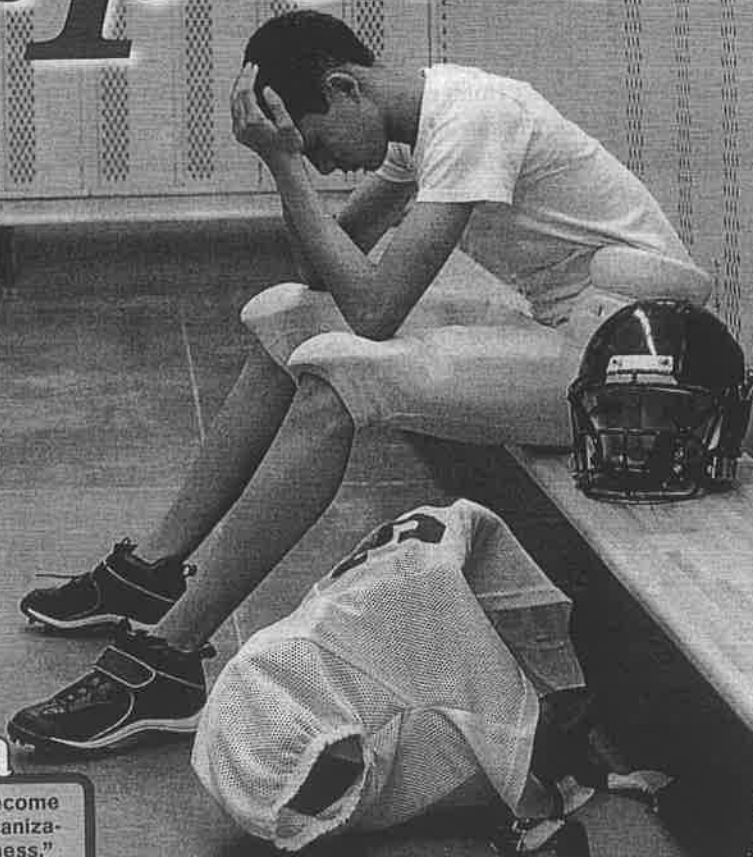


BATTLING A *Superbug*



webextra

C. J. and his mother have become involved in the nonprofit organization "Ricky's MRSA Awareness." Visit the organization's Web site to download informational materials about MRSA for players, coaches, and parents.
www.mrsaawareness.com

10 January 15, 2007

A teen athlete struggles to defeat killer germs

LOCKER ROOM: PHOTODISC/GETTY IMAGES; BACTERIA: BIOMEDICAL IMAGING UNIT, SOUTHAMPTON GENERAL HOSPITAL/PHOTO RESEARCHERS, INC.; JACKSON: COURTESY OF FRANCINE JACKSON

Fourteen-year-old C. J. Jackson never imagined that a red irritated spot on his leg could turn into a life-threatening disease. But two months after he first discovered what looked like a bug bite on his right knee, he was fighting for his life in a Georgia hospital. His body temperature soared to 42°C (107°F), and he had severe *sepsis*—an often-fatal condition in which disease-causing microorganisms have overwhelmed a person's blood.

Although C. J. and his doctor didn't know it at the time, the red spot on his knee was the first sign that his body



ON THE MEND: C. J. recovered for nearly 5 months before returning to the playing fields.

was infected with a dangerous type of the microorganism *Staphylococcus aureus*. Skin infections of this bacterium are relatively common and can usually be cured with antibiotics. But the strain of staph that had infected C. J. was different. Called *methicillin-resistant Staphylococcus aureus* (MRSA), this strain of staph has built-in defenses against many of the antibiotic medicines that exist today. As a result, MRSA (commonly pronounced MUR-suh) infections are difficult to treat.

The bacteria often spread from a person's skin to other parts of the body. "Once it gets in the bloodstream, the infection can be very severe and even fatal," says Dr. Robert Daum, an infectious-disease specialist at the University of Chicago.

