

# From Simulation to Solution

How new technologies can help to finally rid the world of malaria

By Nathan Myhrvold



**FOR DECADES** conventional wisdom has held that eradicating malaria is next to impossible. And as a result, we don't even try. I believe that 2009 should be the year when we put eradication back on the table.

Malaria is one of the great scourges of mankind, infecting some 500 million people a year. Between 1.5 and 3 million people are killed by the disease, a majority of whom are small children and pregnant women. The remaining millions can be wracked for years with recurring fever, chills, and other debilitating symptoms.

We know from successful examples in the West that with enough dedication, it's possible to eliminate the disease. In the 40s and 50s, many industrial countries successfully committed to the work. They invested in civil-engineering efforts to drain the swamps where mosquitoes bred. They went door to door to ensure that every backyard bucket, old tire, each source of standing water where mosquitoes could breed, was emptied. They campaigned for the use of bed nets, for window screens and for every infected person to complete the full regimen of their medication.

This attention to detail is difficult to maintain over a long period of time. Poor countries simply can't marshal the resources to keep the pressure up until the bug is killed. Instead, many developing nations employ so-called "malaria control," feeble attempts to keep the disease in check.

Unfortunately, both the single-celled parasite responsible for malaria, *Plasmodium falciparum* (and its related species), and

the Anopheles mosquitoes that transmit malaria proficiently adapt to every new threat to their existence. When the disease is beaten down but not destroyed, it rears up again and we end up with a *Plasmodium* that is drug resistant and a mosquito that's pesticide resistant. The medicine chloroquine, once dubbed the miracle drug for malaria, is now ineffective in Africa. It's only a matter of time before the same thing happens to the current drug, Artemisinin. In other words: The war against malaria gets harder every time we fail.

Making matters worse, there is very little R&D work on malaria. Worldwide, malaria R&D amounts to about \$65 for every malaria death, or 13 cents for every case. The comparable number for HIV-related deaths surpasses \$4,200. There's little immediate incentive for governments and drug companies to invest in malaria research. In countries whose governments could afford the funding, people are no longer affected by the disease. And the patients who would benefit from drug companies' research cannot afford the product. As a result, the malaria-control programs exhaust drugs and other interventions sooner than they can be replaced.

So what can be done?

Part of the problem can be solved with more funding. We also need a fresh approach that will harness creativity, encourage new thinking, and produce a willingness to test radical ideas. Unfortunately, when resources are scarce, the tendency is to pull back and become more conservative.

Our current approaches to combat the disease are low-tech: bed nets, sold or freely given; spraying or soaking bed nets in insecticide; spraying and draining water in breeding sites. Although these approaches work, they could work better with new technology.

We can now build really good computer models that simulate every aspect of the contagion—geography, climate, age, demographics, etc.—and then predict the most efficient arsenal. More bed nets, or spray? What will be the impact of an El Niño event or a civil war? How disciplined do we need to be? Is 70 percent coverage of houses sufficient, or do we need 80 percent? This would help us develop more operational models on how to cure the disease. We could eradicate malaria in silico a hundred times before it's done in the real world.

We also now have the tools to coordinate hundreds of researchers—or thousands of locals—in eradication campaigns and monitor their efficiency from afar. Another approach

is to create genetically altered mosquitoes that can't carry the parasite, and have them out-compete the existing ones. We don't have to drive them to extinction, only keep the population low enough to decrease transmission to humans below a certain critical threshold.

But technology is only half the battle. The most important thing might be to make the world comfortable with the idea that eradicating the disease is possible. In 2007, Bill and Melinda Gates publicly called for a new commitment to eradication, much to the consternation of the world's public health officials. This skepticism, borne of the failure to eradicate the disease in the 1970s, needs to be overcome.

Lets begin where it's less challenging. Shrinking the malaria map at its edges would build the confidence necessary to tackle more difficult regions. Places like South America and parts of

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Asia have a climate and a culture that make the disease more vulnerable. Islands are particularly good candidates for intensive campaigns. Once cleared, it's easier to keep malaria out. New Guinea, Sri Lanka, and Madagascar pose huge challenges, but victory in any of them would give the world the confidence necessary to tackle more difficult regions.

Even if you look at nothing but the raw economics, eradicating malaria is a great investment. The estimated cost of eliminating the disease is a lot higher than the annual budget of today's control efforts, except that the control effort goes on forever. Add the loss of productivity due to sickness for each country, and the size of this economic drain becomes gigantic. This is a classic case of intense upfront investment promising long-term returns. The developing world is not in a position to do this alone, but with the help of developed nations, eradication can become reality.

—Nathan Myhrvold is cofounder and CEO of Intellectual Ventures. (For full bio see page 8)



#### INSIGHT

Built into the side of a sandstone mountain where permafrost is 300 meters deep, the Svalbard Global Seed Vault—a top-level security depository for the world's seeds—officially opened in February 2008. The vault, which continues to take collections from some 1,500 seed banks around the world, will eventually house batches of seeds from nearly every variety of food crop on the planet. At a time when food crisis is no longer a distant prospect, but a painful reality, maintaining such an archive is all the more critical. As Cary Fowler, executive director of the Global Diversity Crop Trust, said on the day of the opening, "It is the last line of defense against the extinction of our agricultural diversity."

## NOMENCLATURE

### *Virosphere*

**VT-rō-sfi(ə)r\ n: THE COLLECTIVE LOCATIONS ON EARTH (OR OTHER PLANETS) WHERE VIRUSES EXIST**

In the early 20th century, as our understanding of biology grew to include interconnected webs of living things, the term "biosphere" became popular as a shorthand reference to the entirety of Earth's ecological systems. But more recently, new findings are garnering more

attention for a long-overlooked aspect of the biosphere: viruses. Genomic studies have revealed that in addition to their implication in many diseases, viruses play integral parts in the evolution of novel traits in living creatures, as well as in regulating the cycling of nutrients through the biosphere. To explicitly delineate the importance of viruses to life on Earth, Curtis Suttle, a microbiologist at the University of British Columbia, coined the term "virosphere." Today the term is seeing increased usage in scientific papers and popular articles, driven in part by the ongoing renaissance in our understanding of viruses and their multiple roles in life on Earth.