-91 (discussing the role of public health in addressing the "social ills rooted in distal social structures").

n13 M. Marmot and R.G. Wilkinson, eds., *Social Determinants of Health* (New York: Oxford University Press, 1999).

n14 *Healthy People 2010: Conference Edition* (Washington, D.C.: U.S. Department of Health and Human Services, 2000).

n15 W.R. Breakey, "It's Time for the Public Health Community to Declare War on Homelessness," *American Journal of Public Health*, 87 (1997): 153-55.

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Lawrence O. Gostin, professor of Public Health at Georgetown, and Johns Hopkins, Summer 2001, Journal of Law, Medicine, and Ethics, Public Health, Ethics, and Human Rights: A Tribute to the Late Jonathan Mann, p. 122

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### “Public Health is not Private

#### Definitions of “public health” that include “private care” are too broad

Lawrence O. Gostin, professor of Public Health at Georgetown, and Johns Hopkins, Summer 2001, Journal of Law, Medicine, and Ethics, Public Health, Ethics, and Human Rights: A Tribute to the Late Jonathan Mann, p. 122

The problem with an expansive view is that public health--as a field, as a mandate--becomes limitless, as almost everything human beings undertake affects public health. By this account, **public and private activities across a wide spectrum are the work of public health. To many, this all-inclusive notion of public health is counterproductive. First, by defining itself so widely, the field lacks precision. Public health becomes an all-embracing enterprise bonded only by the common value of societal well-being. Second, by adopting such a broad array of behavioral, social, physical, and environmental interventions, it lacks a discrete expertise. The public health professions consequently incorporate a wide variety of disciplines (e.g., occupational health, health education, epidemiology, and nursing) with different skills and functions. Finally, by espousing controversial issues of economic redistribution and social restructuring, the field becomes highly political. While public health practitioners like to conceive of their field as a positivistic discipline that stresses the importance of science and technique, the field is, in reality, imbued with values and influenced by interest-group politics.**

## “Genes”/”Gene Editing”

### What are Genes?

#### Genes

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

Remind me what genes are again?

**Genes are the biological templates the body uses to make the structural proteins and enzymes needed to build and maintain tissues and organs. They are made up of strands of genetic code, denoted by the letters G, C, T and A. Humans have about 20,000 genes bundled into 23 pairs of chromosomes all coiled up in the nucleus of nearly every cell in the body. Only about 1.5% of our genetic code, or genome, is made up of genes. Another 10% regulates them, ensuring that genes turn on and off in the right cells at the right time, for example**. The rest of our DNA is apparently useless. “The majority of our genome does nothing,” says Gerton Lunter, a geneticist at the University of Oxford. “It’s simply evolutionary detritus.”

What are all those Gs, Cs, Ts and As?

**The letters of the genetic code refer to the molecules guanine (G), cytosine (C), thymine (T) and adenine (A). In DNA, these molecules pair up: G with C and T with** A. These “base pairs” become the rungs of the familiar DNA double helix. It takes a lot of them to make a gene. The gene damaged in cystic fibrosis contains about 300,000 base pairs, while the one that is mutated in muscular dystrophy has about 2.5m base pairs, making it the largest gene in the human body. Each of us inherits about 60 new mutations from our parents, the majority coming from our father.

### What is Gene Editing?

#### Gene editing involves deleting part of a defective gene or repairing it

**Patronus Medical**, no date, <http://blog.patronusmedical.com/the-benefits-of-gene-editing> The Benefits of Gene Editing

In many cases, **genetic diseases occur when a mutation appears inside a cell**. Although researchers have been able to identify which cells the mutations occurred in, little could have been done to repair the defective genes. **Gene editing allows doctors to use specialized molecular tools to remove, repair or replace damaged genes with a healthy copy.** Although the technology is still a bit far off from being used regularly by medical professionals worldwide, **animal trials have been successful**. In fact, a team of Chinese scientists will be the first to test gene-edited cells in human patients this month. CRIPSR, or “clustered regularly interspaced short palindromic repeats,” is the most advanced and effective gene-editing technique being utilized by scientists. CRISPR is inexpensive, easy to use and precise. Gene modifications using CRISPR have extended from corn and rice to mice and pigs.

