Lifesaving Science

Dennis Liotta
With the aid of biotechnology research, Dennis Liotta co-invented Emtriva–a component in the Atripla HIV medication. Today, thousands of Americans take pills containing Emtriva.

Georgia researchers use biotechnology to prevent disease and enhance health care around the world.

By Bill Hendrick

It's not unusual for a total stranger to walk up to Dennis Liotta and throw a big hug around his neck. The organic chemist at Emory University in Atlanta co-invented breakthrough AIDS-fighting drugs that have saved the lives of tens of thousands of people—and made life bearable for 10 times that many.

"It's a profound feeling, an emotional one, when it happens—and it happens quite a lot when I go places to speak," Liotta says. "I have a really close friend who is HIV-positive. He is taking a combination of the drugs. It's just marvelous how healthy he appears. You'd never know from looking at him that he's HIV-positive, and that makes me feel just so incredibly wonderful."

The same sort of thing happens to Raymond Schinazi, an infectious disease and antiviral expert at Emory. Together, Liotta and Schinazi invented Emtriva, one of the components in the triple combination pill Atripla, a once-a-day medication. Today, 94 percent of the 1.1 million Americans living with HIV take pills containing either Emtriva or other HIV drugs invented by Emory University researchers.

Liotta and Schinazi couldn't have made their lifesaving discovery without biotechnology—the use of biology and cellular processes to solve health problems. Since the early 1970s, biotechnology has grown into a $21 billion industry, employing 1.3 million people in the United States at 50,000 different companies.

Georgia has 300 bioscience companies, employing more than 15,000 people with $7 billion in reve-

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Dennis Liotta, left, and Raymond Schinazi, right, co-inventors of Emtriva.

nues—making the state a world leader in biotechnology. The industry is aided by the Georgia Research Alliance, a nonprofit entity that has lured 61 top scientists, or "Eminent Scholars," to state universities.

Biotechnology helped researchers develop treatments for several diseases, but their work is far from over. From heart sensors to cancer vaccines, here is a look at the lifesaving research at Georgia's universities and institutions.

AIDS Fighters

Liotta and Schinazi were young scientists who didn't even know each other when their career paths merged, but together they have made breakthrough discoveries in HIV/AIDS research. Schinazi was a professor of pediatrics who had been experimenting with antiviral drugs since 1976. Liotta had become interested in AIDS research as the epidemic emerged in the early 1980s.

It was Jack Arbiser, then a student and now a professor and researcher at Emory, who suggested they join forces, since he was familiar with both scientists' work. That was the start of a long partnership that has produced AIDS treatment drugs taken by millions today.

Liotta and Schinazi's work first yielded a compound called lamivudine. Then came emtricitabine, sold as Emtriva. Both are in the class of drugs known as nucleoside reverse transcriptase inhibitors, which work against the enzyme that produces replication of HIV. Essentially, the compounds are antiviral agents that either stop or slow the spread of HIV, thereby preventing or greatly delaying the development of AIDS.

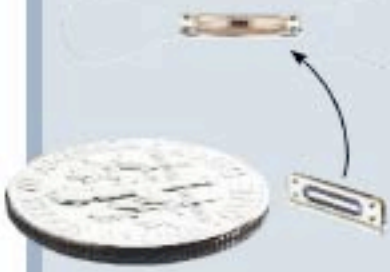
Liotta and Schinazi gained worldwide fame for their discovery of Emtriva, which was approved by the U.S. Food and Drug Administration in 2003. Two years later, when rights to Emtriva were sold, Emory received $540 million in the largest-ever intellectual property deal involving an American university.

Emtriva reduces the HIV load in a person's body and increases immune cells that are associated with improved health. Liotta says the drugs aren't cures, but they can inhibit development of AIDS for many years.

It is not known how long the drugs will remain effective. "It depends on when the virus starts to mutate," Liotta says. "The more it mutates, the more you have to change the regimens. And eventually we run out." However, Emtriva continues to enhance the lives of millions.