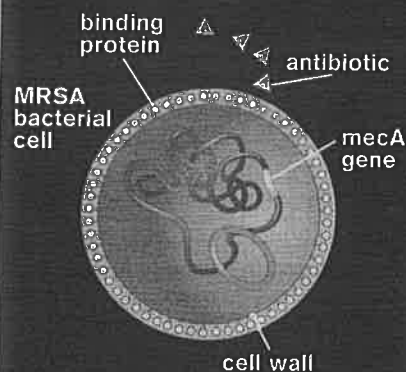
Fortunately, C. J. survived his bout with MRSA. Now, he is join-

ing scientists in trying to spread awareness of the disease. There's good news in C. J.'s message: By following simple steps, most MRSA infections can be avoided or stamped out before they become deadly.

EMERGING THREAT

Just 10 years ago, MRSA infections were rarely seen in healthy people like C. J. But doctors have recently been reporting more and more out-

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Antibiotics can kill many types of bacteria by binding to special proteins located within the *cell wall* (outermost layer). But a MRSA bacterium has built-in protection against antibiotics in the form of a *mecA gene*, a small segment of DNA. This gene instructs the bacteria to make a different type of binding protein to which antibiotics like penicillin don't bind. These resistant bacteria can cause potentially deadly infections.

breaks around the country. "MRSA is now the most common cause of skin infections in the United States," says Jeffrey Hageman, an epidemiologist who studies the spread of diseases for the U.S. Centers for Disease Control and Prevention (CDC).

Studies are also showing that C. J. is part of a population that is particularly at risk: athletes. In sports like football and wrestling, athletes are in close contact with each other, making it easy for MRSA to spread from one person to another.

SPREADING GERMS: A single MRSA bacterium creates more antibiotic-resistant bacteria when it reproduces. The bacterium divides (shown at left), creating two new resistant bacteria.

POWERFUL DEFENSE

Like the bodies of all people, those of athletes are covered with bacteria. "There are billions of bacteria living on each of us," says Daum. And about one in three people harbor one or more strains of staph bacteria on their bodies.

A much smaller percentage of people—about 0.8 percent—carry the MRSA strain of staph. MRSA bacteria have a specific gene, or a segment of DNA, called *mecA*. This gene arms the bacteria with weapons that fight against the most commonly prescribed antibiotics, such as penicillin and cephalosporins (*see Nuts & Bolts, p. 11*).


STOP THE SPREAD

MRSA bacteria can reside directly on the skin. So an athlete who is carrying MRSA bacteria on his or her skin can easily pass it to other players through skin to skin contact.

C. J., who plays football and baseball, doesn't know if he got the MRSA bacteria from contact with another player. But to be safe, he now follows simple steps to avoid another infection. He doesn't share towels or even bars of soap—which may harbor the bacteria. "Good sports hygiene is the most important thing," he says. "It's important to always take a shower after playing." That will wash off any bacteria that may have been picked up during practice or a game.

WHEN MICROBES ATTACK

Even if people get MRSA bacteria on their skin—it doesn't necessarily warrant a trip to the doctor. The skin provides good protection against any harmful effects of the bacteria. But



SWOLLEN: An infection with MRSA can cause a person's skin to swell and become red.

when there is a break in that barrier—such as a cut or a scrape—the bacteria may infect the wound and start to destroy tissue.

"Areas where infections often occur are abrasions from playing football or slide tackling in soccer, or mat burns in wrestling," says

Hageman. Now C. J. is careful to keep his cuts and scrapes covered with a clean bandage so that bacteria can't enter the wound.

If bacteria do enter the skin, the first sign of infection is usually an irritated or pus-filled spot that may resemble a bug bite. If a MRSA infection is caught at this stage, it can usually be cured by removing the infected skin or by taking certain antibiotics that are effective at killing off the bacteria.

But if the infection is left untreated or treated with antibiotics that are ineffective, the bacteria can continue to spread through the body. In C. J.'s case, the bacteria invaded his bloodstream and entered his bones—a condition called *osteomyelitis*. "It was eating into my bones from the inside out," he says.

To rid his body of the bacteria, C. J. had to take strong antibiotics for nine months. And because his bones were injured from the infection, he needed physical rehabilitation to build up strength to even walk again.

