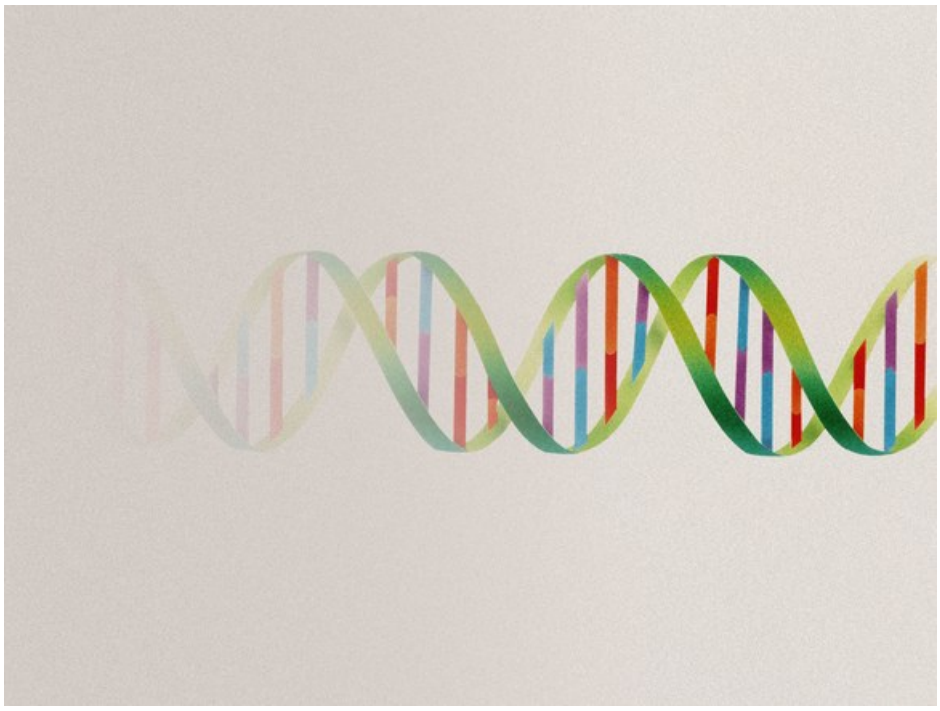
LEE COOPER SCIENCE 06.05.17 10:00 AM

A RADICAL PROPOSAL FOR PREVENTING RARE GENETIC DISEASES



GETTY IMAGES/WIRED

ONE MORNING, A few months ago, I didn't wake up. My 29-year-old heart had suffered from a sudden and complete cardiac arrest as I slept.

Sudden cardiac arrest kills nine out of 10 people who experience it, and it is a leading cause of death in the United States. But it isn't supposed to afflict a healthy young person. Fortunately, my wife is a light sleeper, and unflappable under pressure. She came to my rescue, and saved my life by performing CPR until the medics responded to her 911 call.

WIRED OPINION

ABOUT
Lee Cooper (@leecoo4) works in corporate development for a private biotech company in Cambridge, Massachusetts. He has previously published articles on healthcare markets and innovation.

Genetic testing would soon reveal that I suffer from a rare genetic disease called Long QT Syndrome, or LQTS. Of the 3 billion DNA base pairs that make up a

human's genetic code, I have a single mutation, passed down from my mother, that can elongate the rhythm of my heartbeat by a few milliseconds. And a few milliseconds are all it takes to produce a sudden cardiac arrest.

Experts believe that LQTS accounts for many previously unexplainable deaths in babies, children, and adults. Thankfully, genetics can now put a name to those deaths, and a name gives us something to target. In fact, I believe that we can use a combination of prevention and treatment to eradicate LQTS and many other rare genetic diseases like it.

LQTS is called a monogenic disease because it's caused by a single gene mutation. Some of the other thousands of rare monogenic diseases include cystic fibrosis, Tay-Sachs, and hemophilia. In the case of hemophilia, patients cannot form blood clots, and they can die when a simple cut or bruise turns into uncontrolled bleeding. There are treatments for hemophilia, but they are expensive. What's more, no treatment cures the underlying and hereditary disease, leaving future generations vulnerable.