**Associated Press**, December 1, **2015**, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

While scientists have long been able to find defective genes, fixing them has been so cumbersome that it's slowed development of genetic therapies**. With gene editing, scientists home in on a piece of DNA and use molecular tools that act as scissors to snip that spot - deleting a defective gene, repairing it or replacing it. There are some older methods but a new tool called CRISPR-Cas9 has been adopted by laboratories worldwide because it's faster, cheaper, simple enough to use with minimal training, and allows altering of multiple genes simultaneously.**

### Current Law on Germline Research

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

Where you live determines if, or what kind of, research can be performed on embryos. Some countries, especially in Europe, ban germline research. Others, such as **China, have guidelines described as unenforceable. Britain allows basic lab research only. In the U.S., the NIH won't fund research involving germline editing but private funding is allowed.**

### Human Genome/Germline

#### Human eggs, sperm, embryos – human genome

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

This week, a high-profile group of researchers, ethicists and advocates convened in Washington, D.C., to discuss the ethics of editing human genes. In particular, they're concerned about **changes to human eggs, sperm or embryos—known as the human germline.**

#### Editing the germline means the gene changes get passed down

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

This week, a high-profile group of researchers, ethicists and advocates convened in Washington, D.C., to discuss the ethics of editing human genes. In particular, they're concerned about changes to human eggs, sperm or embryos—known as the human germline.If you edit the genes of an adult, the changes don’t get passed down to that person's children. But **editing genes in the germline would affect the child’s own egg and sperm, so the genetic changes are inherited.**

### China Leads

#### China leads in gene editing

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

The race is on to get gene editing therapies into the clinic. A dozen or so Crispr-Cas9 trials are underway or planned, most led by Chinese researchers to combat various forms of cancer. One of the first launched in 2016, when doctors in Sichuan province gave edited immune cells to a patient with advanced lung cancer. More US and European trials are expected in the next few years.

### Future

#### Future

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

What next?

Base editing

A gentler form a gene editing that doesn’t cut DNA into pieces, but instead uses chemical reactions to change the letters of the genetic code. It looks good so far. In 2017, researchers in China used base editing to mend mutations that cause a serious blood disorder called beta thalassemia in human embryos.

Gene drives

Engineered gene drives have the power to push particular genes through an entire population of organisms. For example, they could be used to make mosquitoes infertile and so reduce the burden of disease they spread. But the technology is highly controversial because it could have massive unintended ecological consequences.

Epigenome editing

Sometimes you don’t want to completely remove or replace a gene, but simply dampen down or ramp up its activity. Scientists are now working on Crispr tools to do this, giving them more control than ever before.

### CISPR/9

#### CRISPR/9 gene editing technique worked to edit a gene embryo

Keren Weintraub, National Georgraphic, December, 2015, <https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/> 5 Reasons Gene Editing Is Both Terrific and Terrifying

THE IDEA OF tinkering with the genes we pass to our children has long been the stuff of science fiction. **But scientists are rapidly solving the technological challenges, and expect such gene editing will soon be feasible. A three-year-old technique called CRISPR/Cas9 is so effective at cutting and adding genes that researchers all over the world have adopted it in their labs. Earlier this year, researchers in China edited genes in a nonviable human embryo to try to treat an inherited blood disease, and ended up with a lot of unintended—and potentially dangerous—changes.**

## Access

"the ability, right, or permission to approach, enter, speak with, or use; admittance."

# Pro

## General Advantages

### Virus Prevention

#### Gene editing used to attack dangerous viruses

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

With gene editing, researchers have made seedless tomatoes, gluten-free wheat and mushrooms that don’t turn brown when old. Other branches of medicine have also seized on its potential. Companies working on next-generation antibiotics have developed otherwise harmless viruses that find and attack specific strains of bacteria that cause dangerous infections.

### Sickle Cell

#### Gene editing can solve sickle cell

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

The biggest use so far is to rapidly engineer animals with human-like disorders for basic research, but promising gene-editing experiments make regular headlines. Much like a bone marrow transplant, researchers hope to use CRISPR for diseases like sickle cell, correcting the faulty gene in someone's own blood-producing cells rather than implanting donated ones.

### Germline Editing Solves Disease

#### Germline editing means no transfer of disease from one generation to the next

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

Altering genes in sperm, eggs or embryos can spread those changes to future generations, so-called germline engineering that might one day stop parents from passing inherited diseases to their children. Chinese scientists reported the first-known attempt to edit human embryos last spring, working with leftovers from fertility clinics that never could have developed into fetuses. They aimed to correct a deadly inherited gene, but uncovered problems that will require more research.

## “Public Health” Advantages/Justification

#### “Public health” intervention is justified when there is a risk of disease

Richard A. **Epstein**, James Parker Hall Distinguished Service Professor at the University of Chicago Law School, Peter and Kirsten Bedford Senior Fellow at the Hoover Institution at Stanford University, and Adjunct Scholar at the Cato Institute, **2003**

[“Let The Shoemaker Stick To His Last: A Defense Of The ‘Old’ Public Health,” *Perspectives in Biology and Medicine*, Volume 46, Number 3, Summer, Available Online to Subscribing Institutions via Project Muse *// BATMAN*]

