

## COMMENTARIES

# The Perils of Gene Patents

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**I argue here that gene patents, and patented genetic tests based on them, are a very bad idea. First, I discuss whether genes can reasonably be the subject of patents in the first place; I maintain that the answer is no. Second, I explain how gene patents interfere with scientific progress, slowing down the development of new cures and treatments for genetic diseases.**

Today we can sequence an individual human genome in just a few days, for less than \$5,000. Once we have a person's genome, we can easily and rapidly discover all known mutations in that genome, and with ever-increasing accuracy we can link these mutations to risk factors for disease. Several companies already offer individualized genetic testing, most of them using even less expensive DNA microarrays, which detect large numbers of single-base changes in the genome. Although there is much debate about the value of these tests today,<sup>1</sup> they clearly are here to stay. People simply want to know as much as they can about what is written in their genes. Unfortunately, our legal system has created a barrier that prevents us from reading our own DNA: bizarre as it may seem, the US Patent and Trademark Office (USPTO) decided almost 20 years ago, when it issued the first gene patent,<sup>2</sup> that we do not own the genes in our own bodies.

## Gene patents should not be allowed

Genes are not inventions. This simple fact, which no serious scientist would dispute, should be enough to rule them out as the subject of patents. When the

USPTO issued its first gene patent in 1982, DNA-sequencing technology was a very new idea and the patent examiners probably had little, if any, idea of where the technology was heading. Once they allowed the first patent, the floodgates opened and patent applications poured in. As genome-sequencing technology improved, scientists using highly automated procedures discovered thousands and later millions of genes, and the flood of gene patents became unmanageable.

After years of protests by scientists and patient advocates, the USPTO decided to limit gene patents by requiring that the applicant describe a use for the gene rather than merely the gene itself. This requirement might have slowed down patent applications slightly, but it fell far short of what was needed, and it failed to address the enormous mistake that the patent office had made in allowing gene patents in the first place.

Mistakes in science are eventually corrected as new evidence comes in, and scientists simply abandon flawed hypotheses. Unfortunately, the legal system does not work that way. Quite the opposite: the legal system (at least in the United States and the United Kingdom) gives tremen-

dous weight to precedent, and as a result, bad decisions may take decades to be reversed, regardless of the consequences. Gene patents now have a large constituency consisting of patent holders, patent attorneys, and university intellectual property offices, all of whom have strong financial interest in the present system. Not surprisingly, these players oppose any limits on gene patents.

One of the most controversial gene patent cases involves the *BRCA1* and *BRCA2* genes, which have been linked to an increased risk of breast and ovarian cancer.<sup>3</sup> Myriad Genetics, which owns the patents on these genes, charges very high fees to anyone who wants to test her DNA for any mutations, including mutations that had not been discovered at the time the patents were awarded. These patents have been controversial because many women cannot afford the fees and because women feel—correctly—that they should have the right to look at their own DNA without paying a license fee.

In March 2010, federal judge Robert Sweet overturned Myriad's patents,<sup>4</sup> supporting the argument that genes are a product of nature and should not be patentable. In late 2010, as part of the appeal of Sweet's decision, the US Justice Department came down strongly against gene patents. In its brief, the government attorneys stated that “genomic DNA that has merely been isolated from the human body, without further alteration or manipulation, is not patent-eligible” and added that “the unique chain of chemical base pairs that induces a human cell to express a BRCA protein is not a “human-made invention.””<sup>5</sup>

More recently, a three-judge panel hearing the appeal reinstated Myriad's patent claims,<sup>6</sup> overturning the lower court ruling from one year earlier.<sup>4</sup> The

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two-to-one split decision rested almost entirely on the tenuous notion that “isolated DNA” is somehow different from naturally occurring DNA and that this distinction allows companies to patent it. By this argument, a blood sample or even an amputated limb is not “naturally occurring” and is therefore patentable.

The dissenting judge, by contrast, pointed out that “patents are for inventions. A human gene is not an invention.” The patent office should have realized this 20 years ago.

### Gene patents are antithetical to scientific progress

Even if gene patents continue to be legal, scientists should refuse to file them for another reason: any scientist who files a gene patent is, perhaps unknowingly, participating in a process that violates the basic rules by which science operates. In particular, scientists should disseminate their findings and encourage others to push their work further. This principle applies to all scientists, but particularly to those of us working in universities, nonprofits, and other academic settings.