Rare genetic diseases are inherited, pre-existing conditions, and they aren't so rare when we add them all up. Any given disease may have just a few thousand patients, but with thousands of rare genetic diseases, there are as many as 30 million people in the US—roughly one out of 10 people—adversely affected by this form of bad luck in a genetic lottery.

I know about many of these diseases because my career has been focused on building biotechnology companies. My job includes raising money from investors and forming collaborations with pharmaceutical companies to accelerate drug development, including for rare diseases. Through a twist of fate, I am now one of those rare disease patients.

As a patient, my greatest emotional challenge has been worrying about passing a deadly gene to unborn children. LQTS is autosomal dominant, which means that my child has a 50 percent chance of inheriting LQTS: a coin flip. This is an intense burden to bear, and so I needed to better understand how LQTS would affect the future health of my family.

When my wife and I began our family planning in the wake of my diagnosis, we discovered that in vitro fertilization could allow us to remove LQTS from our family tree. IVF is typically associated with fertility problems. Instead, for us, if we

created embryos using IVF, doctors could employ a technique called preimplantation genetic diagnosis to examine embryos and determine whether they test positive for LQTS. IVF is certainly less enjoyable (and more expensive) than the old-fashioned way to pregnancy, but it may be a small price to pay to prevent a sudden cardiac death. In this case, prevention is a cure.

A treat-and-prevent approach is the only way to truly wipe out any disease, as exemplified by vaccines. Vaccines cost-effectively immunize us against some of the worst killers in history. They have saved 122 million children in the last 10 years alone, according to the Gates Foundation. Similarly, combining IVF with genetic testing could save countless lives by limiting the dissemination of deadly mutations that lurk in our gene pools.

Disease prevention makes medical sense, and it makes economic sense. Just as a $50 vaccine can prevent hospitalizations and tragic social costs, a comprehensive IVF process for around $25,000 could save more than $300,000 in annual drug expenditures alone. In my case, drug costs are minimal, but I have a surgically implanted defibrillator that will need to be replaced every six to 10 years for the rest of my life. Ultimately, by using tools that already exist, we can reduce the suffering of millions, and save hundreds of billions of dollars for the healthcare system.

And yet, my doctors have seemed reticent to discuss IVF head-on. They have been bashful about the idea of removing this disease from my lineage. Similarly, patient advocacy groups spend little time on alternative family planning, and I have never heard biotech leaders suggest that we can cure rare diseases through prevention. But we can, and we must be able to speak clearly about the best ways to prevent disease if we are serious about eliminating it.

The tepid enthusiasm for using preimplantation genetic diagnosis to screen for genetic diseases is unfortunate, and it is time for a more open dialogue. From a bioethical perspective, screening for morbid monogenic diseases is widely accepted, and easily differentiated from screening for non-disease-related traits. Further, selecting away deadly genes would be more palatable than high-risk, emerging alternatives such as gene-editing embryos.

Imagine a world where a family finds a genetic disease in its blood, and then two things happen: First, the individuals who suffer from the disease begin taking the available treatments. Second, anyone who is a carrier for the gene can select away

the disease-causing gene. Current patients are managed, while unborn children are spared future suffering. Family-by-family, life-by-life, a terrible disease is defeated.

My wife and I haven't yet decided how we want to start our family, but we have seen that the medical system's views on disease prevention are lagging its ability to prevent. I will love my children no matter the diseases they carry, but I am beginning to think that they shouldn't have to carry mine.

Lee Cooper (@leecoo4) works in corporate development for a private biotech company in Cambridge, Massachusetts. He has previously published articles on healthcare markets and innovation. WIRED Opinion publishes pieces written by outside contributors and represents a wide range of viewpoints. Read more opinions here.