SPREADING THE WORD

To help teens avoid an experience like his, C. J. and his mother have been sending materials to local schools about MRSA and how to avoid it. At the same time, scientists like Daum and Hageman are informing the health-care community to watch out for MRSA. "It's something we didn't think about five years ago," says Hageman. ✨

—Britt Norlander

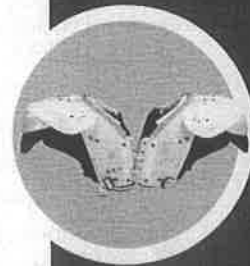
TIPS TO AVOID THE Superbug



1 Keep scrapes and cuts covered with a clean, dry bandage. That will help prevent bacteria from entering the wound.



2 Wash your hands regularly. Shower after playing sports.



3 Don't share razors, towels, or bars of soap. Bacteria can spread via these objects.

4 Wash sports equipment, line pads, and helmets after use.

5 If you have a suspicious spot or muscle pain with a fever, ask your doctor if you might have a MRSA infection. A test can pinpoint the bacteria in a matter of days.

EARTH TORNADOES

TWISTED

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For tips on staying safe during a tornado, visit: www.nssl.noaa.gov/edu/safety/tornadoguide.html



TRICKED OUT: Green's Tornado Attack Vehicle is a modified racing truck.

CHASE

Two daredevils hunt down tornadoes to find out more about these super-fierce storms



Source: NOAA

A car is one of the worst places to be during a tornado. Swirling winds can reach more than 480 kilometers (298 miles) per hour. That's powerful enough to toss even the largest vehicle like a little toy. Knowing this, it might be hard to believe that anyone would intentionally try to drive a car inside a twister. But that's exactly what two daredevils plan to attempt this spring. Sean Casey and Steve Green have souped-up cars they will use to chase the spiraling storms through "Tornado Alley" (see map, above). This band of

land in the U.S. has more tornadoes per year than anywhere else in the world. Each man is on his own mission, but their goals are the same: Both drivers are hoping to capture video footage and scientific data from inside a tornado.

BREWING STORMS

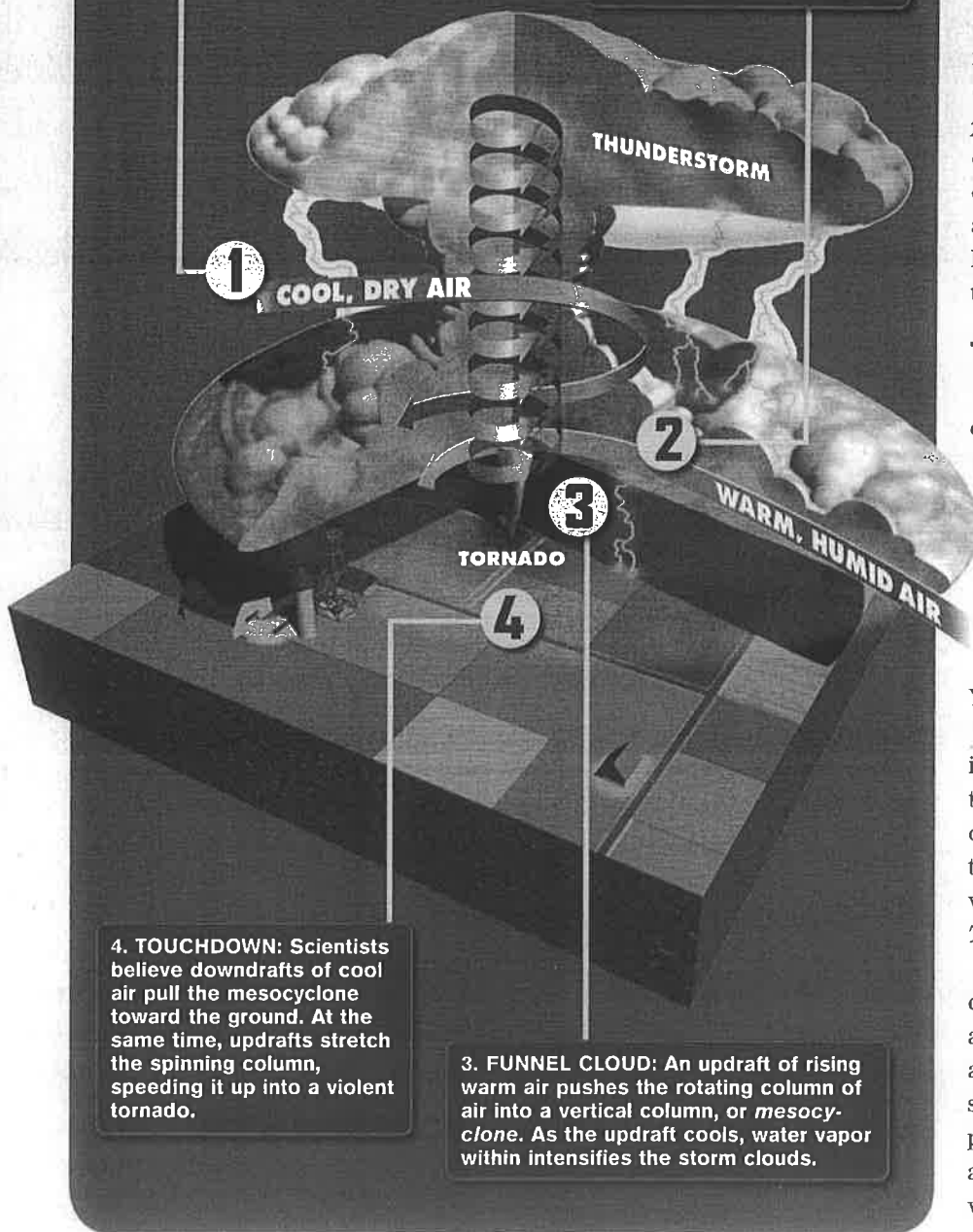
Tornadoes regularly whirl through Tornado Alley because of the region's unique geographic features. Tornadoes are a type of cyclone with inward spiraling winds that rotate. These storms occur when warm, moist air from the Gulf of Mexico forms thunderstorms near and under the *jet stream*, an air mass traveling eastward. As moist air rises in thunderstorms, it cools and the water vapor condenses into clouds, rain,