When scientists file for a patent (or allow their technology transfer office to file one for them), they are required to conceal their work, keeping the “invention” out of the hands of possible competitors until the legal process ensures that the patent is protected. Although an invention can be published once the patent application is filed, patent lawyers prefer to keep inventions secret, whereas scientists should want to make their discoveries public. These two goals are in direct opposition: if the patent lawyers win, then science loses.

From a broad perspective, much of the scientific progress during the past two centuries has occurred because we share our scientific discoveries. The faster our work is disseminated, the more rapidly we move forward. The entire system of scientific journals was created to serve this purpose. Science that remains secret cannot contribute to scientific progress and is for all intents worthless. A counterargument made by defenders of patents is that inventions do not need to remain secret once the legal application has been filed. This argument boils down to claim-

ing that the delay is not long enough to matter, which prompts the question “what benefits does society gain from waiting, especially when the patent covers a human gene?”

Gene patents create another, larger problem: they discourage further work on those genes. By 2005, 4,382 human genes either had been patented or had related intellectual property claims files on them<sup>7</sup> by more than 1,100 different claimants. This presents a bewildering “patent thicket” to any investigator wishing to pursue a new medical application of a gene. Working on a patented gene can involve endless hours talking with lawyers, negotiating licenses, and paying for those licenses. No scientist wants to spend time on such extraneous activities, and, when given a choice, most will simply avoid patented genes entirely, preferring instead to work on other genes. These lost opportunities cannot be measured because we can never know how many investigators chose not to work on a patented gene.

For these reasons and others, patenting genes undermines the scientific process—so much so that one has to wonder why any scientist would do it. The answer is simple: the profit motive. Patent holders hope to enrich themselves, especially if their patented gene is essential to the diagnosis or treatment of a widespread human disease. Thus, the more vital a gene is to human health, the greater the selfish motivation to file a patent. And yet the same crucial genes are the ones that should demand the greatest attention from the research community. Patenting human genes therefore constitutes an indirect threat to human health. Unfortunately, some scientists have put their short-term interest in profit ahead of their larger goals.

To illustrate, consider the patent on nuclear factor- $\kappa$ B (NF- $\kappa$ B) that was given to the Massachusetts Institute of Technology (MIT), Harvard, and the Whitehead Institute for Biomedical Research.<sup>8</sup> This is a “pathway” patent that covers any drugs that modulate NF- $\kappa$ B, a protein that was discovered in 1986 by David Baltimore and colleagues.<sup>9,10</sup> The patent claims to cover any method “inhibiting expression, in a eukaryotic cell, of a gene whose

transcription is regulated by NF- $\kappa$ B.” This intentionally broad language, which is only the first claim of 203 in the patent, covers hundreds of other genes beyond NF- $\kappa$ B. The universities licensed the patent in 2002 to Ariad Pharmaceuticals, which immediately sued Eli Lilly<sup>11</sup> over two drugs developed by Lilly. In 2006, a judge awarded Ariad \$65.2 million plus a percentage of future drug sales, a huge payoff for a company that contributed nothing to the drugs’ development. The basis for this lawsuit was a human gene that no one invented. MIT, Harvard, and the Whitehead Institute patented the gene (presumably) because of the potential profit, ignoring the chilling effect that lawsuits can have on biomedical research.

In March 2010, in a surprising but welcome decision, a federal appeals court overturned this decision, reversing the lower courts. The eight-year court battle over this gene patent illustrates the enormous amount of time and resources that can be consumed by fights over gene patents—resources that instead could have been used productively.

Patent lawyers have no business in the laboratory. But scientists have invited them in, and now we are finding that they are hard to chase out. Once a gene is patented, court cases drag on for years, taking up countless hours of scientists’ time. Lawyers charge by the hour, and these are “productive” hours for them. Scientists measure progress by how many discoveries they make (and publish), and every hour spent on a legal dispute is an hour taken away from real work. Thus, rather than being productive, gene patents are *destructive* of the scientific enterprise. Scientists in the nonprofit world should take a stand and simply say “no” when anyone suggests we patent a gene.

### CONFLICT OF INTEREST

The author declared no conflict of interest.

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