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**U.S. Environmental Protection Agency
Science Advisory Board
Economic Guidelines Review Panel (EGRP)**

**Comments submitted by Dr. Richard Williams for the
EPA's revised Guidelines for Preparing Economic Analyses**

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Dr. Richard Williams

Notes on discounting, uncertainly and gene editing:

For the rules that EPA is promulgating that intend to lengthen life years or reduce future morbidity, EPA economists need to start paying attention to the likelihood that alternative means of achieving these ends is becoming more likely. In particular, gene editing has been used on plants for decades such that most of the foods we eat have been genetically edited using precision biological tools. We have improved plants to give greater yields by making them more resistant to diseases, pests, and drought.

The Impossible Burger is made by taking a gene from a soy root and genetically inserting into a special yeast to grow it in a fermentation tank. Although more recent than plants, we are also editing the genetic make-up of animals for food consumption.

That technology is now being turned to humans as we have discovered that DNA is code and that code can be changed. Much of the research into nature today is not so much to understand nature as to figure it out and, as GMU Professor Emeritus Don Kash says “how to engineer and change it.”ⁱ Termed by some as “transhumanism,” the goal is to enhance “human intellectual, physical and emotional capabilities, the elimination of disease and unnecessary suffering, and the dramatic extension of lifespan.”ⁱⁱ

CRISPR, a tool used to cut DNA to either remove offending genes or make room for replacement DNA, is now cheap and available in kits on the internet worldwide. CRISPR may be rapidly outdated as new tools are constantly being produced to give embryos new traits and capabilities by changing their own DNA or, further in the future, inserting DNA from other humans, animals, or even synthetic sources. We are close to treating or preventing diseases by knocking out or turning off (using CRISPR to edit an epigenetic mark) a mutated gene, replacing a mutated gene with a healthy gene or adding a gene to fight a particular disease. These can be accomplished either in embryos or people.

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Metzl suggests,

It's not that hard to imagine future scenarios when humans would need to genetically alter ourselves in order to survive a rapid change in our environment resulting from global warming or intense cooling following a nuclear war or asteroid strike, a runaway deadly virus, or some kind of other future challenge we can't today predict. Genetic engineering, in other words, could easily shift from being a health or lifestyle choice to becoming an imperative for survival.ⁱⁱⁱ

The point is that this technology is here and is rapidly evolving. In 2018, Japanese scientists engineered mutations into human embryos to affect HIV. Gene editing is not the only technology likely to affect health and longevity and these also should be considered in economic analyses. For example, metformin, a diabetes drug that has been with us since the 1950s, is now undergoing clinical trials as a life extension treatment.

As EPA economists attempt to project benefits 10, 20 or 30 years out, they should not ignore the probability that some human or animal health issues may be resolved by these technologies. This might suggest, for example, that rather than using declining discounts for these types of benefits, they might use increasing discount rates. It also suggests that perhaps we refrain from making predictions about human health benefits too far out. There is simply too much uncertainty.

I suggest that a recommendation to NCEE would be to study these trends and prepare guidance for EPA economists.

Suggested reading:

- Richardson, Sarah S. et. al., *Postgenomics: Perspectives on Biology after the Genome*, Duke University Press, Durham, NC 2015.
- Cullis, Pieter, *The Personalized Medicine Revolution*, Greystone Books, Vancouver, 2015.
- Garreau, Joel, *Radical Evolution*, DoubleDay, New York, NY, 2004,
- Metzl, Jamie, *Hacking Darwin: Genetic Engineering and the Future of Humanity*, Sourcebooks, Naperville, Illinois, 2019.

ⁱ Kash, Don E., printed in Garreau, Joel, *Radical Evolution*, DoubleDay, New York, NY, 2004, p. 252.

ⁱⁱ Garreau, p. 231.

ⁱⁱⁱ Metzl, Jamie, *Hacking Darwin: Genetic Engineering and the Future of Humanity*, Sourcebooks, Naperville, Illinois, 2019, p. 178