This paper investigates the proper understanding of the discipline of public health. How far does it run and what does it encompass? Dealing with this question requires moving back and forth between the conception of public health that is internal to the public health discipline, and the conception of public health as it has been understood outside the public health field by historians and lawyers who are interested in defining the appropriate use and limitations of the state power of coercion. **The old public health established the principle that** [End Page S138] **epidemics offer strong reason for decisive public intervention, whether by quarantine, vaccination, or the creation of public sewers and waste disposal systems. Today, the new public health uses the term "epidemic" to justify state regulation to limit tobacco consumption or control obesity, even though these activities do not pose risks of communicable disease or any other form of recognizable externalities** (pace secondhand smoke) **to other individuals**. **For its part, the old public health tracks the idea of public goods in economics, namely, those non-excludable goods that cannot be supplied to one unless they are also given to another** (for the classical account, see Olson 1971). **It thus invokes an analogous concept for "public bads": those harms inflicted on others without their consent, as, for example, both communicable diseases and pollution. In contrast, the new public health covers matters of general public importance, including obesity, smoking, and genetic diseases**. My broad thesis is that **the "old" public health is superior to the new, whose broad (and meddlesome) definitions of public health help spur state actions—including the regulation of product and labor markets—that in all likelihood jeopardize the health of the very individuals the new public health seeks to protect. The new public health extends regulation into inappropriate areas, and thus saps the social resources and focus to deal with public health matters more narrowly construed**.

## Answers to: Gene Editing Bad

### Answers to: Gene Mutations Bad

#### Risk of a dangerous mutation from gene editing is low – and there are mutations all the time

Michael LePae, March 21, 2105, <https://geneticliteracyproject.org/2015/03/17/how-do-we-weigh-benefits-and-risks-of-human-gene-editing/> How do we weigh benefits and risks of human gene editing?

The trouble is, we don’t know yet if germline editing is dangerous. One of the points of trying it with human embryos is to find out. The main worry is so-called off-target mutations, that is, unintended changes to the genome. Studies that have been done with monkeys suggest the risk is low. The risk also has to be viewed in context: the DNA in our cells naturally mutates. Each of us is born with around 50 new mutations, the vast majority of which have no known effect.

### Answers to: Genome Editing Not Natural

#### We shouldn’t celebrate natural disease and death

John Harris is professor emeritus in science ethics at University of Manchester, August 2018, <https://www.nationalgeographic.com/magazine/2016/08/human-gene-editing-pro-con-opinions/> Pro and Con: Should Gene Editing Be Performed on Human Embryos?

Let’s start with the objection that embryo modification is unnatural, or amounts to playing God. This argument rests on the premise that natural is inherently good. But diseases are natural, and humans by the millions fall ill and die prematurely—all perfectly naturally. If we protected natural creatures and natural phenomena simply because they are natural, we would not be able to use antibiotics to kill bacteria or otherwise practice medicine, or combat drought, famine, or pestilence. The health care systems maintained by every developed nation can aptly be characterized as a part of what I have previously called “a comprehensive attempt to frustrate the course of nature.” What’s natural is neither good nor bad. Natural substances or natural therapies are only better that unnatural ones if the evidence supports such a conclusion

### Answers to: Can’t Decide for Future Generations

#### We decide for future generations all the time

John Harris is professor emeritus in science ethics at University of Manchester, August 2018, <https://www.nationalgeographic.com/magazine/2016/08/human-gene-editing-pro-con-opinions/> Pro and Con: Should Gene Editing Be Performed on Human Embryos?

The matter of consent has been raised by Francis Collins, director of the National Institutes of Health. “Ethical issues presented by altering the germline in a way that affects the next generation without their consent,” he has said, constitute “strong arguments against engaging in” gene editing. This makes no sense at all. We have literally no choice but to make decisions for future people without considering their consent. All parents do this all the time, either because the children are too young to consent, or because they do not yet exist. George Bernard Shaw and Isadora Duncan knew this. When, allegedly, she said to him “why don’t we make a baby together … with my looks and your brains it cannot fail” she was proposing a deliberate germline determining decision in the hope of affecting their future child. Shaw’s more sober response—“Yes but what if it has my looks and your brains!”—identifies a different possible, but from the child’s perspective equally non-consensual, outcome. Rightly, neither Shaw nor his possible partner thought their decision needed to wait for the consent of the resulting child.

### Answers to: It’s Dangerous

#### The status quo is dangerous

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

Finally, there’s the argument that modifying genomes is inherently dangerous because we can’t know all the ways it will affect the individual. But those who fear the risks of gene editing don’t take into account the inherent dangers in the “natural” way we reproduce. Two-thirds of human embryos fail to develop successfully, most of them within the first month of pregnancy. And every year, 7.9 million children—6 percent of total births worldwide—are born with a serious defect of genetic or partially genetic origin. Indeed so risky is unprotected sex that, had it been invented as a reproductive technology rather than found as part of our evolved biology, it is highly doubtful it would ever have been licensed for human use. Certainly we need to know as much as possible about the risks of gene-editing human embryos before such research can proceed. But when the suffering and death caused by such terrible single-gene disorders as cystic fibrosis and Huntington’s disease might be averted, the decision to delay such research should not be made lightly. Just as justice delayed is justice denied, so, too, therapy delayed is therapy denied. That denial costs human lives, day after day.