"Saving lives is what motivates us," Schinazi says. "Some people can make a beautiful painting, and I can make a beautiful drug. That's enough for me."


Jay Yadav



EndoSure

With the aid of biotechnology, Jay Yadav, Mark Allen and researchers at Atlanta-based CardioMEMS Inc. developed a heart sensor called EndoSure. The device—which is smaller than a dime—uses passive wireless sensing technology to take quick blood pressure measurements.

Monitoring Hearts

Never underestimate the power of a tiny glass tube. This one is called an EndoSure sensor, and it's the handiwork of Jay Yadav, an interventional cardiologist at Atlanta's Piedmont Hospital; Mark Allen, a professor of electrical and computer engineering at Georgia Tech; and their researchers at Atlanta-based CardioMEMS Inc.

The inch-long device uses passive wireless sensing technology to take quick and multiple measures of blood pressure. The sensor has been implanted in the aortic aneurysms of some 6,000 patients, making it easy for their doctors to ensure that everything is working properly.

Doctors normally treat aneurysms with stent grafts—slender tubes covered in fabric that are placed in arteries so blood can flow through the stent grafts instead of the artery, preventing it from bursting. When stent grafts fail, however, blood leakage occurs, which can cause aneurysms to burst. Patients need lifetime monitoring, and until recently, the only available method was costly and cumbersome CT scans.

For the past few years, vascular surgeons across the country have been implanting EndoSure sensors along with stent grafts. They hope to eventually replace CT scans with less invasive pressure monitoring.

The EndoSure technology was developed through biotechnology research funded by the Defense Advanced Research Projects Agency. The sensor does not need batteries. Doctors pick up signals by waving an electronic "wand" over the implant area.

"The CardioMEMS sensor measures the actual pressure in the aneurysm sac," says Charles Brown, an interventional cardiologist at Piedmont Hospital. "The sensors have a huge potential use if they are approved for use in patients with congestive heart failure. It's a remarkable tool now, and it will be even better then."

Yadav is convinced the sensor can reduce hospitalizations and deaths caused by congestive heart failure, which currently afflicts more than 5 million Americans.

In an ongoing clinical trial, about 400 people had sensors implanted into their pulmonary arteries. Each person was given a monitoring machine to take home. Every morning, each subject lies on a pillow containing a wand similar to the one used by doctors of aneurysm patients. The patient pushes a button and the machine starts giving verbal instructions as visual prompts show up on a screen. It takes 10 seconds to transmit the data to CardioMEMS' servers. The data is downloaded to a database accessed by patients' doctors, who can adjust medications.

"The goal of the trial is to show that management of the patient's pressure will decrease the rate of hospitalization," Yadav says. CardioMEMS, which Yadav and Allen founded in 2001, is expecting FDA approval next year for use of the sensors in heart-failure patients.

"We have excellent drugs to treat heart failure but not enough information on how much medication they need and what types of medication are best for a given patient," Yadav says. "We hope that with the doctors getting critical pressure information from inside the heart ... patients can be prevented from experiencing complications that require them to be hospitalized. People should feel better and will perhaps even live longer."

Detecting Diabetes

With type 1 diabetes increasing at a rate of 3 percent to 5 percent a year, researchers at the Medical College of Georgia are spearheading a global effort to prevent and cure it. In 2004, Jin-Xiong She and his colleagues identified a gene common to children with the disease, and they will soon publish findings about another. However, "having the genes alone does not push someone over to diabetes. We know there must be environmental triggers," he says. "But there are also things that could be protective and prevent children with the known genetic markers from getting diabetes. It's a puzzle."

Type 1 diabetes—which almost always shows up during childhood—is an autoimmune disease in which the body's immune system attacks the insulin-producing cells.

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>
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BIO BREAKTHROUGHS

When it comes to preventing and curing disease, scientists have turned to biotechnology for decades. From cancer treatments to DNA identification, here's a look at some of biotech's biggest breakthroughs.

