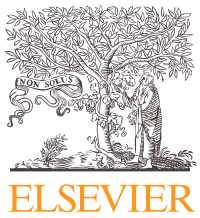
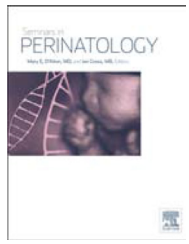
Seminars in Perinatology 42 (2018) 485–486



Available online at www.sciencedirect.com

Seminars in Perinatology

www.seminperinat.com



Introduction

CRISPR (clustered regularly interspaced palindromic repeats) was first described as a gene editing platform in 2012. Since then, this nimble, precise, and easy-to-use molecular tool has taken the biomedical world by storm—CRISPR was termed "one of the biggest science stories of the decade" by *Vox* news and was touted "breakthrough of the year" in 2015 by *Science*. Why is this particular gene editing innovation so exciting? In short, CRISPR defies the principle of the "iron triangle" that for a given product or service "you can have it good, fast, or cheap, pick two." CRISPR achieves all three. CRISPR is "good;" unlike previous methods of genetic engineering, which often resulted in large swaths of DNA being altered, CRISPR can be used to make precise genetic changes, even at the single nucleotide level. CRISPR is cheap; unlike its gene editing forerunners, such as Zinc Finger Nucleases or TALENs, CRISPR is less expensive (150 times cheaper than TALENs). CRISPR is fast; using just two readily available molecular components and a straightforward protocol, CRISPR can create desired gene edits in mere hours. The way CRISPR thus advances genetic engineering has created immense optimism for its ability to treat heritable disorders and other diseases with genetic origin.

The immense intellectual energy surrounding CRISPR is evident in the speed of its development for clinical application and its uptake by researchers across the globe. CRISPR-based therapeutics are in development to treat numerous heritable diseases, such as sickle cell disease, cystic fibrosis, and hemophilia. The clinical applications of CRISPR also extend to cancer and infectious diseases. As one of our contributing authors, Andrew Hong, points out "the global CRISPR technology market is expected to grow to over $10 billion by 2027." Consequentially, CRISPR has generated both hype and promise in the scientific community as well as the general public. Prior to 2012, less than 200 scientific articles had been published on CRISPR. In 2017 alone, nearly 1400 scientific articles referred to CRISPR in their title or abstract. Today, in labs around the world, CRISPR is used to understand molecular pathways, create animal models to study disease, and solve genetic networks.

Like most paradigm-shifting technologies, CRISPR is a double-edged sword. Its gene editing technology has the potential to deliver significant improvements to human health and wellbeing, but if not deployed responsibly, CRISPR could also do great harm. It could increase inequality, perpetuate prejudices, jeopardize health, and even threaten biosecurity. Decisions about how CRISPR should be used must account for multiple (and sometimes competing) societal values. Navigating the transformative complexity of CRISPR and steering its course to maximize benefits and minimize associated risks will be no easy feat. Wise use of CRISPR is an issue that should be examined through a broad lens, informed by a diversity of knowledge and perspectives.

As guest editors, we have taken great care to curate review articles that reflect this important diversity. With contributing authors hailing from various disciplines, including biomedical research, private industry, law, public health, policy and ethics, this issue of *Seminars in Perinatology* discusses the many ways CRISPR is likely to impact the practice of medicine, and in particular healthcare for neonates and children. How CRISPR works and the current state of research, as well as the ethical implications of CRISPR gene editing of heritable mutations is covered in depth by Nemi et al. In reviewing public health applications of CRISPR to reduce childhood morbidity, Martinez and Vigliotti discuss not only *how*, but also *if* CRISPR should be used to suppress vectors of infectious disease. The ethical implications of U.S. "right to try" laws and how they will impact safety and development of CRISPR-based therapeutics is thoughtfully argued by bioethicists, Neuhuas and Zacharias. Each article contained herein demonstrates how an integration of interdisciplinary knowledge and diverse perspectives is needed to address the ethical and societal complexity of CRISPR technology and its clinical applications.

We were equally careful to balance promise and pragmatism. Given the human inclination to imagine CRISPR's most dramatic potential, the articles paint a balanced picture of CRISPR technology's realized power, its promises that are just over the horizon, and its longer-term aspirations. The current state of CRISPR-based clinical research and therapeutics is discussed by Andrew Hong. Pan *et al.* discuss the potential of CRISPR to transform perinatal genetic screening through the creation of novel diagnostic platforms. As guest editors, we contributed a review article outlining the potential effects of CRISPR germline editing on reproductive decision-making for those with heritable genetic diseases. Finally, Robyn Gravelle calls for more research on impacts to maternal carriers in her commentary article.

Medical practitioners will be at the frontline as CRISPR's clinical applications evolve. They will be tasked with guiding patients through informed decision-making and helping them

https://doi.org/10.1053/j.semperi.2018.09.018

cope with their hopes and fears by differentiating between hype and evidence-based reality. In order to provide high quality care, doctors, nurses, genetic counselors, and reproductive specialists need to have the knowledge to empathically communicate the risks, benefits and limitations of CRISPR's clinical applications to their patients. We hope these articles will be a tool to enable providers to practice with an appreciation of the issues implicated by CRISPR, and in so doing, provide the best care possible for their patients.

Katherine L. Kraschel[a]
and Natalie Kofler[b]
[a]*Solomon Center for Health Law & Policy, Yale Law School, 127 Wall Street, 06511 New Haven, CT, United States*
[b]*Editing Nature and Associate Research Scientist, Yale Interdisciplinary Center for Bioethics, Yale Institute of Biosphere Studies, 21 Sachem St., New Haven, CT, United States*
E-mail addresses: Katherine.Kraschel@yale.edu (K.L. Kraschel) and Natalie.Kofler@yale.edu (N. Kofler).