#### 1:25 kids born with a genetic disease

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

Much of the excitement around gene editing is fuelled by its potential to treat or prevent human diseases. There are thousands of genetic disorders that can be passed on from one generation to the next; many are serious and debilitating. They are not rare: one in 25 children is born with a genetic disease. Among the most common are cystic fibrosis, sickle cell anaemia and muscular dystrophy. Gene editing holds the promise of treating these disorders by rewriting the corrupt DNA in patients’ cells. But it can do far more than mend faulty genes. Gene editing has already been used to modify people’s immune cells to fight cancer or be resistant to HIV infection. It could also be used to fix defective genes in human embryos and so prevent babies from inheriting serious diseases. This is controversial because the genetic changes would affect their sperm or egg cells, meaning the genetic edits and any bad side effects could be passed on to future generations.

### Answers to: Designer Babies

#### Making designer babies way too complex; involves making thoudsnds of genes

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

#### Engineering human embryos also raises the uneasy prospect of designer babies, where embryos are altered for social rather than medical reasons; to make a person taller or more intelligent, for example. Traits like these can involve thousands of genes, most of them unknown. So for the time being, designer babies are a distant prospect.

### Answers to: Public Health Violates Individual Liberties

#### No link – we are just saying that gene editing services should be provided by public health authorities, not that public health authorities should require them

#### Individual rights can be limited to solve disease

The Harvard Crimson: Harvard University, February 4, 2015 Vaccines for All, <http://www.thecrimson.com/article/2015/2/5/harvard-staff-measles-vaccine/> DOA: 8-19-15

America was founded upon principles of individual rights: We believe that people should be allowed to live their lives as they see fit. At the same time, however, **individual freedoms must occasionally be limited, especially in situations where unabridged liberty may endanger the safety and welfare of the public. Vaccination against fatal diseases is one such case.**

#### Public health and rights can only exist with security

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 192

Overall, Gostin's approach seems to advocate "a carefully constrained and narrowly delineated interventionist role for government" whenever intervention and civil liberties come into conflict. He does not think that public health and individual rights can always coexist. On the other hand, he also contends that **the exercise of civil liberties is only possible with security; therefore, almost paradoxically, some sacrifice of liberty must be made in order to gain it. After all, "individuals, acting alone, cannot safeguard their own health and safety, even with full access to the sophisticated technologies of modern science and medicine."**

#### People sacrifice their own interests for the common good and are willing to accept rights limitations

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 186

Reviewing the tensions between public health and civil liberties inherent in quarantines, mandatory screening and immunization, and health information sharing, makes it clear that there is much to consider when balancing these values. It is difficult to predict how the American public would react to the implementation of these measures, with much depending on the context of the situation. On the one hand, **there are many historical examples of Americans sacrificing for the greater good in times of war, for example. Similarly, there are many limitations on individual rights that society has agreed to enforce in the name of public health, such as seat belt requirements.**

#### Individuals benefit from societal responsibility

Lawrence O. Gostin, professor of Public Health at Georgetown, and Johns Hopkins, Summer 2001, Journal of Law, Medicine, and Ethics, Public Health, Ethics, and Human Rights: A Tribute to the Late Jonathan Mann, p. 120

Scholars in bioethics have demonstrated convincingly the power and importance of individual freedom. However, they have given insufficient attention to equally strong values of partnership, citizenship, and community. n26 **As members of a society in which we all share a common bond, we also have an obligation to protect and defend the community against threats to its health, safety, and security. Members of society owe a duty--one to another and to all--to promote the common good. A new public health ethic should advance the idea that individuals benefit from being part of a well-regulated society that reduces risks that all members share.**

#### Individuals cannot effectively respond to public health threats

Dorothy Puzio, health care attorney 2003/4, Journal of Law & Health, An Overview of Public Health in the New Millennium: Individual Liberty vs. Public Safety, <http://engagedscholarship.csuohio.edu/jlh/vol18/iss2/3/>, DOA: 8-20-15, p. 177-8

Although the pendulum has swung quite heavily in favor of individual rights in recent decades, "[m]any Americans have come to rethink the role of government and the importance of the public health safety system." n26 September 11th and the subsequent anthrax scare have illustrated the importance of rapidly detecting and reacting to the threats of bio-terrorism and infectious disease.27 Even more significantly, these disasters have made it clear that individuals acting alone cannot effectively protect against many public health threats to their well-being.