- Since the mid-1970s, scientists have used biotechnology to create more than 200 therapies and vaccines to combat diseases such as cancer and HIV/AIDS. Today, these treatments save and prolong the lives of millions.

- In 1982, the Food and Drug Administration approved the use of human insulin produced in genetically modified bacteria. Insulin is often used in the treatment of diabetes, and the new process allowed scientists to produce it in large quantities.

- Founded in 1984, Georgia-based CryoLife, Inc. was the first biomedical company to develop low temperature preservation of implantable human tissues for cardiac and vascular reconstruction surgery. Since then, the company has processed more than 150,000 tissues for limb and lifesaving operations.

- In the mid-1990s, lab scientists used biotechnology to produce substances that can bind to specific molecules. This discovery led to cancer treatments, such as the breast cancer treatment Herceptin, that can target different types of cancer cells—attacking only harmful cells.

- In 1997, researchers developed a bio-based blood test to measure low-density lipoprotein, or bad cholesterol. Since then, medical researchers have taken biotech-based blood tests a step further, using them to diagnose certain cancers.

- Low testosterone affects up to 13.8 million men in the U.S. age 45 and older—with less than 10 percent receiving treatment. In response, Georgia-based Solvay Pharmaceuticals, Inc. markets AndroGel—a daily testosterone replacement therapy. Since 2001, more than 10 million prescriptions have been written for AndroGel.

- China licensed the world's first commercial gene therapy product, Gendicine, a drug used to treat cancer of the head and neck, in 2003. The drug contains the p53 gene, which suppresses prevalent tumors in the human body.

- In 2003, a group of scientists, headed by Francis Collins at the National Institutes of Health, completed the Human Genome Project. It successfully identified approximately 25,000 genes in human DNA. —*B. H.*

She's long-term goal is to discover what triggers the disease, prevent it and cure it.

She is a principal investigator of The Environmental Determinants of Diabetes in The Young (TEDDY) study, funded by the National Institutes of Health. TEDDY's genesis goes back to 2001, when She and researchers from around the world discussed the view that type 1 diabetes is caused by environmental triggers that affect some, but not all, people with certain trademark genes. They embarked on a massive study, screening thousands of infants around the world and tracking their progress for years.

Screenings began in 2004 at research sites in Georgia, Florida, Colorado, Washington, Finland, Germany and Sweden. About 350,000 newborns will be screened and 7,800 will be enrolled over the course of the study. Scientists use biotechnology to examine subjects' blood and detect specific genes. Researchers will track children who are carrying suspect genes for 15 years and test their blood every few months. Parents agree to keep detailed records of what their children eat and when they get sick. The detailed research will give scientists insight into what causes type 1 diabetes in infants.

"We've got to find a way to prevent the disease from ever occurring," She says.

Curing Canine Cancer

People love their pets, and many are willing to spend thousands of dollars to keep them alive. Merial, one of the nation's biggest animal health companies, was recently granted permission by the U.S. Department of Agriculture to use a vaccine to treat canine oral melanoma—the first therapeutic vaccine for treatment of cancer in either animals or people.

"With this vaccine, we have extended the survival times of these dogs well out into the 500- and 600-day period," says Bob Nordgren, Merial's vice president of biologics research and development. "The therapy actually targets the cancer."

The vaccine alerts the dog's immune system to the presence of melanoma cells or tumors. This allows the dog's immune system to stunt or eliminate tumor growth without the aid of chemotherapy. Treating dogs with the cancer vaccine costs significantly less than chemotherapy. Although it does not guarantee survival,

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A poultry flock is evaluated after being treated with Merial vaccines.

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the vaccine may keep the animals alive long enough to die of old age.

In addition to treating dogs, the product has proven to be a pathfinder for human cancer vaccine therapies. Experts at the Memorial Sloan-Kettering Cancer Center in New York are looking at Merial's progress to see if the vaccine could be adapted for human use.

Bill Hendrick is an Atlanta-based writer who specializes in health and science. He spent 29 years with the Atlanta Journal-Constitution and eight at The Associated Press.