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A tornado is a violently rotating column of air that is in contact with both the ground and a cloud base. The most intense tornadoes can destroy anything in their paths. Although scientists are still gathering information about tornadoes, this is how they believe the fierce storms form.

1. FRONTS COLLIDE: Tornadoes form inside of huge thunderstorms called *supercells*. A supercell begins to take shape on the edge of two colliding weather fronts. There a cool, dry air mass above meets a warm, humid air mass below.

2. WINDY: The mixing of the two fronts along with powerful jet stream currents create *wind shear*. As the winds abruptly change direction or speed, a layer of air between the fronts starts rotating.



4. TOUCHDOWN: Scientists believe downdrafts of cool air pull the mesocyclone toward the ground. At the same time, updrafts stretch the spinning column, speeding it up into a violent tornado.

3. FUNNEL CLOUD: An updraft of rising warm air pushes the rotating column of air into a vertical column, or *mesocyclone*. As the updraft cools, water vapor within intensifies the storm clouds.

and hail, releasing extreme amounts of energy. The jet stream's strong eastward current adds spin to the storm (see *Nuts & Bolts*, left).

As of this February, a new scale is ranking the intensity of these whirling storms. The Enhanced Fujita Scale replaces the Fujita Scale, which had been used since 1971. Both scales show the relationship between a tornado's wind speed and how much damage it causes to structures. However, the Enhanced Fujita Scale allows better estimates of this damage. That's because it considers building materials and engineering methods when calculating structural damage (see *That Was Intense*, p. 13). For instance, an EF-0 tornado can rip down tree branches. An EF-5 can turn a house to splinters. Green and Casey both hope to enter a mid-level strength tornado. Green hopes to enter an EF-2.

TORNADO TRACKERS

Green is a former NASCAR race-car driver. He has survived his share of car accidents during races, but driving his *Tornado Attack Vehicle* or *TA-1* into a tornado is a different story. "On a racetrack, there are only so many things that can happen," says Green. "In a tornado, you don't know what's going to happen. You know, I've seen cows fly."