# Con

## Disadvantages – General

### Eugenics, Discrimination, Inequality

#### Gene engineering will promote inequality, discrimination, genetics

Marcy Darnovsky, August 2016, Dranovsky is executive director of the Center for Genetics and Society, <https://www.nationalgeographic.com/magazine/2016/08/human-gene-editing-pro-con-opinions/> Con: Do Not Open the Door to Editing Genes in Future Humans

In opening the door to one kind of germline modification, we are likely opening it to all kinds. Permitting human germline gene editing for any reason would likely lead to its escape from regulatory limits, to its adoption for enhancement purposes, and to the emergence of a market-based eugenics that would exacerbate already existing discrimination, inequality, and conflict. We need not and should not risk these outcomes.

## Shouldn’t Solve Inequality Through Public Health

#### Trying to solve inequality through public health is totalitarian

Mark A. **Hall**, Fred D. and Elizabeth L. Turnage Professor of Law at Wake Forest University School of Law and School of Medicine and Associate in Management at the Babcock School of Management, **2003**

[“The Scope and Limits of Public Health Law,” *Perspectives in Biology and Medicine*, Volume 46, Number 3, Summer, Available Online to Subscribing Institutions via Project Muse *// BATMAN*]

**Beyond the public health arena, there are other good reasons for the government to pursue the more general aims of education, taxation, regulation, and redistribution, but these are broader social and economic policies or they belong to legal realms other than health. Public health advocates can be commended for calling our attention to the health implications of social disparities, but health promotion should not be the primary objective of corrective measures. The main reason to make social inequities an issue of public health authority, rather than simply public health analysis, is to invoke the highly paternalistic, absolutist, ends-oriented thinking associated with public health law. Viewed from a public health perspective, nothing short of totalitarian communism would thoroughly satisfy someone who takes literally the idea that social and economic justice is a primary driver of the "public's health," as that phrase is understood by law. It isn't enough to confer equal rights or equal opportunities; nothing short of achieving the desired results—equal welfare—will abate the threat to public health. Obviously, reformers would never be allowed to go this far, but the fact that this extremism is the logical extension of the social determinant argument shows that public health advocates seriously overstep their bounds when they call on government to address broad economic and political conditions as public health problems, rather than as more general efforts to improve overall social equality and well-being, including health as a component of well-being**. [End Page S208]

#### The terminal impact is nazism, stalinism, and slavery.

Lynne **Henderson**, Professor of Law at the Indiana University School of Law at Bloomington, **1991**

[“Authoritarianism and the Rule of Law,” *Indiana Law Journal* (66 Ind. L.J. 379), Spring, Available Online via Lexis-Nexis *// BATMAN*]

**Substantive authoritarianism means opposition to the "liberal" values of tolerance of ambiguity and difference, insistence on obedience to rules, insistence on conformity, and use of coercion and punishment to ensure that obedience. Frequently associated with xenophobic nationalism or ethnocentrism,** n18 **authoritarianism in the substantive sense is premised on a suspicious and distrustful view of human nature and is frequently linked, both on a personal and political level, to racism, anti-semitism and patriarchy.** n19 **Substantive authoritarianism oppresses in the name of order and control. This form of authoritarianism may reach the extreme level it did in Nazi Germany and Stalinist Russia or appear in milder forms, as it did during the McCarthy era in the United States, when, as a result of fear, hatred and extreme nationalism, the government, with private and judicial support, used law to persecute and punish citizens for being "un-American."** n20

Authoritarianism need not be based only in active coercion and oppression of disfavored groups by government. **The government may also allow authoritarianism to flourish by omission – by permitting other institutions or persons to coerce and oppress others in the interest of maintaining control. Thus, much of the history of slavery in the United States could be characterized as government authoritarianism by omission in the interests** [\*383] **of maintaining order and national and party unity.** n21 Other examples include the government largely ignoring oppression of and violence against African-American women, n22 and a long history of governmental tolerance of private oppression of women and children through violence. n23

#### Their approach “healthaffies” social problems

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1189 *// BATMAN*]

Along with the promise of this approach, however, is considerable peril that deserves discussion. We are concerned that **the study of social and economic factors in public health may have unintended consequences that, paradoxically, serve to preserve disparities rather than eliminate them**.10 **This can occur because public health research transports social issues into the health domain, where they are examined through the narrow prism of health relevance instead of within their political, social, and economic contexts. We refer to this as the "public healthification" of social problems**, akin to the "medicalization"11 and "healthism"12 that have

#### This approach inevitably leaves social problems unaddressed

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1189-1190 *// BATMAN*]

**As social problems are refracted through the public health prism, their scope is narrowed. This narrowing is due to the mismatch between the theories, methods, and values of public** [end page 1189] **health research and the broader political and socioeconomic factors that characterize social problems. We discuss 3 perils posed by the broad approach to public health: a focus on the individual, the institutionalization of research paradigms and findings, and the valuation of social problems by their health consequences**. We illustrate this process with the recent history of public health research on homelessness.

