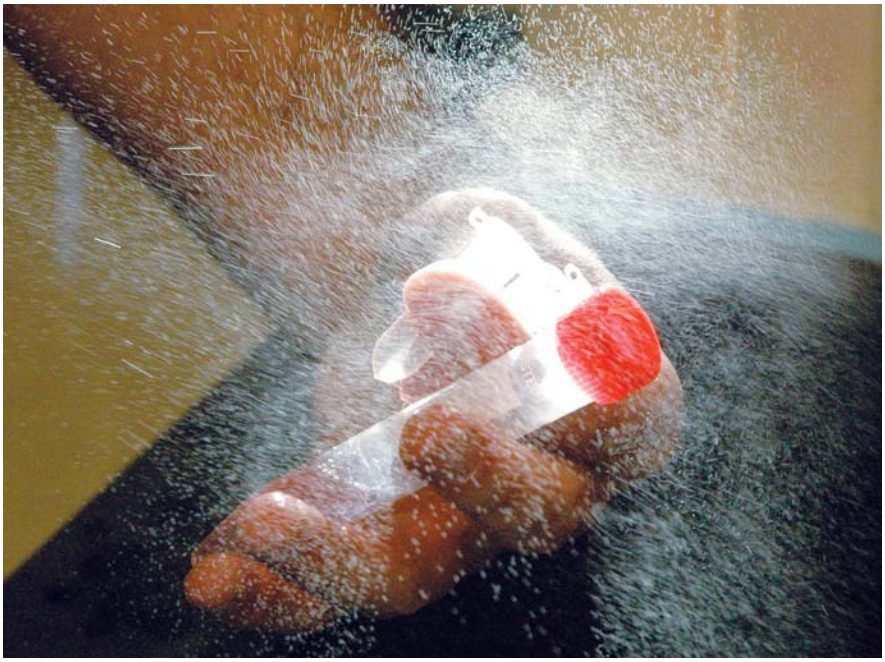
written + photographed
BY TOM LEVY

With support from a victim's family, a Children's Hospital scientist discovers a meningitis bacteria vulnerability and exploits it to develop a new vaccine.

Meningitis Wars



WARRIORS: Gregory R. Moe, PhD, at far left, leads a research team at Children's Hospital Oakland that's developing a vaccine for a deadly strain of bacterial meningitis.

At left, Brent Hagen, a research team member, sprays tubes used during research procedures with a sterilizing liquid. Late afternoon sun backlights the spray.

In September 2006, Jennifer Wells, a 21-year-old senior at the University of Virginia, woke up with a raging headache. She stayed home, but by the end of the day, she had lost consciousness and been hospitalized. Two days later, she died.

The killer was a deadly strain of bacterial meningitis that infects the tissue surrounding the brain and spinal cord.

Like many college students, Jennifer had received a meningitis vaccine; but it only protects against four of the five most dangerous strains of the disease. It was the fifth, known as MenB, that took her life.

Jennifer's family was shocked by her death, and determined to raise money to fight the disease. Their quest led them to Gregory R. Moe, PhD, an earnest yet unassuming scientist at Children's Hospital & Research Center Oakland.

Dr. Moe had been studying MenB intensely for a year. He knew the slippery MenB bacteria had evolved the perfect disguise. Its sugar-based outer coating mimics human cells, allowing MenB to fly under the radar of the human immune system.

Discovering MenB's weak spot

That disguise had previously made a vaccine against MenB impossible. But Dr. Moe and his colleagues had discovered a crack in the camouflage that promised the possibility of a vaccine against MenB.

It was this breakthrough that convinced Jennifer's family to donate the $40,000 they'd raised to Dr. Moe's team. "They decided to turn the tragedy of Jennifer's death into something positive, to keep this from happening to somebody else," said Dr. Moe.

While rare, meningococcal meningitis is extremely fast acting. Every year it afflicts about 3,000 Americans. With modern medical care, including antibiotics, most survive.

But even with antibiotic treatment, about 10 to 14 percent of those sickened by MenB die. Of those who survive, the same percentages are left with debilitating nervous system damage, including hearing loss, paralysis or mental retardation.

"It's a disease you want to prevent, not treat," said Dr. Moe.

Rocket launchers disguised as station wagons

The tricky MenB cells have an outer coating made of a sugar called polysialic acid, commonly found in human cells. That's why human immune systems don't see MenB as dangerous. The deadly bacteria pass through our bloodstreams like rocket launchers disguised as station wagons.

But interspersed among the strands making up MenB capsules, Dr. Moe found an unusual variation of the polysialic acid called deacetyl sialic acid (DSA). While most of MenB's coating is slippery like Teflon, the DSA strands are sticky like Velcro.

Now Dr. Moe had to design an antibody that would stick to the Velcrolike region on MenB's skin.