Casey is an IMAX filmmaker who is collaborating with scientists to help them learn more about the behavior of tornadoes. He hopes to capture the turbulent images on his camera, which is mounted to his homemade *Tornado Intercept Vehicle (TIV)*.

Both Casey and Green have designed their cars with safety and science in mind. The cars are armored with strong metal plates and shatterproof windows. The shielding protects the drivers from flying debris and weighs down the cars in strong winds. Casey's *TIV* weighs more than

6,000 kilograms (13,227 pounds) and Green's *TA-1* tips the scales at 3,628 kilograms (8,000 pounds).

Green enlisted the help of engineers from his NASCAR days to redesign a race vehicle for tornado chasing. He even wears protective gear similar to that worn by NASCAR drivers, like a flame-resistant suit and a crash helmet.

Both cars have a hydraulic system that lowers the body of the vehicle to the ground. Any space between the car and the ground may allow the extreme winds to get underneath the vehicle, causing it to topple over or get tossed through the air. Inside, the cars are equipped with various sensors to record scientific data.

"I want to make the ultimate IMAX film [on tornadoes]," says Casey, "and at the same time help the [tornado scientists] learn about what goes on inside a tornado."

STORMY SCIENCE

While Green has not officially paired with a scientific institution, Casey has teamed up with Josh Wurman, the head of the Center for Severe Weather Research in Boulder, Colorado. Wurman scans the skies for



tornado activity using a device called "Doppler On Wheels (DOW)." This instrument looks like a big satellite dish sitting on the back of a flatbed truck. It uses radar to measure precipitation and the wind conditions that favor tornado formation, and maps the winds inside tornadoes.

Wurman parks the radar truck near a storm and uses a two-way radio and Global Positioning System (GPS)-aided vehicle tracking systems to navigate Casey to the tornadoes. "The hardest part of tornado chasing is finding a tornado and being in its path when it touches down," says Casey, who has been hunting tornadoes since 1999.

Wurman has equipped Casey's *TIV* with several meteorological devices for recording characteristics of weather. These instruments include a *barometer* to measure air pressure, *anemome-*

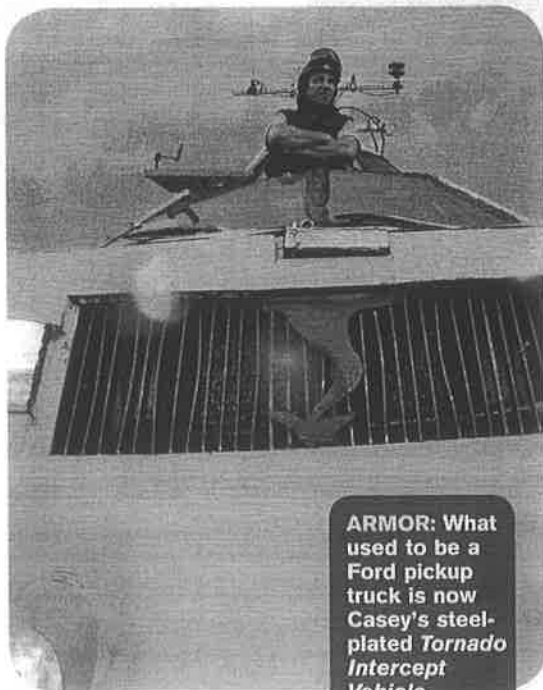
ters to measure wind speed and direction, and a *thermometer* to measure the temperature inside a tornado.

Knowing the air pressure in a tornado tells scientists how much force the air exerts. Gathering information about the speed and direction of a tornado's winds tells scientists about the behavior of a tornado as it spins. Warm air fuels a tornado, so collecting information about the tornado's temperature may tell researchers how heat influences a tornado's severity.

Scientists have used radar to get information about the top and middle sections of tornadoes, but very little information about the ground level exists. Wurman is hoping that Casey's *TIV* will help him find out what is happening in the bottom 10 to 15 meters (33 to 49 feet) of a tornado.

This type of information—whether from Casey or Green—could help people design buildings that are better protected from the devastating force of a tornado, says Wurman. ❀

—Andrew Klein



ARMOR: What used to be a Ford pickup truck is now Casey's steel-plated *Tornado Intercept Vehicle*.