#### To solve social problems, we have to treat them as social problems, not as health problems

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1190 *// BATMAN*]

**Another peril of studying social problems in public health is that they become institutionalized as public health problems. Once a social problem is established as a health problem, a research paradigm develops, following a scientific method** (e.g., the epidemiologic study of risk factors for homelessness). **Soon a large body of literature is created, with its language, common assumptions, methods, and sets of legitimate constructs.**16 **Thus, a linguistic category "the homeless" was constructed, and "facts" about risk factors for homelessness became widely accepted. In the process, the research question and its method of investigation were validated and institutionalized. This body of literature created the need for further research** (recommended by most articles on the topic) **and elicited governmental resources in the form of research grants and contracts. This scientific discourse established homelessness as a public health research question. Solutions are now sought from within this discourse**.

**But**, as described above, **public health research findings pointed to individual-level solutions. Such solutions are palatable to, and indeed supportive of, the social structures and forces that many agree produced the problem in the first place. Even as governmental policies that reduced availability of housing for the poor have been claimed to be the culprit, public health has produced a body of knowledge that, by documenting individual responsibility for homelessness, may be used to absolve the government of its responsibility**.17 **Thus, in establishing homelessness as a public health problem, public health researchers may have unintentionally reduced the possibility of remedying the problem by addressing the core structural factors—those that lie within the larger public-policy and socioeconomic domains. The peril is that remedies may be sought within a public health framework, from a narrow clinical or even biomedical perspective. Such clinical interventions may help subgroups among the homeless but not reduce the magnitude of the problem**.18,19

#### The Pro’s approach diverts away from social problems

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1190 *// BATMAN*]

**In practice, despite the conceptual understanding of the role of structural causes of homelessness, homelessness has been studied as if it were a disease, an outcome defined as residing in the individual. The tools used in public health research for examining individual variation in disease led to the identification of individual rather than structural factors in the etiology of homelessness**.14 **Research highlighted individual characteristics as risk factors for homelessness, including sociodemographic characteristics** (e.g., age, gender, ethnicity), **psychiatric and substance use disorders** (e.g., schizophrenia, alcoholism), **and disruptive family and childhood experiences** (e.g., foster care and group home placements) (see, for example, the review by Susser et al.15). **The structural factors often asserted to be distal causes of homelessness**, and cited by Breakey as the impetus for broadening the scope of public health research,9 **were left largely unexamined. Thus, the promise held in examining upstream causes of health problems was broken. Instead of addressing fundamental social causes, public health researchers highlighted individual characteristics that serve to obscure rather than illuminate the social and economic causes of homelessness**.

#### It gauges the importance of an issue by its health outcomes – homelessness becomes bad only insofar as it harms public health.

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1190 *// BATMAN*]

Perhaps **the most serious peril in the transportation of social problems into the public health arena is that health outcomes become the evidence for and definition of the wrongfulness of social problems. In this way, research results are used as a moral battleground. Public healthification implies that homelessness is problematic because it is a health-related problem. But would homelessness divorced from its health impact be any less troubling? In a wealthy country, the sight of people living in subways and in shelters is evidence of a wrong that needs no further justification for action. Similarly, should an argument against inequality be dependent on research findings that document the negative health outcomes of inequality? Is discrimination any less unjust if it does not lead to adverse health outcomes?** We think **this is a perilous stance**.

#### Homelessness is just an example – our evidence applies to other social issues, too.

Ilan H. **Meyer**, Deputy Chair for Master of Public Health Programs and Associate Professor of Clinical Sociomedical Sciences at Columbia University’s Joseph L. Mailman School of Public Health, **and** Sharon B. **Schwartz**, Associate Professor of Clinical Epidemiology at Columbia University’s Joseph L. Mailman School of Public Health, **2000**

[“Social Issues As Public Health: Promise And Peril,” *American Journal of Public Health*, Volume 90, Issue 8, August, Available Online to Subscribing Institutions via Academic Search Elite, p. 1190 *// BATMAN*]

**We have used homelessness as an example of the potential unintended consequences of examining social problems through a health prism. But our concerns are not limited to homelessness. A public health focus on violence, war, discrimination, or inequality caries the same risks. In each case, public healthification may inadvertently lead to a focus on the individual, institutionalization of the problem as a public health research problem, and valuation of the social and moral import of the problem solely by its health consequences**.