Antibodies are essential to the immune system. They act like bull's-eyes on the backs of foreign objects in the body. Once attached to a MenB bacterium, an antibody attracts immune system warriors able to find and destroy the previously unnoticed invader.

The vaccine Dr. Moe designed enlists the body's own antibody-making machinery, stimulating the immune system to make MenB antibodies. So far, the evidence shows he and his team are succeeding.

After three years of work, Dr. Moe's team has shown, in the test tube and in mice, that its vaccine is effective against MenB bacteria. They believe further experiments will show their vaccine will work against two major meningococcal

No one else knows what Moe knows To this day, only about a dozen scientific papers have been written about deacetyl sialic acid (DSA). And of those, only four, written by Dr. Moe's team, deal with its presence in the meningitis bacteria that took Jennifer's life.

One paper has been published, two are in review at scientific journals and Dr. Moe is still working on the fourth.

Publishing their work in peer-reviewed journals is crucial. "Publishing is the key to everything in science," Dr. Moe said. It gets the word of their discoveries out and encourages other scientists to try to replicate their findings. Replication by other reputable scientists will add credibility and momentum to their work.

So far, he and his team have this discovery to themselves. "This is something really new, that people just don't know much about," said Dr. Moe. "We probably have more knowledge about this than anyone else because we have studied and analyzed and figured out ways of making and characterizing these chemical derivatives."

To protect their work, they're also taking two more steps: patenting the vaccine through Children's Hospital's technology transfer office and licensing it to a private pharmaceutical company for further development. That's considered a rare business-world blessing of any scientist's work.

But the real blessing will come when the MenB vaccine developed by Dr. Moe and his team becomes available to save lives around the world.

strains, MenB and C, which cause more than 90 percent of meningococcal disease in developed countries. They look forward to one day showing their vaccine is safe and effective in people.

"This is a classic science story," said Dr. Moe. "We started out on a different path several years ago, but made an observation that didn't make sense." Digging for the explanation has helped Dr. Moe strike scientific gold; he and his team are on their way to a first-time vaccine against the killer bacterium, MenB.

RESEARCHER PROFILE:
From childhood chemistry set to grown-up vaccine lab

Dr. Moe's father was a county sheriff in small-town Minnesota. The family home included the sheriff's office and jail cells. In addition to keeping house for the family, Dr. Moe's mother was the jailer and radio dispatcher.

The cellmates fascinated Dr. Moe. When he wasn't cooking up stink bombs and colored crystals with his childhood chemistry set in Granite Falls, Minn., he was talking with many of the county's "unsavory characters." He found them surprisingly friendly.

This unlikely pair of pursuits led Dr. Moe to an interest in psychology—and chemistry. In high school he read books by psychologists; but in college, his interests turned to physiological psychology and brain chemistry.

In 1985, Dr. Moe earned a PhD in chemistry at the University of Chicago. After postdoctoral work at the University of California, Berkeley, Dr. Moe became an assistant professor in chemistry and biochemistry at the University of Delaware in Newark, Del.

When his wife landed a job in the Bay Area in 1995, Dr. Moe joined her, taking a visiting scientist position at the University of California, Berkeley.

A year later he joined Children's Hospital Oakland's research center. He and his wife, now director of late-stage development at Genentech, have two daughters. One is a senior in high school; the other has just started her studies at the University of California, Los Angeles.

LAB TALK: Dr. Moe, at left, talks with research assistant Brent Hagen while pointing at data in Brent's notebook.

Money raised by Jennifer's family helps support MenB researcher

The $40,000 Jennifer Wells' family raised is helping pay the salary of one of Dr. Moe's team members. Jessica Ing is the first promising young scientist hired as a temporary "fellow" to help with his research.

Jessica grew up in a Castro Valley family where there "was always an emphasis on serving the community." As a kid, she often tagged along with her parents—a physician and a community activist—to community activities in Oakland's Chinatown. As a high school and college student, Jessica went to Chinatown on her own, to tutor adolescents.

Now, as a researcher in Dr. Moe's lab, Jessica is helping Dr. Moe develop a vaccine for MenB.

Jessica graduated from the University of California, Berkeley, last year, with a triple major bachelor's degree in molecular and cell biology, psychology, and integrative biology. Now she's interviewing with East Coast medical schools. "As a doctor, you can do things that will benefit youth for the rest of their lives," said Jessica, who's considering a future in pediatrics or adolescent medicine.

Knowing her MenB lab work is partially funded by Jennifer's family is inspiring. "It really puts a face on what we're doing," said Jessica. "It makes what I'm doing here more meaningful."

To learn more about Jennifer Wells, visit www.moonlight4meningitis.com. To make a donation to help Dr. Moe's research or to help fund a science fellow, visit www.chofoundation.org.