## Gene Editing Fails

#### Gene editing can fail

Ian Sample, January 25, 2018, The Guardian, Gene editing – and what it really means to rewrite the code of lifehttps://www.theguardian.com/science/2018/jan/15/gene-editing-and-what-it-really-means-to-rewrite-the-code-of-life

Modern gene editing is quite precise but it is not perfect. The procedure can be a bit hit and miss, reaching some cells but not others. Even when Crispr gets where it is needed, the edits can differ from cell to cell, for example mending two copies of a mutated gene in one cell, but only one copy in another. For some genetic diseases this may not matter, but it may if a single mutated gene causes the disorder. Another common problem happens when edits are made at the wrong place in the genome. There can be hundreds of these “off-target” edits that can be dangerous if they disrupt healthy genes or crucial regulatory DNA.

### Risks – General -

#### The wrong gene could be accidentally cut

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

Safety is a key question because gene editing isn't always precise enough; there's the possibility of accidentally cutting DNA that's similar to the real target.

### Germline Editing Bad

#### Future generations can’t consent to gene editing, negative side effects could manifest in future generations

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

Germline engineering "has been viewed almost universally as a line that should not be crossed," National Institutes of Health Director Francis Collins said at the time. After all, future generations couldn't consent, and any long-term negative effects might not become apparent for years. There's also concern about babies designed for better intellect, athleticism or appearance rather than to prevent disease.

#### Gene editing could alter the environment

Associated Press, December 1, 2015, <http://www.foxnews.com/health/2015/12/01/potential-benefits-and-ethical-implications-gene-editing.html> The potential benefits and ethical implications of gene editing

Human gene editing aside, there are environmental concerns, too. Experiments are under way to force genetic changes to spread rapidly through populations of animals and plants - changes that could wipe out invasive species or disease-carrying insects. A California team reported a first step last week, hatching malaria-resistant mosquitoes that could easily spread their new protective gene to their offspring.

### Risks

#### Too risky now

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

The organizing committee ended the discussion by issuing a statement saying that “it would be irresponsible to proceed with any clinical use of germline editing” until more safety and effectiveness research can be done, risks and benefits weighed, and a social consensus reached. The group called for regulatory oversight of use in people, and concluded that “as scientific knowledge advances and societal views evolve, the clinical use of germline editing should be revisited on a regular basis.”

In Washington, scientists and ethicists talked about science, ethics, human rights, government relations and Aldous Huxley’s futuristic 1932 novel Brave New World, offering five basic reasons that gene editing is exciting—but scary:

### Answers to: Need to Stop Inherited Genetic Disease

#### Inherited genetic disease can be stopped through other methods

Marcy Darnovsky, August 2016, Dranovsky is executive director of the Center for Genetics and Society, <https://www.nationalgeographic.com/magazine/2016/08/human-gene-editing-pro-con-opinions/> Con: Do Not Open the Door to Editing Genes in Future Humans

Beyond technical issues are profound social and political questions. Would germline gene editing be justifiable, in spite of the risks, for parents who might transmit an inherited disease? It’s certainly not necessary. Parents can have children unaffected by the disease they have or carry by using third-party eggs or sperm, an increasingly common way to form families. Some heterosexual couples may hesitate to use this option because they want a child who is not just spared a deleterious gene in their lineage, but is also genetically related to both of them. They can do that too, with the embryo screening technique called pre-implantation genetic diagnosis (PGD), a widely available procedure used in conjunction with in vitro fertilization.

PGD itself raises social and ethical concerns about what kind of traits should be selected or de-selected. These questions are particularly important from a disability rights perspective (which means they’re important for all of us). But screening embryos for disease is far safer for resulting children than engineering new traits with germline gene editing would be. Yet this existing alternative is often omitted from accounts of the controversy about gene editing for reproduction.

# General Pros & Cons

#### Five pros and cons

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

In Washington, scientists and ethicists talked about science, ethics, human rights, government relations and Aldous Huxley’s futuristic 1932 novel Brave New World, offering five basic reasons that gene editing is exciting—but scary:

1. Curing disease

By eliminating genes that cause disease, doctors could treat a wide range of illnesses, from heart disease to Alzheimer’s.

Scientific challenges remain, such as making sure that the right gene—and only the right gene—gets changed. But gene therapy is now being used to treat eye disease, and early trials suggest that it may be able to treat the blood disorders beta thalassemia and sickle cell anemia, said Fyodor Urnov of Sangamo BioSciences, a leader in blood disease research.

Even for this seemingly noble cause, there are moral challenges: namely, which conditions to treat. And not everyone necessarily wants to be “cured.”

To some people labeled with disabilities, “editing may be more akin to getting pushed through a shredding machine,” said Ruha Benjamin, an African-American Studies and bioethics professor at Princeton University.

2. Stopping inherited disease in its tracks

Diseases that are passed down in families, like Huntington's and Tay-Sachs, might one day be simply snipped out of the family line.

Though we can already screen for some genetic diseases and avoid them using in vitro fertilization, new CRISPR methods could potentially make much more complex edits. Harvard Medical School geneticist George Church recently showed that with the new CRISPR methods, he could edit 60 embryonic pig genes simultaneously. This may be harder in people, though, and since we don’t know the full roles of most of our genes, we can’t know the risks involved in editing them.

People who carry a genetic risk for Alzheimer’s might some day be able to benefit from new efforts to change genes.

Rudolf Jaenisch, a stem cell biologist at MIT and the Whitehead Institute, raised another ethical concern: Is it morally acceptable to edit the genes of healthy children in the hopes of preventing unhealthy ones? In his research on mouse embryos, he’s found that he can’t edit the genes of diseased mice without also affecting the genes of mice that would otherwise be healthy.

In trying to prevent a genetic mutation in sick children, doctors would have to introduce a gene mutation into healthy ones. Such a mutation would carry forward into the human population, and no one knows whether it would have an unintended effect.

3. Creating a better you

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

Theoretically, gene editing could also be used to make so-called designer babies. Traits governed by a small number of genes would be the most straightforward to manipulate, such as muscularity, eye color, height, and memory, said George Daley, a stem cell biologist at Harvard Medical School.

Editing genes for more complex traits like intelligence would be more difficult or impossible. “You don’t know what else you’re going to get,” Sheldon Krimsy of Tufts University, who writes about science and ethics, said in an interview. “The genome is an ecosystem. Everything is in some kind of balance. You try to maximize one quality and you may affect another one.”

What's more, if a change is introduced into the human population, and can be inherited, it could be hard to remove—and won't stay put in a particular community or country.

Unlike curing disease, genetic enhancement would be morally reprehensible, said Marcy Darnovsky, who heads the nonprofit Center for Genetics and Society.

She worries that parents will feel pressured to “improve” their kids and that wealthy families will have greater access than poor ones. “There would be fertility clinics vying to sell the latest upgrades." And parents might be pressured to ‘give their child the best start in life.’

4. Saving endangered species

Keren Weintraub, National Georgraphic, December, 2015, https://news.nationalgeographic.com/2015/12/151203-gene-editing-terrific-terrifying-science/ 5 Reasons Gene Editing Is Both Terrific and Terrifying

The same technology used to edit human genes can be used on animals. This could mean protecting a species like the Tasmanian devil, now endangered by an infectious cancer, or engineering the East Coast's chestnut trees to resist the chestnut blight that has devastated their growth.

“We’re faced with the sixth great mass extinction," Gary Roemer, a wildlife ecologist at New Mexico State University, said in an interview, "and this allows us to avert or perhaps just postpone the decline of certain species.”

On the other hand, he and others were horrified at the possibility that someone might use gene editing as justification for putting off a species rescue “because we can always solve the problem later.”

"We’re faced with the sixth great mass extinction." —Ecologist Gary Roemer

“I’m very much against that kind of arrogance,” said Stuart Pimm, the Doris Duke professor of Conservation Ecology at Duke University. “We should be good stewards. We should look after biodiversity.”

5. Resurrecting extinct species

Gene editing could even be used to bring back extinct species, or at least parts of them, for example by mixing genes from extinct species back into existing ones. A group called The Long Now Foundation supports these scientific efforts, and hopes first to bring back the passenger pigeon and then the wooly mammoth.

De-extinction could also resurrect traits lost to commercial breeding, like the great natural taste of tomatoes, bioethicists, R. Alta Charo of the University of Wisconsin-Madison, and Henry Greely of Stanford, wrote in a paper published Wednesday.

But, they write, somewhat tongue-in-cheek, gene editing could also be used to blend or make new species “on a whim” or for commercial or artistic purposes. “Why should we not expect dwarf elephants, giant guinea pigs, or genetically tamed tigers? Or—dare we wonder—the billionaire who decides to give his 12-year-old daughter a real unicorn for her birthday?”

# Books

[**A Crack in Creation**](https://www.theguardian.com/books/2017/jun/17/a-crack-in-creation-by-jennifer-doudna-and-samuel-sternberg-review)**:** Gene Editing and the Unthinkable Power to Control Evolution by Jennifer Doudna and Samuel H. Sternberg

[**The Gene: An Intimate History**](https://www.theguardian.com/books/2016/jun/06/the-gene-an-intimate-history-siddhartha-mukherjee-review)by Siddhartha Mukherjee

[**The Epigenetics Revolution:**](https://www.theguardian.com/books/2011/aug/19/epigenetics-revolution-nessa-carey-review) How Modern Biology is Rewriting our Understanding of Genetics, Disease and Inheritance by Nessa Carey

[**Modern Prometheus: Editing the Human Genome with Crispr-Cas9**](https://www.guardianbookshop.com/modern-prometheus.html) by Jim Kozubek